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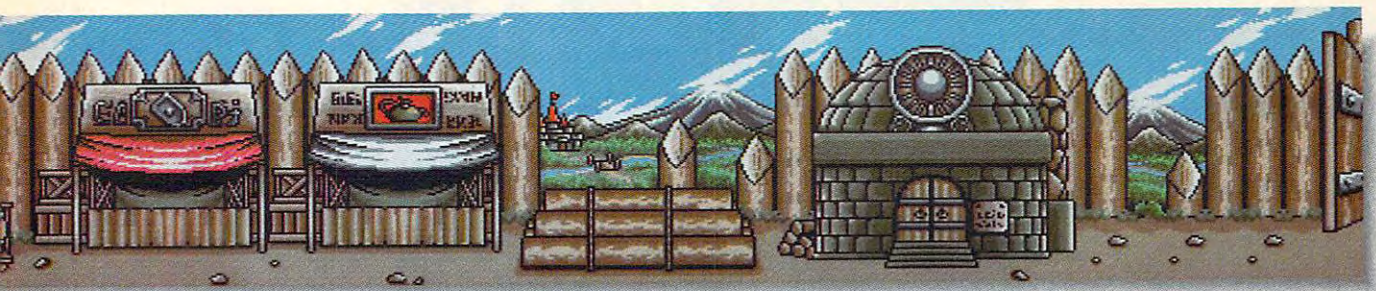
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ake a good fantasy world in perspective.

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COMPUTE

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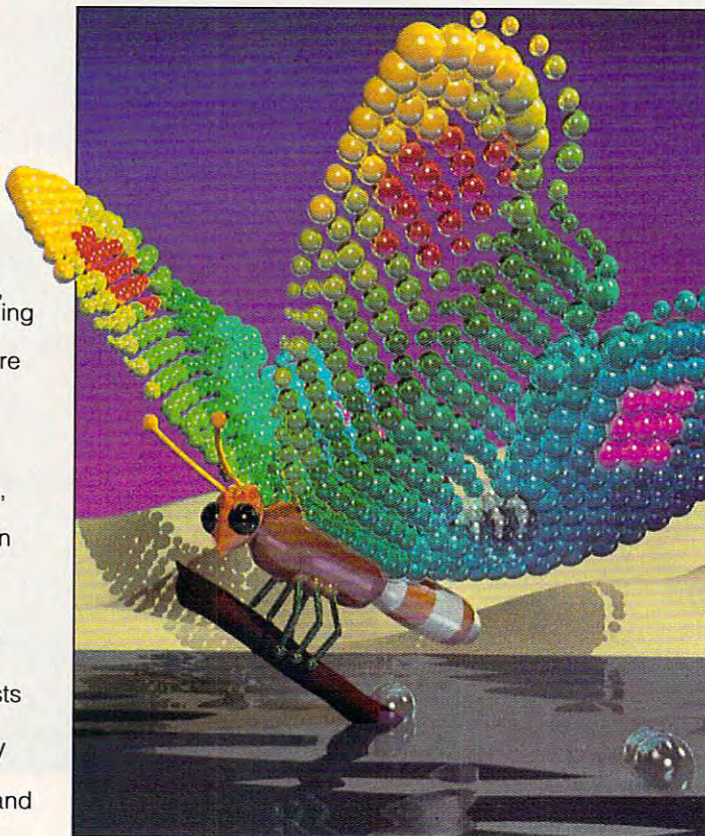
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Melvin L. Prueitt of the Computer Graphics Group at the Los Alamos National Laboratory created the image on our November cover using a ray-tracing program called SCOPE running on a Cray YMP mainframe computer. The entire image, which he calls Contemplating Liftoff, was composed through mathematical functions, from the shapes to the gradation of color.

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Computer Gaming World

August 1991

"With its associated software, it has quietly (no pun intended, but what the heck) become the standard sound system for advanced PCs."

Jerry Pournelle, BYTE June 1991

COMPUTE August 1991

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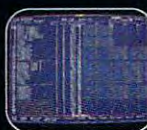
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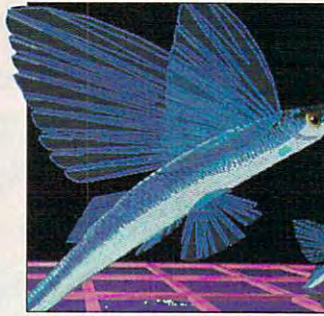
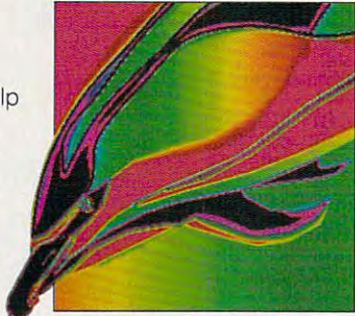
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EDITORIAL LICENSE

Peter Scisco

A few months back, magazines and newspapers all over the country ran stories about the tenth anniversary of the IBM personal computer, pausing to look at where PC technology has been and where it's going.

From the spreadsheet to multimedia, PCs have exploded onto the modern scene like few other phenomena. Yet for all of its whiz-bang promises and electronic pyrotechnics, many of us still wonder where PC technology will

software developers have produced tens of thousands of applications, games, and learning programs for PCs.

Amiga and Macintosh still command loyal followings, and even the Commodore 64 has a sizable audience. But it's the IBM PC that defines computing at home, even if some of its best ideas—like graphical interfaces and multitasking—are borrowed from other platforms.

What do you need to participate? What computer should you be running at home to

take full advantage of your investment? One thing's for sure: With the price of technology falling rapidly, it pays to look forward. More and more big-name software companies are looking to support the most sophisticated machines, and the trend will continue in this decade.

as PC peripherals and as combination machines for playing videogames and audio CDs. Be on the lookout for HDTV links by the year 2000 and for telephone companies to enter the arena—with home information services, banking, and shopping, for starters.

None of this will happen immediately, but if you want to take advantage of computing now and still be able to incorporate the advances, set your sights on a PC capable of performing those tasks.

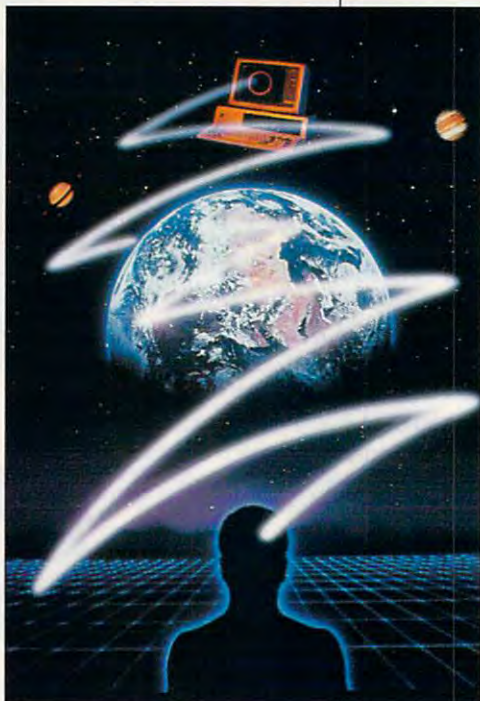
If you're new to computing or getting ready to upgrade to a new machine, the minimum configuration you should look for is an IBM-compatible with an Intel 386SX chip running at 16 MHz, 2MB of memory, DOS 5.0, 16-bit VGA graphics, a sound card that uses an FM synthesizer and digital-to-analog conversion techniques (like the Sound Blaster or new Ad Lib Gold), a 40MB hard disk, and a mouse.

For added value, look for a system that's bundled with *GeoWorks Ensemble* or *Microsoft Windows*. If you buy through office superstores and mail order, such a fully configured system will run in the \$1,200–\$1,500 range. That's the machine you want. Anything less fails to capitalize on the possibilities.

You may disagree. Good XTs and ATs are available for hundreds of dollars less, but sooner or later, you'll want better graphics. Sooner or later, you'll want more speed. Sooner or later, you'll want applications that require extended memory. And sooner or later, the most innovative software won't run on anything less.

Remember that. When you take a look around the computer stores and electronics dealers this holiday season and you find yourself drawn to the shiny new PCs in the window, remember the future. □

What do you need to participate in the Information Age now? Look to the future of computing.



lead and whether it will sort itself out in the next decade—at least enough to allow more people to participate in the Information Age.

The debate over where PCs are moving revolves around a larger debate over the shape of that technology. IBM PC clones claim the lion's share of the home market because of their relatively low cost and their compatibility with the largest share of business machines. And, too,

IBM-Apple alliance works, we could see powerful machines with new interfaces that reach across a variety of hardware platforms. If that happens, the search for a computing standard will have taken a great leap forward.

Beyond that, we can expect major consumer electronics companies like Sony, Panasonic, and Philips to develop computerlike devices for the mass market. Certainly compact disc devices are in store, both

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NEWS & NOTES

Novell Absorbs DRI

By acquiring Digital Research (DRI), giant network system software marketer Novell signaled its frustration with Microsoft's failure to create *NetWare* network links in standard MS-DOS and *Windows*. DRI is the creator of DR DOS, an MS-DOS competitor. Novell intends to establish a desktop networking/operating system standard that's independent of Microsoft. Novell and DRI have been cooperating for a year on this venture.

DRI's first operating system, CP/M, was used almost universally by desktop computers in the late 1970s and early 1980s. DR DOS versions 5.0 and 6.0 have received very favorable reviews and are credited by some industry watchers with forcing Microsoft to make MS-DOS 5.0 friendlier and more frugal with memory.

Novell's impetus in purchasing DRI seems to have been Microsoft chairman Bill Gates's statement in a leaked memo that network capabilities built into MS-DOS would favor other network standards over Novell's *NetWare*. Integrating DR DOS with *NetWare* should help Novell remain competitive with other popular network software publishers, including Microsoft.

This news comes hard on the heels of an agreement between Novell and IBM that allows IBM to market Novell's products. Microsoft is beginning to look isolated in its conflict with one-time allies IBM, Apple, and Novell.

What does all of this mean for you? If you're on a network, it could mean that you won't have to go through the step of logging onto the network, that incompatibilities between your computer's operating system and your network will disappear, and that your computer's memory will be put to much better use. If you aren't on a network, you could still benefit from DRI's sudden access to the research and financial resources of a company ten times its size.

ROBERT BIXBY

There is some competition in the large-capacity, small-format area. The 2.88MB drive has been on the market for some time but has been impeded by high disk and equipment costs in return for only a twofold increase in capacity.

Panasonic recently introduced and then withdrew a 10MB drive from the market, intending to boost capacity to 20MB. NEC, Brier, and Springer Technology are all players in the field, but none have met with success yet. On the horizon is Sony's erasable CD in small format, which could arrive with a capacity of up to 128MB. Mass storage for little machines has never been such an exciting area for technical advances and marketing.

ROBERT BIXBY

An Empire Strikes

"The Force" may soon be with Lucasfilm Games and its use of CD-ROM technology as the company moves with new marketing and development strategies into the interactive entertainment industry. The newly consolidated organization plans to use its connections with the film industry to ensure the success of its games.

According to creative director Howard Phillips, the CD-ROM's ability to store massive amounts of data is like having a massive movie budget. Keeping that in mind, Lucasfilm Games plans to create cinematic games with strong stories, stunning visuals, and enthralling audio by utilizing the resources of other LucasArts divisions such as Skywalker Sound and Industrial Light & Magic.

Lucasfilm Games will introduce *Indiana Jones and the Last Crusade*, *The Secret of Monkey Island*, and a talking version of *Loom* for CDTV in 1992 along with several CD-ROM-based games over the next two years.

The Flop's a Hit

Floptical technology promises to change the way you store data. The read-write optical disk will come in a familiar package—a square of plastic that's virtually indistinguishable from the shirt-pocket 3½-inch disk—but on that disk you can store a whopping 21MB of information. The disk format, now supported by Insite Peripherals, Iomega, Hitachi Maxell, and 3M, involves stamping concentric rings in a barium-ferrite disk.

The rings assist the read-write heads in such perfect horizontal tracking that 1250 tracks can be laid down per inch.

The actual data is stored magnetically between the stamped rings.

The same drive can read and write 720K and 1.44MB 3½-inch disks.

Commodore International has selected the Insite Floptical drive for use in its Amiga 3000.

Floptical technology disks have more than ten times the storage capacity of existing high density floppy disks.





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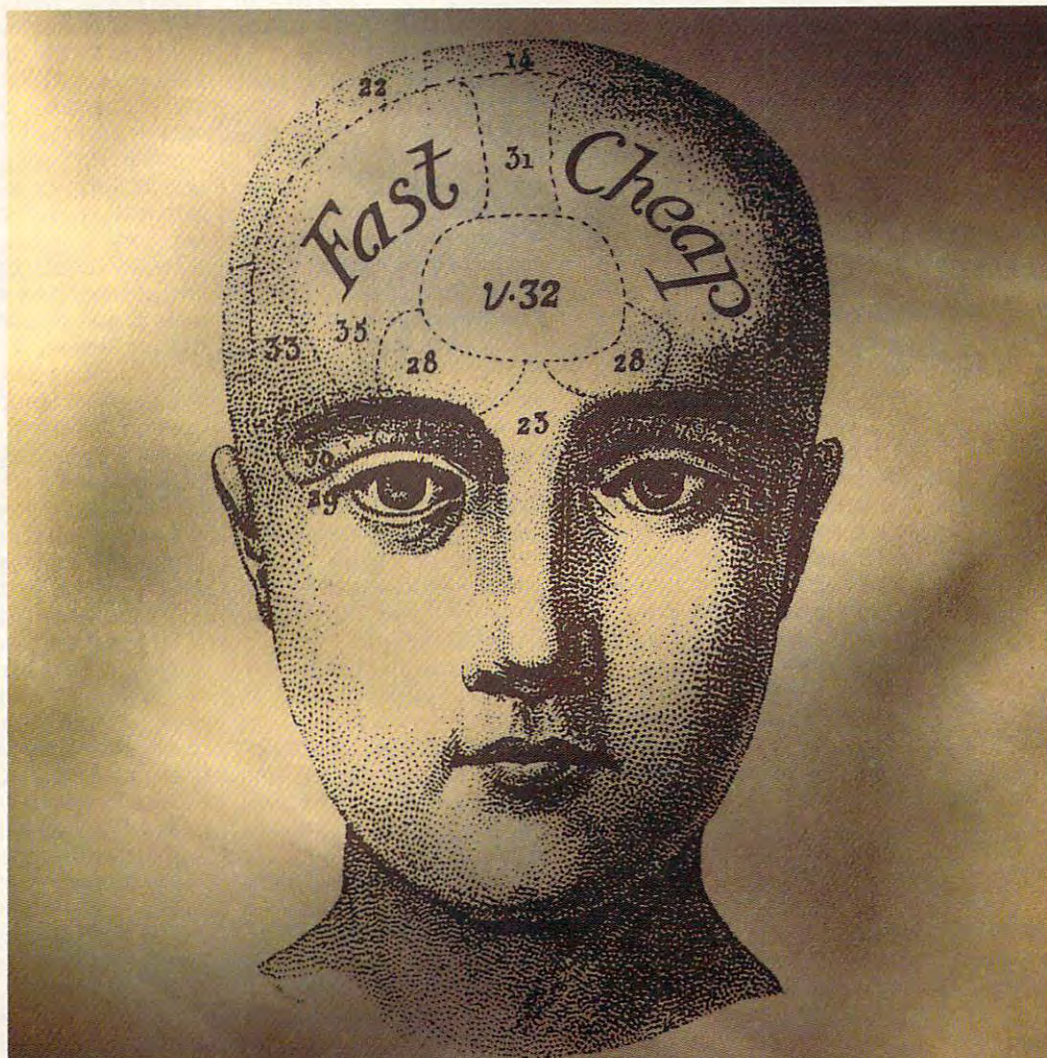


Fig.32

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Three Lucasfilm Games—*Loom*, *Zak McKracken and the Alien Mindbenders*, and *Indiana Jones and the Last Crusade*—are now available for Fujitsu's FM Towns. The company is also introducing its first videogames this fall.

ERIN RICHTER

The Mother of All Soldiers

Foot soldiers may soon join the ranks of those using high-tech military machines with the introduction of a new pocket-sized computer destined to revolutionize ground military action. Texas Microsystems, a manufacturer of Mission-Critical microcomputers, will study the feasibility of a portable Soldier's Computer.

Deployment of the one-pound, high-speed portable computer could be as early as 1995 and is slated to have some of the same advanced communications and graphics capabilities found in fighter aircraft, tanks, and other sophisticated weapons systems. The Soldier's Computer, which will be about the size of a cigarette pack, will initially use Intel's 80386 architecture.

One possible configuration for the Soldier's Computer uses a radio to transmit both voice and data messages and a heads-up display mounted on a helmet or worn as glasses to project a virtual image. It could have a microphone for voice messaging and an integrated "Global Positioning System" to allow soldiers to pinpoint their exact locations at any time. Soldiers would also view a realtime map showing friendly and enemy troop positions, weapons sites, danger spots, and terrain features.

Although it could add new meaning to the concept of war games, Texas Microsystems also predicts widespread application of the portable PC in other areas. For example, it could just as easily be configured as

the Automobile Mechanic's Computer, the Policeman's PC, or the Emergency Medical Technician's Computer.

ALAN BECHTOLD

Future Textbooks

Interactive multimedia computing has entered the public schools in a big way. *Windows on Science*, the nation's first videodisc-based science program approved as a textbook, has been adopted by 65 percent of the 3400 elementary schools in Texas. This is the first time in the U.S. that a videodisc-based program has competed head to head with traditional textbooks for state textbook-adoption funds.

Optical Data, producer, publisher, and distributor of *Windows on Science*, says the program will serve as the sole science curriculum in two large Texas school districts, replacing textbooks altogether. This year, more than 7000 Texas educators learned how to integrate *Windows on Science* into their curriculums. The program consists of 11 videodiscs as well as lesson guides, activities, and a language lab.

ALAN BECHTOLD

Personal PrintPartner

Fujitsu's DL3600 PrintPartner is a 24-wire dot-matrix printer and software bundle designed primarily for small businesses, corporate departments, and home offices that need a single printer to do the work of several office machines.

Combined with Fujitsu's *ZipType*, *Creative Faces*, and *DLMenu* software, the DL3600 emulates the font handling of a PostScript printer, the color capabilities of a thermal transfer printer, the functionality of a wide-carriage dot-matrix printer, and the most useful features of an office typewriter.

ZipType is a pop-up utility for creating templates that make filling out common office

forms a snap. *ZipType* also has a typewriter mode in which the printer responds directly to keyboard instructions, so you can use the printer as a typewriter to complete other forms, labels, and documents not programmed as templates.

DLMenu allows you to configure and reconfigure printer setup conditions from your computer—without exiting your current application. *Creative Faces*, offered free with the purchase of a color upgrade kit for the DL3600, is a *Windows* 3.0 driver that allows you to print charts, graphs, and other graphics in seven colors.

The wide-carriage DL3600 prints up to 360 cps (characters per second) for drafts and 108 cps for letter quality printouts. It accepts both continuous-feed and cut paper; handles four-part forms up to 16½ inches wide—with exceptional last-copy legibility; allows automatic paper loading, first-line printing, and top-of-form tear-off; and includes a paper-parking feature.

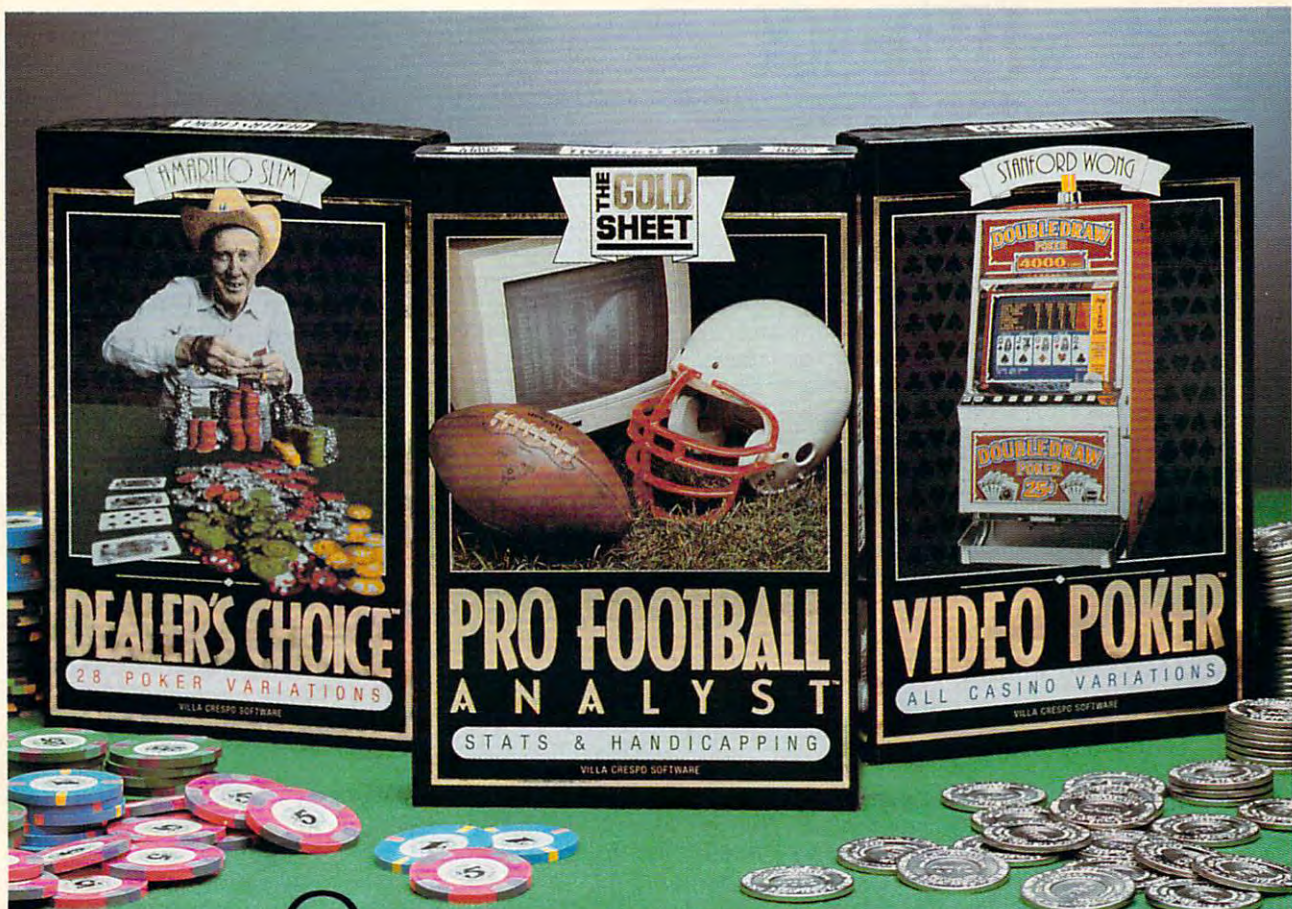
Optional single- and double-bin sheet feeders for preloading different cut paper stocks are also available. The DL3600 boasts an 8000-hour MTBF (Mean Time Between Failures) reliability rating and comes with a two-year warranty—one of the longest in the midrange class of printers.

Bundled with *ZipType* and *DLMenu*, the PrintPartner package lists for \$949 and includes coupon offers for a free copy of *Creative Faces* with the purchase of a color upgrade kit, two free font cards with the purchase of a cut-sheet feeder, and a two-for-one offer on black ribbons.

For more information on the PrintPartner package, contact Fujitsu America Computer Products Group, 3055 Orchard Drive, San Jose, California 95134; (800) 626-4686.

JILL CHAMPION

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GeoWorks Spooler

As a longtime subscriber I've found that your answers to problems and questions have been excellent. But I have a bone to pick with you about one reply. I tried using *GeoWorks Ensemble's* spooler and *Windows'* spooler while playing solitaire as you suggested. For all levels of print quality in both environments, the time it took the documents to begin printing was between 10 and 12 seconds. *GeoWorks Ensemble* is superb software.

JOHN F. HOWARD
VIRGINIA BEACH, VA

Protection and Unprotection

In response to your reply to Travis May in the June 1991 issue, most manufacturers now employ off-disk copy protection because on-disk protection is a nuisance to them and to the consumer. This means that the disks can easily be backed up with standard DOS copy commands like DISKCOPY, but copies are useless to anyone but the original purchaser because the programs won't run unless you enter the correct response from a code wheel or a hard-to-photocopy sheet of dark-colored paper.

TERENCE LAU
CENTERVILLE, OH

petscii sTRIKES aGAIN

I have a PC now, but for years I did all my correspondence on Commodore 8-bit computers. I bought SOGWAP's *Big Blue Reader* to transfer my old letter files to PC disks. Now I've lost the Commodore disks and can't correct an error I discovered in every single file: The upper- and lowercase letters are reversed. I've been able to find utilities that convert files to all uppercase or all lowercase, but so far I haven't found anything that reverses case. Is there any way I could convert

my files with a simple GW-BASIC program?

JAMES KILMARTIN CONDON
SCOTIA, NY

PET ASCII, for no known reason, reversed the codes for upper- and lowercase letters. Big Blue Reader will compensate for that—if you're aware of the problem—making the switch as it transfers the files. Unfortunately, since you don't have the original disks anymore, you can't simply transfer the files again.

Here's a brief conversion program written in Microsoft QuickBASIC (GW-BASIC is simply too limited to write an equivalent program). All it does is change lowercase letters to uppercase and vice versa. We named the program CAPNO.EXE. The syntax is CAPNO filename.

```
CLS
NAME$=COMMAND$
OPEN NAME$ FOR BINARY AS #1
A=LOF(1)
FOR J = A TO 1 STEP -1
GET #1, J, $$
GOSUB CONVERT
PUT #1, J, $$
NEXT
CLOSE
END
CONVERT:
IF $$="" THEN $$=""
IF $$<"a" THEN GOTO CHECKCAP
IF $$>"z" THEN RETURN
$$=CHR$(ASC($$)-32):RETURN
CHECKCAP:
IF $$<"A" THEN RETURN
IF $$<="Z" THEN $$=CHR$(ASC($$)+32)
RETURN
```

A Lifetime Guarantee

The April 1991 issue of *COMPUTE* featured an article about malfunctioning PCs ("Is There a Doctor in the House?"). I read this with great interest because my PC, a four-year-old Tandy 1000HX with a memory-expansion board installed recently, was spending its second

week at the shop. The installation booklet that came with my new floppy drive said that floppy drives last five years—but the warranty was only for 90 days. I'd like to know how long PCs run before they require major repairs. And have some brands been found to be more reliable than others?

WILLIAM CIABURRI
HAMDEN, CT

How about it, readers? Let us know what kind of machine you're using and what kind of torture you've put it through. How many years has your PC hung in there? Tell us your hero stories about the PC that ran for the long haul and your horror stories about the PC that gave up the ghost in the first quarter mile. Send your letters to "Feedback" (the address is at the end of this column). Tell us the complete model name and make of the PC (or peripheral) and how many months it has been operating. We'll print the best and tabulate the rest.

Battling BASICS

In the January 1991 issue of *COMPUTE*, in the PC section, there was a letter about an encrypting program. You wrote the reply, but in *QuickBASIC*. Unfortunately, I don't own *QuickBASIC*. Please send me a copy of a GW-BASIC version of this program.

ANDREW ARMOND
RUSTON, LA

Generally, we translate everything into QuickBASIC for this column for the sake of consistency, but in this case that language was used in part because GW-BASIC lacks the sophisticated file-handling capabilities of a language like QuickBASIC. With QuickBASIC and other modern BASICS, you can open files as binary files, which allows them to be read byte by byte. GW-

Kudos for GeoWorks, case reversal, reliable brands, Imperium lost in Kuwait, requests for new features, and more

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POSITION	T	IP	H	ER	SO	U-L	SV	ERA	HB	AVG
1. AROSTO	R	52	131	43	245	3-1	0	3.52	15	234
2. SCOTT	R	205	184	13	241	3-13	0	3.32	37	233
3. VALAQUEZ	R	126	107	30	222	11-10	0	3.52	36	233
4. GULLIGAN	R	193	221	29	214	10-14	0	3.45	35	228
5. DARMAN	R	152	128	27	230	11-4	2	3.33	20	211

BULLPEN										
POSITION	T	IP	H	ER	SO	U-L	SV	ERA	HB	AVG
SHANKE	L	203	153	10	255	7-12	0	3.75	23	223
CLANCY	R	76	100	17	202	2-3	1	3.22	12	222
ANDERSON	R	95	73	33	255	5-2	7	3.65	17	210
SMITH	R	60	45	23	153	6-6	23	3.45	11	118

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FEEDBACK

BASIC can read files, too, but since it's set up to read data files, it reads paragraph by paragraph (records in data files are typically delimited by carriage returns, like paragraphs in a text file). Since there are restrictions on the length of a string variable that can easily be exceeded by the length of a text paragraph, writing the program in GW-BASIC is much more trouble than it's worth.

Compiled BASICs are great bargains, and there are some good ones out there. You might be able to get a bargain if you can find a discontinued, but excellent, language called Turbo Basic. Microsoft Quick-BASIC, True BASIC, and PowerBASIC (which is an updated version of Turbo Basic) are widely available, inexpensive, powerful, and exceedingly easy to use.

Here are the addresses of the companies that make these languages: Microsoft QuickBASIC, Microsoft, One Microsoft Way, Redmond, Washington 98052; (800) 426-9400; PowerBASIC, Spectra Publishing, 1030 Duane, Suite D, Sunnyvale, California 94086; (800) 245-6717; and True BASIC, True BASIC, 39 South Main Street, Hanover, New Hampshire 03755; (800) 872-2742 or (603) 298-8517 in New Hampshire.

More Tips

I would appreciate more how-to articles about DOS and dBASE III PLUS, which I use a lot. You could include batch files and utilities—not just to copy, but with explanations of how they work.

A. H. STAUB
BANGKOK, THAILAND

Struggling Through

I enjoy your magazine and look forward to it each month—especially the how-to articles that deal with writing

small programs in BASIC and BAT files. However, with just one year of computer experience, these articles sometimes are beyond my knowledge and understanding.

There must be other readers who feel the same way. I think that a monthly article aimed at the novice would be of interest to your readers—articles by a less-informed computer person who would experience the same problems and solutions to everyday computing questions.

WILLIAM R. BAILEY
GOSHEN, IN

Lost Imperium

Several years ago I purchased one of the best computer games that I have ever encountered. Unfortunately, I had to leave this game, among others, in Kuwait in August 1990. I would like to replace it, but I have been unable to find it in any local outlet. I don't remember the manufacturer, but the game in question was titled *Imperium Galacticum*. Any help you can provide in this matter will be greatly appreciated.

LARRY W. MYERS
HOUSTON, TX

If anyone recognizes the game, please contact us at the address below, and we'll forward your replies.

