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**PC Magazine  
Editors' Choice  
May 1999**

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Processor	Intel Pentium III processor 450MHz	Intel Pentium III processor 500MHz	Intel Pentium III processor 550MHz
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Hard Drive	8.4GB Ultra ATA hard drive <sup>o</sup>	8.4GB Ultra ATA hard drive <sup>o</sup>	15GB Ultra ATA hard drive <sup>o</sup>
DVD ROM	6X var. speed DVD-ROM drive	6X var. speed DVD-ROM drive	6X var. speed DVD-ROM drive
Modem	3Com USRobotics V.90 WinModem <sup>**</sup>	3Com USRobotics V.90 WinModem <sup>**</sup>	3Com USRobotics V.90 WinModem <sup>**</sup>
Graphics	16MB nVidia AGP graphics	16MB nVidia AGP graphics	16MB nVidia AGP graphics
Micron U	1-year free <sup>a</sup> training @ Micron U online	1-year free <sup>a</sup> training @ Micron U online	1-year free <sup>a</sup> training @ Micron U online
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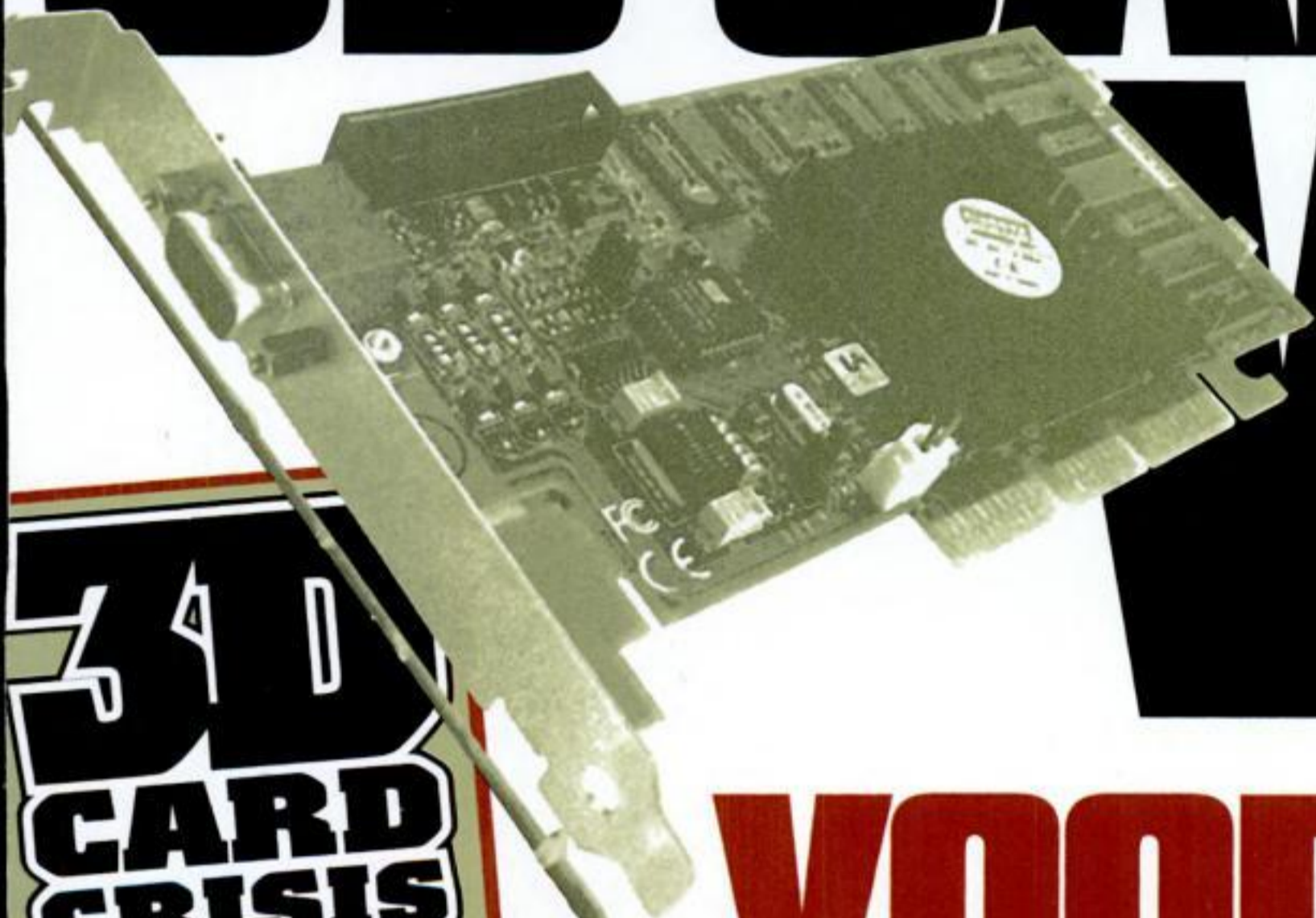
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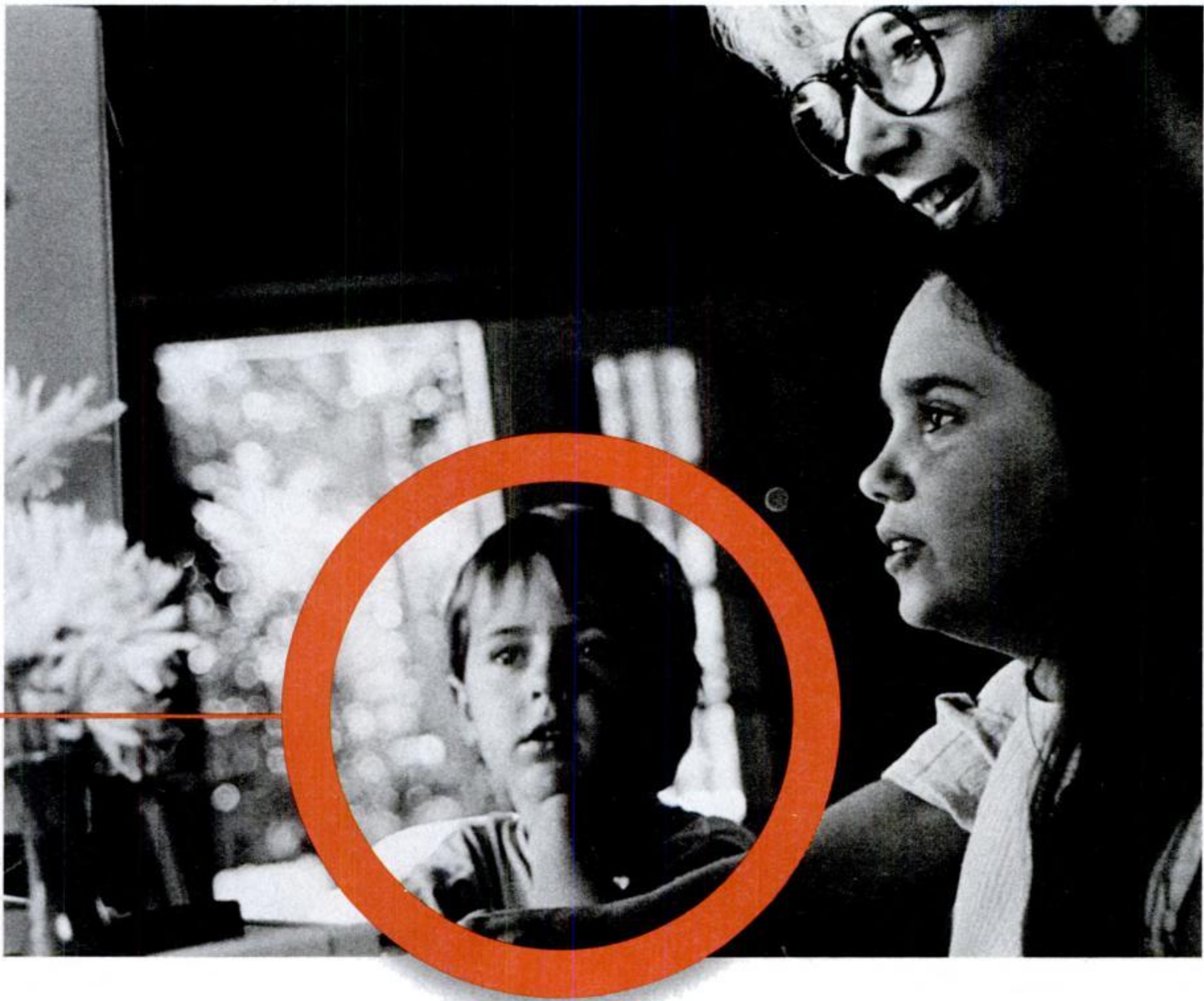
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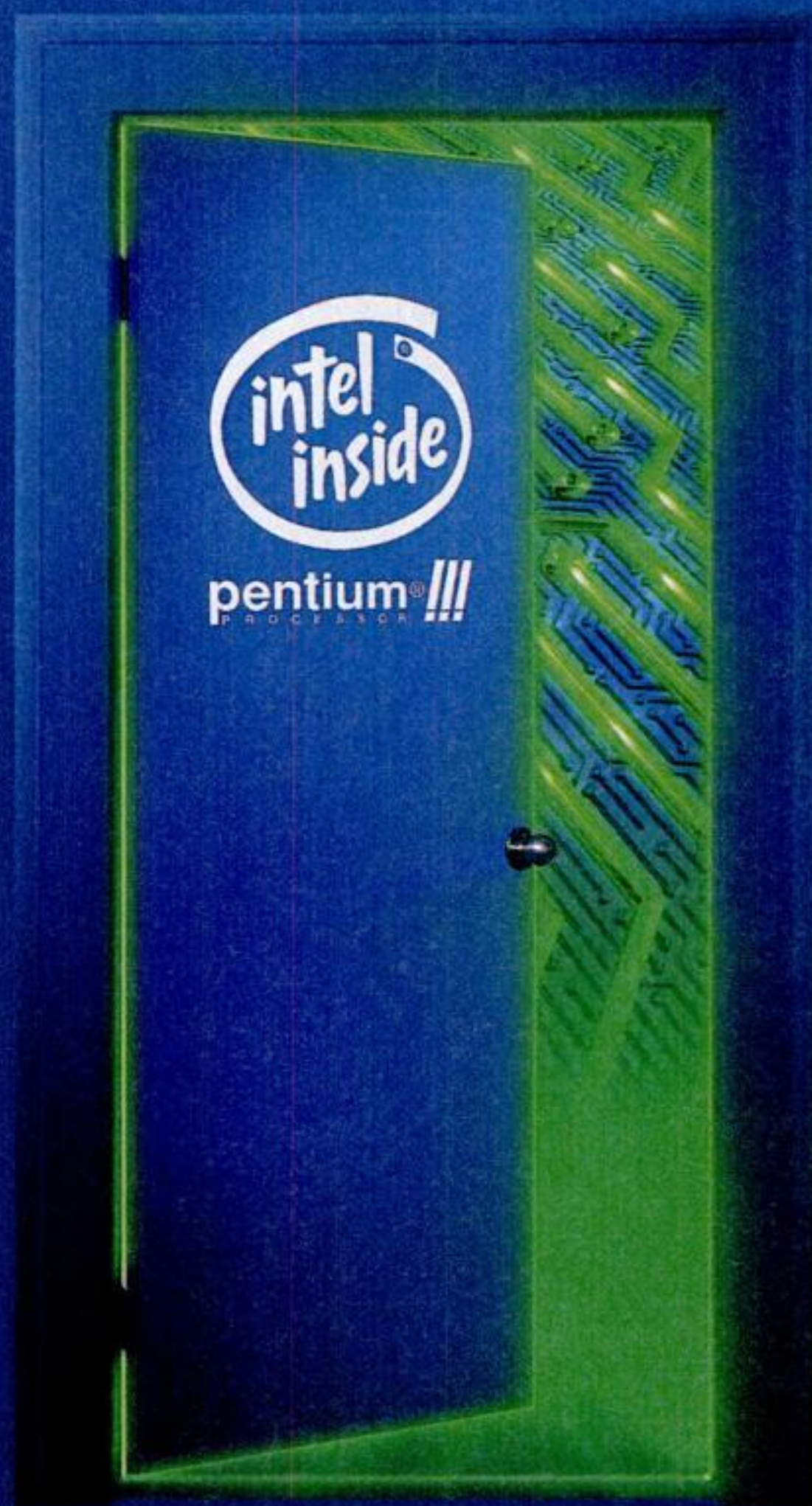