Readers whose letters appear in "Feedback" will receive a free COMPUTE's PC clock radio while supplies last. Do you have a question about hardware or software? Or have you discovered something that could help other PC users? If so, we want to hear from you. Write to COMPUTE's Feedback, 324 West Wendover Avenue, Suite 200, Greensboro, North Carolina 27408. We regret that we cannot provide personal replies to technical questions. □

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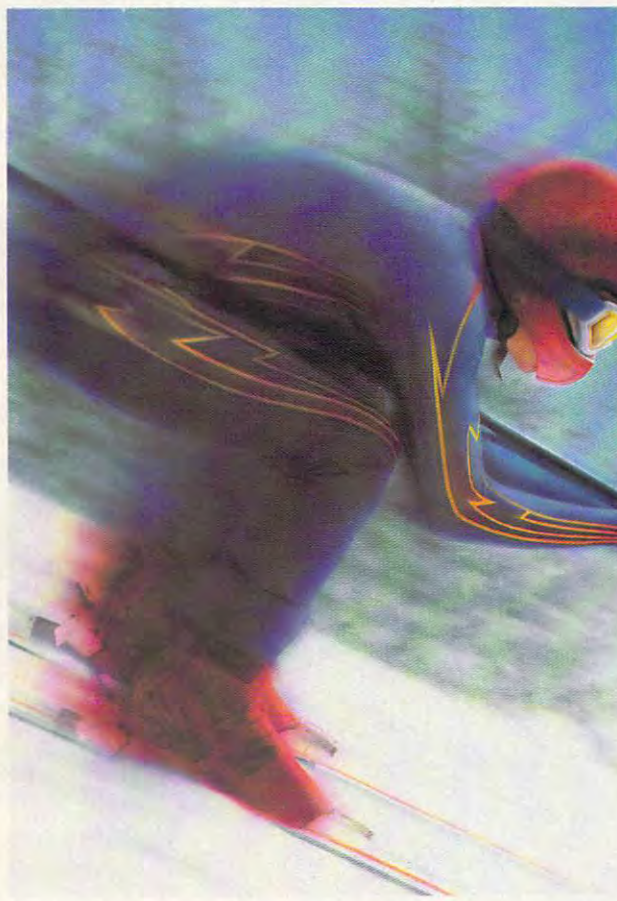
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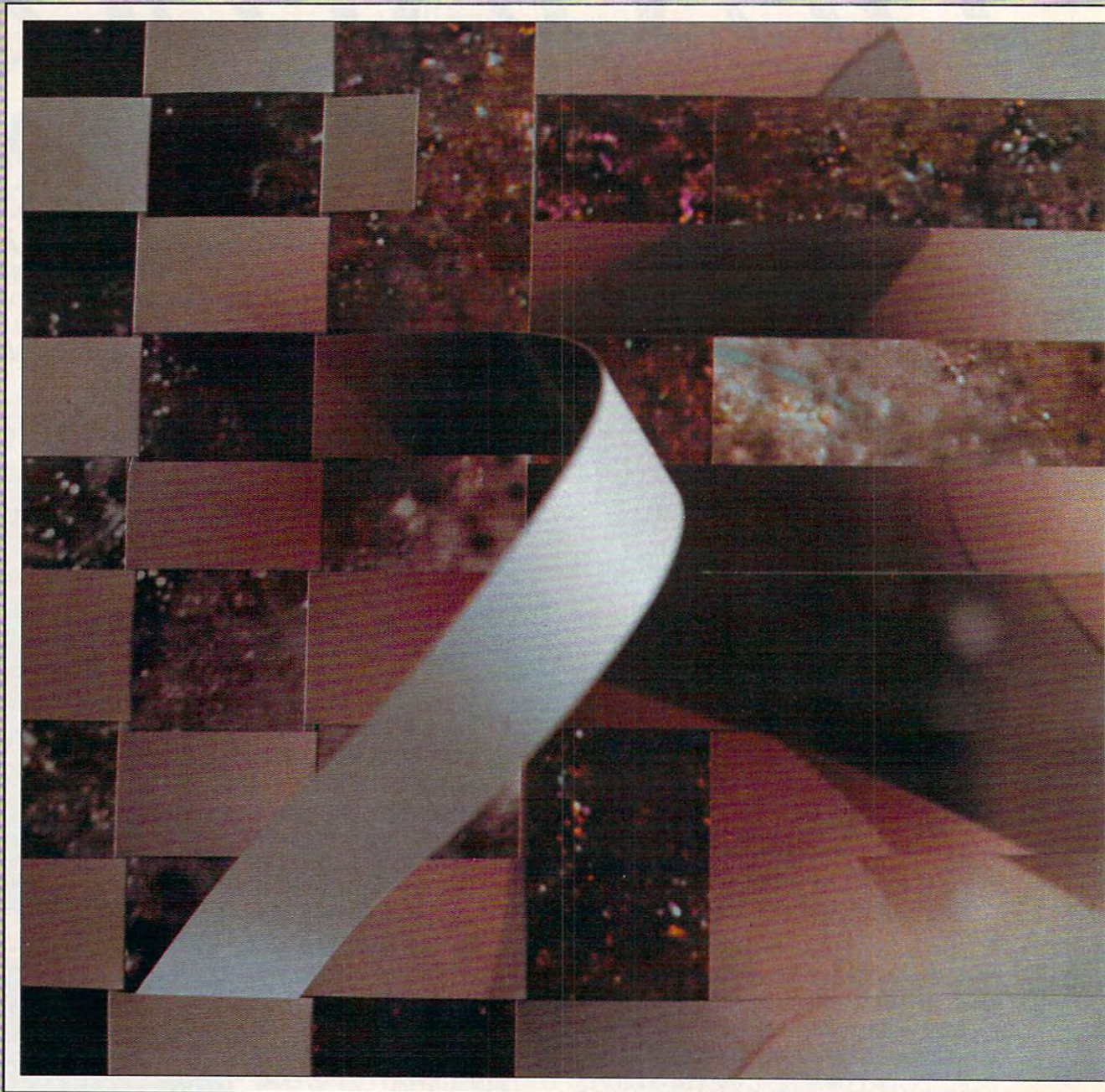


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At the vanguard of technological and social change, the computer provides a new tool, a new medium, and a new way to look at art.

The New Renaissance:

The Computer in Fine Art

BY LEE NOEL JR.

A striking vision is poised in the artist's mind, ready to amaze the world. What tools will the artist use to bring this vision to reality? Increasingly, artists are turning to the personal computer and workstation as tools for producing fine art.

This fact shouldn't be surprising. Art and technology have walked hand in hand through most of human history. It isn't unusual for an artist to be using—or even developing—cutting-edge technology. To understand this, you must know something about the history of art and artists. Let's take a brief trip back in time.

It's now fairly clear that humankind began producing art as soon as it realized it could. You might even say that art produced humankind. Art is the uniquely human ability to synthesize the outer, real world and the inner world of thought and emotion into meaningful works. It might have been the ability and the need to express such things that led mankind away from its primitive roots.

Among the earliest preserved pieces of art we know about are the 20,000-year-old cave paintings of France and Spain. Many scholars think these had religious purposes. Highly realistic and beautifully executed, these cave paintings indicate that the artists who created them already had a well-established artistic tradition. Creating the paints for these renderings must have been the result of much experimentation and study—the rudiments of chemistry.

Moving ahead a few centuries, the Sumerians developed the first written language as a derivation of artistic drawings used in commerce. Another Sumerian example of art driving technology was when the potter's wheel took a 90-degree turn and became a chariot wheel.

Leonardo da Vinci (1452–1519) created prophetic designs of flying machines and other undreamed-of marvels. Michelangelo (1475–1564) was a master architect, responsible for the design of the dome of St. Peter's in Rome. Ex-

traordinarily, these men were not at all unique among artists. Artistic projects from prehistoric times to our own have required precise observational skills coupled with a systematic approach to solving problems. Since artists were among the first regular practitioners of scientific methods, it's not surprising that many of their discoveries had technological ramifications.

For Art's Sake

If solving problems is the artist's stock in trade, it should be no surprise that artists would turn to the computer—the most multitasking problem-solving device since the human brain.

A computer is a single device that is paint, brush, and canvas. Modern VGA monitors can display millions of colors, supposedly more than the eye can perceive. Perfect gradations from one color to another are a snap for these machines. Over the years, artists have developed an automated paint box with a range of abilities from drawing perfectly straight lines of any thickness to rapidly painting the inside of a closed figure with an intricate repeating pattern.

Computers can also simulate imperfection. There are computer tools that render the variable weights of calligraphic pen or brush strokes. Through fractal programs, computers have painted everything from fractured planetary surfaces to gnarled vegetable life forms. You can even find clip art of irregular stone surfaces for use in desktop publishing projects.

Preparing the Canvas

When it comes to three-dimensional work, CAD (Computer-Aided Design) applications can aid in the development of sculpture. And CAM (Comput-



LILLIAN SCHWARTZ

er-Aided Manufacturing) computers can directly create 3-D objects. Some are used to drive milling machines that can carve out parts or structures with incredible precision. There are even a couple of prototyping devices that will fit on a large desktop, in which the computer directly forms an object from liquid wax or plastic.

The computer is an electronic matrix embedded with modules of human thought. Putting the right modules in the right machine can result in producing virtually anything that can be thought of. An artistic feast.

New Ideas: Traditional Resistance

In fact, there has been resistance to the use of the computer in art from both the public and a certain portion of the art community itself. Some artists have an instinctive disdain for technology of any kind—some still argue that

photography is not an art form.

This resistance is particularly odd, considering the fact that much of modern abstract art seems to have predated computer art. With their geometric forms, many of the works of Klee, Kandinsky, Duchamp, Mondrian, or the cubists might have been created through the use of a computer.

The Soul of the Machine

Michael Gosney, whose *VERBUM* magazine has long been a beacon for computer art and aesthetics, is due to open an Electronic Art Gallery in New York soon. Exhibitors are likely to include some of our featured artists, as well as Amiga artists Sandra Filippucci and Roz Dimon and Macintosh wizards Barbara Nessim and Burt Monroy.

Silicon is the most common element in the earth's crust. With their reliance on silicon and the phosphors that glow on monitor screens, computer artists paint with the very bones of the earth. It would be difficult to think of a clearer connection with the cavern galleries of the ancestral hunt painters. Great artists in every era use all the tools they can find. In the computer, artists find them all in one place.

In the Tradition of the Masters

Lillian Schwartz is the artist who used computers to analyze Leonardo's most famous painting. Commonly called the *Mona Lisa*, this work has long been an enigma. Leonardo seemed to have a special regard for the picture. He never sold it.

Now the mystery is uncovered. According to Schwartz's analysis, the *Mona Lisa* is actually an image of Leonardo da Vinci himself.

Much of Schwartz's corroborating evidence, wrought from rigorous analysis



LILLIAN SCHWARTZ

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GEORGE SHORTESS

of facial structure, followed an instant of discovery on the computer screen. While testing a new program with one of her colleagues at the AT&T Bell Laboratories in New Jersey, she slid a digitized image of half the *Mona Lisa's* face alongside a similar section of da Vinci's only known self-portrait. The result: virtually a perfect match.

Schwartz was not only a pioneer in using the computer to analyze other artists' work, but she was also among the first to use it in creating her own artistic efforts. Her recent book, *The Computer Artist's Handbook*, written in collaboration with her son, Laurens, is replete with examples. From an early effort in computer-controlled kinetic (moving) sculpture at the 1964 New York World's Fair to her current paintings, her career encapsulates the history of computer art.

Her interest in the computer followed a decades-long career in art. With her background in Western European traditional art and exposure to Japanese calligraphy (undertaken as therapy to break the grip of polio-induced paralysis), Schwartz has built her electronic work on a rock-solid foundation.

Lillian Schwartz says, "What's wonderful about the computer is that you're creating your own medium."

Computer as Chisel Viewer as Stone

Sculptor George Shortess is a longtime subscriber to *COMPUTE*. Indeed, he still sometimes uses the Commodore VIC-20, an early mainstay of this magazine, in his work. Shortess is both a professor of perceptual psychology and an adjunct professor of art at Lehigh

University in Pennsylvania. He prizes the freedom Lehigh gives him to mix disciplines and considers it a factor in the advancement of his art.

Shortess's sculpture, based on traditional art training and including familiar 3-D elements, has won wide recognition. He doesn't stop, however, with merely creating an intrusion into three-dimensional space. He uses computers to enhance the viewer's perception of the piece—and to highlight perception in general.

Mayfair Network is a Shortess sculpture you walk *through*. Its framework is a living willow tree. An array of photocells responds to your location, sending signals to a computer, which triggers assorted sounds.

This is not a typical art museum experience, but Shortess says he must show most of his work indoors to protect the electronic components and few galleries show computer art regularly. Happily, he does find exceptions.

In his interactive book, *What Is* (shown in Canada and at Ars Electronica in Austria), a desktop PC system runs a complex program that scans a photocell array and generates interrogative screen displays. The viewer responds by typing and by changing the light levels on the photocells. Once the process is completed, the sculpture prepares, prints, and delivers a personalized page to the viewer.

Since Shortess's sculpture is not tied to any particular display system, processor, or other device, he uses any computer that seems appropriate for a given project. That's why he is

still actively using VIC-20s. He's also used samplers, sequencers, and desktop PCs. As always in art, part of mastery is the judicious selection of tools.

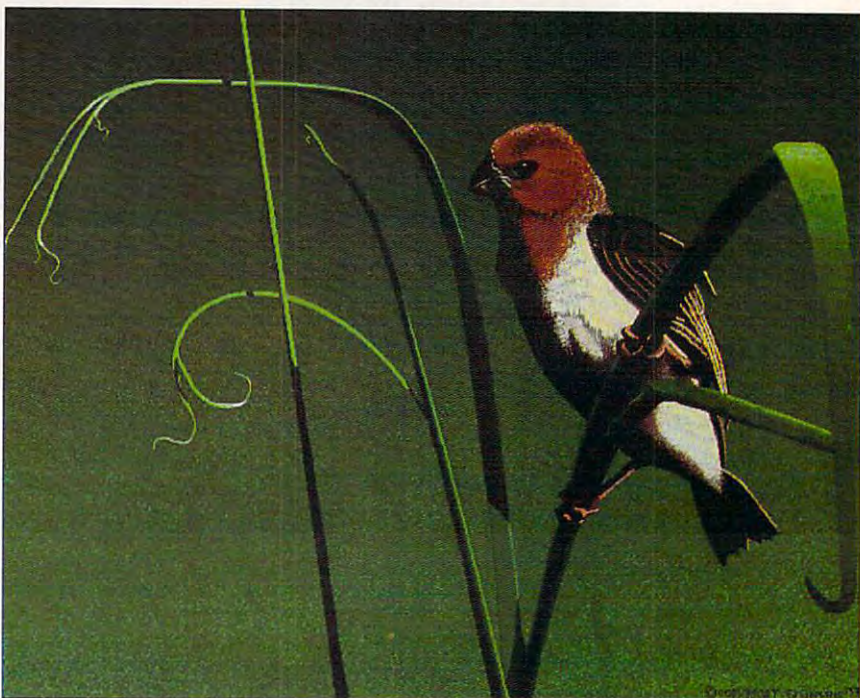
Some people don't react positively to Shortess's work. Some don't see it as art at all, and others question the use of a computer—and especially this use—because sculpture should be separate from the beholder.

"We're still exploring the potential of the computer, and it's not clear what the best way to use a computer is at this point," Shortess points out. But the intent of Shortess's work is serious. He's extending the definition of sculpture into a mysterious territory. He won't allow the viewer to be passive. Instead, the perceiver becomes a participant; the sculpture becomes a process rather than an object.

With Mouse and Macaw

Art is not just the domain of the traditionally trained or widely accepted. Entirely self-taught, Ed Stephens, at 25, is the youngest and least prominent of our artists. Like the others, however, he is well versed in traditional media, having painted both in oils and in acrylics.

The road to artistic fulfillment and success is always a difficult one, but Stephens has additional impediments. A diving accident in the 11th grade left Stephens a quadriplegic. With a considerable range of movement in one hand, however, he can handle a mouse comfortably. It's important to keep in mind that the tough-natured Stephens has, like all the other artists featured here, adopted the computer



ED STEPHENS

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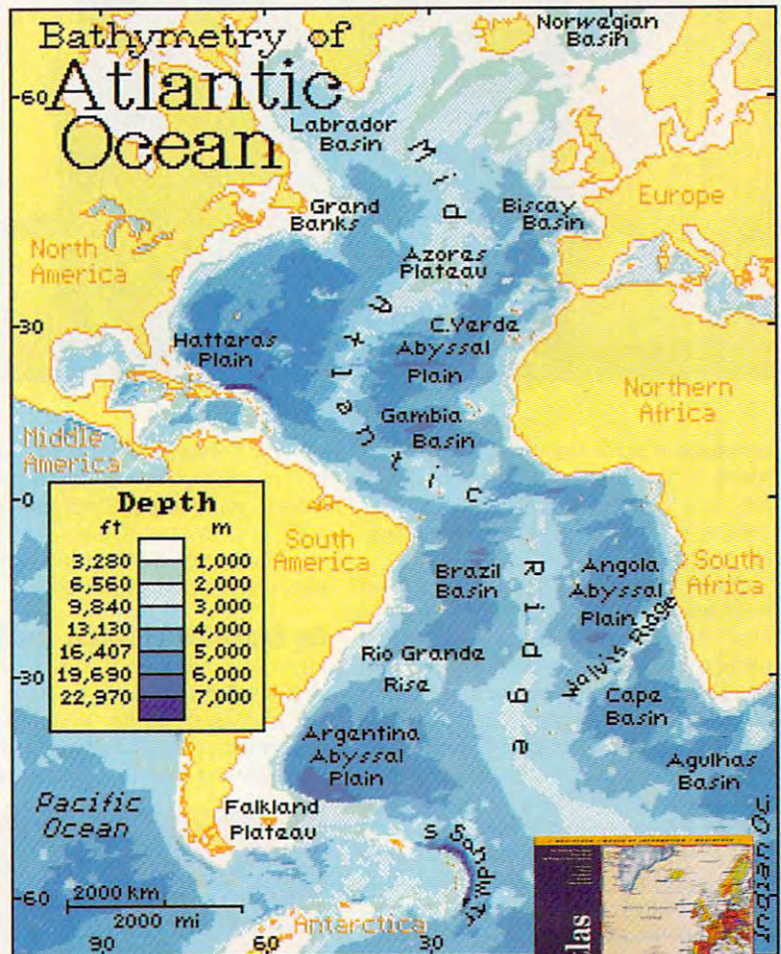
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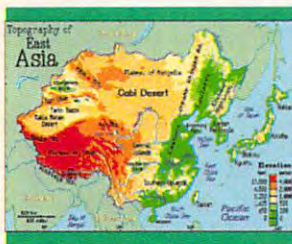
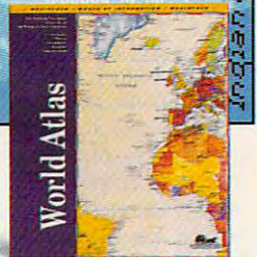
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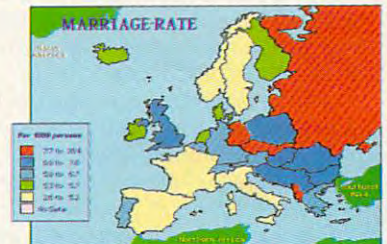
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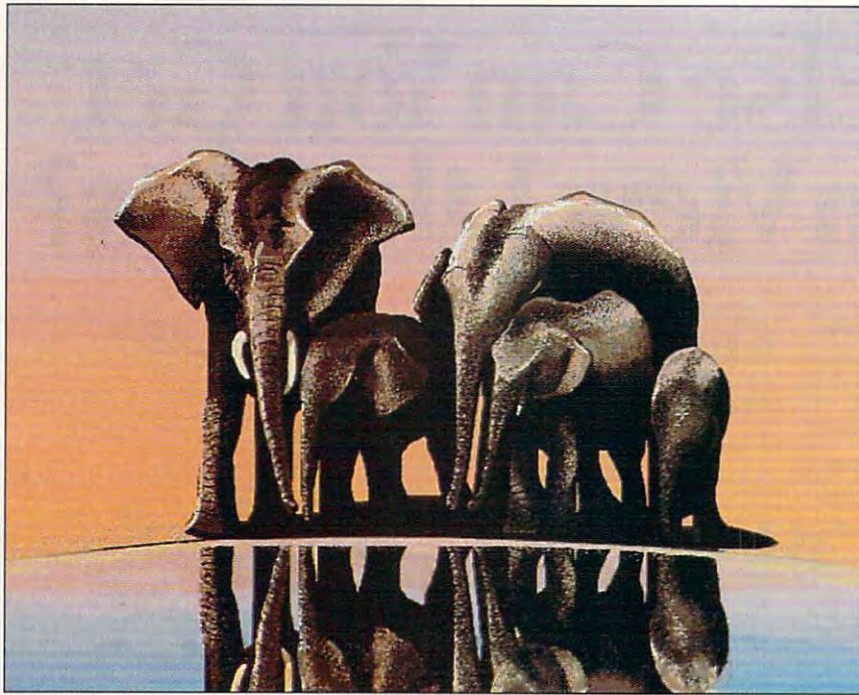
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because it suits his artistic temperament. It may be a self-contained studio, but it's merely his current tool of choice. His handicaps are another matter entirely.

As in the case of Joni Carter (see next section), Stephens has, for the time being, fairly well settled on a choice of hardware platform. All the images shown here were created on a 20-MHz 386 PC using *ColorIX VGA Paint* software in 256 (8-bit) VGA mode. This relatively new art program has enabled Stephens to explore his love of animals with few restrictions. He has a special affection for birds and will admit with a little prompting that he'd be happy to see an "autofeather" tool built into the program.

Working from photographs and rendering his images entirely freehand, Stephens achieves a high degree of realism even with limited palette and resolution. He is forced to render images by intermixing pixels of a few basic colors in areas where other colors are needed. He describes the process as "just sitting down, editing pixel-by-pixel to get the gradations."

Stephens's pictures contain echoes of nineteenth-century French artist Henri Rousseau. Vibrant, even violent, jungle colors are a hallmark of Rousseau's work, as they are in Stephens's.

Even though he dropped out of high school after his accident, Stephens has proved himself in many ways the master of the computer. He explains it simply: "I've always painted and sketched, and it just makes sense that I'd start doing art with the comput-

er. That's mainly why I got interested in it." In addition to his computer-based artistic endeavors, Stephens works as a PC specialist at a major bottled-water producer in California, where he keeps a macaw at the office.

An Explosion of Talent and Energy

Here's a paradox: Joni Carter has achieved many firsts or near firsts in her wildly successful 16-year career as a computer artist, yet in 1975 when she started painting in her late 20s,

she'd never touched a brush before.

Her first pictures reflected her love of sports. She made rapid progress, selling everything she painted, almost always on a sports theme. Although she did not have a conventional art education, she spent the next few years working intensively in the most traditional of media—paint, brush, and canvas.

In the early 1980s she heard about art on computers and moved decisively to adopt the new medium. Once she'd achieved mastery, she found a great advantage in the environment. She could take a computer on the road and set it up at the sites of the sports events she wanted to portray. With marketing savvy to match her artistic flair, she began to appear on television, producing live art on the computer that matched the compelling immediacy of the events taking place on the course, field, or racetrack behind her.

"After my first brush with technology, I never went back to the conventional method," she says. Something must have clicked because the business grew so fast that she soon had her whole family, including her mother, father, and sister Kate, working with her.

Recently, Carter created a set of commemorative Olympic track and field stamps, released by the U.S. Postal Service in the tens of millions. She is among the first women ever commissioned to paint stamps, and she is the first artist ever to create a series of stamps entirely on computer.

In the process of creating the stamps, Carter has invented a new twin-computer, mobile art studio. Run-



JONI CARTER

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JONI CARTER

ning paired IBM PS/2s, she's developed an ingenious working method. One computer acts as a video controller. This is her "model." She uses it to zero in on a desired frame of sports videotape, which is then blown up and used as the basis for the sketching and painting she does on the other machine. There, she has 24-bit paint software called *Lumena* that enables her to create images of the highest quality. Of course, since the images are computer based, they're easy to resize and recolor—a process the postal service had her go through again and again in the making of the stamps.

Carter sticks to a fairly settled hardware/software mix for lengthy periods of time. And she's unstinting in her praise for and devotion to IBM. That very first computer she took on the road was a genuine IBM AT. She believes that this machine's reliability was a major factor in making her touring art show a success.

She's also adamant that new computer art possibilities will open vast numbers of careers. Carter's own career is an example without parallel. As she puts it, "I want artists out there to know that there's this huge chance now that hasn't been there [before]."

Ambassador of Light and Space

Now in his late 30s, David Em creates works that glow with the emotional power and technical mastery of the mature artist in his prime. He is also gifted with a unique perspective and philosophy on his place in the brief history of computer art, and on art in general.

In the mid 1970s and early 1980s,

Em's works were among the most frequently seen computer art images. He was working with Dr. James Blinn at the Jet Propulsion Laboratory (JPL) in Pasadena, California. Blinn was the pilot who created software spaceships that gave us highly realistic simulated views of the planets being surveyed by space probes like Voyager and the Viking Mars lander. Blinn's programs and JPL's success became Em's studio and inspiration. Not surprisingly, Em's work from that phase has something of a science fiction flavor.

In a typical picture of the period,

structures rise from a vast plain unfolding under the watchful eye of a satellite. For all their power to strike awe and wonderment into viewers, images from this period may seem a little cold, almost as if the vacuum of space is insulating the observer from direct contact.

Although he occasionally refreshes himself through refuge in traditional painting or plastic sculpture, Em has always returned to the computer.

He's pleased that things are moving "to a hardware-independent zone." Although the time at JPL gave Em access to the leading technology in the world, he's happier to be a little behind the leading edge, concentrating on his art rather than the tools used to produce it. He works with a number of systems and programs but is quite impressed with Adobe's *PhotoShop* for the Macintosh, finding the finish of commercial software a welcome change from fighting with undocumented experimental programs and devices.

As for the question of whether the computer is an appropriate tool for art, his viewpoint is straightforward. "The device is an extension of sensibility, so . . . whether it's a medium or not has always seemed a nonissue."

Em is modest about his achievement. As he puts it, "We're all standing on the shoulders of people who were really putting it on the line." He says that children growing up today with ready access to powerful computers with high resolution graphics have enormous potential. "Now is when we're really going to see the Leonardos and the Michelangelos come out." □



DAVID EM

MORE BABES. MORE BREWSKIS. MORE BAD JOKES.



the nights, however, are a different story!

ERNIE IS BACK!

Welcome to *Spellcasting 201: The Sorcerer's Appliance*. Ernie Eaglebeak is back at Sorcerer University for his sophomore year and he wants to join a fraternity. No problem, except for those quaint, harmless initiation rituals known collectively as... HELL WEEK!

RETURN TO ANIMAL HOUSE

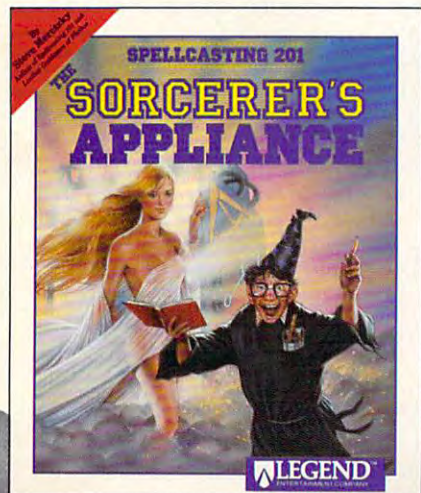
Every night, in a mysterious chamber below the fraternity house, a vindictive pledgemaster dons a ceremonial chicken suit and burdens Ernie with a series of ridiculously impossible hazing tasks. Fortunately, Ernie knows where to get help. He creates it!

A TALE OF HIGH EDUCATION AND LOW MORALS

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WE HOPE YOU'VE DONE YOUR HOMEWORK

Join Ernie and Eve in this hilarious romp through the bedrooms, turrets, and tunnels of both Sorcerer University and nearby Barmaid U (where grading on a curve takes on a whole new meaning). To pass this course you'll need to cast ridiculous spells, solve ribald puzzles and "interact" with gorgeous women. Any questions? We didn't think so. Class dismissed.

From the scandalous imagination of Steve Meretzky, *Spellcasting 201* is the sequel to his award-winning hit, *Spellcasting 101: Sorcerers Get All The Girls*. These games may be considered unsuitable for young minds, as they contain material and situations that children have already seen in far greater detail on daytime television. Available for MS-DOS and compatibles.



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SHAREPAK

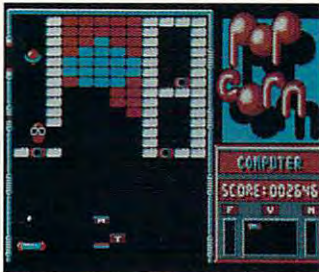
Richard C. Leinecker

A FIVE-STAR NOVEMBER

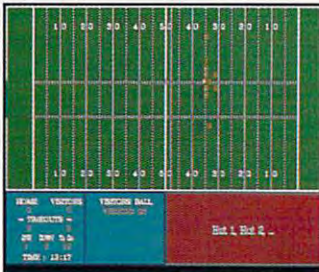
This month's *SharePak* brings you five stellar performers you'll want to keep on your hard drive for a long time.

For gamers, *POPCORN* reminds me of *Breakout* and *Arkanoid*, while *CUNNING FOOTBALL* makes me feel like Don Shula, the Miami Dolphins football coach. In the utilities department, you'll find

November brings five great shareware programs you'll want to keep right at your fingertips.



Catch the tiles in *POPCORN*, this month's addictive time passer.



Fall is *CUNNING FOOTBALL* season for sports fans.

Copy Tree, a backup-and-copy program for everyday use; *Directory Enhancer*, a utility that improves on the old DOS display in a colorful way; and *AMORTZ*, a convenient loan amortization program you can count on to count your dollars.

When you buy *COMPUTE's SharePak* disk, you get the best shareware without paying expensive connect-time and long-distance charges. Plus, we offer a money-back guarantee if you're unhappy with your disk for any reason.

POPCORN

This game takes the prize for most addictive time waster. It's like the old *Breakout* game where you try to knock out tiles with a paddle, only *POPCORN* adds some new twists.

Tiles turn into falling objects you catch for special powers—one tile makes your paddle bigger, one creates a wall to bounce the ball back if you miss it, and there are more.

The game's graphics are well executed, even though they're in CGA. It doesn't matter if your computer is fast or slow—you can set the speed for virtually any system. Either a mouse or keyboard will work great with *POPCORN*. A high-score list gives you a goal each time you play.

CUNNING FOOTBALL 4.0

This dynamic, menu-driven football game will keep you busy and entertained for hours. It challenges your skill and strategy as you maneuver the players and call the plays. There are interceptions, penalties, and other subtleties found in real football. Game control with a keypad, joystick, or mouse makes playing easy since you choose the device.

One of the nice things about *CUNNING FOOTBALL* is that it plays on just about any monitor—Hercules, CGA, EGA, and VGA video cards are all supported. And a 384K memory requirement doesn't omit many systems.

Copy Tree

Here's a utility you'll put in your DOS directory and use daily. It's as easy as the simplest DOS command. Just type *CT* followed by the path mask and the destination, and *Copy Tree* copies the files you've specified to their destination. If you forget how to use the program, just type *CT* by itself, and you'll be prompted for the correct responses.