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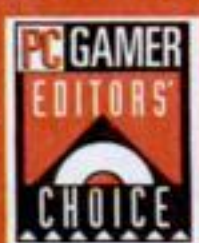
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JULY 1999

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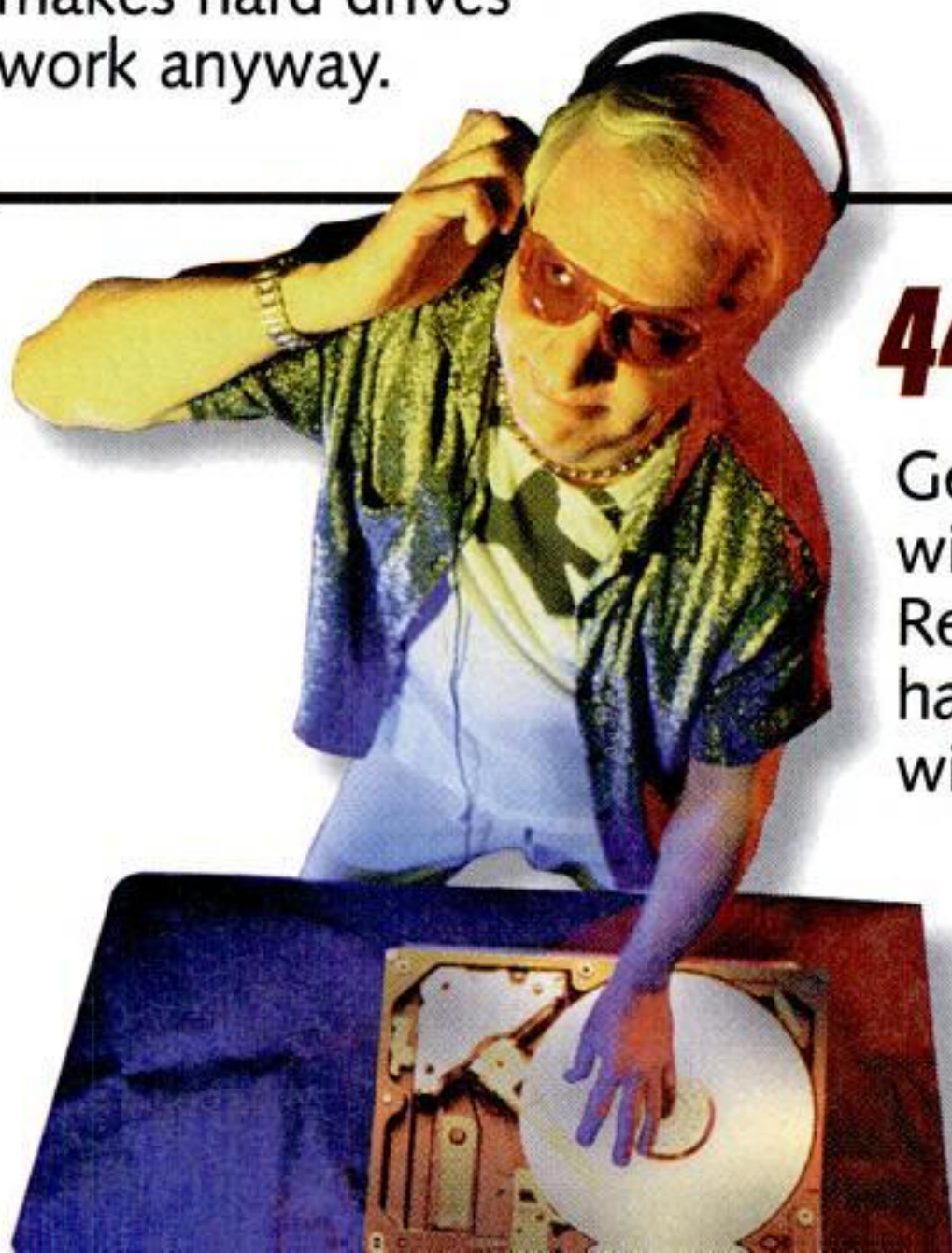
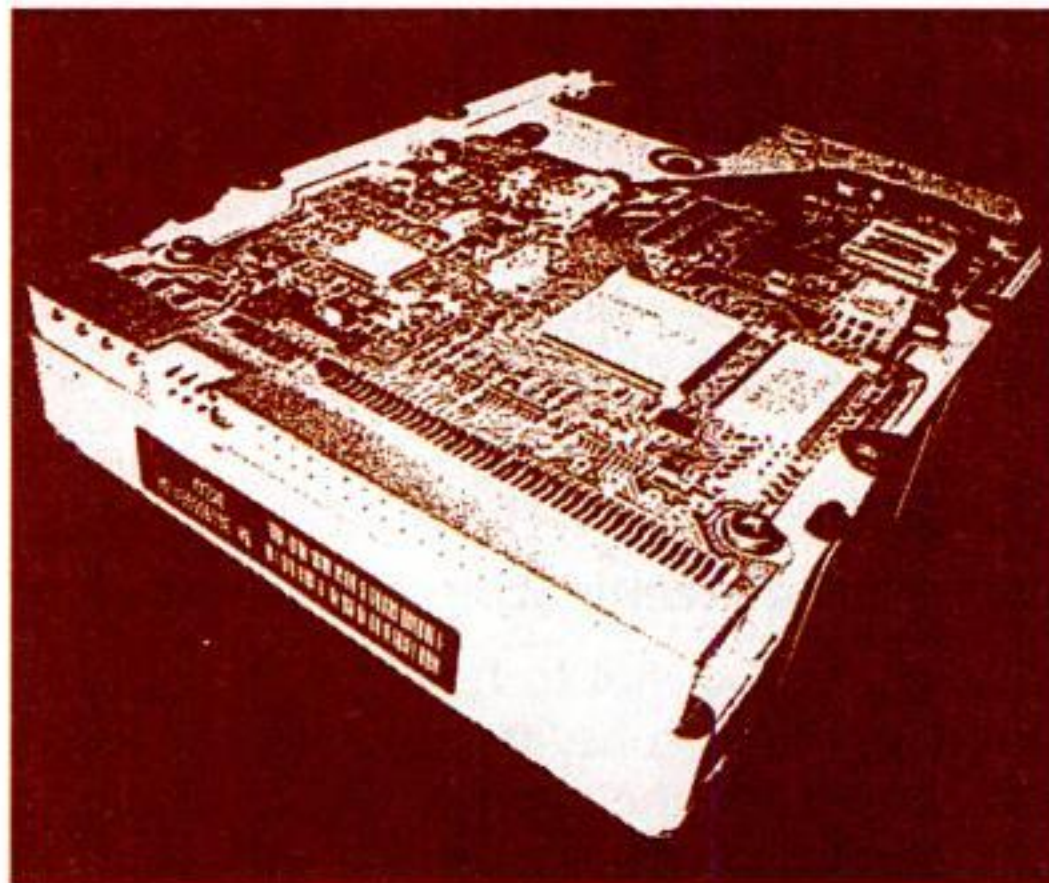
## 60 3D Card Crisis 99

Five new 3D chipsets are fighting for dominance over gamingdom. Our **Special Report** provides all the intelligence you'll need to buy the best card for the next-generation of 3D games. Includes reviews, benchmarks, and white papers on the latest technology.