Copy Tree runs on any IBM compatible and monitor.

Directory Enhancer 1.41

Directory Enhancer makes DOS friendlier by adding color to its otherwise bland screen. Files and directories are highlighted so you can quickly find what you're looking for.

Directory Enhancer is a memory-resident program, but it takes up only 1.3K of memory and even loads into high memory with programs like *QEMM* and *386Max*. To use it, you just add a line that says *DE* to your *AUTOEXEC.BAT* file. Then, when you reboot, the program is there. It couldn't be simpler.

You can run *Directory Enhancer* on any IBM compatible system, although it's best on color systems. Monochrome users can change highlights and underline text.

AMORTZ 1.3

So you want to buy a car or a house. Can you afford it? You could see a CPA or a financial planner, but wouldn't you rather figure out the interest and payments on your own? *AMORTZ* lets you do just that quickly and easily without a lot of bells and whistles.

You'll be surprised at how fast this program, designed by a CPA, calculates your payments for different loans. Plug in the loan amount, interest rate, and number of years to see what your payments will be, including the percentages that go toward interest and principal and your total interest paid during the life of the loan. Plug in different variables, using whatever amounts you choose, and let *AMORTZ* help you decide on the most affordable terms for a loan. It gets my vote for the amortization program I'd rather use.

AMORTZ runs on any IBM compatible with 256K of memory and any monitor. □

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OCT 90: *Amado*, match scrambled blocks to the computer pattern; *Captain Comic*, great EGA graphic adventure game; *Funny Face*, Mr. Potato Head-type animation faces; *Fusion*, great game similar to *Tetris*; *Power Poker*, create poker hands in two dimensions. (#CDSK1090)

MAR 91: *Cash Control*, simplify financial recordkeeping; *Personal Inventory 2.11*, maintain a record of household items. (#CDSK0391)

APR 91: *Schedule*Master*, manage your daily schedule; *Meal-Master*, menu-driven database system for managing recipes; *The Monuments of Mars!*, great graphic arcade/adventure game. (#CDSK0491)

AUG 91: *TurboPaint 1.5*, full-featured paint program; *Math Voyager*, guide starship by answering math problems; *EARTH-WATCH*, graphically displays 24-hour day-and-night cycles. (#CDSK0891)

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TEST LAB

The 80386SX desktop computer has never been more capable or more affordable. A year ago, SX machines were underpowered or overpriced. Today, it's a different story, as this month's Test Lab shows. The 9 machines reviewed here—7 running at 16 MHz and 2 running at 20 MHz—offer both tremendous value and impressive features. Why are we seeing these improvements in price-



CMS 386SX/16-40

The CMS 386SX/16-40 has everything I find indispensable in a desktop system: VGA graphics, dual floppy drives (5¼- and 3½-inch), a 40MB hard drive, and 2MB of RAM. Right out of the box it's a machine that's ready to do business.

MS-DOS 4.01, GW-BASIC 3.23, and TriGem EMM driver software are furnished with the machine, and an optional hi-res 14-inch VGA color monitor with .29-mm dot pitch completes the system reviewed here. The VGA board has 256K of video RAM

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ing and features? Improvements in computer technology, new microprocessors, and competition have driven prices down and produced a dizzying array of choices. Now you can have your choice of hard drives, memory, monitors, microprocessors, warranties, service, expansion capabilities, keyboards, software bundles, and much, much more. So whether you're new to computing and have modest needs or you're an experienced hacker with a hunger for storage, speed, and power, our benchmark statistics, sidebars, and hands-on reviews will help you make the right decision.

**Test Lab street prices are an average of prices advertised in computer magazines and national newspapers during August.*

and yields a maximum resolution of 800 × 600 pixels. The Oak Technology video BIOS is multimode, providing EGA, CGA, MDA, and Hercules graphic modes in addition to VGA.

The CPU case gives you plenty of room for expansion with two 8-bit and four 16-bit slots (the VGA board uses one of the 16-bit slots, however). Occupying a footprint 14¾ inches wide by 16¾ inches deep, the box itself isn't space hungry. Since the expansion cards mount into the slots vertically (rather than horizontally as in some "low profile" desktops), the case is about 6½ inches tall, which will allow it to stand with stability on its side next to your desk if you wish.

Although there is no dedicated mouse port, two 9-pin serial

ports are provided for serial device I/Os, along with a parallel port. The VGA card has D connectors for 9- or 15-pin monitor cables, along with a bank of DIP switches for video mode selection.

The keyboard connects via a standard 5-pin port also mounted at the rear of the cabinet. The 101-key keyboard is very nice, offering a very light and springy (not mushy) touch. Good tactile and audio feedback make it a pleasure to use, especially if you're a relatively fast touch-typist. Indicator lights for Num Lock, Caps Lock, and Scroll Lock keys show keyboard conditions at a glance; dedicated cursor control keys and a full numeric keypad make data entry fast and accurate.

I popped the four Phillips screws on the back of the system cabinet, slid the case cover forward, and took a look "under the hood." In keeping with the latest engineering and manufacturing practices, the motherboard makes extensive use of VLSI (Very Large Scale Integration) technology, with only a handful of chips performing numerous tasks. This type of design not only keeps manufacturing costs low (resulting in lower consumer prices), but it also allows the machine to run cooler and more reliably, since there are fewer components to generate heat and possibly fail.

The 145-watt power supply has an extra pigtail connector for attaching another peripheral device (for example, an internal CD-ROM drive or a second hard drive). While this should be adequate for most users, if you're a power user intending to fill up every slot and add an additional drive (magnetic or optical), you might want to upgrade the power supply to a 200-watt unit to handle the extra demands for juice these peripherals will require.

The review unit came equipped with a high-density, 1.2MB 5¼-inch floppy drive in the upper bay position and a high-density 1.44MB 3½-inch drive in

the lower bay. Unfortunately, no additional exposed bays are available, so adding an internal CD-ROM drive, an internal high-speed tape backup unit, or another floppy drive isn't an option. Another hard drive could easily be mounted inside the cabinet, however, since you wouldn't need to access it physically from outside the machine.

All of the components and all of the workmanship appear to be of very good quality, and the overall layout and design of the machine's interior are excellent.

A socket for an 80387 math coprocessor is provided on the motherboard, as well as space for RAM expansion of up to 8MB. The AMI software BIOS performs a complete set of diagnostic tests with a single keystroke on boot-up, and changing the CMOS configuration to reflect any changes made to the system (such as adding extra RAM) is a breeze as well.

The documentation for the CMS 386SX/16-40 is truly first-rate: clear, well organized, and uncommonly complete in what it covers. Virtually anything you'd like to know about the system is contained in the operations guide. In addition to the system specifications, you get useful information regarding various memory configurations, I/O addresses, connector pin-outs, and more—even a section on removing the motherboard and running diagnostics.

The system performs admirably, thanks to its 16-MHz 80386SX CPU and a very quick 40MB IDE hard drive. During my review I ran several programs under DOS version 4.01 (included with the system) as well as *Windows* 3.0 and found the CMS to be quick and reliable. If you're a DOS aficionado, upgrading to DOS 5.0 should make it perform even better. The included TriGem EMM drivers and utilities disk facilitate taking advantage of the expanded memory above the base 640K and configuring it for use in your applications.

CMS backs the machine with

a one-year parts and labor warranty covering repair or replacement when it's returned to the factory.

If the configuration reviewed here doesn't fit your requirements precisely, the base system can be ordered to your specific configuration requirements with more (or less) RAM, higher capacity hard drives, a math coprocessor, and more. If you're of the hands-on, do-it-yourself persuasion, you can order a bare-bones unit consisting of the basic

The first thing I noticed about the Dell 320SX is how neatly the computer and monitor are packed. Everything has its own place. The monitor comes packed in four pieces of styrofoam rather than two. When you remove the monitor, you don't have to wedge your arms in and around the packing and pull everything out at the same time, so you're less likely to drop the monitor or injure your back.

Setup is a breeze, thanks to



DELL COMPUTER CORPORATION
9505 Arboretum Blvd.
Austin, TX 78759-7299
(800) 289-3355
List Price: \$2218
Street Price: n/a

cabinet, motherboard, and power supply only and dress it up according to your own particular recipe. Or you can order it with some components in place and add others at a later time yourself. You get the idea; CMS custom-builds the units any way you wish.

Overall, I was very favorably impressed with the appearance, performance, and design of the CMS 386SX/16-40. It's a "real world" machine that delivers plenty at a price that won't break the bank.

TOM BENFORD

Circle Reader Service Number 301

DELL 320SX

Outstanding quality, support, and reputation make the Dell 320SX a computer you should consider.

Dell's excellent Getting Started manual. Step by step it covers everything you need to know and provides great sketches.

The case is sturdy and compact, taking up no more space than is absolutely necessary. To open it, simply remove four screws, and the cover pops right off, ready for your next upgrade. Once inside, I was amazed at the roominess of this compact case; it should provide adequate ventilation, and almost everything is easily accessible. Configured with two megabytes of SIMM memory, the motherboard can very easily take up to eight megabytes of memory.

You switch between the Dell's 8-MHz and 20-MHz speeds with software commands; there's no reset button, but the power switch is conveniently located below the

TEST LAB

floppy drive. For security, Dell provides a lock.

This review system came with a 40MB IDE drive, one 5¼-inch floppy drive, a VGA monitor, DOS 4.01, a package of Dell utilities, and the keyboard. There's one more drive bay available, which you might use for a tape backup system, a CD-ROM drive, or another floppy drive. The three 16-bit expansion slots may not seem like a lot, but all serial, parallel, video, and mouse ports are built into the motherboard. You should be aware of one drawback to this type of motherboard; if the built-in controller or video adapter fails, the entire motherboard will probably have to be replaced, and replacing the motherboard will cost you more than replacing a controller card or a video adapter card.

The monitor has an antiglare screen and a .31-millimeter dot pitch to ease eyestrain. However, stepping up to a .28-millimeter pitch might be easier on your eyes and worth the extra cost. There was a noticeable flicker when I changed screens in *Windows 3.0* and other graphic-intensive packages. The monitor's tilt swivel base seems to easily point in any direction you need.

The motherboard video configuration that came with this machine supports standard VGA modes. You can install an addi-

tional 256K of video RAM to get additional high-resolution modes, another option worth the money.

Like the rest of the machine, the keyboard has a nice tight feel to it—not at all cheap or wobbly. I personally like smaller keyboards, but I quickly fell into sync with it. The keys feel solid, aren't crowded, and have a quiet but audible click. The standard 101 keyboard does not have the oversize Enter key.

The 320SX uses a Phoenix BIOS and should run any software on the market today. I tried *Prodigy*, *Windows 3.0*, *PC Tools 7.0*, *WordPerfect 5.1*, and several games, all of which ran without a hitch. *Windows*, however, was relatively slow (I have run *Windows* faster on other machines), and after running the *PC Tools 7.0* Disk Benchmark Test, I found out why. The disk came in at a seek time somewhere between 24.70 and 29.98 milliseconds.

Technical support is toll-free. The address is conveniently located on the back of most of the manuals.

I gave the 800 technical support line a try and was impressed. The technicians know what they're talking about. If you have a question, first give the technician the UPC code from the back of your machine; he or she has the exact configuration of your ma-

chine. From there you can get answers to any of your questions.

Another impressive point: I didn't stay on hold for 15–20 minutes waiting for a technician to answer the phone. Once finished with technical support, I was quickly transferred to the sales department for other information. All the staff members I spoke with, from the sales department to technical support to the spare parts people, were knowledgeable, courteous, and ready to help.

The Dell 320SX comes with a one-year on-site warranty through the Xerox corporation as long as you are in the Xerox service range. Before your purchase, technical support can quickly tell you if you are located in a service area. However, if you are out of the service area, you can always ship your computer back to Dell. You pay shipping to Dell; Dell pays shipping to you.

The warranty covers all manufacturing defects for one year. Dell's "Total Satisfaction" return policy is a nice feature and is becoming more widespread with other organizations these days. Dell offers a 30-day money-back guarantee. You must, understandably, return the equipment in its original packaging.

The system I reviewed sells for \$2,218. Dell custom-configures its computers, so you get the sys-

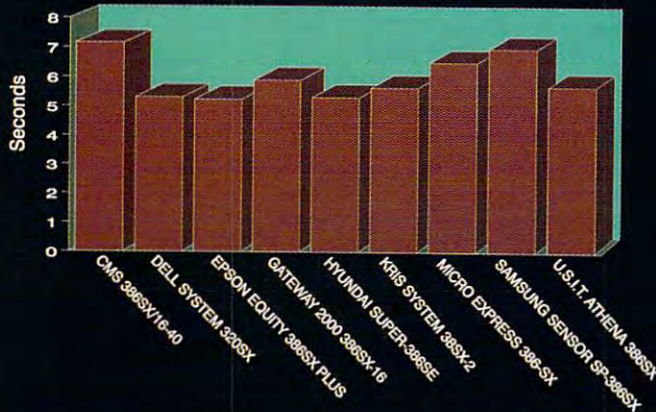
COMPUTE APPLICATION INDEXES

Since the Test Lab section is designed to give you the best information about how systems will perform when you take them home or to your office, we performed a set of tests involving commonly used applications.

The timings indicate how long it took a particular computer to sort a database, perform a search and replace in a word processor, recalculate a spreadsheet, and redraw an object in a CADD (Computer Aided Design and Drafting) program.

—RICHARD C. LEINECKER

Spreadsheet Recalc



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tem that meets your needs. There are less expensive machines on the market than the Dell. There are other machines that operate a little faster or that come with a higher-resolution monitor or something standard that is extra on the Dell. However, you get what you pay for. Here, you pay for rugged equipment, superior technical support, and a company that will be here tomorrow to back up the product it sold you today. All Dell's computers are assembled, and some parts are manufactured, here in the U.S.—another reason to buy a Dell.

My only two recommendations before purchasing this machine would be to upgrade to a faster, larger hard drive (100MB if your budget permits) and to purchase a monitor with a .28 pitch.

PEER PLAUT

Circle Reader Service Number 302

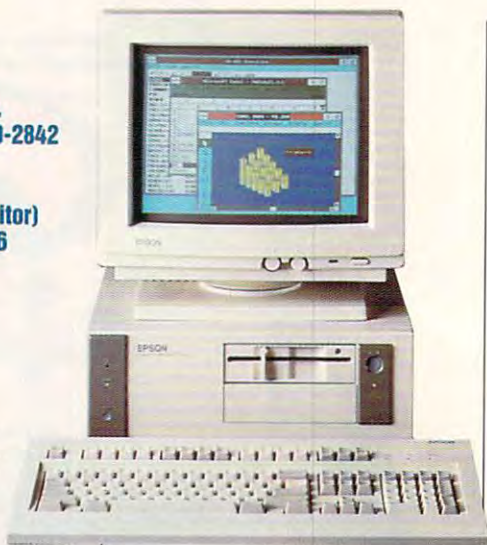
EPSON EQUITY 386SX PLUS

I've enjoyed the benefits of a 386SX at the office for quite a while now, so when asked to take a look at the Epson EQUITY 386SX PLUS, I eagerly agreed.

The EQUITY 386SX PLUS features an Intel CPU operating at 16 MHz turbo speed and 8 MHz nonturbo. It has serial and parallel ports built in and a PS/2-compatible mouse port as well. No mouse was provided with the machine, however, so I operated it with a Logitech MouseMan for a while and then switched to a Summagraphics digitizing tablet plugged into the serial port.

You can order this machine with either a 1.44MB 3½-inch or a 1.2MB 5¼-inch floppy drive. I use the 3½-inch format almost exclusively, and it does appear to be very much an industry standard. But if you still have an abundance of 5¼-inch disks in your collection, it's nice to have a choice. A 40MB IDE hard drive comes standard. There are three internal

EPSON AMERICA
2770 Madrona Ave.
Torrance, CA 90509-2842
(800) 922-8911
List Price: \$1,989
(not including monitor)
Street Price: \$1,246



drive bays, allowing you to customize the machine with a hard drive and two floppies or two hard drives and a single floppy.

This Epson offers you quick and easy access to the system box, thanks to a well-designed plastic case with a sturdy flip-top cover. Turn a knob, press two buttons on the back of the case, lift the top, and you'll find four expansion slots—three 16-bit and one 8-bit. Installing cards and extra memory won't have you fumbling about in a too small space. Expansive and comfortable, the keyboard sports keys that click—an unusual detail for a machine designed and marketed for discount and department store sale. Its VGA monitor provides bright, sharp color.

The starter machine comes with 2MB of RAM and can expand to 14MB on the motherboard. If you go with a memory card option instead, the ultimate capacity of the Epson EQUITY 386SX PLUS peaks at 16MB.

The VGA included with the base machine is flexible. Using bundled utilities, you can use up to 800 × 600, 16-color, and 132-column text mode.

Despite its built-in mouse port and video card, the EQUITY isn't too difficult to upgrade. To move up to Super VGA, for example, you merely disable the existing video board by pulling a jumper on the motherboard and then slip your new graphics card into a slot on

the expansion bus. While this kind of integration is reliable and perfectly suited for the beginner, it does squander resources. For this reason, consider carefully whether you really want to purchase a fully integrated PC rather than a standard architecture PC—especially if you think you'll be expanding the system over a period of time.

For security, there's a power-on option allowing you to require that a password be entered before anyone can use the computer after a cold start or a reset.

Despite some frustrating waits for technical support, when I did get through, they were always courteous and helpful.

The computer was a comfortable fit in a crowded office space—quiet, comfortable for typing, and visually attractive. Epson enjoys a longstanding reputation for solid, dependable computers and peripherals, and this machine would be a perfect first computer for a student or the head of a home office. If you have modest needs for a personal computer, you'll enjoy owning and operating the EQUITY. The test unit gave me no problems worth mentioning, and its finer points make it an amiable workmate for most situations.

ROBERT BIXBY

Circle Reader Service Number 303

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GATEWAY 2000 386SX-16

Gateway's 2000 386SX-16 offers you plenty of attractive features at a very competitive price. With a 14-inch antiglare Super VGA monitor, 2MB of memory, a 40MB hard drive, five 8- or 16-bit open expansion slots, and more, this computer should appeal in a big way to the average-income consumer.

I needed approximately five minutes to set up this Gateway 2000 system. The 40MB hard drive was already formatted, and *Microsoft Windows* was installed. I simply checked the user guide for anything unusual, plugged in the appropriate cables and power cord, removed the cardboard insert from the 5¼-inch drive, and flipped the switch.

The easy-to-understand Gateway 2000 Complete Systems User's Guide provides you with all the necessary information as well as helpful illustrations and troubleshooting tips. Other documentation includes the MS-DOS Operating System Guide, the *Microsoft Windows* User's Guide, and an operations manual for the CrystalSCAN 1024 monitor.

The MS-DOS guide is divided into four sections with a table of contents and index for each. The *Windows* guide is divided into sec-

GATEWAY 2000
610 Gateway Dr.
N. Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
List Price: \$1,495
Street Price: n/a (only through Gateway)

tions for beginning users and advanced users; I like the conversational, nontechnical language that the manual uses.

To check the 2000's compatibility, I ran a variety of applications, including *Telnet*, a shareware telecommunications program; *Wing Commander*; *Express Publisher*; *XyWrite 3.0*; and several other commercial programs. All of these programs ran without a hitch on the Gateway.

Inside the 2000, a riser card vertically houses the open expansion slots. All but the lowest card located next to the power supply unit allow easy access. The system's integrated design—with mouse port, parallel and serial ports, floppy and hard drive controllers, and video adapter as part of the system board—leaves the expansion slots open to other options. Since the video adapter is integrated, however, upgrading the video won't be as easy as changing video cards. The 2000's adapter is first-rate, though, so this shouldn't be considered much of a negative.

Vents along the lower left side of the unit keep the system's power supply from overheating. After I left the unit on for most of the day, the shell over the power supply unit wasn't even warm.

Easy access to Reset and On/Off buttons is essential, and both these buttons are located on the front of the Gateway 2000. The Tur-

bo button is also located on the front for easy access.

Many computers now use AA alkaline batteries to keep CMOS RAM intact. The Gateway 2000 is no exception. The four AA batteries reside between the power supply unit and the 5¼-inch disk drive—definitely close quarters. I wouldn't want to have to change those batteries.

You might eventually want to make the leap from 16 MHz to 20, and the Gateway 2000 entices you to hit the upgrade path by making the process a simple one. Just remove the CPU module connected to the system board and replace it with a 386SX 20-MHz module. This won't invalidate your warranty.

You can easily access the 2MB of SIMM RAM chips on the motherboard. Two empty RAM sockets are available if you'd like to add more memory in the form of 30-pin SIMM memory modules. RAM prices change constantly, but the price I was quoted for 1MB of RAM was \$62.50. So for \$125.00, you could add 2MB of RAM for a total of 4MB—not bad.

The first-class monitor that Gateway supplies with the 2000 provides a flicker-free, dark-tinted, antiglare picture tube sure to minimize eye fatigue. The brightness and contrast controls are conveniently located on the front right-hand corner of the monitor while the other controls are located on the back of the unit.

The unique AnyKey keyboard supplied with the 2000 is top of the line. You get two sets of function keys as well as a Program Macro key, a Repeat Rate key, and a Remap key. With the Program Macro key, you can enter sequences of keystrokes (macros) into a single key. Entering macros on this keyboard can be accomplished in a few seconds, and you no longer have to create script files for your keyboard macro program. Moreover, you can just do away with those memory-consuming TSRs alto-

gether; this hardware solution's the perfect replacement. Want to suspend your macros while you run an application that comes with preassigned Alt-key combinations? Just toggle your macros off with the Suspend Macro key.

You can store your new keyboard configuration to your hard drive with the ANYKEY utility included in the system software; this allows you to have several different keyboard setups on tap. The Repeat Rate key lets you adjust the keyboard's repeat rate, and the Remap key makes tinkering with key assignments fun and quite useful. If you have trouble finding a particular key, for instance, just remap it to a function key that you can easily locate.

The keyboard itself feels slightly mushy, though you still hear a click when the keys are pressed. When I first began my review, I disliked the softness, but the more I typed, the better I liked it. Diehard fans of firm keys can order a standard 101-key keyboard to go with the 2000 at no additional cost.

In comparison to those offered with a lot of other systems, the 2000's one-year limited warranty rates better than some. Gateway offers toll-free customer service and technical support numbers.

A solid system, the standard issue 16-MHz 2000 won't disappoint most users. Programmers, though, would probably be better off with the 20-MHz system, since compile time means idle time. From novice user to computing professional, Gateway promises value and service.

JOYCE SIDES

Circle Reader Service Number 304

HYUNDAI SUPER-386SE

The Hyundai Super-386SE appears to be perfectly cut out for general office or home office use. Though it's not a top-of-the-line corporate screamer, it has plenty of ability to handle a variety of computing tasks. The Super-386SE is a serviceable low-end entry into the world of 386 computing.

The machine I tested—configured with 2MB RAM, a VGA monitor, a Conner 40MB hard drive, and a 1.2MB 5¼-inch floppy drive—should be able to handle just about anything a home/office generalist needs it to do. The system includes one parallel and two serial ports and a disk drive interface built into the motherboard. No disk controller board is required unless you plan to add a second hard disk. The system is set up to accommodate a second floppy disk drive without additional hardware.

**HYUNDAI ELECTRONICS
AMERICA**
166 Baypointe Pkwy.
San Jose, CA 95134
(800) 727-6972
List Price: \$2,524
(review configuration)
Street Price: \$1,781

This small-footprint system (15.9 × 15.2 × 6 inches) includes five expansion slots (four 16-bit and one 8-bit), allows for up to 8MB of memory on the motherboard using 256K or 1MB SIMMs, and includes a socket for a math coprocessor. The video adapter occupies one of the system's five slots. Although the system seems to invite expansion, it comes with a 130-watt power supply, which probably would need upgrading before you could load the Super-386SE to the hilt.

The generic Super VGA card can handle resolutions up to 1024 × 768, and the Hyundai 14-inch color VGA monitor has a dot pitch of .28. The video card includes an automatic monitor detection feature allowing it to configure itself for the monitor in use without operator intervention.

The Super-386SE uses a Phoenix BIOS and a chip set by Headland. BIOS and video ROM can be copied into shadow RAM if the extra 384K of the first megabyte of system RAM is configured as EMS memory. This arrangement improves system performance by copying often-used BIOS code from ROM to faster RAM. If you don't opt for ROM shadowing, the extra 384K can be configured as extended memory.

The Hyundai Super-386SE was a snap to set up right out of the boxes. The monitor power cable plugs into the power supply rather than a wall outlet, making switched operation of the whole system possible. The machine came with DOS 4.01 and a full set of documentation for MS-DOS and GW-BASIC as well as a system User's Guide and small manuals for the monitor and video adapter.

The User's Guide provides adequate technical information on the machine and an ample number of illustrated tips on adding additional disk drives and memory. Digging through the User's Guide is somewhat difficult, though, as it includes introductory tutorials on MS-DOS and GW-BASIC inter-



TEST LAB

mixed with the technical data.

Among the disks in the DOS package is a utilities disk that includes diagnostic programs used to check the health of system components. Although DOS 4.01 came with the system, I quickly upgraded to MS-DOS 5.0 without difficulty. Other software including word processors, *Windows* applications, a wide variety of commercial utility packages, and a host of games ran without problem. One game, a 256-color version of a pop-

consider a machine with a little more speed and power.

As with many of today's machines, the inside of the Hyundai is simple and clean-looking. The motherboard, though small, contains more components than motherboards of days past. Hyundai positioned the expansion slots at the rear left of the machine and the SIMM memory sockets to the right of the card slots. These memory sockets are easily accessible as long as the card

Hyundai also includes a hard disk activity LED, which confirms that the nearly silent Conner hard drive is accessing information.

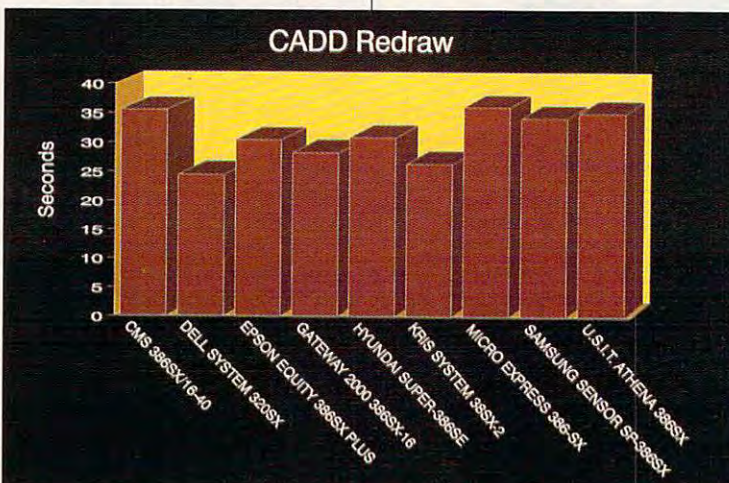
Other front panel controls include a push-button on/off switch and a reset button. The 2¼-inch speaker on this model has the normal tinny qualities we've grown accustomed to in the sound systems on DOS systems, but the Hyundai's design introduces an additional level of irritation. When playing notes of certain frequencies, the speaker's vibrations induce rattles and vibrations elsewhere in the system—specifically in one component of the on/off switch.

While the Hyundai's power supply is at the system's rear, the on/off switch is on the front panel. A small tube connects the two. It is this lightweight metal tube that rattles disturbingly when the speaker plays certain notes. This feature is most noticeable and annoying during gameplay where soundtracks set off this sympathetic vibration with alarming frequency.

All in all, this computer system has what it takes to be a competent general-purpose workstation.

TONY ROBERTS

Circle Reader Service Number 305



ular graphic adventure game, failed to run, however, owing to a memory shortage on the video adapter, which sported only 256K of video memory. The adapter needs at least 512K to display more than 16 colors at resolutions of 640 × 480 or 800 × 600, or more than 4 colors at 1024 × 768.

Software performance was typical for a 16-MHz 386SX. The Super-386SE offers a significant performance improvement over a 286 system in graphics environments such as *Windows* or when running a large database application or spreadsheet. Nevertheless, if you know going in that you'll spend a majority of your computing time with graphics-intensive programs, huge spreadsheets, or databases, or if you intend to make frequent use of the 386's multitasking capabilities,

cage isn't full. The User's Guide provides information on inserting and removing the memory modules, but the illustrations in the guide are a bit confusing since their orientation is the opposite of that of the actual memory sockets. In our system, all eight banks were filled with 256K SIMMs for a total of two megabytes. Expanding memory would require removing the 256K SIMMs and replacing them with either four or eight 1MB SIMMs.

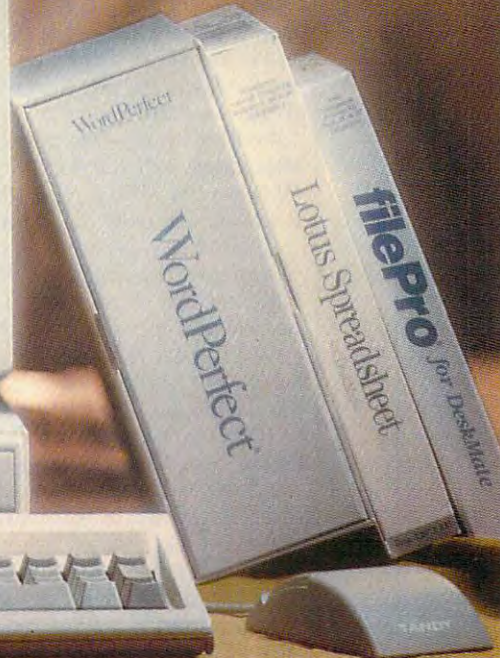
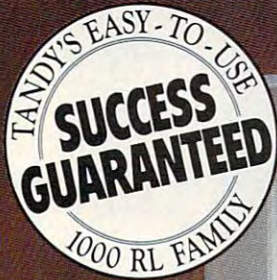
Operating speeds of the Hyundai Super-386SE are 8 MHz and 16 MHz. Select your preferred boot-up speed via the setup routine and store it in CMOS memory. You can change clock speed by pressing the Ctrl-Alt-Plus or Ctrl-Alt-Minus key combinations. Front panel LEDs indicate the current system speed setting. The

KRIS SYSTEM 38SX-2

Try this at home. Pop any tape into your VCR. If your machine has a Pause/Slow key, run the tape in slow motion. Remember how that looks. Resume normal speed; then, while the tape's still playing, hold down the Fast Forward button for a quick scan in fast motion. Remember how that looks. Got it?

Good, because now you know how I felt going from my trusty old IBM XT-compatible personal computer with its 8086-type microprocessor to KRIS System's 38SX-2, a PC with an 80386 microprocessor running at 20 MHz. Besides taking me from a Model T crawl to a Porsche sprint, the KRIS System 38SX-2 and the accompany-

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ing PMV14VC Super VGA monitor also proved to be generally well designed, easy to set up, and agreeable to use.

After opening the boxes and separating the PC and monitor from their packaging, I had the system up and running in only about five minutes. This desktop computer comes equipped with a base perfect for setting it up out of the way on the floor, freeing up desk space. Its two floppy disk drives—a 1.2MB 5¼-inch and a 1.44MB 3½-inch—are positioned accordingly, with the slots horizontal when the KRIS System 38SX-2 stands vertically on its base.

The monitor, printer, and other peripherals plug into the back of the computer. However, the keyboard does, too—a configuration I found to be a drawback. Because the front of the machine must face you to provide access to the floppy drives and Turbo, Power, and Reset buttons, having the keyboard plug in at the rear necessitates an overlong stretch of its cord. As a result, I had a little trouble keeping the keyboard on my desktop.

Aside from the less-than-elegant cord stretching, though, the keyboard is perfectly acceptable, with keys neither too crowded nor too scattered. The 12 function keys are arrayed in one horizontal row across the top, with the basic letter keyboard gravitating to the lower left corner. I found it a little awkward doing most of my typing toward one end of the keyboard, but that's certainly not a major gripe. There are two sets of Ctrl and Alt keys—one on either side of the space bar. The number keypad lies at the far right, with four distinct arrow keys and the other directional keys—such as Home and End—situated between the letter and number keyboards. The keys responded well, clicking audibly, although they weren't quite as crisp as I'd like them to be.

I made no special adjustments for any software I tried with the

KRIS TECHNOLOGIES
260 E. Grand Ave.
S. San Francisco, CA
94080
(800) 282-KRIS
List Price: \$1,803
Street Price: n/a



KRIS System 38SX-2. It handled my word processor, business ledger, and a couple of complex adventure games equally well.

Although the computer can handle an EGA or VGA monitor, the PMV14VC Super VGA monitor is a particularly good one, offering crisper lines and more vivid, lifelike colors than my standard VGA monitor. Making its good display better takes only the adjustment of a couple of perfectly accessible knobs located just under and to the side of the monitor's lower right corner. Unfortunately, the PMV14VC Super VGA's one obvious flaw couldn't be ignored: The pronounced frame surrounding the recessed screen casts an arch-shaped shadow across the top of the screen, lapping over any display and detracting from an otherwise excellent picture.

As for the inner workings of the computer, a quick glance inside the case revealed the KRIS System 38SX-2 to be a well-designed machine. The removal of four readily accessible screws at the back of the machine allows the sturdy case to slide off easily, and the vertical design of the KRIS System 38SX-2 makes for easy access to the disk drives and motherboard from two directions. Given the machine's deep, relatively open setup, you should have few problems adding new cards in expansion slots or installing additional memory chips. Before opening

the case, however, I noticed that the fan operated at average-to-above-average loudness.

The exterior proved less acceptable. A plastic overlay marking the Turbo and Reset buttons was loose, flaring out to give the machine a somewhat cheaper feel; the flaw was basically inconsequential, yet hard not to notice. In addition, the round, white Turbo and Reset buttons are identical and side by side, making an accidental reset virtually inevitable at some point. The buttons should have been given distinct designs and separated. A larger round white button nearby controls the power, but its size and placement are distinct enough not to cause confusion when your fingers fumble around under your desk in search of the correct button. The arrangement of the floppy drives is more satisfactory, with the 5¼-inch drive placed above the 3½-inch drive at the top of the PC's face. A row of small lights indicates whether turbo has been engaged, the presence of a high-density disk, and activity by the hard drive.

Whatever they're doing, chances are the KRIS System 38SX-2 and accompanying PMV14VC Super VGA monitor are doing it well. Solid and fast, this machine offers exhilarating computing to anyone accustomed to older models.

EDDIE HUFFMAN

Circle Reader Service Number 306



Smartcom Exec,™ the newest communications software from Hayes, is remarkably easy to operate. In fact, Computer Shopper said "Many people... will be able to install and use the program without touching a book, because the interface is quite self-explanatory and help is just a function key away."

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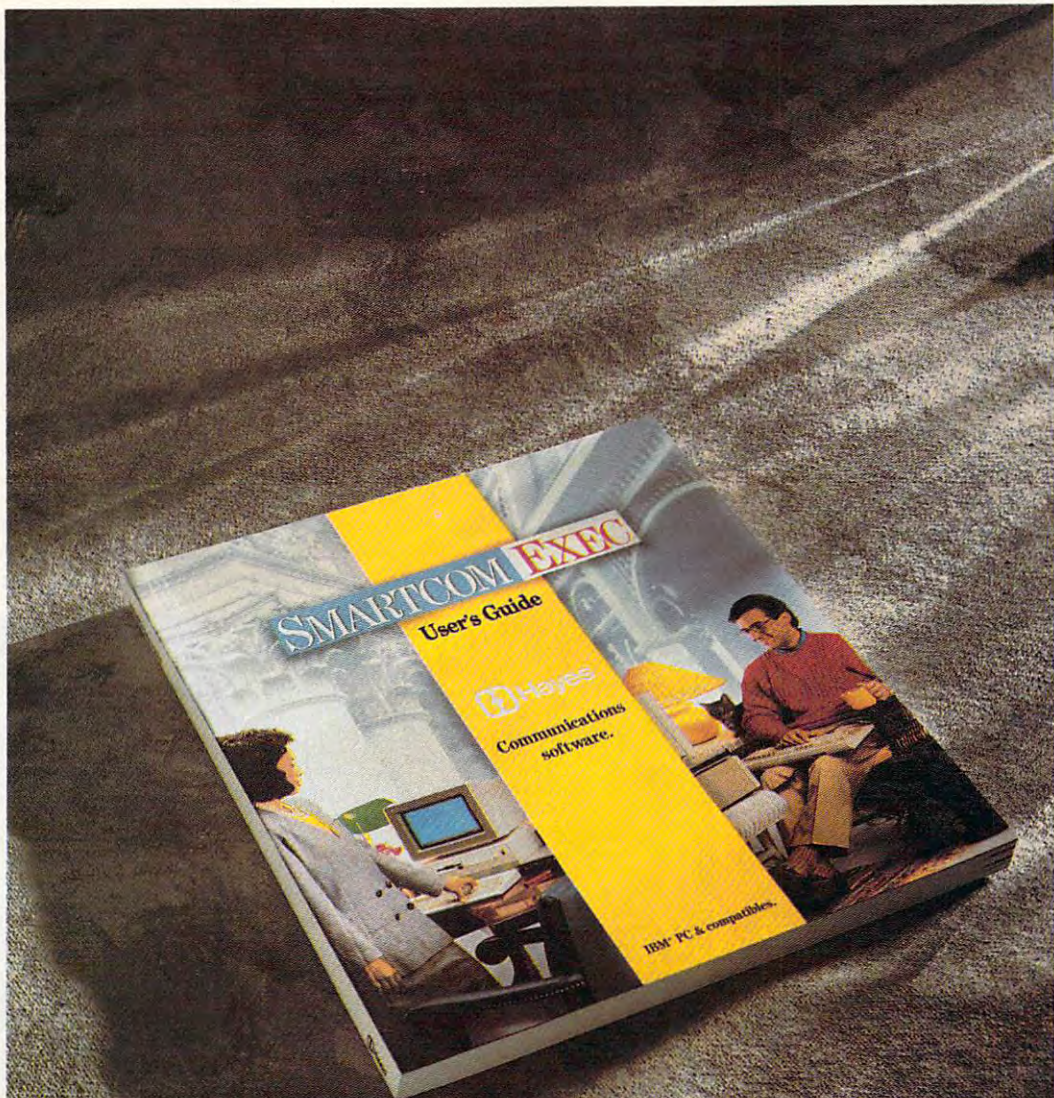
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MICRO EXPRESS
1801 Carnegie Ave.
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(800) MICRO21
List Price: \$1,394
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MICRO EXPRESS 386-SX

As I pulled the Micro Express 386-SX unit out of its cardboard box, I breathed a sigh of relief. Important elements of the machine's architecture—VGA card, hard drive controller, and I/O ports—were all distinctly separate from the motherboard. Some newer machines have all the cards and I/O ports as part of the motherboard. This may save the manufacturer a few dollars, but when there's a breakdown, replacing the hard

drive controller means replacing the entire motherboard. This can be expensive, costing only about \$300 less than a new computer. Standard architecture also allows for use of inexpensive clone hardware for future upgrades and replacement, keeping both of these costs well within reason. With six expansion slots available to you (four 16-bit and two 8-bit), you can expand your system at will, budget allowing.

The machine comes with 2MB of SIMMs (Single In-line Memory Modules) and will expand to 4MB. Easy to replace or upgrade, these SIMMs cost even a bit less than DRAMs (Dynamic Random Access Memory). If you choose to install the memory yourself, you may find it easier to remove the moth-

erboard than to wrestle with the SIMMs in cramped quarters.

Located just above the Reset button, the computer's readily accessible Turbo switch bumps the processing speed up to 16 MHz. Be aware that both the Turbo switch and the Reset switch are exactly the same shape and color as the case. You could easily reset the machine by accident when you intend to hit the Turbo switch; I did. Most of the time you'll probably run the processor at 16 MHz anyway. Probably the only time you'll want to intentionally slow down the motherboard is when you want to play games.

The Micro Express comes standard with a 3½-inch 33MB IDE (Integrated Device Electronics) hard drive manufactured by Quantum. Included in the drive package is also one 5¼-inch 1.2MB floppy drive. There's plenty of room to add the 3½-inch floppy disk drive and a tape backup system or one more hard drive. If you call Micro Express, it will configure the machine any way you desire before you buy it. I suggest these extras: the popular 1.44MB floppy disk drive and a 100MB drive instead of a 33MB. This may sound like a lot of hard drive space, but given the size of today's programs, it's not. Take advantage of Micro Express flexibility and order exactly what you

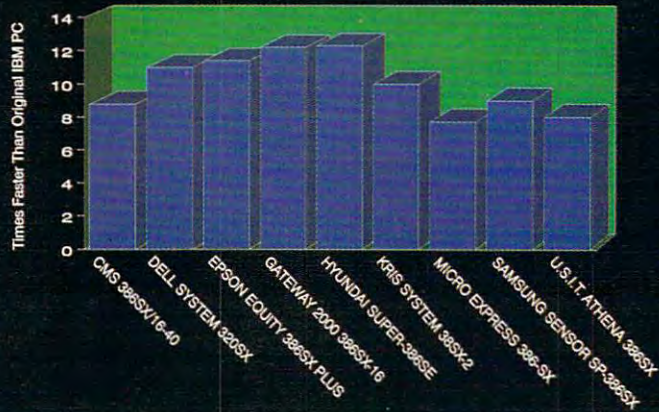
NORTON INDEXES

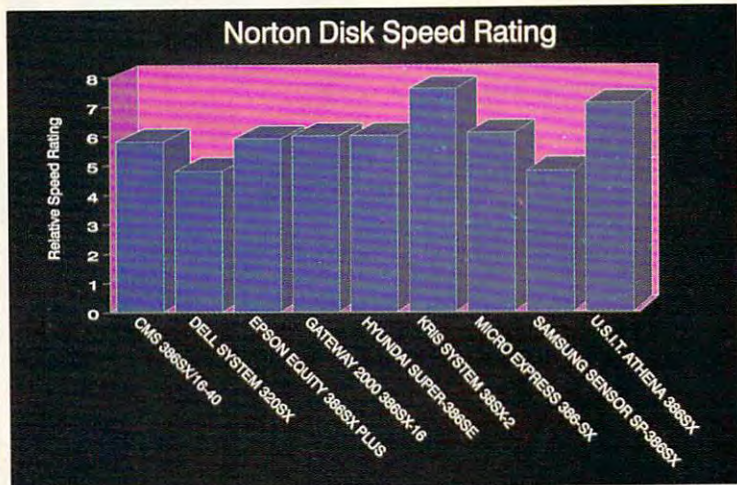
The Norton computing, disk, and overall indexes show how well a computer performs when compared to a 4.77-MHz XT (the original IBM PC). Such an XT has an index value of 1.0. If a computer is twice as fast, it will have a value of 2.0. The greater the index value, the faster the computer—and the faster your applications will run.

The computing index rates a computer's processing performance based on integer operations, such as addition, subtraction, multiplication, and division. The disk index rates the performance of a system's hard drive. The overall performance index factors in the computing and disk indexes among other things.

—RICHARD C. LEINECKER

Norton Computing Index





want and need for the computer. From an aesthetic point of view, the case won't win any prizes. However, thanks to its small size, the case can sit under your desk and never be noticed. One problem with this setup, and also when the machine rests on a desktop, is that the power switch is located on the back of the machine—very awkward.

Ventilation should not be a problem—the case seems large enough, and the fan located in the power supply is standard fare. The computer is no noisier or quieter than the average desktop. Its footprint, too, takes up an average amount of space on your desk.

My Micro Express 386-SX shipped with a 14-inch analog Super VGA color monitor with resolution up to 1024 x 768 and a .28 dot pitch. The colors on this monitor did not appear especially bright, but the picture was crisp because of the .28 pitch. The nonglare screen helps when you're working at odd angles for long periods of time, giving your eyes a little more mileage.

Keyboard layout ranks high on the list of significant attributes for any computer. Micro Express's keyboard (a standard clone) has the familiar row of 12 function keys across the top, an extended numeric keypad, and cursor movement keys. An audible click

accompanies each keystroke, and each key feels solid. Still, I prefer a more compact keyboard. Trim the borders and move the function keys a little closer to the numeric keys across the top, and the keyboard would work well. Nevertheless, this machine and I were up to speed in no time.

The standard Micro Express 386-SX sells for \$1,394 and will serve two purposes extremely well. If you're looking for a replacement 386SX, this machine will meet your needs. If you don't like the keyboard, keep it as a spare. Any of your existing hardware and software should transfer readily to this machine.

If this is your first experience

shopping for a 386 computer, and you already own some software, this standard system is a good place to start. You can easily install more memory and add a mouse or a 3½-inch disk drive. Be forewarned, however, that the Micro Express comes with no software outside of your choice of DOS 3.1 to 4.01. Manufacturer-installed software often helps computer newcomers get in the swing. With the Micro Express 386-SX, you'll start almost from scratch.

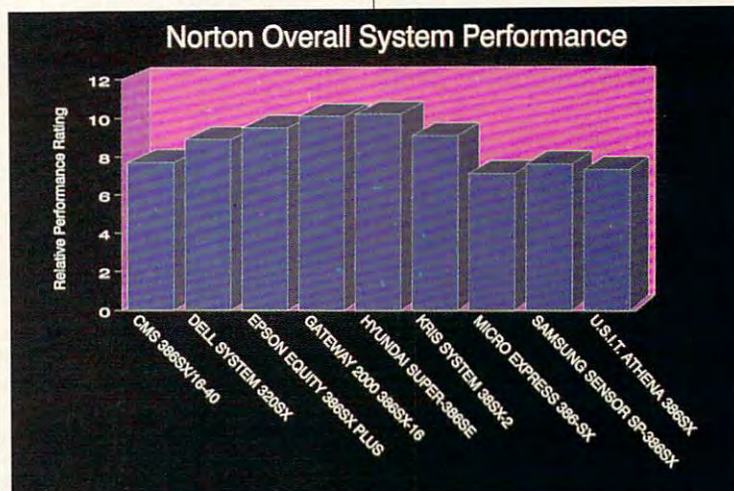
Technical support has always been important to me. Nowhere in the manual did I find a technical support number or even a mailing address—true to form for a lot of mail-order businesses. Hang on to the toll-free technical support number that shows up on Micro Express invoices; that's your ticket to unlimited free, knowledgeable, and friendly technical support.

PEER PLAUT

Circle Reader Service Number 307

SAMSUNG SENSOR SP-386SX

The Samsung Sensor SP-386SX offers a lot to those entering the computer world. Easy setup, compact design, and built-in features—which cost extra with other systems—make the Sensor a



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remarkably complete package.

Getting the system up and running took me only about ten minutes, thanks to the installation and setup guide packed with clear illustrations. If you lack computer experience or need more reassurance, the VHS videotape manual and the User's Guide lead you from setup through your first work session with step-by-step introductions to the system's hardware and software.

Samsung packs quite a bit into its system box, which has a small 15 x 13¼ inch footprint. The sturdy metal case opens easily. Inside, you'll notice a roomy and accessible layout, which should simplify installation of boards and extra memory.

However, you may consider additions and upgrades unnecessary. The Sensor comes with a mouse port, parallel port, serial port, Super VGA graphics, and 2400-baud internal modem—all built into the motherboard. In addition, the Sensor has an external floppy disk drive connector for adding the Sensor SP-FDD 5¼-inch External Disk Drive. For most computer users, especially for those just entering the computer world, these features will make the two IBM AT-compatible expansion slots more than sufficient.

The Sensor comes with 2MB of RAM, expandable to 8MB on the motherboard using SIMM chips. Adding memory expansion boards lets you expand to 16MB. The motherboard's speed is factory set at 16 MHz but can be switched to the slower 8 MHz.

The fan, located at the back of the case, remains relatively quiet—just loud enough to let you know the computer's on. And there's enough space in the system box to allow for adequate ventilation.

The system includes a mouse and a sleek keyboard. Function keys line the top of the curved, 101-key keyboard. Slightly crisp, the keys offer an audible click, adequate resistance, and enough space for good finger maneuvera-

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bility. I especially like the oversize Enter key and the location of the Ctrl key in the lower left-hand side of the keyboard. The mouse rolls smoothly, and it comfortably fits the contours of the hand.

The motherboard video configuration supports 256 colors at 1024 x 768 screen resolution. With a .31-mm pitch and antiglare screen, the Sensor's Super VGA monitor helps ease the strain of using a computer. My eyes and neck appreciate the size and tilt-swivel capabilities of the 14-inch monitor. Conveniently, the monitor power switch is located on the front of the monitor, and the brightness and contrast controls are within reaching distance to the side. Likewise, for convenience, the computer power and reset buttons are located on the front of the case.

Samsung has covered all the bases in the Sensor's complete documentation, and misplacing one of the eight sunflower-bright manuals should be next to impossible. The clear and thorough manuals divide discussions of the system and application software into individual sections, each with its own table of contents and index. Most of the manuals include tech support or troubleshooting sections of some sort, and many include a glossary. The manuals are easy to read, and many include helpful illustrations.

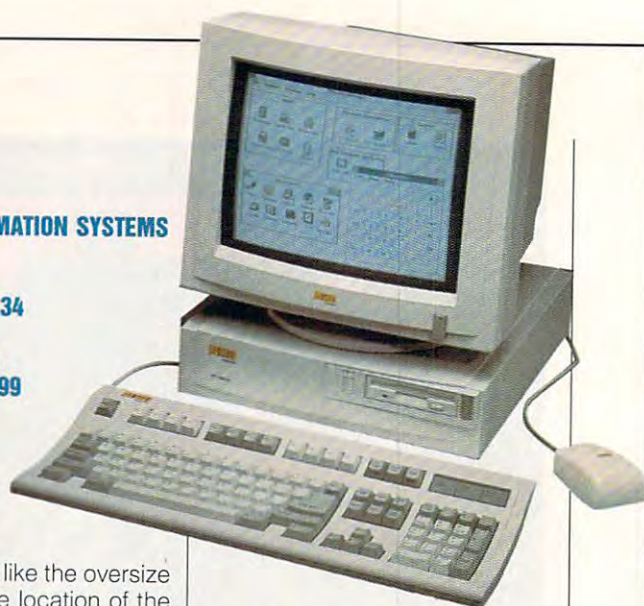
Although designed for almost everyone, the Sensor really shines in its attention to quelling the fears

of those new to the computer world. The video manual and the User's Guide suggest that users take a tour of the system through the *System Tutorial*, perhaps the most informative application that accompanies the Sensor.

The *System Tutorial* impressed me with its realistic graphics and detail. It goes beyond the system's basics to include information on computers and disks in general, quite comforting for the computer wary. It also takes you on a tour of your computer's insides if you're not confident enough to open it up and look for yourself. (And just in case you haven't plugged in your computer at this point, it shows you how.)

Several of the other applications included with the Sensor help keep you organized. You get *YourWay*, a personal management system; *Balance Point*, an application for check writing and personal finance; *The Norton Utilities*; *The Norton Backup*; *GW-BASIC*; *Microsoft Windows 3.0*; and *MS-DOS 4.01*. (An offer to upgrade to *YourWay 2.0* for \$49.95 is included in the Sensor paperwork.) As an added bonus, the Sensor also comes with a free month of Prodigy, the interactive personal service that provides news, educational programs, games, shopping opportunities, and more.

To test the Sensor's performance, I added XYQUEST's



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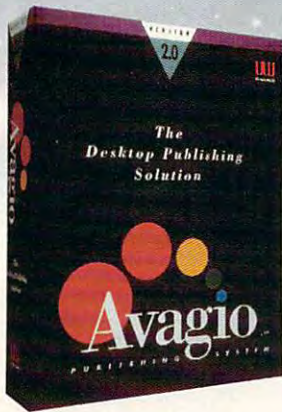
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XyWrite, Interplay's *Dvorak on Typing*, and Disney's *Arachnophobia* to the system's applications. The Sensor handled these with no hangups. I found *Dvorak on Typing* and *Arachnophobia* a bit hard to hear. This computer's sound system, like that of most PCs, would greatly benefit from an external volume control.

The hardware technical support staff responded courteously and calmly to my volume control inquiries but told me a technician would have to check out the system. The Sensor provides a 6-month on-site labor/12-month parts warranty, clearly detailed in the documentation. Samsung provides hardware support for free through a toll-free number, but software support costs \$1.50 per minute after the first minute.

With all it has to offer, the Sensor successfully fulfills its goal of being operable and productive for users without any specialized knowledge or training. The 40MB hard drive and two expansion slots may not be powerful enough or offer enough flexibility for every computer user. But the price, compact design, thorough documentation, and added hardware bonuses make the Samsung Sensor a formidable contender in the 386 race.

ERIN RICHTER

Circle Reader Service Number 308

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3023 Research Dr.
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List Price: \$1,995
Street Price: n/a (sold only at list)

U.S.I.T. ATHENA 386SX

The US Integrated Technologies Athena comes well packaged, and setup takes little time.

Longtime computer users could probably set it up blindfolded, but even computer novices should have little difficulty. The Getting Started chapter in the manual is straightforward and well illustrated with photographs outlining each step of the assembly process. U.S.I.T. has clearly labeled the ports on the back of the system box. As with most computers, all you'll need is a small flat-head screwdriver to tighten the monitor connection. Although plugging in the hardware poses no problems, the Athena comes to you bare, without any version of MS-DOS.

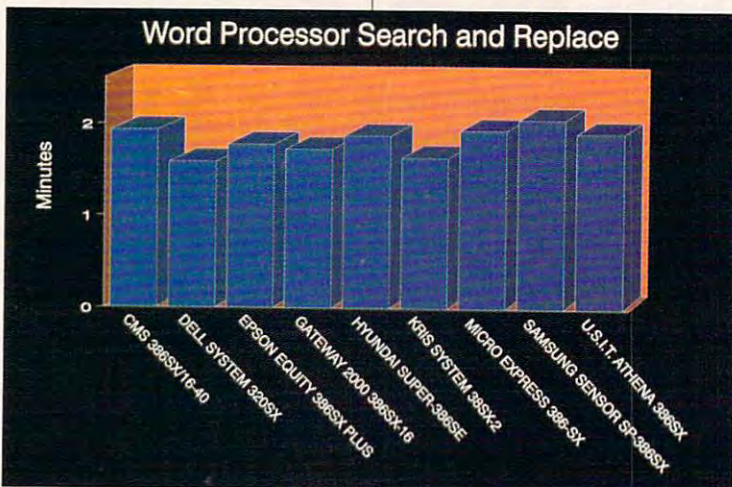


An attractive machine overall, the Athena has a design vaguely reminiscent of ancient Grecian architecture. I wish the small Power and Reset switches had more distinctive markings, however, to prevent confusion between the two.

Once inside the medium-footprint case, you'll find plenty of room to move around. And with this much room, don't expect any ventilation problems. The fan located in the back of the case runs quietly. In addition to the 5¼-inch floppy drive, there's one more drive bay that can be accessed from the outside of the machine, and there's room in the hard drive bay to add another hard drive.

The video adapter, mouse port, keyboard port, one parallel port, and two serial ports are all integrated into the motherboard. This configuration leaves you with three open 16-bit expansion slots to install whatever cards you wish.

This computer uses SIMMs (Single In-line Memory Module), and you can upgrade to 8MB. The review unit shipped with 1MB of mem-



All Benchmark/Performance Testing is conducted by Computer Product Testing Services (CPTS), an independent testing and evaluation laboratory based in Manasquan, New Jersey. Every effort has been made to ensure the accuracy and completeness of this data as of the date of testing. Performance may vary among samples.



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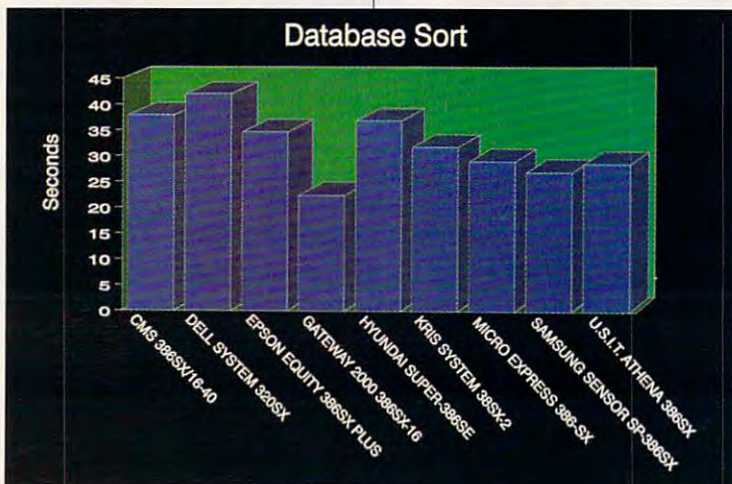
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ory, but you should upgrade to at least 2MB if you plan to run *Windows 3.0*. For most desktop applications, 1MB should suffice.

U.S.I.T. sells only one keyboard, which compares favorably with most other keyboards. If you dislike a smaller-than-usual Enter key, though, you might want to hold on to the keyboard from your old machine. A nifty perk for those who use the U.S.I.T. stock keyboard: the Caps Lock, Scroll Lock, and Num Lock keys have their own on/off lights located con-

ucts. I found this answer a little confusing; all I wanted to know was if I could upgrade to a different monitor. You can always go to your local dealer to see what is available if U.S.I.T. doesn't have a monitor that suits your needs.

The video adapter card supports resolutions up to 1024 x 768 but only in two colors and only with the 512K memory upgrade—information best confirmed by talking with technical support, since there's no monitor manual included in the package.



veniently on the keys themselves. This feature proved very helpful.

The shining star of this hardware bundle—the .28-pitch VGA monitor—insists on pampering your eyes by supporting only 640 x 480 resolution. Running *Windows 3.0*, I thought my eyes were playing tricks on me; the screen appeared tiny. I quickly whipped out my tape measure, only to find that the diagonal screen measurement was 11½ inches across—something I never would have noticed until I ran a graphics-intensive program like *Windows*. I like the .28 pitch and would choose the smaller monitor with this high resolution over a 14½-inch screen with a lower resolution any day. When I asked about the availability of a different monitor, I was told different monitors come with different prod-

This computer's video adapter leaves a lot to be desired; most people use more than two colors on their Super VGA monitors. With the 512K video memory upgrade, the video adapter will support 256 colors in 640 x 480 mode. This is also the capability of the monitor that is standard with the computer. You can, however, disable your on-board video adapter and add your own. Since the expansion slots are industry standard 16-bit, the video card of your choice should work.

The installed 42MB Western Digital IDE hard drive rates at less than 18 milliseconds—fast enough for most users.

I tried several applications on the Athena, and all ran without a hitch. The better-known software I ran was *Windows 3.0*, *Microsoft*

PLANNING AHEAD

Buying a computer is a big decision—one you should base on future needs as well as current ones. As you look ahead, ask yourself the following:

1. Will I use *Windows*? You'll need at least 2MB of RAM to run *Windows* adequately, and if you use other memory-intensive software or require more speed, you should plan on even more memory.
2. How many applications will I run, and how big will they be? While 20MB hard drives seemed plenty big at one time, today's massive applications gobble up that much disk space in no time. So many standard drive configurations specify at least a 40MB drive, and usually you'll have the option to move up to bigger drives. This is an option you should seriously consider.
3. How much expansion might I need? While integration of the video adapter, drive controller, ports, and more keeps slots open for expansion, there are more ways than ever to use your slots. Fax cards, modems, scanners, and other peripherals can require a slot. Think about what you might add, and choose accordingly.
4. Am I willing and able to work inside my computer? If you're afraid to go inside to add a drive or upgrade your memory, you'd be wise to anticipate your needs and order enough memory and storage for the future if you can afford it. Otherwise, you'll have to pay someone to do the upgrade or find a friend to do it for you. Pay attention, also, to the warranty and service policy. Readily available help could make a tremendous difference, especially if you depend on your computer for business.

If you aren't afraid to go into the computer yourself, pay attention to how accessible the case is and consider how easy or difficult it might be to make the upgrade.

—MIKE HUDNALL

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I had the opportunity to call the technical support people twice. On both occasions they were courteous and helpful. The Athena line is sold through Value Added Resellers (VARs) and Inacomp. Technical support, should you need it with the Athena model, isn't toll-free. Since the computer is sold through VARs, I suggest you contact your reseller before calling U.S.I.T., which supplies many different lines to many different resellers with many different options. The Athena could be packaged any number of ways. Because of this, technical support had trouble identifying my equipment and telling me if the equipment I had was right for the machine I had.

The computer comes with a standard 12-month warranty but with no standard on-site service. However, you can purchase an on-site service contract. The warranty is backed by U.S.I.T. but is handled through your reseller. U.S.I.T. does not have any specific guidelines as to how a reseller handles warranty work. If you buy the Athena from a reseller, find out how he supports the warranty. Does he give you a loaner, or will you be without a computer for three weeks while your computer has been shipped off to California?

An average machine, the Athena runs *Windows* well because of the faster hard drive installed, but processing performance doesn't exceed any other 386SX 16-MHz computer. If the Athena meets your minimum standards and you like the price, it would be a wise purchase.