## 51 Hard Drive Torture Test

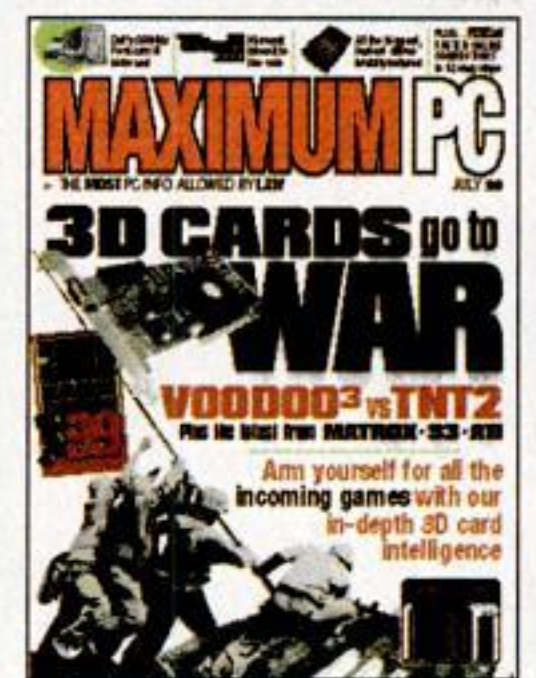
A high-speed hard drive might be just the fuel-injection your sluggish system needs. We race five mega-gig muscle disks through our grueling time trials—and explain just what makes hard drives work anyway.



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# 3D WAR



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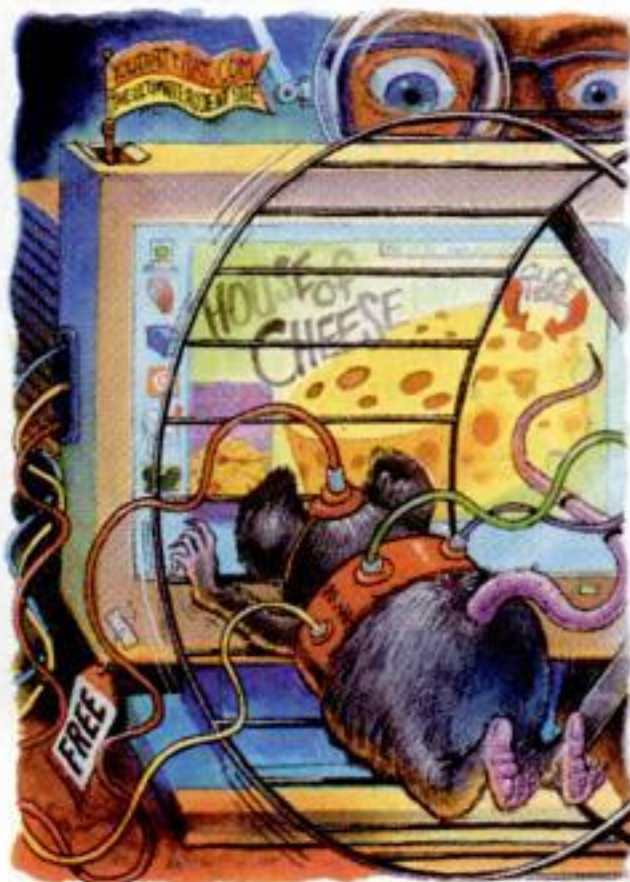


▶ **NEWS**

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News for discriminating tech-heads

▶ To **free PC** or not to free PC? That is the question facing consumers looking for the bargain offer of the moment. We look at what consumers have to give up for a chance to get something for nothing and what's feeding these crazy deals.



Free PCs, p.22

▶ **Also:** Is the DVD drive half empty or half full? We look at what's keeping the DVD format down.

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You want it. We got it.

You want fast? We pop the hoods on the fastest **550MHz P-IIIs** from **Dell** and **Quantex**. You want office productivity? We get inside Microsoft **Office 2000**, Microtek's **ScanMaker 4** flatbed, and Epson's **Stylus 900** inkjet printer. You want the creative juices flowin'? We create new worlds with MetaCreations' **Bryce 4** and Play's **Amorphium**. Plus... **UPSes** from APC and Guardian.