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Service Plan: through local servicer, on-site service from participating servicers, technical support through Epson

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Service Plan: contract with TRW for on-site service in most locations, or can send to Gateway; after warranty expires, Gateway provides free labor, but the customer must pay for shipping both ways; technical support offered through toll-free number and BBS

Hyundai Super-386SE

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tended each year after 18-month period

Service Plan: through the dealer; plan dependent on dealer

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Warranty: two years for parts, 18 months for labor; one-year extensions available through Dow Jones
Service Plan: through Dow Jones, on-site service optional, technical support through toll-free number

Micro Express 386-SX

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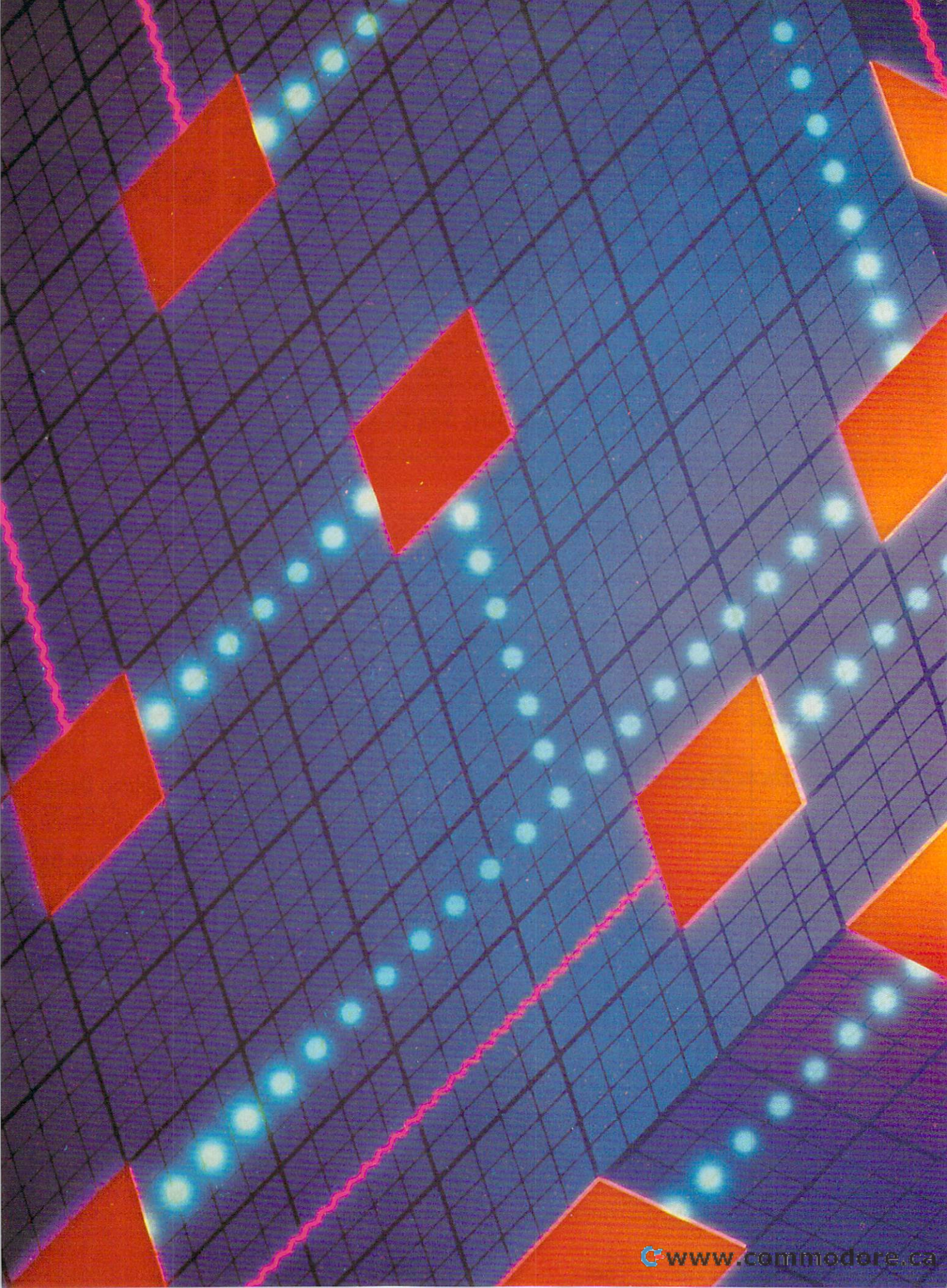
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HOW TO CHOOSE A VGA SYSTEM

Still using that old monochrome monitor? Suffering through video snowstorms whenever your CGA scrolls text? Or just tired of hearing your neighbors and coworkers brag about how great *Windows* looks on their superduper whiz-bang VGA 800s?

In April of 1987, IBM introduced VGA with its PS/2 line. At that time, VGA was about the neatest video around for most PC users. In four short years, however, it has become the minimum ante for new computers. That's largely due to the greater emphasis placed on graphics today. Desktop publishing and *Windows* applications need graphics, and, of course, most games require at least EGA graphics to be attractive.

VGA has spawned a host of new problems, as vendors all seem to be offering their own variations of Super VGA. (And now there's XGA, but mortals like you and me won't be able to afford it—or the monitors it requires—for a while.) How do you know what to buy?

In this article, I'll show you how to choose the right VGA board and monitor for your system. I'll define terms and cost

ranges, and keep you from spending a lot of money on a dead-end system that won't meet your needs.

VGA Board Basics

The VGA, or Video Graphics Array, video standard was preceded by several less-powerful standards: the Monochrome Display Adapter and its third-party cousin, the Hercules Graphics Controller; the Color Graphics Adapter (CGA), which offered low-resolution graphics (640 dots—pixels—across the screen, 200 pixels down); and the Enhanced Graphics Adapter (EGA). EGA offers good text and fairly nice graphics (640 × 350 resolution) but lacks 100-percent compatibility with CGA. It also has some design flaws that make writing software for it a bit of a chore.

VGA's entry in 1987 wasn't so much a revolution as a bug fix. VGA offers only slightly better resolution than EGA—640 × 480—but, more important, it fixes the CGA compatibility problem and the programming design flaws. And it adds *much* better color.

At the same time, IBM offered the 8514/A adapter, an even higher-resolution board (1024 × 768), but it's not that

BY MARK MINASI

popular because it's fairly expensive, and its display is interlaced and thus hard to read.

There's not enough space here to explain interlacing in detail, but basically it's a trick to get a monitor to produce a higher resolution than it's capable of. A neat trick, but there's a side effect—the screen flickers. Work with an interlaced display for a while, and it'll drive you crazy and give you eyestrain headaches, so avoid interlaced video. By the way, the new XGA also has a 1024 × 768 interlaced resolution, so you want to avoid it unless you've got lots of aspirin.

No sooner had VGA come out than vendors began offering Super VGA boards. The first offerings were 800 × 600, a significant step up from 640 × 480. These boards were 800 × 600 interlaced, unfortunately. They were interlaced because the monitors available at the time—the original NEC Multi-sync, for example—couldn't handle noninterlaced 800 × 600. Today's monitors can display noninterlaced 800 × 600 and better, as we'll see.

How Much Memory?

Most VGA boards nowadays support Super VGA, even the inexpensive clones. You can pick up a no-name VGA board for about \$80–\$150, and in addition to standard VGA, it'll probably have some kind of 800 × 600 mode. The more expensive Super VGA boards (\$200–\$300) support 1024 × 768, either in interlaced or noninterlaced mode. More resolution means

more dots on the screen, which means that the video board needs more memory to display those dots.

A video board's memory requirements are determined by two things: its resolution and the number of colors it can display. For instance, some VGAs can display 320 × 200 with 256 colors, but when in the higher 640 × 480 resolution, they can only display 16 colors. That has nothing to do with the constraints of the monitor or even of the VGA board except for the amount of memory on the board.

High Resolution

Standard VGA comes with 256K right on the board. Resolutions like 1024 × 768 with 256 colors obviously require more memory—that's why you see ads for VGA cards with an option for either 256K, 512K, or 1024K on the board. If all you're doing is regular old VGA, you only need 256K—there's no point in spending the extra money for 512K or 1024K. (I hear you asking, what resolution *do* I need? Hang on, I'm getting there.) Following is the amount of memory that a video board needs for the most common resolution and color combinations:

Horizontal Resolution × Vertical Resolution with Colors—Memory
640 × 480 with 16 colors—256K
640 × 480 with 256 colors—512K
800 × 600 with 16 colors—256K
800 × 600 with 256 colors—512K
1024 × 768 with 16 colors—512K
1024 × 768 with 256 colors—1024K

Should You Buy Super VGA?

Look in magazine ads, and you'll see that most VGA boards offer some kind of Super VGA mode. In many cases, you get a Super VGA mode free. Sounds like a good deal? It may be, but look closely; there are three catches.

- To use the Super VGA mode, you may have to spend twice as much money for a monitor that can display Super VGA than you would if you just bought standard VGA.
- Your application software may not support the Super VGA mode, and you have no guarantee that the video board vendor will be around in the next few years to supply you with drivers for the software. In a few years, your board's Super VGA mode may be a white elephant.
- Having all those extra pixels on the screen means that the processor must manage them all. Higher resolutions are generally slower.

Suppose you buy a no-name VGA card for about \$90. Then you leaf through the documentation that came with the board and notice that it has a Super VGA 800 × 600, 16-color mode. The problem is, a standard VGA monitor (which costs \$250–\$350) won't display the 800 × 600 mode. You need a multifrequency monitor (which costs \$450–\$1,000) to display 800 × 600. (The section on monitors is coming up.) So the free Super VGA mode will cost you \$200 more for a monitor to see the high resolution.

VGA GLOSSARY

aspect ratio—The relationship between the width of a display and its height. A display with square pixels has a square aspect ratio. In the PC world, only VGA and MCGA have square aspect ratios.

CGA—Color Graphics Adapter. CGA was introduced with the original PC. It offers a maximum resolution of 640 × 200 and a palette of 16 colors.

character matrix—The number of dots that make up a character. CGA's characters are in an 8 × 8 matrix; VGA's, 8 × 16.

dot pitch—The size of a pixel. Generally, the smaller the pixel, the better.

EGA—Enhanced Graphics Adapter. EGA systems offer a maximum resolution of 640 × 350 and a palette of 64 colors. IBM calls EGA's monitor ECD (Enhanced Color Display), but most people simply call it an EGA display.

8514—IBM's 1024 × 768 high-resolution standard. The 8514's display is interlaced. The number 8514 refers to the monitor; 8514/A is the monitor's adapter card.

horizontal scan frequency—Multiply the horizontal resolution of a monitor by the vertical scan frequency, and you'll have its hor-

izontal scan frequency. Measured in kilohertz (kHz).

interlacing—When a display is interlaced, it requires two scans to display one screen. The first scan displays even-numbered lines; the next scan displays odd-numbered lines.

MCGA—MultiColor Graphics Array. MCGA is a mode between EGA and VGA in performance. It was introduced with the PS/2 Model 25 and Model 30.

MHz (Megahertz)—One megahertz is 1,000,000 cycles per second. Megahertz is used to measure a microprocessor's speed or a monitor's refresh rate.

multifrequency—Any monitor that supports a range of vertical and horizontal frequencies. You need multifrequency monitors to display Super VGA and 8514. Also called a VFM, for Variable Frequency Monitor.

Multisync—NEC's brand name for its line of multifrequency monitors.

palette—Because of hardware limitations, most color video cards can display more colors than the monitor can handle. The set of colors that can be displayed at any one time is selected from an overall

group of colors called the palette.

pel—IBM's name for a pixel.

pixel—Pixels are the dots that make up a display. Look closely at your monitor, and you'll see thousands of dots, just like on a television set. Those are pixels. Color monitors have three dots per pixel; monochrome, just one. That's why monochrome monitors are always sharper.

resolution—The sharpness of a computer image. Generally, the more pixels a display supports, the sharper the image.

Super VGA—Any resolution of 800 × 600 or higher is considered Super VGA.

vertical scan frequency—The number of times a screen is redisplayed per second. CGA monitors (and most televisions) redraw the screen's image 60 times per second for a vertical scan frequency of 60 Hz. Vertical scan frequency is also called refresh rate.

VGA—Video Graphics Array. VGA was introduced with IBM's PS/2 line in all systems except the Model 25 and Model 30 (both of which use MCGA). VGA incorporates the MCGA modes and adds its own higher-resolution modes.

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The second problem arises when you try to do anything with the Super VGA mode. You need a driver program for each of your applications to exploit Super VGA—a driver for 1-2-3, one for *WordPerfect*, and so on. How do you know that the VGA vendor will be around to continue to support his board? On the other hand, this won't be a problem if you buy your boards from a big-name vendor like Paradise, Orchid, Headlands Technology, Sigma, or ATI—they'll probably all be around for years to come.

The software compatibility problem

til then, consider carefully whether or not you really want Super VGA. Are you willing to put up with the annoyance of loading third-party drivers into *Lotus*? The documentation that comes with some of these boards is atrocious. And do you mind spending almost twice as much for a higher-resolution monitor, when standard VGA may be fine for your purposes?

Going to 1024 x 768 sounds nice, but there is one consideration that you never hear vendors talking about. The extra overhead that high resolution entails. You see, the video boards that

hardware (called a graphics coprocessor) can be developed to speed up the graphical process.

The CPU could describe an entire screen with a few commands and go back to computing while the graphical hardware handled the tough work. These coprocessor boards are still very expensive—\$1,000 and up. But they'd get cheaper if a lot of them were sold. I wish VESA had labored to develop a standard on graphics coprocessors rather than agreeing on how to burden the CPU further with more pixels to shove around.

Putting VGA in Context

Card	Resolution	Color	Number of Colors in Palette	Text	Graphics
Official IBM Graphics Modes					
MDA	720 x 350	Monochrome	Monochrome	■	
CGA	320 x 200	4	Two palettes†	■	■
	640 x 200	2‡	16		■
	640 x 200	16	16	■	
EGA	320 x 200	16	64		■
	320 x 350	16	64	■	
	640 x 200	16	64		■
	640 x 350	16	64	■	■
	720 x 350	Monochrome	Monochrome	■	
MCGA	320 x 200	256	262,144		■
	320 x 400	16	262,144	■	
	640 x 200	2	262,144		■
	640 x 400	16	262,144	■	
	640 x 480	2	262,144		■
VGA	320 x 200	256	262,144		■
	360 x 400	16	262,144	■	
	640 x 200	16	262,144		■
	640 x 350	16	262,144		■
	640 x 480	16	262,144		■
	720 x 400	16	262,144	■	
8514	1024 x 768	16	262,144		■
Special Modes					
PCjr	320 x 200	16	16		■
Tandy	320 x 200	16	16		■
Plantronics	320 x 200	16	16		■
Hercules	720 x 348	Monochrome	Monochrome	■	■
Super VGA	800 x 600	16	262,144		■

† In 320 x 200 mode, CGA's background can be any of 16 colors. The foreground colors are drawn from either of two three-color palettes: cyan, magenta, and white, or green, red, and yellow.

‡ In 640 x 200 mode, only CGA's foreground color is selectable.

How Many Bits?

Video boards were originally designed to cater to the lowest common denominator. In the PC world, this means XT-class machines. Since XTs aren't very fast, there wasn't any point in designing video boards to be fast. So older VGAs and VGA clones are fairly slow at putting text and graphics up on the screen.

One way to speed up video is to double up on the data transfer rate by buying a 16-bit video board. Older video boards transfer data 8 bits at a time, since that was the maximum rate XTs could handle. But any AT-class 286, 386SX, or 386 system can accommodate a 16-bit video board with no problem. So buy 16-bit video boards, rather than 8-bit boards.

In actuality, you'll find that most of the VGA boards available today are 16-bit boards. But there are still a few 8-bit boards out there, so take a minute to be sure that you're buying a 16-bit board.

There is one more feature you'll see on a few boards: VRAM, Video RAM. It's a special kind of memory chip that is not only high speed but also dual ported. What this means is that the video circuitry can read the memory at the very same time that the program is writing to it. That means snappier screens. It's a nice feature, but it's awfully expensive at the moment. Pass it up unless you need the very best.

Refreshing Monitors

A monitor provides the illusion of a clear, flicker-free display by painting 60 full-screen images on the CRT per second. If there were fewer images painted on the screen per second, you'd see a flashing or flickering effect, particularly on horizontal lines. The number of screens displayed per second is called the refresh rate or the vertical scan frequency. It's measured in hertz, abbreviated Hz. For example, 60 screens per second is a 60-Hz refresh rate. CGA, EGA, and VGA use a 60-Hz refresh rate.

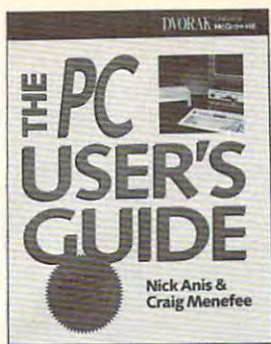
may be reduced soon, however. A group of VGA vendors called the Video Electronics Standards Association, or VESA, has developed a set of standards for 640 x 480 with 256 colors, 800 x 600 with either 16 or 256 colors, and 1024 x 768 with either 16 or 256 colors.

If enough Super VGA board makers adopt the standard, then software vendors will begin supporting it. Prices on 800 x 600 monitors will soon drop, and 800 x 600 will be a good buy. Un-

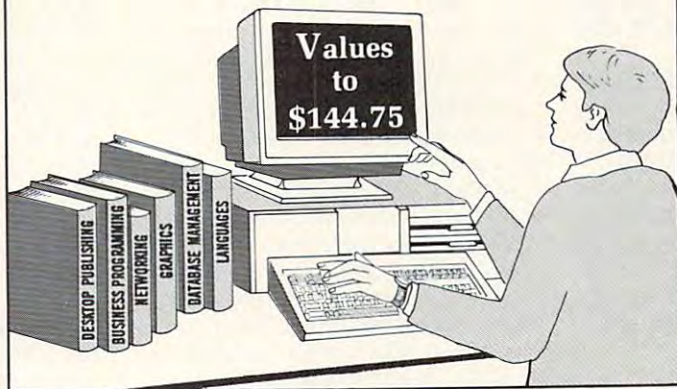
we use in the PC world are almost all dumb—the CPU does all the work. For instance, if a program wants to put a picture of a circle on the screen, it must compute the location of all the dots on the screen and activate the corresponding pixels, one by one.

More advanced systems use an object-oriented approach, whereby the CPU just issues a command to the (intelligent) video board. For example, video board, draw a circle, place it here, and color it blue. That way, specialized

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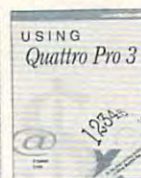
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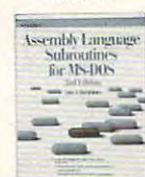
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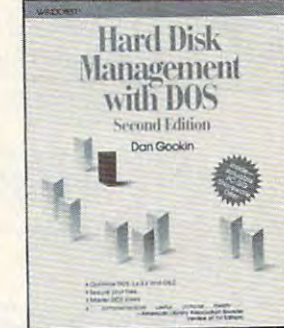
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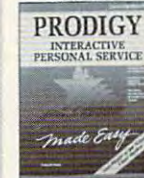
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Some vendors offer Super VGA boards that include 70- or 72-Hz modes, boards that refresh the screen 70 or 72 times per second, leading to a more solid screen. It may not sound exciting, but when you sit down in front of one of these VGAs, you'll know there's something different. Even if standard VGA doesn't seem flickery to you now, it will after you use a 70-Hz VGA for a while.

The downside of 70- or 72-Hz VGA boards is that they won't work with a plain-vanilla VGA monitor. You need a more expensive multifrequency monitor—the same kind you'd use for Super VGA. So if you've decided to go Super VGA, you might as well spend a little more and buy a board with 70- or 72-Hz VGA output, since you're buying the more expensive monitor anyway.

Monitor Mumbo Jumbo

A monitor works by directing a beam of electrons against the inside of its screen. Phosphors on the inside of the screen become excited and glow. Causing phosphors to glow or not to glow defines images on the screen. From a computer's point of view, a video display is just an array of pixels.

Resolution refers to the number of dots that can be put on the screen. The electron beam sweeps across the

tube, painting lines of dots. CGA uses 200 lines top to bottom, EGA 350, and VGA 480. Since it uses higher resolutions, Super VGA does even more.

Consider the number of horizontal lines that a monitor must draw per second. In basic VGA, each screen has 480 lines, and there are 60 screens per second. 480 times 60 is 28,800 lines per second. That's called the horizontal scan frequency, as it's the number of times that the beam sweeps horizontally per second. It, too, is measured in hertz or kilohertz (kHz)—thousands of hertz.

Actually, VGA has a somewhat higher horizontal scan rate than 28,800 Hz (28.8 kHz), since the monitor has extra lines that you can't see (they're called overscan). How many extra lines a monitor has varies from video mode to video mode. A CGA monitor has a horizontal scan frequency of 15,750 Hz, or 15.8 kHz. EGA uses 21.8 kHz, and VGA 31.5 kHz. So the horizontal scan frequency your monitor needs to serve your board is determined in part by two important factors: the number of horizontal lines on the screen and the screen's refresh rate.

Dot Pitch

Monitor ads tout .28-mm dot pitch. What are they talking about?

We've seen that more resolution means more dots (pixels) on the screen. The width of the dots that the monitor can display is the monitor's dot pitch, and it's measured in millimeters (mm). The smaller the dots, the higher the horizontal resolution that a monitor can show in a crisp and readable manner. A larger monitor can have a larger dot pitch without sacrificing resolution, since its screen is larger.

In reality, you'll see four dot pitches for VGA monitors: .34, .31, .28, and .26 mm. Avoid .34 on 12-inch VGA monitors, but you may find it quite acceptable on 14-inch monitors—go take a look at one before you buy it. And .34 on a 14-inch monitor or .31 on a 12-inch monitor is fine for VGA only, but buy .28 if you plan to use a Super VGA in 800 × 600 resolution and .26 for a Super VGA using 1024 × 768 resolution.

Multifrequency Monitors

The last important monitor feature I want to mention is multisyncing, the ability to handle multiple resolutions automatically. Recall that the horizontal frequency you need to display an image is determined by the refresh rate (the vertical frequency) and the horizontal resolution.

Until 1986, monitors were fixed-frequency in both horizontal and verti-



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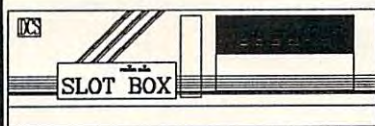
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cal directions. When you bought a CGA monitor, it could only do one set of frequencies: 15.75 kHz horizontal, 60 Hz vertical. The EGA monitor had to be able to do double duty, as it could be attached to either CGA or EGA boards, and so had two sets of fixed frequencies: 15.75 kHz/60 Hz for CGA boards and 21.8 kHz/60 Hz for EGA boards.

Standard VGA knows three sets of frequencies: one for CGA modes, one for EGA modes, and 31.5 kHz/60 Hz for its native standard VGA mode. So a plain-vanilla VGA monitor is a fixed-frequency monitor that only supports CGA, EGA, and VGA—no high-resolution Super VGA modes.

In 1986, NEC changed that with its Multisync monitor. The Multisync could detect and synchronize with any horizontal frequency from 15 to 31.5 kHz and any vertical frequency from 50 to 70 Hz. That meant that a single monitor could work on any kind of video board available at the time. More important, when IBM introduced VGA in 1987, the Multisync was ready—it could handle VGA's 31.5-kHz horizontal frequency with no problem.

Now, most video vendors offer their own Multisync-like monitors. They're generically called variable frequency

monitors (VFM). NEC doesn't sell the original Multisync anymore, but it has Multisync models from the 3D (31.5–38 kHz horizontal, 50–80 Hz vertical; about \$620 discounted) to the 5D (30–66 kHz horizontal, 50–90 Hz vertical; \$3,700).

The competition's not asleep, however. The most reasonably priced high-resolution VFM is from Sony. The Sony Multiscan HG CPD-1304 (just call it the Sony 1304, and people will know what you're talking about) is a great deal—.26-mm dot pitch; 28–50 kHz horizontal, 50–87 Hz vertical; available discounted for \$700. It'll display sharp non-interlaced 1024 × 768 screens, as well as 800 × 600 at a rock-solid 72-Hz refresh rate. For high-end Super VGA, the Sony 1304 just can't be beat.

Buying a VGA Board and Monitor

Whew! That's a lot of information. What's it all boil down to?

First, decide if you'll need standard VGA or Super VGA. In either case, buy a 16-bit board.

If you can be happy with standard VGA, then it's easy. Get a fixed-frequency VGA monitor, like the Gold Star or Samtron VGA. They can be found for about \$250 to \$350. For the VGA board itself, get a no-name VGA

board with 256K of memory and a 16-bit bus interface. Don't waste money on more memory on VGA—it won't do a single thing for you. The board should run around \$80–\$100 from mail order and discount houses.

If you'd like to use Super VGA or 70- or 72-Hz VGA, you'll need to choose a VFM monitor.

Buy the Super VGA board from a big name—Paradise, ATI, Headlands Technology, Orchid, or Sigma. That way, you'll be able to get drivers for *Windows* version 7, *AutoCAD* version 22, 1-2-3 version 16, or whatever appears in years to come.

Among the five, the ATI boards are fast, flexible, and a bit cheaper than the others. Unfortunately, that lower price has inevitably led to poor support: ATI's support lines are constantly busy, they're often late in delivering drivers, and the drivers often leave something to be desired. (For example, the ATI VGA Wonder can display 1024 × 768 resolution, but the driver retains the low-resolution VGA fonts. The result is unreadably tiny letters. You'll get a headache after looking at the screen for more than a minute.) If you have a question for ATI, fax it in. You can usually get a one-day turnaround on questions faxed to tech support.

Paradise (Western Digital) and Headlands are a bit more expensive, but they're always right out in front with special drivers to allow their boards to strut their stuff. Orchid and Sigma are somewhere in the middle. Any of those five vendors' Super VGA boards are good buys—and don't forget to get enough memory to support the resolution that you intend to use.

And if you're going to get a Super VGA board, spend a couple of bucks more and get one with the 70- or 72-Hz refresh rate option. Your eyes will thank you.

More and more Super VGA boards support both 800 × 600 and 1024 × 768 resolutions. You may have to add some memory to the board in order to support the full 1024 × 768 resolution, however. A 512K Super VGA board from one of these vendors will run about \$200–\$300 discounted.

Super VGA Monitors

For a Super VGA board, you've got to choose a Super VGA monitor. Note that it will be a VFM. There are very few fixed-frequency Super VGA monitors, although the VESA standard may create a market for them. There are basically three levels of VFMs under \$1,000.

The first group can synchronize up to 35.5 kHz horizontal. They're cheapest, and you shouldn't buy them. They can't do 70-Hz VGA, and the only way they can accommodate 800 × 600 is in an interlaced 56-kHz mode. This group is fading out, so they may be quite cheap, but save yourself some eyestrain and resist the temptation.

The remaining two groups are the 800 × 600 and 1024 × 768 camps. The 800 × 600s are represented by the NEC 3D (\$620 discounted) or the Seiko 1440 (\$480 discounted) that can handle horizontal syncs up to 38 or 40 kHz. (They also do vertical syncs up to 90 Hz). They'll display 70- or 72-Hz VGA and noninterlaced 800 × 600. They may even do interlaced 1024 × 768, but your eyes will fall out from eyestrain if you use that mode. If you're in doubt about whether or not a given monitor will work with your Super VGA board, contact the board's manufacturer for specific compatibility information.

The more expensive 1024 × 768 noninterlaced monitors are VFMs that can synchronize up to 50 kHz or more horizontal and 50 to 87 Hz or higher vertical. (87 Hz is a magic number because it's the frequency that 8514 would use if it were noninterlaced, and a few video board vendors offer a noninterlaced 8514.) If you need this resolution, buy the Sony CDP-1304 or something similar. But it won't come cheaply. Expect to pay \$700 or more for the

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Again, note that the big cost at high resolutions is the cost of the monitor, not the board. That's why XGA will be expensive for at least a few years. Unlike hard drives and motherboards, monitors aren't new—CRTs have been around for a while, so prices for 1024 × 768 monitors won't do the familiar nosedive that we've seen from memory, motherboards, drives, and the like. Prices will come down, but not tremendously. A 1024 × 768 monitor will probably cost around \$500 in 1993.

VGA Bottom Line

To summarize, your choices are the following:

- Standard VGA—board costs around \$100, monitor about \$300.
- Super VGA (800 × 600)—board costs around \$200, monitor about \$500.
- 8514/A Super VGA (1024 × 768)—board costs around \$250 (it has extra memory), monitor about \$700.

So the packages for standard VGA, Super VGA, and high-resolution 8514 cost roughly \$400, \$700, or \$950. Take your pick, and happy viewing! □

NOVEMBER 1991 COMPUTE 61

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TIPS & TOOLS

Untipping a Tool

In our July "Tips and Tools" column we listed a BASIC program to save your computer's CMOS to disk. Unfortunately, there was a small typo that caused the program not to work properly. Here's the correct BASIC program listing for SAVECMOS.BAS:

```
10 DEFINT A-Z:DIM CMOS(63)
20 FOR I=1 TO 63:OUT 112,I
30 CMOS(I)=INP(113):NEXT I
40 OPEN "CMOS.RAM" FOR OUT
   PUT AS #1
50 FOR I=1 TO 63:WRITE
   #1,CMOS(I)
60 NEXT I
70 CLOSE #1:SYSTEM
```

For those who missed the July 1991 issue, here's the listing for the BASIC program that can be used to restore your computer's CMOS, RESTCMOS.BAT:

```
10 DEFINT A-Z:DIM CMOS(63)
20 OPEN "CMOS.RAM" FOR
   INPUT AS #1
30 FOR I=1 to 63:INPUT
   #1,CMOS(I)
40 NEXT I:CLOSE #1
50 FOR I=1 to 63:OUT 112,I
60 OUT 113,CMOS(I):NEXT I
70 SYSTEM
```

Mouse Routines for C

Now that most computers have mice, you'd think mouse support would be universal. Far from it. But here's a set of routines that cover the basics you'll need for accessing the mouse from a C program.

Start by creating the following module containing the four routines you'll use. The `mvector` pointer that you see is a precaution for DOS 2.1 where the mouse vector is NULL, and calling the mouse interrupt will crash the system. If this pointer is any nonzero value, then it's safe to call the mouse interrupt. The mouse handler follows.

```
#include <dos.h>
```

```
int InitMouse( void );
void ShowMouse( void );
void HideMouse( void );
void GetMouse( int *, int *,
  int * );
```

```
/* Returns 0 for no mouse, nonzero
  if it finds an active mouse driver */
```

```
int InitMouse( void )
{
  long far *mvector;
  union REGS in, out;
```

```
  FP_SEG( mvector ) = 0x0000;
  FP_OFF( mvector ) = 0x00cc;
```

```
  if( *mvector ){
    in.x.ax = 0;
    int86( 0x33, &in, &out );
    return( out.x.ax );
  }
  else return( 0 );
}
```

```
void ShowMouse( void )
{
  long far *mvector;
  union REGS in, out;
```

```
  FP_SEG( mvector ) = 0x0000;
  FP_OFF( mvector ) = 0x00cc;
```

```
  if( *mvector ){
    in.x.ax = 1;
    int86( 0x33, &in, &out );
  }
}
```

```
void HideMouse( void )
{
  long far *mvector;
  union REGS in, out;
```

```
  FP_SEG( mvector ) = 0x0000;
  FP_OFF( mvector ) = 0x00cc;
  if( *mvector ){
    in.x.ax = 2;
    int86( 0x33, &in, &out );
  }
}
```

```
void GetMouse( int *mx, int
  *my, int *button )
```

```
{
  long far *mvector;
  union REGS in, out;

  FP_SEG( mvector ) = 0x0000;
  FP_OFF( mvector ) = 0x00cc;

  if( *mvector ){
    in.x.ax = 3;
    in.x.bx = in.x.cx = in.x.dx = 0;
    int86( 0x33, &in, &out );
    *mx = out.x.cx;
    *my = out.x.dx;
    *button = out.x.bx;
  }
}
```

Using the routines is simple. Start your program by calling `InitMouse()`. If it returns a 0, there is no active mouse driver. Your program can still safely call all of the other mouse routines. They just won't do anything. If your program ever changes video modes, you should call `InitMouse()` again.

The mouse pointer is invisible until you call the `ShowMouse()` routine. Make sure that every time you draw or print to the screen you first call `HideMouse()`, and then when you're done, call `ShowMouse()`. If you don't, your draw operations may overwrite the mouse, which can be very messy.

To find out where the mouse's position is, you need to call `GetMouse()`. You have to pass the address of three integers. The first is the x-coordinate variable, the second the y-coordinate variable, and the third the Button variable.

Here's an example that assumes you're linking in the above code.

```
#include <stdio.h>

int MouseFlag, Mx, My, Button;

void main( void )
{
  MouseFlag = InitMouse();
```

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TIPS & TOOLS

```
ShowMouse();

while( Button != 3 ){

    GetMouse( &Mx, &My,
              &Button );

    HideMouse();
    printf( "X:%d Y:%d
            Button:%d\n",
            Mx, My, Button );
    ShowMouse();

    HideMouse();
}

```

RICHARD C. LEINECKER
REIDSVILLE, NC

Graphics to the Max

This simple C code loads PCX paint files for three video modes. To use other video modes, change the value assigned to linebytes and change the value in the while(y < 200) condition.

```
#include <dos.h>
#include <conio.h>
#include <stdio.h>

/*If you want to prototype the
functions use the following lines.
void LoadPCX( char * );
void PutLine( int,
              unsigned char *);*/

char far *VideoMode;
unsigned char far *ScreenMemory;
unsigned int CGABank;

void LoadPCX( char *filename )
{
    unsigned char Buffer[768];
    FILE *fp;
    unsigned int y = 0;
    unsigned int linebytes;
    unsigned int currentbyte = 0;
    unsigned char data;
    unsigned char reps;
    unsigned char count;

    fp = fopen( filename, "rb" );
    if( !fp ) return;
    fread( Buffer, 128, 1, fp );
    VideoMode = ( char far * )
        0x00000449;
    switch( *VideoMode ){
```

```
case 4: /* CGA 320x200x4 */
    ScreenMemory = ( unsigned
        char far * ) 0xb8000000;
    CGABank = 0;
    linebytes = 80;
    break;
case 13: /* EGA 320x200x16 */
    ScreenMemory = ( unsigned
        char far * ) 0xa0000000;
    linebytes = 160;
    /* Set the EGA card for the
    writes that we'll be doing */
    outpw( 0x3ce, 3 );
    outpw( 0x3ce, 5 );
    outpw( 0x3ce, 7 );
    outpw( 0x3ce, 0xf08 );
    break;
case 19: /* MCGA 320x200x256 */
    ScreenMemory = ( unsigned
        char far * ) 0xa0000000;
    linebytes = 320;
    break;
}
while( y < 200 ){
    fread( &data, 1, 1, fp );
    if( ( data & 0xc0 ) == 0xc0 ){
        reps = data & 0x3f;
        fread( &data, 1, 1, fp );
        for( count=0; count<reps;
            count++ ){
            Buffer[currentbyte++] = data;
            if( currentbyte == linebytes ){
                PutLine( y, Buffer );
                currentbyte = 0;
                y++;
            }
        }
    }
    else Buffer[currentbyte++] =
        data;
    if( currentbyte == linebytes ){
        PutLine( y, Buffer );
        currentbyte = 0;
        y++;
    }
}
if( *VideoMode == 13 ){
    /*Reset EGA card defaults*/
    outpw( 0x3c4, 0x0f02 );
    outpw( 0x3ce, 0x0f07 );
}
else if( *VideoMode == 19 ){
    /* Set the MCGA palette */
    fread( &data, 1, 1, fp );
    fread( Buffer, 768, 1, fp );
    outp( 0x3c8, 0 );
    for( y=0; y<768; y++ )
        outp(0x3c9, Buffer[y] >> 2 );
}

```

```
fclose( fp );
}

/*One line of data on the screen*/
void PutLine( int y, unsigned char
    *Buffer )
{
    int i, j;
    unsigned int egi;
    switch( *VideoMode ){
    case 4:
        for( i=0; i<80; i++ )
            *ScreenMemory++ = Buffer[i];
        ScreenMemory -= 80;
        CGABank ^= 8192;
        FP_OFF( ScreenMemory ) ^=
            CGABank;
        if( !CGABank ) ScreenMemory
            += 80;
        break;
    case 13:
        egi = 0x0102;
        /* Four bit planes */
        for( i=0; i<4; i++ ){
            outpw( 0x3c4, egi );
            /* 40 bytes per bit plane */
            for( j=0; j<40; j++ )
                *ScreenMemory++ =
                    Buffer[j+i*40];
            egi = ( egi &
                0x00ff ) ( ( egi &
                    0xff00 ) << 1 );
            ScreenMemory -= 40;
        }
        ScreenMemory += 40;
        break;
    case 19:
        for( i=0; i<320; i++ )
            *ScreenMemory++ = Buffer[i];
        break;
    }
}

```

RICHARD C. LEINECKER
REIDSVILLE, NC

If you have an interesting tip that you think would help other PC users, send it along with your name, address, and Social Security number to COMPUTE's Tips & Tools, 324 West Wendover Avenue, Suite 200, Greensboro, North Carolina 27408. For each tip we publish, we'll pay you \$25-\$50 and send you a COMPUTE's PC clock radio while supplies last. □

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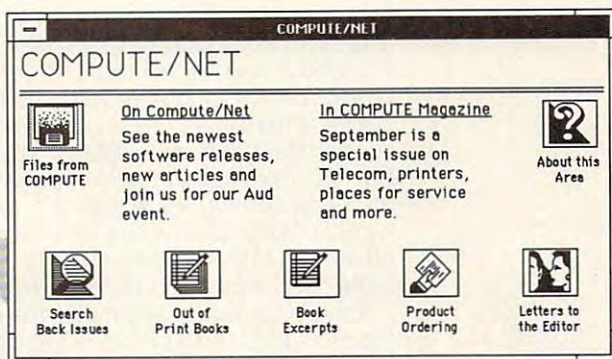
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COMPUTE/NET

Richard C. Leinecker

SOMETHING NEW ONLINE

There's a new source of online information. It's called COMPUTE/NET, and it's found on GENie, Q-Link, and America Online. What's there? Back issues of *COMPUTE* and COMPUTE's other magazines, terrific programs that we've published, colorful picture files of official NASA photos, COMPUTE books, and more.

There's so much there that this month all I can squeeze in is an orientation tour. Exploring online services is fun. And you won't soon run out of places to go on COMPUTE/NET.

Let's start with the lighter side of our *COMPUTE* editorial staff. On COMPUTE/NET you can read the biographies of our editors. Here are some fast facts that'll surprise you: Pete Scisco earned the Dantzler-Dantzler Award as an undergraduate. Clif Karnes has a master's degree in music theory, but he can program a computer with the best. David English has a B.A. and two M.A.'s and has nearly completed his coursework for a Ph.D. in cinema studies. Mike Hudnall was an assistant professor at Berry University, where his students often referred to him as Dr. Harbrace. David Sears loves music from the fringe by such artists as Skinny Puppy and My Life with the Thrill Kill Kult. Rob Bixby is a prolifically published author who likes rock-'n'-roll, computer graphics, and artificial creativity. Tom Netsel plays the bagpipes for any audience who will supply him with malt whiskeys. Jill Champion is owned by her four-year-old cat, Liesl. And Denny Atkin was born to one of the last remaining families of nomads.

For the complete details, do one of the following: On GENie, from the main COMPUTE

RoundTable menu, pick menu item 6, About COMPUTE and the COMPUTE Editors. On America Online, from the COMPUTE/NET window, click on the icon with the question mark and the text that says About This Area. If you want to really get to know these people, go to the COMPUTE Bulletin Board on GENie, Category 1, Topic 2. On America Online click on the COMPUTE Letters to the Editor icon. Once in the message area, you can leave messages to the editors and make suggestions or ask them questions. They want to hear from you. Go ahead; make their day.

If you're on GENie, after reading about the *COMPUTE* editors, you'll want to play our online games. (The games are only available on GENie; all the other items mentioned are available on GENie, America Online, and Q-Link.) They're easy to play—all multiple choice questions. And if you're really smart (or maybe lucky), you can win a prize. You could win a free subscription to one of several General Media magazines like *OMNI*, *Four Wheeler*, *COMPUTE*, or *Longevity*; a free COMPUTE disk product; a free COMPUTE book; or free connect time for GENie. To play, make sure you're at the COMPUTE RoundTable main menu. Choose menu item 14 and then pick the game you want to play. There's a scavenger hunt in which you answer questions by scanning *COMPUTE* magazine, a computer trivia game, and a puzzle-and-riddle game that will perplex, entertain, and delight you.

Don't you love seeing photorealistic pictures on your screen? Don't you love pointing at them and telling your spouse "That's what I got for all the money I spent on this computer system"? You might even be a space buff and

want official NASA photos for your collection. If you fit into any of the above categories (or just like cool pictures), here's how you get them. From the main COMPUTE RoundTable menu on GENie, pick menu item 3, Software Libraries. From the COMPUTE/NET window on America Online, click on the COMPUTE Files icon in the upper left corner. Now, search the directory using the keyword *NASA*. You'll see a list of digitized photos that we scanned from official NASA releases. They're all in GIF format. If you don't have a program that loads in GIF pictures, download *VPIC* from our software section.

If you're like a lot of readers, you often remember useful consumer information presented months back in *COMPUTE*. Maybe you would like to reread it because there was a lot of useful information about buying a monitor or about desktop publishing, or maybe there was a sidebar that made you smile. But you can't find the issue anywhere. You're in luck. You can download any of our back issues or read them online. By the time you read this, we'll have the magazines as far back as mid 1989 available. Within a couple of months, we'll complete the collection, and you can have a field day browsing the articles. From the GENie main menu, pick item 11, Back Issue Database, and follow the prompts to find what you want. On America Online click on the Back Issue icon and follow the prompts.

You can ask questions or make comments in our Bulletin Board on GENie or the America Online Message section. If you want to send me E-mail, my GENie address is RLEINECKER, my America Online screen name is Rick CL, and my CompuServe number is 75300,2104. □

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INTRODOS

Tony Roberts

BATTLE OF THE FIVE-0s

Microsoft's MS-DOS 5.0 has made its big splash, and many PC users are pondering whether to make the upgrade.

The issue is clouded a bit by Digital Research, which unveiled its DR DOS 5.0 in mid 1990. DR DOS was considered by many to be a sneak preview of what MS-DOS 5.0 was to become. DR DOS's advantage was that it beat MS-DOS 5.0 to market, but it carried a list price of \$199, which scared off more than a few customers.

As the release of Microsoft's long-awaited MS-DOS 5.0 grew near, however, Digital Research sought to increase its market share by announcing a "Toss Your DOS" special. The promotion offered DR DOS 5.0 to upgraders for a more competitive \$79, and the offer was eagerly accepted by users anxious to take advantage of DR DOS's memory management capabilities.

So should you upgrade your DOS? Without a doubt. It's time to have the latest and greatest on your system, but whether to go with Digital Research's or Microsoft's product is a tossup.

I latched on to DR DOS several months ago because I needed the ability to load device drivers and TSRs into high memory. The goal was to have enough conventional memory left to run my regular DOS applications and *Windows* without running into memory problems. DR DOS met these needs and provided several pleasant surprises including a command line retriever, extended directory and delete commands, and a full-screen text editor.

Microsoft's new product offers its own array of enhancements, including a command line retriever, full-screen text ed-

itor, and undelete utility; but in general, I like DR DOS better than MS-DOS.

Despite my preference, though, I've switched to MS-DOS 5.0 because it seems to work a little better with *Windows*. Since I earn a good part of my living using *Windows* applications, that stability is comforting.

I find that I'm able to load DOS, drivers, and TSRs into high memory more efficiently with MS-DOS, leaving more conventional memory free.

If I didn't run *Windows*, however, I'd stay with DR DOS, and here's why.

- Enhanced CONFIG.SYS. DR DOS makes it easy to change the system configuration at boot-up because its CONFIG.SYS files support labels, as well as GOTO and ECHO commands. At boot-up, you can have the system ask you how you want the system configured, and you can specify on the fly whether any or all of your favorite device drivers should be loaded.

- Powerful XDIR and XDEL commands. DR DOS provides extended directory and delete commands that are more powerful and more flexible than those offered in MS-DOS 5.0. The command XDEL *.TMP /S can delete all the files with a TMP extension anywhere on your hard disk. As the command works, the names of all the deleted files are displayed so you can see what has been erased and, if necessary, bring an undelete program to the rescue.

- Handy TREE command. DR DOS has turned this command into something useful. Not only can you get a graphical look at your hard disk's organization, but TREE tells you how many files are in each subdirectory and how much space those files occupy. This is a great help during those disk cleanup sessions.

You can tell at a glance which directories are the most likely candidates for saving space.

- Interactive setup. DR DOS provides an interactive setup and configuration program that can be rerun as your needs change. This is a big help to users who dread the thought of editing their CONFIG.SYS files. MS-DOS 5.0 includes an installation program that performs a basic setup, but users are on their own for fine-tuning.

- Flexible command line. DR DOS is generally more flexible on the command line. For example, the XDEL command permits naming of multiple files for deletion, the /P switch can be added to any command to pause the display after each screen is full, wildcards can be used with commands such as TYPE (as in TYPE *.TXT), and the DR DOS RENAME command can be used to move files from one subdirectory to another.

Despite coming in second in some areas, MS-DOS has a decided advantage in other areas. MS-DOS 5.0 now offers an UNDELETE command—an essential program for any computer user. It also includes the *QuickBASIC* interpreter as well as quick FORMAT and UNFORMAT commands.

Both operating systems make help available from the command line, and both offer a DOS shell. Although I don't use shells often, I favor the MS-DOS shell over its DR DOS counterpart, which, with its application and data icons, bears a resemblance to the Atari ST interface. Also, Microsoft's shell permits a limited form of task switching.

So if you're contemplating a DOS upgrade, don't delay. Both Microsoft's and Digital's products offer significant enough improvements over previous DOS versions to justify making the switch. □

It's a great time to upgrade your DOS. And now you have two choices instead of just one.

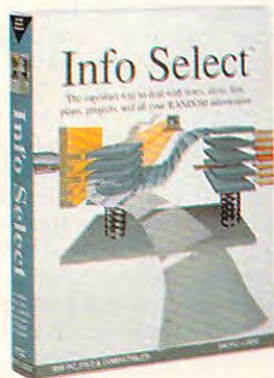
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Will I be better off doing this now or that later? Keeping priorities straight can make or break your career or your business. INFO SELECT lets you keep on top of what's hot.

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Info Select allows you to: add columns of numbers; store data in EMS; use template or free-form windows; import and export files, screens, and databases; move, join, and duplicate windows and much more.



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HARDWARE CLINIC

Mark Minasi

INCREASE YOUR MEMORY POWER

One of the neatest things in the new MS-DOS 5.0 is the addition of a memory manager, a program that you once had to buy separately. A memory manager's most important job is to create and manage things Microsoft calls UMBs—Upper Memory Blocks. The whole idea with UMBs is that they give DOS more memory.

The trouble is that the DOS 5.0 installation program still doesn't do anything about setting up UMBs for you. This month, I'll get started telling you what UMBs are, why you want them, and how to set them up.

First of all—what is a UMB, really? Well, you no doubt are aware of the annoying 640K memory restriction that DOS lives under. The 640K restriction is actually caused by two things: the original PC's processor chip—the 8088—and the way IBM designed the first PC. The 8088 provided a restriction in that it's incapable of working with more than 1024K, one megabyte, of memory. DOS was (and still is) written for the 8088, so it shares the 8088's limitation. The hardware limitation of DOS, then, is really 1024K, not 640K.

The 640K limitation comes from IBM's design of the PC. IBM needed to set aside some of that 1024K for system use. Here's how it originally was divvied up: 0K–639K (DOS and user programs), 640K–767K (special RAM allocated to video), 768K–959K (ROMs and RAM buffers used by expansion boards), and 960K–1023K (System BIOS).

I could discuss all of these memory areas in gruesome detail for pages and pages—in fact, I have, in my PC troubleshooting book published by COMPUTE—but let me briefly summarize what each of these

areas does. The user memory area is self-explanatory; it's the 640K you've been limited to all of these years and is sometimes called conventional memory. The video RAM area isn't that interesting, except to note that all video boards must have memory on them. Video memory doesn't count in the system memory count-up that you see when you turn your machine on. If you've got 640K of memory, that's 640K in addition to your video RAM.

The 64K above the video area, between 960K and 1023K, is the system BIOS, a chip on your system's motherboard that contains the Basic Input/Output System—a bunch of software on a chip that's vital to your system's operation. BIOS software isn't shipped on a disk like other software; it's contained in a special chip called a ROM (Read Only Memory).

I left the 768K–959K area for last because it's the place where we'll spend the rest of our time. IBM knew that some add-on boards would have ROM on them. For example, every VGA board has ROM on it. What's in the ROM? It's an extension of the system BIOS that enables the system to use the board.

Not all boards have ROM. Looking at a small sample—the three computers on my desk—one of the three computers has a hard disk controller with ROM, all three have video boards with ROM, and one has a scanner interface card with ROM on it. The occasional board also has a small RAM buffer addressed somewhere in the 768K–959K range, so keep an eye out for them.

You probably noticed ROM addresses when you poked through an expansion board's documentation, but the hexadecimal addresses may have put you off. Stuff like "the VGA BIOS uses addresses C0000 hex through C7FFF hex"

makes me want to forget this nonsense, go outside, and play Frisbee, too. But you've got to get comfy with hex, so I'll offer two easy ways to cope with hex a little later.

Anyway, IBM set aside 192K of memory addresses as places for potential ROMs. Most systems don't use the whole space. For example, on my main PC, there's only 48K of ROM in the area, leaving 144K of memory addresses unused. Unused and wasted—and that's where UMBs come in.

Remember that DOS's "hardware" limitation isn't 640K; it's 1024K. If we could stuff memory into unused memory addresses between 768K and 959K, we could put programs up there. Consider my main PC. Here's how addresses 768K through 959K are used: 768K–799K (used by video ROM), 800K–815K (unused memory address), 816K–831K (used by hard disk controller), and 832K–959K (unused memory address).

In the case of this particular PC, I could use the memory in the two unused areas, 800K–815K and 832K–959K. Those areas are the UMBs.

What Do I Need?

First of all, you must have a 386-class computer: 386 or 486, SX or DX. Second, you must have at least 1MB of accessible memory. Third, you need a memory manager, which DOS 5.0 supplies as two programs: HIMEM.SYS and EMM386.EXE. Fourth, you need to know the addresses of any ROMs or RAM buffers on your circuit boards. Drag out that documentation or harass your dealer. But don't be lazy; this can be a bit tricky if you're working with inadequate information.

My examples so far have been in friendly old decimal—768K, 800K, and all that. But you've got to know hex, be-

**DOS's
elusive Upper
Memory
Blocks are
explained
in plain English.**

cause that's the only thing that the documentation reports and because memory managers insist that you communicate with them in hex.

You can use the *Calculator* in *Windows*, a terrific hex-to-decimal converter. Or you can use the power of the *QuickBASIC* interpreter that comes with DOS 5.0. Just type in this four-line program with any ASCII text editor such as *Notepad* in *Windows* or DOS's *EDIT* or *EDLIN*. Call the file *CONVHEX.BAS*.

```
INPUT "Number to convert from
hex"; a$
inval& = VAL("&h" + LTRIM$(a$)
+ "&")
PRINT "Decimal equivalent=";
inval&;" or ";inval&/1024;"K"
SYSTEM
```

To run it, just put it in your DOS subdirectory and type *qbasic /run convhex.bas*. It will prompt you for a hex value; type one in, press the Enter key, and it will report the converted decimal value.

Creating UMBs

Look back at the PC with the video ROM and the hard disk controller ROM; I'll use that PC as my example machine. To get the DOS 5.0 memory manager to work, you first need to load the HIMEM.SYS and EMM386.EXE drivers and use the new DOS=HIGH,UMB command. Now, if you've got a 386-class machine, the DOS installation program has probably already set up your CONFIG.SYS so that it looks something like this:

```
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH
```

I'm going to assume that your DOS programs are sitting in a subdirectory called C:\DOS. If that's not true, change the subdirectory references accordingly. We're next going to

change the DOS= line and add another line:

```
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\EMM386.EXE
NOEMS
DOS=HIGH,UMB
```

That's the basic CONFIG.SYS, but we need to tweak the EMM386.EXE line. EMM386 attempts to figure out for itself which areas in memory are available, but it's not too bright. It usually misses altogether the 64K from 896K-959K. So we'll help it out. The upper memory situation in my PC looks like this: hex A000-C7FFF (decimal 640K-799K, video RAM and ROM), hex C800-CBFFF (decimal 800K-815K, free), hex CC00-CFFFF (decimal 816K-831K, hard disk controller ROM), hex D000-EFFFF (decimal 832K-959K, free).

Next, we tell EMM386.EXE to exclude the used areas and include the unused areas. You do that with the X= and I= parameters. You put these parameters on the same CONFIG.SYS line as EMM386.EXE. The ranges must be in hex, and you have to drop the rightmost digit: C0000 becomes C000, CFFFF becomes CFFF. Updated, the CONFIG.SYS statements look like this:

```
DEVICE=C:\HIMEM.SYS
DEVICE=C:\DOS\EMM386.EXE
NOEMS X=A000-C7FF I=C800-
CBFF X=CC00-CFFF I=D000-EFFF
DOS=HIGH,UMB
```

If you were having trouble figuring that out from the DOS manual, don't feel bad. The manual doesn't even offer a clue that multiple I= and X= parameters are legal; I just stumbled onto it. Remember that all you have to do is (1) find out where your ROMs and RAM buffers are by checking over your documentation,

(2) use that information to build the I= and X= parameters, and (3) put the EMM386 and DOS=HIGH,UMB statement into your CONFIG.SYS.

Using UMBs

You can now load device drivers and TSR programs into your newly created UMBs. Instead of loading a device driver with DEVICE=, load the device driver into a UMB with DEVICEHIGH=. To load a TSR into a UMB, use the command LOADHIGH.

I use the SMARTDRV.SYS disk cache that comes with *Windows* and DOS. It's a device driver that I load with a line something like this:

```
DEVICE=C:\DOS\
SMARTDRV.SYS 512
```

The 512 configures the cache to be 512K in size. To load it into a UMB, substitute the following CONFIG.SYS line:

```
DEVICEHIGH=C:\DOS\
SMARTDRV.SYS 512
```

For a TSR example, let's use that nifty DOSKEY program that comes with DOS 5.0. It's a little 4K TSR that remembers the last 20 or so commands that you've typed to DOS and lets you recall them with the Up Arrow key. You'd generally load it by putting the line C:\DOS\DOSKEY in your AUTOEXEC.BAT. But to load it in a UMB, you'd put this line in AUTOEXEC.BAT:

```
LOADHIGH C:\DOS\DOSKEY
```

To see the effects of the LOADHIGH and DEVICEHIGH statements, run the MEM command before you install LOADHIGH or DEVICEHIGH and note the amount of free memory you have. Install the new commands, reboot, and run MEM again. I think you'll be pleased with the result. □

POINT & CLICK

Clifton Karnes

EASY WINDOWS PROGRAMMING

The release of *Microsoft Visual Basic* (Microsoft, One Microsoft Way, Redmond, Washington 98052; 206-882-8080; \$199) means one thing: fast and easy *Windows* programming!

Visual Basic (VB) is the combination of a screen design toolkit and a full-featured BASIC compiler. With it, you can create real *Windows* EXE files that will run on any *Windows*-based system and look great.

The *VB* programming environment is a functional masterpiece, consisting of a main win-

Windows controls, including command or push buttons, option or radio buttons, check buttons, text fields, labels, combo boxes, list boxes, pictures, scroll bars, and selectors for drives, directories, and files.

Every control in the toolbox has a list of properties displayed in the properties combo box on the properties bar of the main window. And each property has settings you select or type in using the settings combo box to the right of the properties box.

To give an example of a control, property, and setting, let's look at a command button. All command buttons have a cap-

be set, it also has a group of events to which it can respond.

For example, a command button can respond to a click event. If you want this button to do something when the user clicks it, you write a subprogram, or event procedure, to handle it. To write an event procedure, double-click on the control, and a code window pops up. Choose the event you want from the combo box on the procedures bar of the code window.

After writing your first event procedure, you can test the program by choosing Start from the Run menu. You can halt execution at any time and test code fragments in the immediate window, or you can single-step through your program.

If you're satisfied with your *VB* program, you can create an EXE file by selecting Make EXE File from the File menu. Your *VB* EXE program will require a 270K runtime module, *VBRUN100.DLL* (which you can distribute free of charge), but the EXE files themselves are very small and quite fast.

One of the most exciting things about *VB* is that its environment can be extended. The most interesting way to extend *VB* is with custom controls. These extensions are special-purpose or enhanced *Windows* controls that appear on your toolbox alongside standard *VB* controls. Some give more power to standard controls; others introduce completely new control types.

The other way *VB* can be notably enhanced is with custom DLLs. These libraries are like the special link libraries BASIC programmers have been using for years, but with *Windows*, DLL code can be dynamically linked in at runtime.

There are already a large number of these extensions available, and next month, I'll look at the best of the *VB* custom controls and libraries. □

In 1974, Bill Gates invented microcomputer BASIC. This year, he reinvented it, opening *Windows* to easier programming.



dow, a toolbox window, a project window, and a form window. The main window is the control center with a menu bar and a properties bar.

Below the main window at the left is the toolbox—a palette of controls. At the right is the project window—an automated make file that keeps track of all the program elements in each project. In the screen's center is the form window—the canvas on which you create your *VB* program.

To create a *VB* program, you begin by selecting controls from the toolbox and placing them on forms. The toolbox provides all the standard

tion property—a label that appears on the button—which can have any number of settings. A button might have a caption setting of *OK*, *Run*, or *Exit*, for example. This same button might have its background color property set to gray.

After you've chosen and arranged your controls and set their properties, you're ready to attach code to the controls.

VB, like *Windows* itself, is event-driven. A model *VB* program simply responds to events—like clicking the mouse on a control or pressing a key—the user initiates.

Just as each *VB* control has a group of properties that can

DISK UPDATE

Richard C. Leinecker

AT COMPUTE, DISK SAFETY IS NO ACCIDENT

Every time my computer acts strangely, I begin to wonder if it has a virus. And many of our subscribers are the same way. *COMPUTE's PC Disks* are as safe as any disk product can be—we go to great lengths to ensure this. But in spite of our periodic assurances to our audience, we still get a few calls each year.

How can we be sure that our disks aren't infected with viruses? We start by getting the final version of each program directly from the author. Although the online services check rigorously for viruses, we get a disk straight from the programmer, so there's no risk of tampering.

Our computers here at *COMPUTE* are scanned every week with the latest virus-scanning software. And we watch for any telltale signs of infection on our computers.

We inspect each *PC Disk* master with virus software and put it through special testing that we've developed. Each file in each archive is checked. We even test *CMOS*.

The *COMPUTE* staff members all practice safety habits that prevent most viruses from spreading. If you're interested in finding out how to keep from catching a virus, read "Computer Viruses from A to Z," in our October issue.

OK, so now you believe me. But you have our latest disk, and after running scanning software, you've discovered a virus on your hard drive. The first thing you suspect is our disk because of the reputation that shareware has gotten and because the last program you ran was from our disk.

Let's set the record straight. Shareware rarely con-

tains viruses. The more likely suspect is pirated software. And most viruses are controlled by sophisticated time delays—they are rarely triggered when first transmitted.

If you should find a virus on our disk, our disk was the recipient, not the transmitter. I recently received a call from someone who had scanned his hard drive and our disk and found the Stoned Virus. That's a boot sector virus. That type of infection only spreads when you boot from an infected disk. Since *COMPUTE's* disks aren't bootable, it's impossible for them to spread any boot sector viruses.

New Program, Old Face

COMPUTE's Menu Operating System has been rewritten. Sure, it looks the same, but every line of code is new. The old menu program uncompressed slowly under *Windows*, probably due to slow runtime disk routines. We thought it was important to change this, since many of you are running *Windows*.

We're also starting to include more programs than our old system could accommodate. If you see the word *More* on the menu, there's another page of programs. You can press P to show the next page or click on *More*.

Our December disk has more changes. It will use the words *Previous* and *Next* to navigate among pages. Then you'll be able to click the mouse on *Previous* or *Next*, or press P or N to go between pages.

We fixed another problem that occurred when several programs had support files with the same name. We used to install all the programs on a disk to the same subdirectory. When the files were installed, any existing files with the same name as those being created were over-

written. There are probably a million programs with files called *README*. Because of that, each program and its support files are now installed in their own directory.

File Allocation Table Blues

One of our subscribers wrote in to say that after he uncompressed a program from our April 1991 disk, the *COMPUTE* disk developed problems. *Norton Disk Doctor* reported an unrecoverable file allocation table. I couldn't contact the reader by phone to get to the bottom of things, but this illustrates several points about using our disks.

You should always make a backup copy of the disk before running it. That way, any mishaps or accidents won't leave you empty-handed. Never install files on the distribution disk (or even the copy). If you're running our menu program from a 5¼-inch disk, there's simply no room to uncompress the files.

A lack of disk space shouldn't cause any serious problems, but there's always the chance that some older versions of *DOS* or an off-brand *BIOS* might not correctly send the proper *Disk Full* error message to our program. The last thing to remember is to write-protect the disk before you install the programs. That way nothing will be written to your disk, and there's no possibility of ruining it.

If you have trouble when you run our disk, try other disks of yours that you know are good. If they don't work, either, make a visual inspection of your computer equipment and check it with a diagnostic program. If you're still convinced that our disk is bad, send it, along with a note of explanation, to *PC Disk Problems*, 324 West Wendover Avenue, Suite 200, Greensboro, North Carolina 27408. □

When it comes to computer viruses, one small bit of prevention is worth ten megabytes of cure.

HOME OFFICE

COMPUTE CHOICE. This powerful spreadsheet exhibits more talents than ever, including the surprising ability to make music.

Keith Ferrell

QUATTRO PRO 3.0

Less than a year after the release of *Quattro Pro 2.0*, Borland has introduced an even more ambitious revision of what has been from the beginning the most compact and elegant spreadsheet on the market. Not only does *Quattro Pro 3.0* offer outstanding WYSIWYG and presentation features, but its bells and whistles can also make real music. A sound and visual effects package comes with the program. Whether or not the world is ready for an audible spreadsheet, it's here.

Sound is, of course, pure lagniappe; what matters in a spreadsheet is its number-crunching ability, and here *Quattro* more than excels. For operations ranging from simple row and column math to complex linked spreadsheets, *Quattro Pro* provides the user with a great deal of automation and a number of sensible shortcuts. Thorough mouse and macro support leaves you free to focus on your data. Menus and push-button commands are logically arrayed around an easy-to-read screen.

Screen display is one of the high points of the new version. This is a true WYSIWYG program, offering graphical features that are carefully and thoughtfully incorporated into the program's overall performance. I particularly like the ability to preview spreadsheet output on the fly, as it were, taking an advance look at how my work will appear in print. The program's zoom feature lets you reduce the screen image, making more data available at a high-speed glance.