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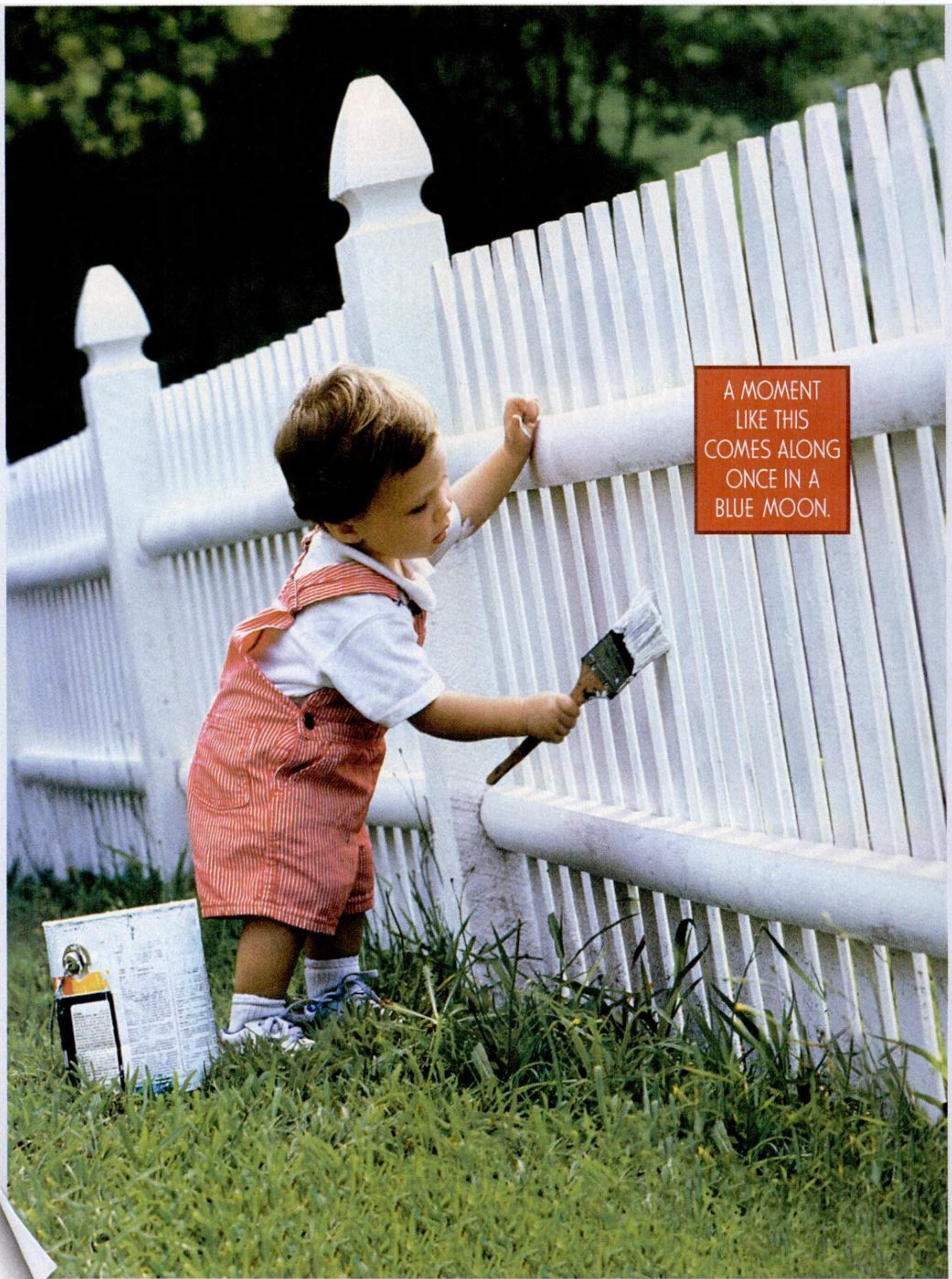
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# The Perfect Tool

Look no further than page 23 of the magazine you currently hold to find yet another "expert" who believes the sky is falling and the end of the PC is nigh.

John Latta, president of research firm 4<sup>th</sup> Wave, claims high-end PCs will shrink into the background as information appliances emerge. "As more intelligent devices come along," he says, "you won't be using the PC." The story goes on to report that Latta believes "consumers will trade power and flexibility for ease of use and convenience."

And Latta is not alone. Report after report predicts that the day of the PC is over and low-power, low-cost Internet appliances are the shape of things to come.

True and false.

Many times in the PC's storied history, pundits have prophesied the death of the platform. Back when studies first revealed that word processing was the predominant use for PCs, companies rushed to provide a stand-alone substitute. Competing on price, traditional typewriter makers came out with dedicated word processors—essentially electric typewriters with just enough technology to pass as a word processor. Today these are as hard to find as an iMac on the desk of a serious gamer.

The death knell was sounded again when Sony decided to get into gaming. Years of observing what made PC gaming tick allowed Sony to adopt key technologies and package them in a standalone system. At less than \$200, the PlayStation was an instant competitor. It provided one-button simplicity without significant sacrifices to graphics or gameplay.

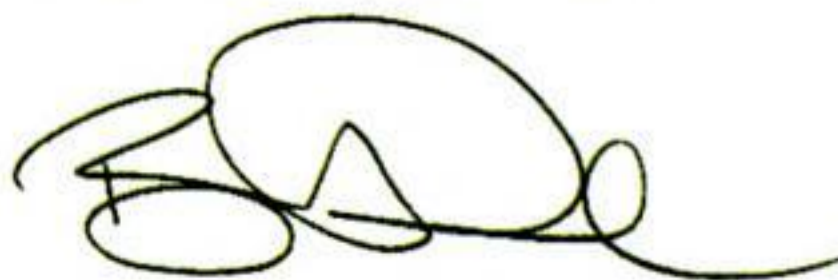
But technology marches on. Instead of taking a dirt nap, the PC evolved. Modern PC games sport innovations, such as online competition and

downloadable levels/patches/demos, plus graphics that are not possible with a fixed platform such as the PlayStation. The strength of a locked-down standard is also its curse: the inability to evolve. PlayStation2 is on the horizon, promising killer tech (DVD with MPEG-2 decoding, built-in modem, USB and IEEE 1394 ports, and a 128-bit CPU). Combined with the embedded "Graphics Synthesizer" chip, the PSX2 should spew 75 million polygons/second, blowing away even the burliest workstations.

But it'll be many, many months before PSX2 arrives on our shores and, in that time, the PC will continue its nonstop evolution. It may not beat the estimated \$300 pricetag, but it will no doubt eventually surpass the PSX2's locked-down hardware. That's just the nature of the beast.

The latest would-be PC assassin is the Internet. The most-recent surveys show accessing the web to be the number-one reason people buy a computer. But the PC and the Internet are *not* a match made in heaven. Sure, PCs *can* tap the net, and they are the best way of doing so here and now, but ultimately the PC is simply too much power for online motoring. Using a 500MHz P-III to access your e-mail is like firing up a 500-horsepower Dodge Viper to burn rubber down the driveway to your mailbox. It's silly and certainly not cost-effective.

We've already seen low-priced concept devices from big-name manufacturers that do everything most people want from an Internet appliance, but *that* doesn't represent a threat to the PC. The PC's power and lasting justification is rooted in its versatility. That's why we place such a high value on expansion in every review we perform. The PC is the ultimate tool, capable of transforming itself for whatever job our imaginations can muster. As such, it will never be obsolete until the human imagination is obsolete.



Brad "Big Daddy" Dosland  
Editor in Chief



**Technology marches on, but instead of taking a dirt nap, the PC evolved.**

## EDITORIAL

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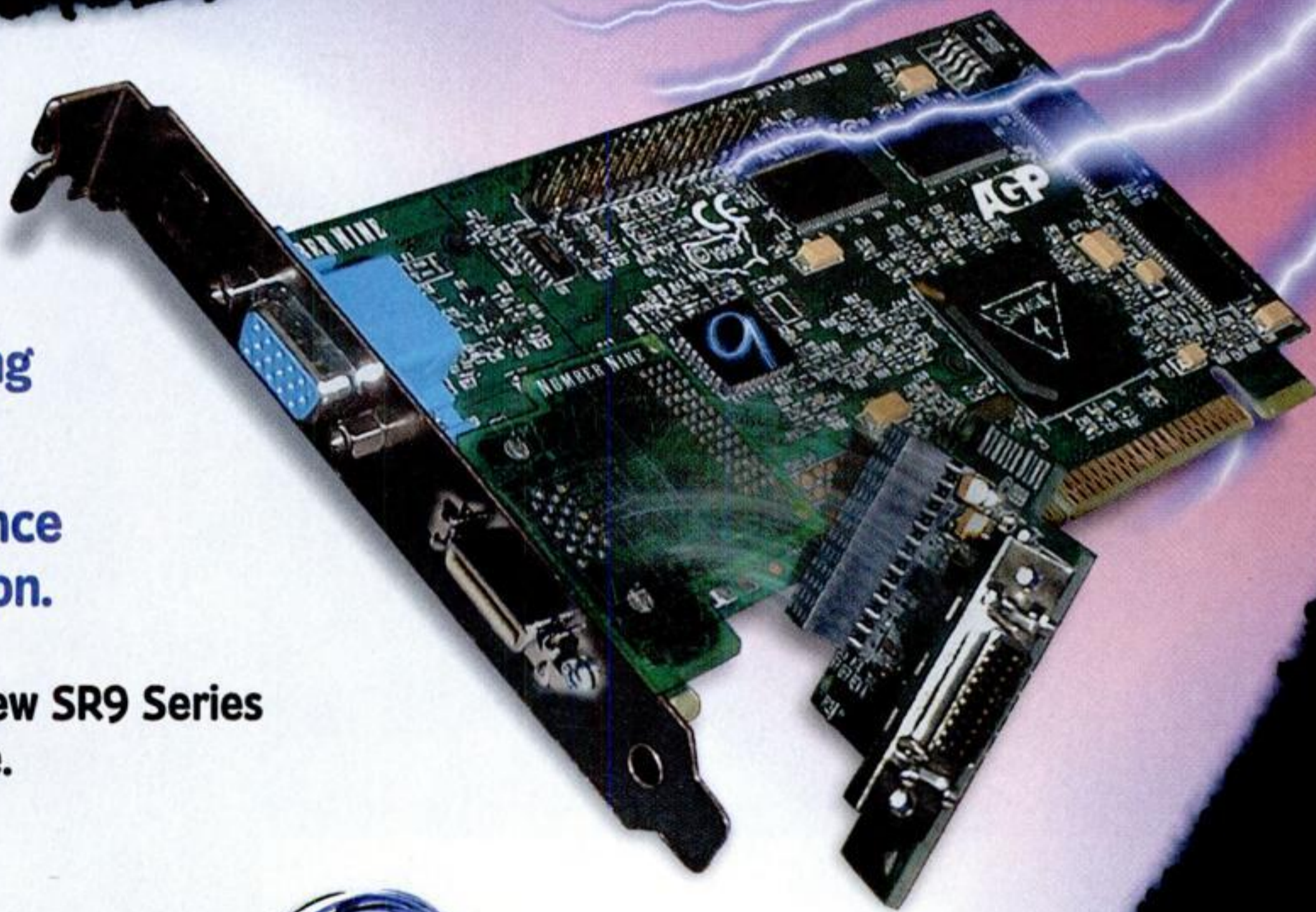
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## Letters from the Smartest Readers in the World

Here's the deal: You (being the smartest readers in the world) write letters about the magazine, the PC industry, the software you love or hate, and the hardware that runs it. We read it and share as much of it as space permits in the mag and online, and respond or comment when the letter calls for it. Get it? Now get busy and write us at [commport@maximumpc.com](mailto:commport@maximumpc.com).