Quattro's graphing capabilities are the equal of graphing capabilities in any spreadsheet. Graphs can be defined and displayed with a few clicks of the mouse. The type of graph—pie, bar, and so on—can be changed with equal ease. Labeling and incorporating text within these graphs cause only slight complications.

Elegance of code remains a Borland hallmark, amazingly so in *Quattro Pro 3.0*. In fact, the aspect of *Quattro* that I find most impressive is its size. Borland has stuck to its determination to deliver a product that runs effectively in the smallest possible memory area. In this case that's 512K. This is one full-featured business product that can still run on the XTs of the world. Naturally, the program runs better on a 386 machine, but that's beside the point. What's important here is that a company that has grown with users has not neglected those early *Quattro Pro* fans still content with less powerful equipment.

Microsoft Windows users should be aware that this re-

mains primarily a DOS-based program; a fully optimized *Windows* version is in the works. *Quattro* does, however, run well enough as a DOS application under *Windows*.

Quattro Pro 3.0 takes advantage of expanded memory for large spreadsheets. You can also simultaneously display a large number of spreadsheets. Borland's documentation reports the capability of a whopping 32 concurrent spreadsheet windows, but I've not needed more than a third of that at a time. Individual windows can be stacked, tiled, or arranged to your particular tastes. Use either the mouse or keyboard to transfer data among different windows simply by defining source blocks and targeting their destination.

You can also link spreadsheets easily, drawing upon the contents of one sheet for calculations in another. Again, either keyboard or mouse commands can be used, but linkage really flies under mouse control. It's a matter of a few

clicks to bind diversely located information into a formula on your central spreadsheet. This powerful feature—one that seemed ferociously complex a couple of years ago—has now become routine and almost transparent.

Through its macros, visual orientation, and superb mouse support, *Quattro* effectively offers you a self-contained, object-oriented programming environment. Because spreadsheets are in some ways an adjunct to my work, rather than its primary focus, I've tended in the past to go only deep enough into their operation to get my work done. *Quattro Pro 3.0's* object orientation—everything that can be made visual *has* been made visual—made it simple and appealing for me to go farther. In a short time I learned to build more sophisticated linkages and formulas, leaning on the mouse as much as the keyboard. A particularly nice feature is the Transcript function, which records your scripts as you create them.

I've even gotten to the point where I'm willing to show my onscreen work to professional bean counters. Part of that willingness rests upon the first-rate—and increasingly essential—presentation tools that come with *Quattro*. Not everyone's a born showman, but this spreadsheet wants to bring out the entertainer and financial wizard in us all.

Special effects may not be something you customarily associate with spreadsheets, but the *ProView PowerPack* included with *Quattro Pro 3.0* comes equipped with a variety of visual and sound effects aimed at enhancing presentations. Text and graphics can be scaled and shaded, lend-

ing 3-D effects to the display. "Slide shows" based on your work can be livened up with any of two dozen transitional effects such as dissolves, wipes, and redraws. A library of useful presentation macros is included in the *PowerPack*.

Then there's sound. Incorporating digitized sounds into a presentation has at least one initial advantage; you can startle unexpected onlookers (on-listeners?). Although they could be louder, the sounds work surprisingly well on a standard PC speaker; I haven't tried the program with a sound board. Many of the sounds are self-congratulatory: applause, trumpet fanfares, and the like. These are fun, but there's a part of me that would like to have "Spike Jones" capability—wilder groans, shrieks of agony, and so on.

Paper presentations remain my most frequent output, and again *Quattro Pro 3.0* delivers more features than I need. Printer support meets Borland's high standards, providing shading, sideways printing, and the especially noteworthy print-to-fit feature.

The print-to-fit option will bring a smile to the face of harried spreadsheet users. When you need to fit a spreadsheet on a single sheet of paper and you don't want to spend time fussing with font size, *Quattro Pro 3.0* will reduce your work automatically. For single print blocks, *Quattro* will choose an optimum size; your work will never shrink beyond all readability. Yet another significant addition to the print options menu, banner printing allows you to print very large spreadsheets across multiple sheets of fanfold paper. Unlike the landscape printing option



(still available in this version of *Quattro*), the text output isn't interrupted from page to page, resulting in one impressively long table of information.

Quattro Pro 3.0 installs as easily as it works. Documentation is divided among three volumes, the slimmest of which is called Getting Started and warrants a glance from even experienced users. Existing spreadsheets can be imported and automatically translated from *Lotus 1-2-3* but not from *Excel*. Raw data can be brought into *Quattro* in ASCII or delimited formats.

I have no serious qualms about *Quattro Pro 3.0*, but to be honest, the program is so powerful and feature-laden that I am still nibbling at its upper levels. At the same time, I don't doubt that as I incorporate more sophisticated features and functions into my work, *Quattro Pro 3.0* will continue to delight and deliver. □

IBM PC and compatibles; 512K RAM; CGA, EGA, MCGA, or VGA; hard disk with 5MB free—\$495.00 (Owners of *Quattro Pro 1.0* can upgrade for \$99.95; owners of 2.0 can upgrade for \$49.95.)

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WORKPLACE

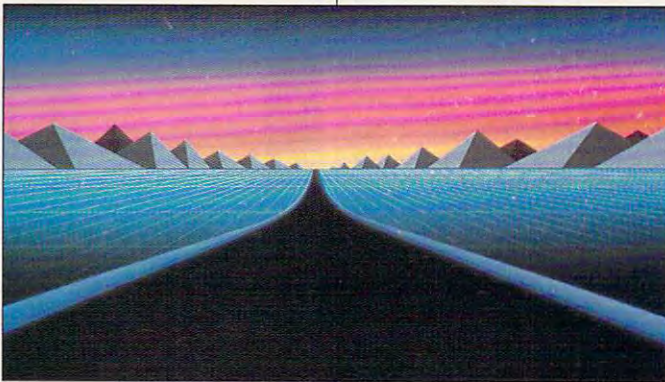
Daniel Janal

HARD DISKS TO GO

Every night at six o'clock, Tim Berry packs up his files and heads home to eat dinner with his family—and then settles down to a night of work.

As president of Palo Alto Software and Consulting, Berry gives sales training seminars for high-tech companies and takes the extra time at home to write course materials. Forgetting a file would mean a wasted evening. That hasn't happened since Berry began using a transportable hard disk to shuttle data between home and office.

Headed for far reaches of the world? Take your office with you on a portable hard disk.



"This disk is a response to being a unified family," Berry says. "We might be the last family in America that sits down to dinner at 6:00 p.m. with Mom and Dad and five kids. I have to close shop every day to do this, and I need to have a few more hours to finish work. Those few hours come from this disk."

"This disk" is a removable hard drive from Liberty Systems (160 Saratoga Avenue, Suite 38, Santa Clara, California 95051; 408-983-1127). It's another 80MB of storage for Berry's computers and another four hours to his workday. With the \$1,000 device, Berry's assured of having every file and font when he needs it.

"Floppy disks have become less practical because work files have become so big," Berry says. So he just unplugs the drive, takes it home, and plugs it into his Mac. Once he calls it a night at home, he copies the revised files back to the portable drive to go back to his office.

Removable hard disks are the wave of the future for office executives who take work home, says Joel Levine, vice president of marketing for SyQuest Technology (47071 Bayside Parkway, Fremont, California 94538; 415-226-4000), which has shipped more than 600,000 of the drives. Yet the idea is hardly new.

When mainframes ruled in the 1960s and 1970s, transportable hard drives were the norm. "Disk drives were designed to be removable," Levine says, "so users would have unlimited storage capabilities as well as total security for their data." With the advent of PCs, however, disk drives became fixed internally.

Iomega (1821 West 4000th S, Roy, Utah 84067; 801-778-1000), another leader in the mass-storage industry, recently introduced the Bernoulli Transportable 90, a 90MB hard drive that can connect to PCs and laptops through a variety of options, including a laptop's parallel printer port. The drive looks like a transportable car ra-

dio, weighs 8½ pounds, and retails for \$1,149. And it's rugged enough for the mail.

Before copying your corporate program files to a removable hard disk, however, you should check with your MIS director to make sure you aren't violating any copyright laws or licensing agreements that were made between your company and a software vendor.

Only the copyright holder—the software vendor—has the right to make a copy, according to Ken Wasch, executive director of the Software Publishers Association, which wages a vigorous antipiracy campaign. Companies that license from software publishers, however, might have *permission* to make extra copies. Just be sure you carefully follow the licensing agreements.

Companies who violate the law can find themselves sued for unregistered copies, fined for the practice, and embarrassed in the media. The SPA monitors software piracy and helps companies monitor their own software usage with *SPAudit*, a disk-based software program available free from the SPA (1730 M Street NW, Suite 700, Washington, DC 20036; 800-388-7478).

Another advantage of the transportable hard disk is that it provides Berry with a complete copy of his computing environment, including program and data files, so he can take the disk with him when he visits clients or holds seminars in far reaches of the world.

"Since I travel a lot, my portable goes with me," Berry says. "It's assurance that I'll have everything I need. You don't want to be in Hong Kong and find out you don't have the right fonts. When I go with my own disk, I have all the fonts and software I need."

That's a good feeling to have when you're computing away from the office. □

IT
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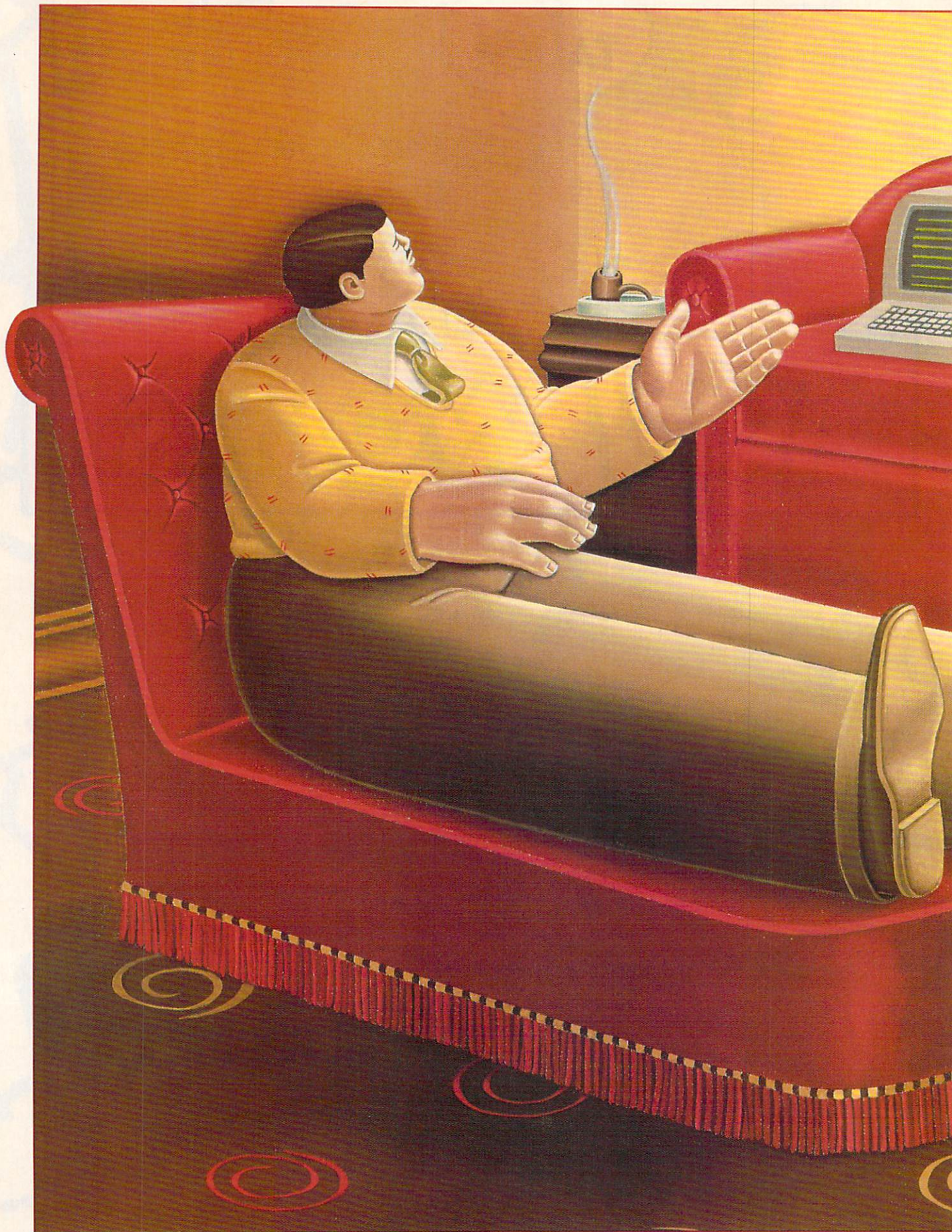


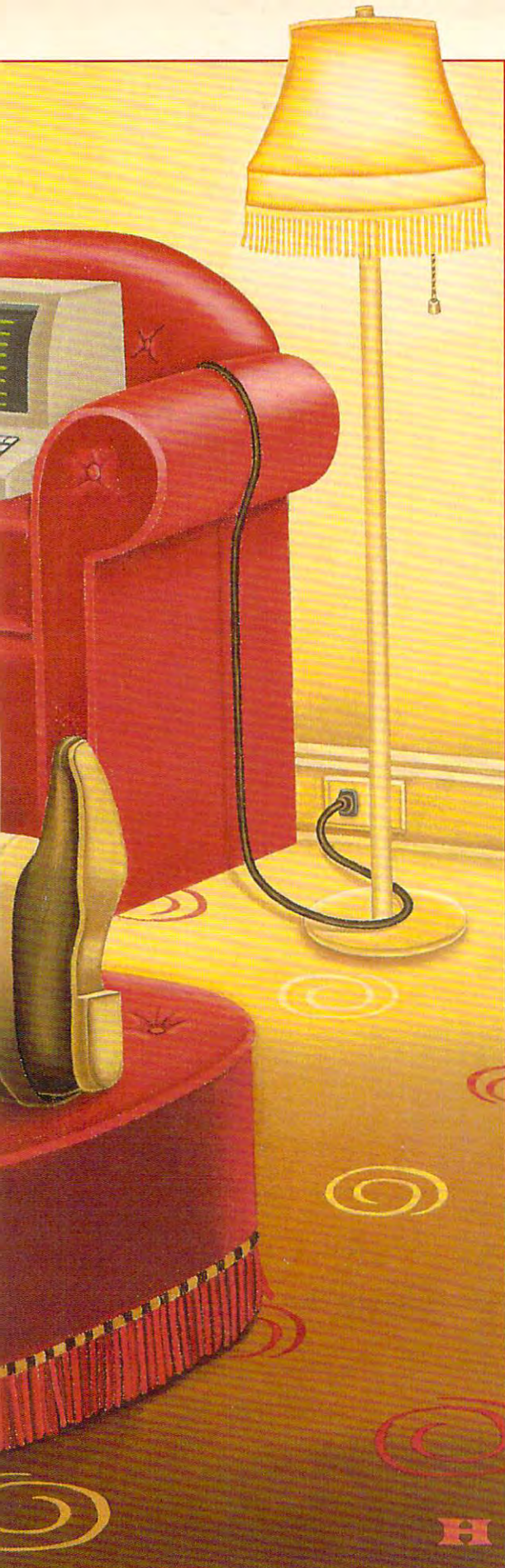
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DESIGNING A HOME OFFICE
FOR COMFORT AND
SUCCESS IS EASY—IF YOU KNOW
THE POTENTIAL PITFALLS.

DESIGN INSPIRATION

BY SHERRY ROBERTS

Millions of people go to work every day and never step out the front door. They manage this trick, for the most part, by using their computers, modems, fax machines, laser printers, and telephones as their electronic eyes and ears. Their ranks include writers, artists, accountants, executives, entrepreneurs, desktop publishers, and consultants of almost every persuasion. Unfortunately, few of them are professional interior designers.

And there's the rub: How can a home office worker create a comfortable, efficient, and productive work environment next door to the laundry room with the rattling washer or adjacent to the nursery with the colicky baby? What do you do if your home office shares a room with the Nintendo? Is it possible to create a professional home office that you would be proud to show clients—a place where professionalism can live in harmony with domesticity?

More people than ever before are finding themselves working in an "electronic cottage" and facing these questions. According to *Entrepreneur* magazine, there were 18.3 million home-based businesses in 1989—a 23-percent increase over 1988 when about 14.9 million businesses were run from the home.

Office Sweet Office

Whether you are founding the next corporate dynasty or simply searching for a quiet place to pay the monthly bills, the first and most difficult step is determining where to put the office. Don't decide too quickly. Don't leap to the conclusion that the perfect location is the spare bedroom, vacant basement, or never-used attic. A home office has to fulfill all the requirements of a corporate office—and more.

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"Eyeball your house," says Mark Alvarez, author of *The Home Office Book: How to Set Up and Use an Efficient Personal Workspace in the Computer Age* (Goodwood Press, 1990). "The most obvious space may not really be the best space."

Alvarez, who works from his home office in Woodbury, Connecticut, even has a rule about bad space: No matter how tempting it is, never establish your home office in a location that will often be uncomfortable. Forget the uninsulated attic that's freezing in winter and boiling in summer or the basement with a single light bulb dangling from a cord, unless you are willing to spend the time and money to make them habitable. After all, a home office is a habitat, a place where the typical home-based entrepreneur spends more than eight hours a day.

Nancy W. Lasater, owner of Design Associates, a Greensboro, North Carolina, interior design firm specializing in commercial office space, says, "Most people start off with the attitude of where can they fit the office instead of asking what are their needs."

Lasater, who was an in-house corporate designer responsible for the interior design of RJR Nabisco's world headquarters and company offices, started her business in a home office. She recommends that home office dwellers select a space big enough to fit their needs three years from now.

Thinking big is especially important for the high-tech cubbyhole. If you have ever-changing equipment and technological needs, Lasater says, flexibility is the key to both the size and the layout of your office.

Another consideration in locating your home office is the amount of traffic your business will generate. "You want your clients to walk through as little of your house as possible," Lasater says. "For example, if you plan to put your office in a bedroom, locate it in the bedroom nearest to the living room, since the living room tends to become the lobby of most home offices."

But what if your office must share space with the television, the Nintendo, or a dollhouse? Many home office work-

ers set their space apart, not with walls but with time, negotiating schedules with the other family members.

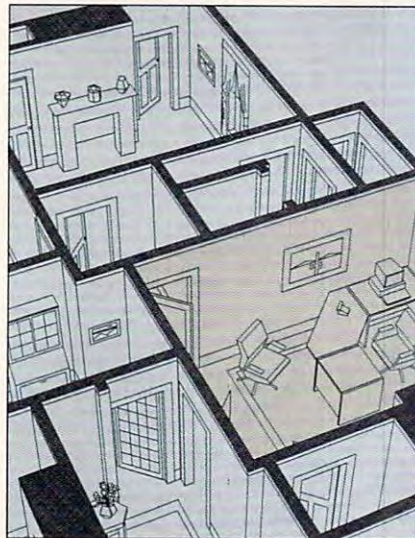
Even so, both Lasater and Alvarez suggest that you find some way to distinguish your office space, to make it your own, to capture symbolic privacy if not actual privacy. A rug or platform can mark the limits of your office. Use barriers such as plants, screens, panels, and bookcases. And if all else fails, don't forget Les Nesman, the newscaster of "WKRP in Cincinnati," who carved his niche out of a crowded communal office using only a roll of tape.

The Layout for Your Dream Office

"Design your office the same way you design a kitchen," Alvarez says. "You don't want it to get in the way, to be a problem. It ought to be efficient, given the way you work."

Before arranging your office, Alvarez suggests analyzing the way you work, the type of equipment you will use, and even your physical characteristics. Are you right- or left-handed? Tall or short? Do you have any physical handicaps?

There are four standard office layouts, according to Alvarez:



Design an office with ROOMER3.

- The strip, the most basic office design, is a straight line of office furniture and components. This is the least desirable if you have to accommodate lots of equipment.
- The L-shaped layout is common in home offices because it uses wasted corner space and offers a convenient arm for the printer.
- The galley, which is basically two strips with a chair in between, is a favorite in executive offices. The computer can be set up on one work surface, while the other surface is used for phone calls and handwork.
- The U-shaped layout, says Alvarez, "is like sitting at your own personal control center—everything important is usually within easy reach."

The best thing about designing your own office is that you don't have to stick with some plan dreamed up by the corporate designer. You can find the arrangement that is most comfortable and productive for you.



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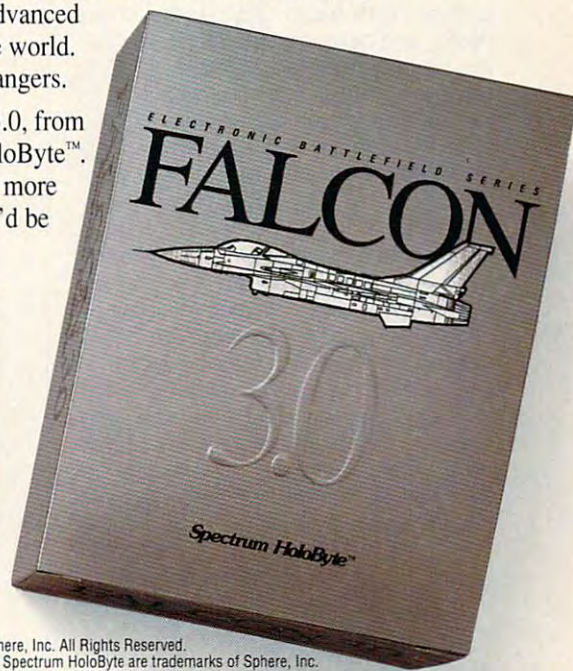


**You and your wingman
begin the attack, deep
behind enemy lines.**

... Nearly blacked out, you ease forward on the stick. The g's drop, and you can see again. There he is! You're on HIS six now. This is going to be sweet. As you get tone you know he's yours.

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Furniture

Today's office is more than a table and a chair. To underscore this fact, consider that an ordinance requiring adjustable furniture in businesses with more than ten employees went into effect in San Francisco in January 1991.

Jeff Larson, marketing communications manager for Krueger International in Green Bay, Wisconsin, says the ordinance illustrates the growing concern about safety in office environments: "Researchers have found you're just as much at risk doing any repetitive motion such as keyboard strokes as you are out on the plant floor."

Larson has been following the San Francisco legislation because Krueger is the eighth largest furniture manufacturer in the United States. The company produces 50 different lines of chairs as well as workstations and Data-Bord—a line of furniture designed for computer support with slide-away and adjustable-height work surfaces.

Larson says, "People tend to put a lot of money into their computer but go cheap on the items to support it." Which is a mistake. Your comfort and health are even more important than the horsepower of your computer.

The most important piece of furniture in the home office is the chair. "Choosing a chair is like test-driving a car," Larson says. "You have to sit in the product."

Professional designers recommend work surfaces with adjustable height. Alvarez prefers tables, which often are bigger and more adjustable than desks, and notes that the standard writing height of a work surface is 29½ inches. Standard typing height is 26½ inches. The proper typing height is the one that permits your elbows to bend at a 90-degree angle when your hands are on the keyboard.

A desk should be at least 22 inches deep, Alvarez says, considering that a CPU and keyboard can easily consume more than two feet. Also there should be at least 18 inches on either side of the keyboard for workspace.

You can save precious workspace by turning your CPU on its side and standing it beside the desk, then propping your monitor on an articulating arm. Recommended placement of the computer monitor is 16 to 28 inches from your face. Alvarez also suggests setting the monitor below eye level, so that you look down 10 to 20 degrees when you're reading from it.

Access to Power

When you choose the space for your home office, make sure it has several power outlets and phone jacks. If you only have one electrical outlet and

FURNISHED COMFORT

Computer furniture has become as innovative as the computers themselves, providing high-tech comfort through almost infinite adjustability.

Haworth (P.O. Box 5574, Kalamazoo, Michigan 49003-5574; 800-344-2600) offers an adjustable computer table that allows you to place the keyboard and the monitor at a wide range of completely adjustable levels.

Human Factor Technologies offers a whole range of adjustable furniture, some of which is electrically operated. This company can be reached at 55 Harvey Road, Londonderry, New Hampshire 03053; (603) 432-4495.

If you're among the truly hip, you're into comfort to the maximum. Check out the offerings of Biomechanics Corporation of America (1800 Walt Whitman Road, Melville, New York 11747; 800-248-3746). This company is hard at work developing chair technology. By using hundreds of ad-

justments through tiny pneumatic tubes shaped like little fingers, its Intelligent Seat conforms to your seat to provide maximum comfort to your glutei.

There's more to furnishing than furniture. You need dozens of small items to make your home office work efficiently, and there is a significant industry built around making an office comfortable, efficient, and attractive. Curtis Manufacturing is a supplier of surge protectors, monitor bases, antiglare screens and sundry items for the office. To assist you in making good decisions, Curtis has released a series of pamphlets titled "Tips to Computing More Comfortably," "Surge Protection and the New UL 1449 Standard," "VDTs and Radiation," and "Design Ideas for Your Home Office." These pamphlets are yours free of charge from Curtis Manufacturing (30 Fitzgerald Drive, Jaffrey, New Hampshire 03452; 603-532-4123).

—ROBERT BIXBY

three computers, two printers, a fax machine, a scanner, a stereo, and an answering machine, you need to consult an electrician.

Also don't scrimp on surge protectors. You don't want to lose valuable information when the air conditioner kicks on or someone pops popcorn in the microwave. Power hogs like copi-

ers and laser printers should be on separate circuits from the PC.

Alvarez says one of his most popular chapters is the one on lighting. And no wonder: Monitor glare is the computer user's nemesis. It causes eyestrain, headaches, and sore necks (from leaning and squinting at the screen).

To eliminate monitor glare, position



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your monitor so that light sources are to the side of the monitor. Don't place the monitor in front of a window so that you are constantly looking into the bright, natural light. Also beware of windows behind you that cause distracting squares of light on your screen.

Shades of the Professional

The colors in your home office are a personal preference, but the professionals have good reasons for recommending off-white or neutral colors. "Neutral wall colors are best because, as far as reflections go, they don't change much under different lighting from morning to afternoon," Alvarez says. "They also hide dust, which is important in some home offices."

If clients will be visiting your home office, color selection may be important in other areas of the house as well. "When you walk into a commercial office, you are getting a prepackaged first impression," Lasater says. "When you walk into someone's home, it is a real summation of that person."

The client of a home-based business is slapped with a full-force dose of the homeowner's personality. Dirty laundry, dying plants, and fleas do not give the impression of professionalism. Remember the client is asking, "Do I want this person to handle my work?"

GETTING IT ON PAPER

You can design your home office on the back of a cocktail napkin, with general graphic design software such as *Micrografx Designer*, or with specific floor plan and interior design software.

ROOMER2 (Hufnagel Software, 501H Main Street, Clarion, Pennsylvania 16214; 814-226-5600; \$79) is a special-purpose CAD program that creates floor plans and furniture arrangements for home or small offices in 3-D. Creator Henry M. Hufnagel released **ROOMER3** (\$395) in the fall of 1990. A video about the software is available for \$10; it's included in the **ROOMER3** product at no extra charge. The chief differences between the products is that **ROOMER2** supports CGA and Hercules and has no mouse support while **ROOMER3** supports the mouse and VGA.

Generic CADD 5.0 (Generic Software, 11911 North Creek Parkway, Bothell, Washington 98011; 206-487-2233; \$495) is a full-featured drafting and design program. Available for the PC (a similar product is available from Generic Software for the

Mac), this program does more than let you push furniture around on your computer screen. It calculates dimensions, adds notations to renderings, and scales drawings. A special library of images of office furnishings is available.

If you have no interest in floor plans, call Norm Abelson, a Lake Oswego, Oregon, consultant specializing in trade shows and exhibitions. He has developed the Instant Office "to put to use those underutilized areas of the home."

Instant Office comes in three sizes (8 x 12, 12 x 12, and 12 x 16 feet) and includes an Allen wrench to lock the units together. The units come with a videotape to lead you through the assembly, which Abelson says takes about two hours.

The kit, which runs \$5,000 to \$7,000 depending on the size of the room, has walls, ceilings, fluorescent fixtures, doors, wiring (ready to be hooked up by an electrician), phone jacks, outlets on all four walls, and vinyl-covered paneling in three finishes (light, medium, and dark.)

Does It Work?

After you've designed your office, how do you know if you've got it right? "The tipoff is if your home office gets in the way," Alvarez says. Alvarez, for example, realized after he developed an ear problem that he had his telephone on

the wrong side of the desk. Simply moving the phone to the other side made the office work better.

The key to designing your home office is to constantly look at it with a fresh eye. You must build an environment in which you can live and work. □

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ARTS & LETTERS

Robert Bixby

FUTURE IN MY HAND

Ever wish you'd been around when Apple got started? Well, I got a glimpse of something that made me feel excited about personal computing all over again.

I wasn't among the cheerleaders when people first started mumbling about pen computing a couple of years ago. Long ago I left legal pads behind in favor of typing. The last thing I wanted to do was give up being able to type—a process that very nearly keeps up with my thoughts—and return to the slow hand.

Writing slowly enough to be legible (even to myself) would mean letting ideas go by and dreading second thoughts that would require rewriting. Pen-based computing might be embraced by people ignorant of the advantages of keyboards, but I knew better.

That was my mindset as I approached the Waldorf-Astoria

Hotel in New York one June afternoon for a product demonstration of something new (hohum) in pen-based computing. The address of the demonstration and the fact that the call came from the Regis McKenna agency did make me take notice, however.

I was met at the elevator and led to a quietly elegant suite where I saw something that may very well change the way we conceive of the computer for the next generation or two—Momenta's entry into pen-based computing, called pentop computing to distinguish its approach from that of Grid. Momenta's reason for differentiating its machine is that it understands the resistance of people like me and has provided for us a fully functional keyboard to supplement the touchscreen.

The keyboard represents the company's philosophy that the thing pen-based computers do the worst is handwriting recognition, and, ironically, this is the activity that uses the most processing time. It makes more sense to process text through a keyboard and use the touchscreen as a pointer and editing tool.

Regular readers of this column will recall my long search for the mouse killer—some device to eliminate the need for desktop rodents forever. The problems I've encountered so far have been response speed and the fact that most GUIs were designed for mice in the first place, which puts any other device at an instant disadvantage.

Momenta, while built on top of a fairly conventional 386SX DOS-based 4MB system, uses a specially designed GUI (in 1.5MB of ROM) that takes specific advantage of the pen and the motions peculiarly suited to pen input. For example, it can detect when you're trying to

create an ellipse or a rectangle on the drawing screen.

When you want to embellish or delete an object, you move the pen in one of six directions from the object's center point—a flick of the wrist, and the object is gone or copied to the clipboard or ready to move, or a menu is called, or a file is opened or closed, and so forth—the commands relate to the current activity. The range of actions is complete. Recognizing pen movement is the province of a special chip, so response is lightning quick, and it takes nothing away from the CPU.

It's clear from the moment you sit down with the wedge-shaped computer that a great deal of thought went into this device before its design was implemented. The wedge shape, for example, fits as naturally on the lap as a sketch pad. The RAM expansion uses standard SIMMs, so you won't have to pay a lot for your memory.

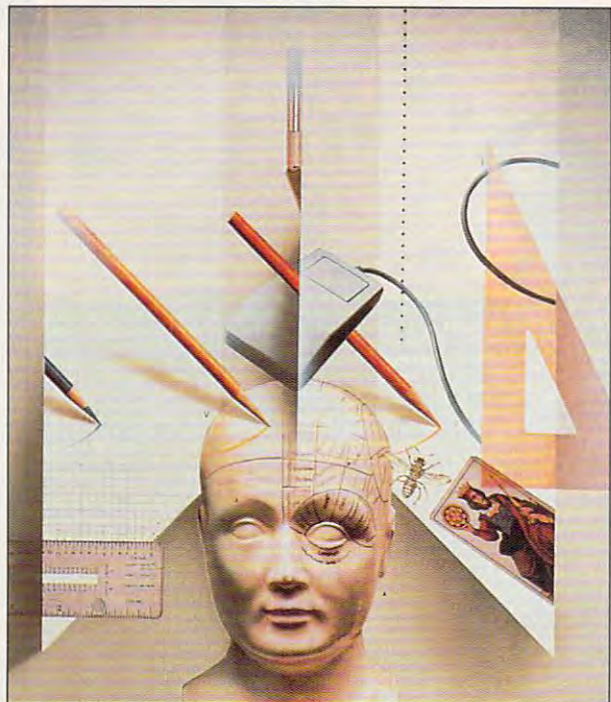
The system is equipped with a cold shutdown, which means that when you aren't actually interacting with the computer, for all intents and purposes, it's turned off with almost no battery drain. The result is about six hours of battery life from its ten standard penlight cells in continuous use.

Since the machine is built on an Intel chip and MS-DOS, you'll be able to run standard DOS software from the machine's 40MB hard drive as well as from the pen-based GUI Momenta will build in.

Although Momenta opted not to attempt raw handwriting recognition, the GUI is capable of deciphering print, so you'll be able to enter text in dialog boxes, for example. It would be prohibitive to enter text this way for word processing, however.

Watch Momenta. It has the future written all over it. □

Momenta's new pentop computer has all the momentum to make pen-based computing the twenty-first century standard.



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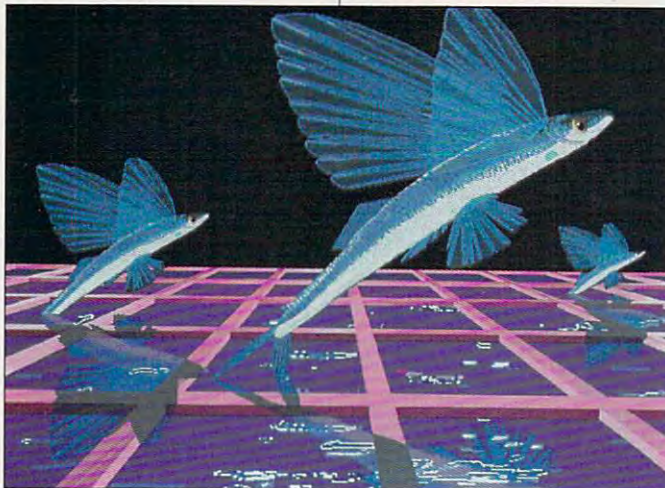
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David English

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It was hard work for the Disney Studios to string together millions of individual drawings to create an animated movie. Each frame of *Pinocchio* and *Fantasia* was carefully painted by hand and photographed in sequence with a motion picture camera. In the movie theater, the cels were projected 24 times every second to generate fluid motion.

With Autodesk Animator Pro, you can create animation that rivals today's professional animation.



By contrast, much of today's animation is called limited animation—most of the time only the characters' mouths and hands move. It's just too expensive to use Disney's methods. Not even Disney used to. Costs are kept down by using computers to create some of the backgrounds. A computer can quickly calculate the steps necessary to move an object from point A to point B.

Given the state of today's animation—limited animation on the low end and computer-assisted on the high end—and the graphics capabilities of today's powerful 386- and 486-based PCs, you can create fine computer animation.

And there's no better place to start than with the recently released *Autodesk Animator Pro* (Autodesk, 2320 Marinship Way, Sausalito, California 94965; 415-332-2344; \$795).

Like *Autodesk Animator* (\$295), which was released in 1989, *Autodesk Animator Pro* offers cel animation (where you can create each frame as an individual picture—much like traditional Disney animation), tweening (where you can transform one shape into another by letting the computer draw

tweening, better font support, WACOM graphics tablet support, and a new animated cel option that lets you paint one animation over another as though you were painting with a brush.

Although it's a great program, there are limitations. As you advance to higher resolutions, you'll find that your animations slow down. While Autodesk recommends a 286 with 640K of RAM for *Animator*, it recommends a 386 or 486 with 4MB of RAM for *Animator Pro*.

There are some things you can do when using these programs to place less strain on your PC's processor. While you'll probably want to use the full screen for your backgrounds, try to keep the moving objects relatively small. With tweening, color cycling, and the optical animation techniques, you can create dramatic effects without having to move the entire frame. And if you plan to bring your animations over to video, consider purchasing or renting a video recorder with the ability to record single-frame video. Then you can make your animations as complex as you like because you won't have to depend on your PC to move the objects in realtime.

Both *Animator* and *Animator Pro* have an easy-to-use interface that actually makes it fun to try out your ideas. And the *Animator Pro* package includes a generous selection of animation files that illustrate many of its techniques. (You'll need a whopping 11MB of hard drive space to install everything that comes with the package.) By the end of the year, you can expect to see a Windows-based animation player, a Visual Basic DLL, and support for sound cards within Windows. Add it all together, and you have a great way for a future Walt Disney to get started in animation. □

each in-between shape onto a separate frame), and optical animation (where you can use television-style special effects to add swirling, twirling, spinning, flipping, and squashing motions to a shape or an entire frame). Both programs include text titling and a built-in 256-color paint program.

But while *Animator* restricts your work to a resolution of 320 × 200, *Animator Pro* lets you work in 640 × 480, 800 × 600, and even 1024 × 768. Because the animation backgrounds are stored in GIF format, I downloaded several interesting 640 × 480 photographs and was able to load them directly into *Animator Pro*.

Other improvements in *Animator Pro* include enhanced

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Private eye Tex Murphy is back in a hilarious new interactive movie adventure from Access Software. For the first time, players will be able to interact with full motion video characters on a disk-based product, as they help Tex face murder, romance, deception, and prophecy from present day San Francisco to the year 2039.



WORDTRIS

A new challenge from the TETRIS people at Spectrum HoloByte. The fast action, falling blocks now have letters on them, which players try to form into words. Time is of the essence as you try to maneuver letter tiles to spell words, as they fall from the top of the screen into the well. If you like TETRIS, you'll love WORDTRIS.



FACES...TRIS III

You'll meet some pretty strange characters playing this addicting Soviet mind-teaser from Spectrum HoloByte. Falling block pieces of famous and not-so-famous faces must be stacked in the proper order (mouth to chin, eyes to nose) to form complete faces. Remember there are no points for "double chins" in this game!

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COMPUTE CHOICE. Outstanding graphics and sound accompany the bunny's return.

Heidi E. H. Aycock

READER RABBIT 2

Only a few years old and, already, *Reader Rabbit* has gotten a face-lift. Kids are growing up so fast these days.

Seems like only yesterday *Reader Rabbit* was a cleverly designed program with engaging, but not spectacular, graphics. Now, *Reader Rabbit 2* features more than solid educational programming with impressive pictures. This newest addition to the *Reader Rabbit* series sparkles with the kind of graphics usually reserved for entertainment software. For people with sound cards in their PCs, this new program also brings great music and sound effects to the arena of children's software.

But what's more important? Graphics or educational value? To the Learning Company, responsible for grooming Master Rabbit, education comes first. *Reader Rabbit 2* helps children between five and eight years old hone their reading skills. Following the young rabbit through four fun sections of Wordville, children improve their understanding of spelling, phonics, vocabulary, and sequencing.

To begin, hop on the crosstown train and head for the Word Mine, where you search for special crystals. The crystals display word or letter combinations, and the mining car holds another word or letter combination. As with all of the sections, four levels of difficulty challenge you. First you create compound words by matching a picture and half the word on the mining car with a word on one of the crystals. On the second level, you select the three-letter crys-



tals that complete words started by the two-letter consonant blend on the mine car. On the third level, reverse the skill you practiced on the second level; the three-letter crystals begin words ended by the two-letter blend on the mining car. On level 4, type the appropriate words or letter combinations with no cues from the game. Whether the car holds a compound word or a two-letter blend, this level is very challenging.

The Word Mine flexes at least two reading muscles. As you build words, you expand your vocabulary. Like a game of Scrabble, *Reader Rabbit 2* may send you scrambling for the dictionary. As you work with blends and letter combinations, you develop a stronger friendship with phonics, too.

To try a new section of *Reader Rabbit 2*, just hit the Escape key or click on the train icon, and you're off to the station. At the station, you can choose one of the other exercises.

Vowel Pond, second in the list of choices, tests your understanding of vowel sounds.

At the pond, you find Reader

Rabbit casting off from a dock, his net and bucket poised for catching fish. When he finds a good spot, our angling hero waits for the fish to swim out of a nearby log. Each fish has a word emblazoned on its scales.

On the easiest level, you catch fish which match the short vowel sound shown at the top of the screen. With a stroke of the Return key, Reader Rabbit dips his net into the water and scoops up the fish. Sometimes the vowel sounds are represented by the same letter combinations—*cup* matches *sun*, for example. Sometimes the matches are tougher, complicated by different letter combinations—*leg* matches *bread*, for example.

Vowel Pond's second level tosses long vowel sounds into the water. Besides being a new concept, long vowel sounds can be made up with even more letter combinations than short vowel sounds—*lane*, for example, matches with *train* and *day*, as well as *vane*. The third level mixes short and long vowel sounds. By the time you reach the

fourth level, Master Rabbit has two pails, one for the short sound of a vowel and one for the long sound. You not only match sounds but also pick which pail should hold each fish that swims by. Fishing is a wonderful way to spend an afternoon, but *Reader Rabbit 2* has two more fun exercises. Flag down the Wordville Train and explore the other areas.

In Match Patch, you play that old standby, concentration, but the matches are much more challenging. The carrots in this garden are labeled with words. In the first level, you match carrots that rhyme. These rhymes are usually represented by similar spellings. On the second level, you match words that sound the same but are spelled differently. Take this opportunity to talk about what these words mean, and you'll add vocabulary skills to this exercise. You can also use this technique on the third level. These carrots are labeled with opposites. The fourth level plants more difficult rhymes in the soil—*night* rhymes with *bite*, for example.

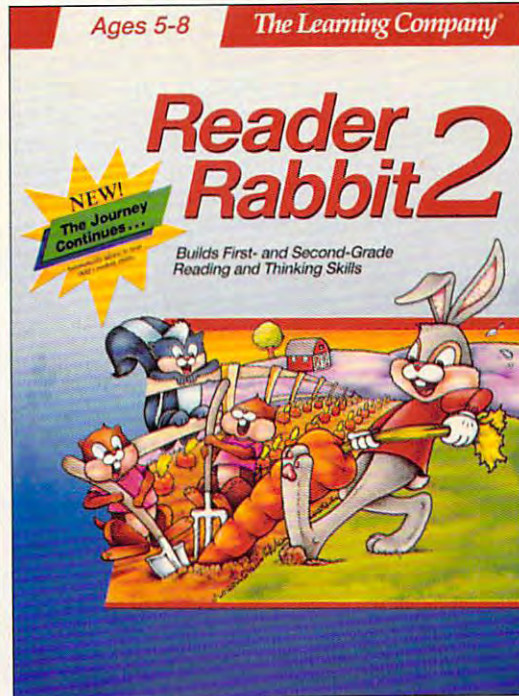
Finally, Alphabet Dance works on sequencing skills. The screen shows four animals tapping their toes. The animals' interesting names—like Cecil and Quala—are printed with the waiting figures. You put the names in alphabetical order so the critters can cut the rug. On the first level, these names are just one letter apart from each other—*Albert*, *Ben*, *Cami*, and *David*, for example. On the second level, the names are more spread out in the alphabet—*David*, *Mary*, *Robert*, and *Yul*, for example. On the third and fourth levels, some names start with the same letter, so

you have to sort them by the first and second letters.

With these four exercises, the Learning Company has, once again, released an excellent educational package. *Reader Rabbit 2* is packed with good lessons and valuable practice. Best of all, this program is not simply an electronic workbook. With its animation and sound, *Reader Rabbit 2* takes full advantage of computer technology. If you've seen the first *Reader Rabbit*, you may be surprised by the description of *Reader Rabbit 2*. Sure, the first program had nice graphics, but they were blocky, simplistic, and nothing overwhelming. This new program is truly exceptional in comparison to what you may have seen in other educational packages.

Each section of Wordville is populated by adorable creatures and interesting visual effects. In the Word Mine, shimmering sparkles highlight the crystal that has been selected. In Vowel Pond, humorous cartoon fish frolic and make faces in Reader Rabbit's bucket. If our heroic hare catches the wrong fish, the scaly scoundrel scowls at the rabbit and leaps back into the water. The Match Patch grows vibrant orange carrots, at least as big as the gophers that push them out of the ground. The poor gophers strain and puff under the weight of these vegetables. Finally, the Alphabet Dance features several different characters who tap their toes and clap their hands to the music. In VGA, the game's images seem to jump out of the screen because their colors are so rich. Added depth to the images lends a three-dimensional quality.

Excellent sound accompa-



nies the sharp graphics. The different themes bounce as energetically as the game itself. Your children will especially appreciate the seven different songs that play during the Alphabet Dance. You'll need a sound card to enjoy the music to its fullest, but the effect that great music can have on youthful learners can't be discounted. Boredom with an oft-repeated game sequence can be averted for many days by simply piping in harmonies. Here's another reason to buy that sound card you've always wanted; your kid's education just might stand to benefit from that purchase.

What you'll see when you boot up *Reader Rabbit 2* is an education program that has been through a cosmetic overhaul. Now learning can be as visually and aurally stunning as the slickest videogame. □

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PATHWAYS

Steven Anzovin

COMPUTING IN THE GREEN

Working at your computer, you may feel smugly separate from nature, but maybe you and millions of other computer users are worsening the greenhouse effect, destroying the ozone layer, pouring toxic chemicals into the air and water, and creating thousands of tons of unrecyclable solid waste. If that thought concerns you, read on.

You may hear claims to the contrary, but the computer industry isn't inherently green. For example, in many plants, circuit boards are still cleaned with chlorofluorocarbons that

Energy Efficient Economy. The single best way to save juice and combat the greenhouse effect is to turn off your equipment often. If you can't turn it off every time you leave your desk, at least turn off the monitor and printer. To save even more energy, use low-wattage fluorescent task lighting instead of incandescent.

Instead of buying a whole new computer, save plastic, metal, and packaging by getting your current hardware to do more for you. Enhance your computer's performance with an accelerator board. Buy internal modems, hard drives, and other components instead of external ones because they're composed of

less material. Share seldom-used peripherals with another person, or rent them.

One idea I particularly like is file-compression software. Such programs (and optional compression boards) let you squeeze up to double the number of

files on your current hard disk so you can put off buying a larger drive. One such program for the PC is *Stacker* from Stac Electronics (5993 Avenida Encinas, Carlsbad, California 92008; 800-522-7822; \$149, \$229 with a compression board).

Do you really need to print that draft? Flip over some used sheets and print on the backs. Do a lot of faxing? Get a fax modem—it will save paper every time you send or receive a fax. A paper-saving print utility is *DynoPage* from Portfolio Systems (21 East Market Street, Rhinebeck, New York 12572; 914-876-7743; \$125), currently available only for Macs. *Dyno-*

Page lets you print reduced multiple pages on one sheet, but best of all, it prints consecutive pages on both sides of the paper, potentially cutting your paper use in half.

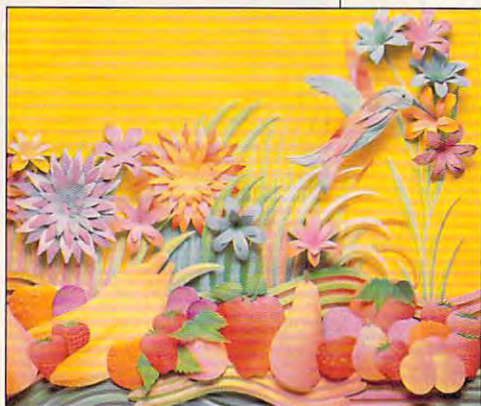
Keep a special recycling basket next to the computer to catch ruined print jobs, drafts, and perfories from tractor-fed paper. For fresh stock, use recycled paper when possible. A good-quality recycled paper can actually be better for laser printing since it's more flexible and less likely to warp when exposed to heat and stress. You can buy recycled computer paper at many computer stores. To order a wide assortment of recycled paper by mail, try PaperDirect (205 Chubb Avenue, Lyndhurst, New Jersey 07071; 800-272-7377).

Paper isn't the only consumable you can recycle. Check out the machines that reink printer ribbons and recharge laser toner cartridges. You can save quite a bit of money on printing. Floppies, of course, can be used again and again. When you're ready to upgrade, recycle the entire computer by selling it or donating it to a local school or charity. Most schools are desperate for computers. Most donations are tax-deductible at the computer's depreciated value. (The IRS considers computers to be fully depreciated after five years.)

Consider a used PC for your new machine, too. A slightly used 386SX/20 brand-name PC can cost 40 percent less than the street price. Check with the Boston Computer Exchange (800-262-6399) or the National Computer Exchange (800-359-2468) for the latest prices.

Want to share your personal tips on green computing? Send your ideas to me at Box 2173, Amherst, Massachusetts 01002. If they're green enough, you'll see your name and idea in a future column. □

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results, so
get in
on the act
of green
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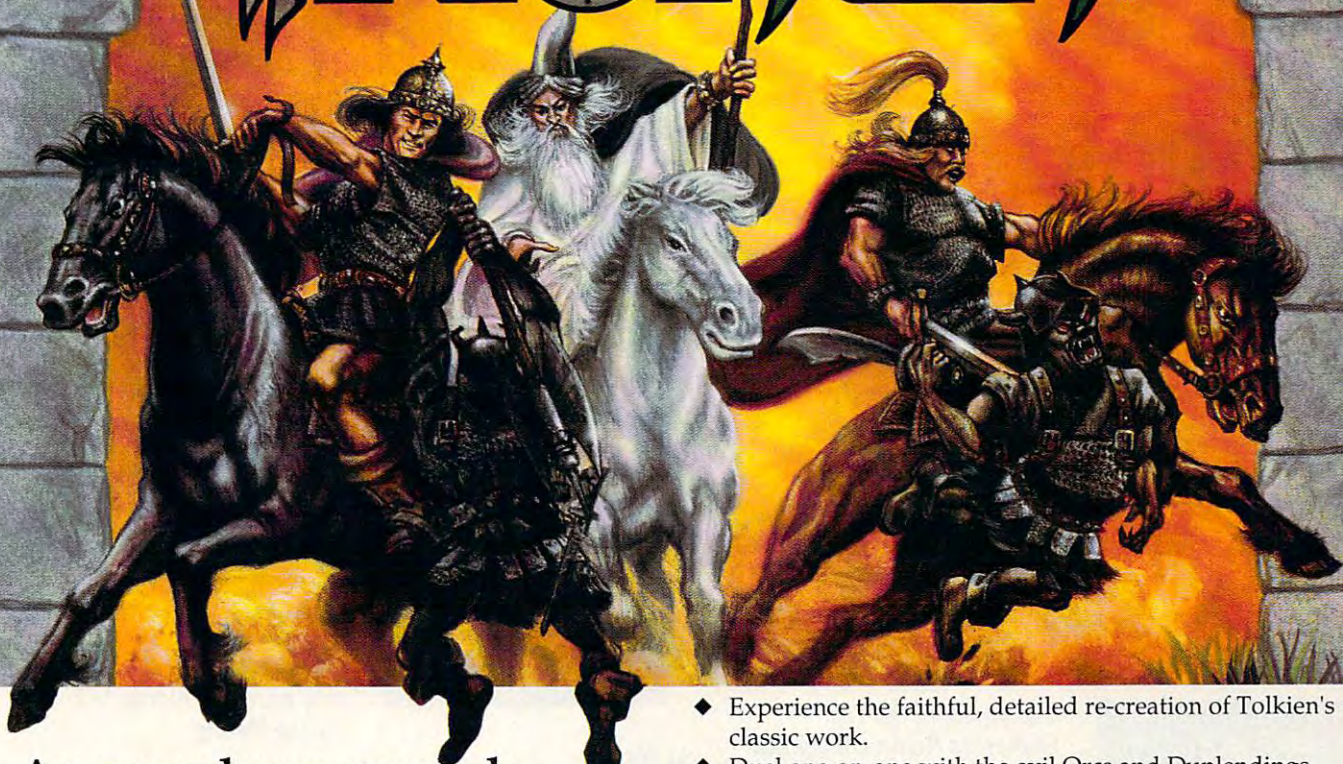
damage the earth's ozone layer, so buy your computer components from companies that use a water-based process.

Computer retailers need to clean up their acts, too. If you order by mail, use companies that ship in recycled packaging without foam peanuts and bubble pack. PC Connection is one such company (6 Mill Street, Marlow, New Hampshire 03456; 800-243-8088). Put the squeeze on other vendors to do the same.

Every kilowatt hour of electricity you use adds more than two pounds of carbon dioxide to the atmosphere, according to the American Council for an

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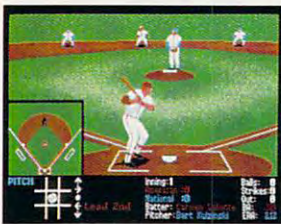
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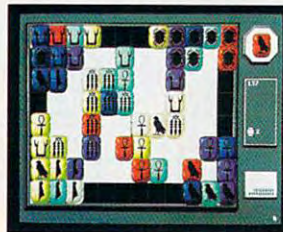
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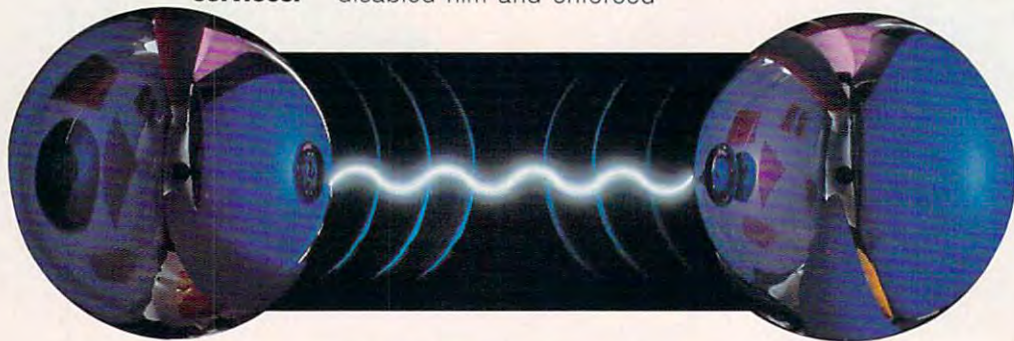


THE ONLINE GAMES PEOPLE PLAY

This is a story about the basic facts of life. It's a story about birth and death, love and sex, and cyberspace.

Ralph McAuley is a 57-year-old grandfather from Sarasota. He is no longer the Type A personality who roared across Florida blacktop at over 100 miles per hour. The former owner of a computer software company, McAuley spent 30 intense years dealing with Big Oil, Big Banking, and Big Government. His life changed forever when a heart condition disabled him and enforced

Explore
the cyberspace
playground
of today's online
services.



inactivity became his bottom line for survival.

"Reading, playing with my computer, and watching TV was all I did. No interaction with people. I felt like a vegetable and would become dependent because I couldn't be mentally active and challenged. Then I discovered Prodigy and *Baseball Manager*. For the first time in five years, I look forward to getting up in the morning. *Baseball Manager* may have saved my life."

McAuley is talking about an interactive, multiplayer, online computer game—one where he competes against other people. Played on Prodigy, the computer network created by Sears and IBM, *Baseball Manager* is one of dozens of games available on major national online services. While both single-player and multi-

player games exist on these networks, the interactive ones enjoy the greatest popularity. These games include most of the traditional types—adventures, fantasy role-playing, interstellar trading and fighting, combat simulators, and the like. In general, they cost anywhere from \$2.00 to \$12.50 per hour to play, depending on the service, the time of day, and your modem speed. *Baseball Manager* is the exception to the rule. It's a "rotisserie" baseball league. For \$119.95,

side world. Disabled people, people with few friends, the socially inept, people who have difficult times forming relationships because of their appearance or size—all these people can interact equally online.

Ken Williams is the cofounder (along with his wife Roberta) of Sierra On-Line, the publisher of the King's Quest series of computer adventure games, the Leisure Suit Larry series, and other titles. Despite the company name, however, Sierra had nothing to do with online gaming. That changed in May when the country's newest national online service became available. The Sierra Network (TSN) is unique in the field because it ignores all of the other traditional offerings of the online universe, concentrating instead on interactive game playing and chatting. Right now, the games available include backgammon, checkers, chess, bridge, hearts, and cribbage. "I wanted a place for my grandmother to be able to play a bridge game 24 hours a day," said Williams.

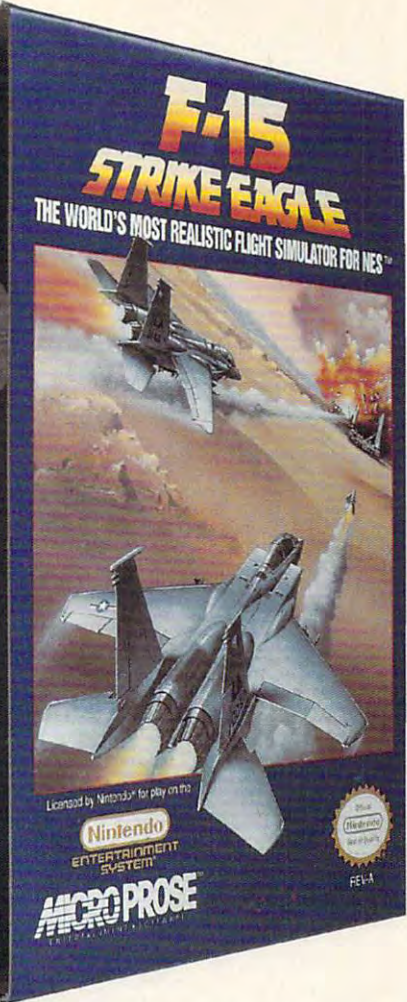
As meager as these choices seem, they do fulfill Williams's promise to his grandmother, so much so that this part of TSN is named Constant Companion. TSN plans to make two other familiar game-playing environments available early in 1992—LarryLand and Sierraland. In LarryLand, players will take on roles and interact with each other's alter egos in bars, convenience stores, and other sleazy locations from the Larry games. It could have a pretty adult tone to it. Sierraland will include interactive adventure and combat games like *Red Baron*. "The closer people get to the game-playing experience, the more they'll behave like real people," Williams

you can purchase a team to play for the season—and that's on top of Prodigy's \$11.95 monthly fee. Ralph McAuley bought six teams to start.

"I can afford it," he explains, "but if someone had told me six months ago that I'd be doing this, I wouldn't have believed it. It opens up a whole new world and new friends to me. I meet two or three new people every day, and the interaction is so deep. But because this is fantasy, there is no stress. It's definitely role-playing, but using real events." It is this combination of interaction and role-playing that gives online gaming its greatest appeal.

For many people like McAuley, online gaming and online relationships can be their chief connection to the out-

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says. "Role-playing is always fun. Soon we'll be seeing lots of 'virtual reality' worlds online where people can live."

What does Williams mean by "soon"? He predicts that in five years online game playing will be more important and more popular than the games we buy in boxes today. Williams and others see a merger of disk-based and online gaming as inevitable. Some of that is already happening.

In June, America Online introduced *Neverwinter Nights*, a fantasy role-playing game based on SSI's series of *Advanced Dungeons & Dragons* games. The game looks, plays, and has the same interface as the *Forgotten Realms* titles, except that the online players can talk to and help each other. SSI worked with America Online in developing the product, leading to unconfirmed speculations that soon there would be software "hooks" in SSI games to allow characters from the boxed games to move to the online game.

This fall, GENie is introducing *Multiplayer Battletech*, an online version of Activision's box product *Mech Warrior*. GENie already has a multiplayer version of *Harpoon* available. Along with TSN's promised *Red Baron*, these games just might be the first overlaps toward the predicted merging of the two gaming environments. If that happens

and you've never played games online, you'd better be prepared to enter an entirely new world.

Carrie Washburn administers the Multiplayer Games RoundTable on GENie. She first got in-

involved in online game playing just after her son was born in 1986. "Paul was 14 weeks premature, 13 inches long, and only weighed two pounds, three ounces. In the neonatal intensive care unit, he seemed more wires than baby." During the 2½ months Paul was in the hospital, Carrie and her husband discovered *Island of Kesmai* on CompuServe.

"*Kesmai* became our link back to reality. After a day of work and our time in the hospital with Paul, we would enter a fantasy world in order to forget the real one. The online friends that we met there helped pull us through."

Washburn became addicted to *Kesmai* and stayed with it even after her first marriage ended. She admits to a phone bill of over \$2,000 one month and others of over \$500. In the fantasy role-playing game, her identity became Lynn De'Leslie—adventuress and tease. "More of a slut, really," she admits.

Ironically, it was there in *Kesmai* that she met the man to whom she's now married. They had a two-year online relationship both in *Kesmai* and the real world before serious romantic involvement.

"One of the great things about meeting people online is that you get to really know them," Washburn enthuses. "The entire relationship is built on talking." Their marriage in May, though, is not unique by online standards. Carrie's assistant at GENie also met her husband online—she was in Florida, and he lived in Seattle—but they do live together now. TSN had its first marriage less than three months after it was launched. "It's getting to be commonplace," is an often-heard description of this phenomenon. "There are also divorces and bankruptcies," interjects Wash-

burn. "It's just like real life."

What makes online gaming so addictive seems to be not so much the games themselves (which tend to be quite good anyway), but the idea that they are an excuse for interaction among players. Jim Pasqua, game product manager at CompuServe, contends that people like to play games with other people.

"There's a range of emotions with online games that you just don't get with PC games. There, if you win, you feel as if you've just beaten the machine or the game's designer. Online, you beat other people." Ralph McAuley describes his experience as "more than just a computer interchange . . . an interchange of personalities."

Perhaps even more significant, though, is the idea of role-playing. A significant number of people in the online world are not known by their real names. It is customary to take on what is known as a handle, a name that you are known by online, such as Big Bad Mama, Slasher, Scorpia, CyberPunk, or something even more (or less) colorful. Many people spend years online with few ever learning their real names.

Online gaming takes this even farther. Handles become identities, and this makes virtually every major online game an exercise in role-playing. When you start asking questions, it becomes apparent that this just might be the point behind spending several dollars an hour in connect time charges.

Carrie Washburn: "The role-playing is at least as important as the games themselves."

Ken Williams: "People want to vicariously live other lives. The game is irrelevant. The game gets people together and gives them a chance to chat and interact. We tell peo-