### The Blame Game

In the wake of the horrific events in Littleton, CO, we are being subjected to the inevitable media attacks on video games. I'll buy that video games may have contributed in shaping those twisted kids' evil scheme, but so did TV, newspapers, books, movies, the Internet, every lonely moment, and every rotten thing that ever happened to those two boys.

There is blame enough for everybody in a tragedy such as this. For my money, I'll point the big finger at school officials and parents. My question isn't "Where were you while these kids were playing shoot-'em-up video games?" My question is "Where in the hell were you when your kids were dressing like outlaws, stock-piling real guns, and making pipe bombs?"

—Gary Johnston

There's a side of the Littleton massacre that isn't being discussed much. We need to look at the effects of "profiling" the killers. "Profiling" results in the persecution of a large group of misfits that don't deserve the fallout they are receiving. The bottom line is that there are plenty of people that fit the profile of the killers who *haven't* gone off the deep end. The exception is being used to judge the whole. Why don't we figure out why these people were different?

And in light of the recent, inevitable finger-pointing at the gaming arena...

Since the dawn of man, children have had sword fights with sticks. The youth of every generation takes part in mock violence. It is a natural development. Children playing games aren't ignorant. They can tell the difference between pushing a button on a keyboard and pulling the trigger on a real shotgun, just like you knew you were chasing your friends with a toy gun instead of a real rifle when you were young. It's pretend.

Computer gaming is no different. We aren't creating crazed psychopaths, we're creating couch potatoes with vision problems. Gamers are quite aware that they aren't really Bruce Willis.

The solution for diagnosing these real exceptions is not so simple as some would believe. Those who nail gaming as the scapegoat may just be afraid to dig and find the "real" problem. Or they just don't have the energy for something that isn't quite so simply explained.

—Keven Scott

### Clone Arranger

Is there software to create a bootable CD with the complete installation of your system? The zillionth time I had to reinstall my whole system (Win98 and WinNT in dual-boot), I realized how much time I waste reinstalling and configuring the OSes, with the apps, games, and tweaking the environment.

—Jim



"Children can tell the difference between a keyboard a real shotgun."

### Technical Editor Sean Cleveland replies:

Unfortunately, there isn't any retail package we know of that does all that you ask. With its CD burners, Plextor offers hard drive disaster-recovery software, *CD Res-Q*, which restores your system without having to install any software. For the lab machines, we use Adaptec's *Easy CD Creator* to burn a bootable CD-ROM that contains an installed copy of PowerQuest's *Drive Image 3.0* and an image file of the hard drive. You need to install *Drive Image* on your machine and then copy the installed directory and contents to the CD-ROM image in *Easy CD Creator* along with the image file you've already created. Since

you'll be doing all this in DOS, keep in mind that long filenames are truncated, so install *Drive Image* using a small directory name like "dimage". Also, long filename support isn't supported with bootable CDs, so you're forced to use the DOS 8.3 file-naming scheme. Once you've booted the CD-ROM you created, change into the *Drive Image* directory, launch using "PQDI.BAT," and restore.

### Q & A

*Maximum PC* keeps getting weirder and weirder.

1. Why the heck was the eighth *Maximum PC* CD labeled "7" instead of "8"?
2. And why do my *Maximum PC* CDs always get scratched the first time I use 'em?
3. Why is every issue of *Maximum PC* getting shorter?
4. How come all the other PC magazines are mad-deningly hard to read once I've read yours?
5. Who the heck does your layout?  
It kicks ass!
6. How come you changed Big Daddy's picture from a rock-hard psycho killer to a big teddy bear?
7. How can the Big Daddy read all the incoming mail? If he does, he's a machine!

### This month:

- ▶ The scam of advancing technology
- ▶ The biggest TNT2 card in the world
- ▶ Sex and the PC mag
- ▶ Fun with Egploror

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8. And why can't I remember any of my real beefs when it comes time to send an e-mail?

—Pimp Daddy

### Editor in Chief Brad Dosland

**replies:** By the numbers: 1. We were testing our Y2K compliance and got caught. We've since had to eliminate the number on the disc altogether because we couldn't find the bad code that generated the erroneous number. 2. Quit polishing 'em with sandpaper. 3. Maybe you're just getting taller... hmmm? (Seriously, look for bigger mags later this year.) 4. 'Cause the truth hurts, baby! 5. Our layout is conceived and executed by our crack art team: Kevin, Sherry, and Linda. They rock! 6. Big Daddy wasn't getting enough "lonely housewife" letters with the psycho pic. 7. Actually I'm only half machine. My left arm, right eye, and a significant number of internal organs are all human. 8. What? You had even more questions?

### Luddites Unite!

We consumers seem to be on the losing end of the deal whenever we buy a PC and/or upgrade. No sooner do we buy the latest and greatest than the technomoguls inform us that our new monster is about to be obsolete or incompatible with some next-generation hardware, software, or Internet technology!

To add insult to injury; the average buyer must pay the monthly note on their computer loan. If not for high-interest financing, 75% of today's computer buyers would be totally excluded from the market! And where the hell is all the cheap and affordable computer technology we're always being promised whenever we hear about some "Major New Breakthrough"? Every year the advances are more easily and cheaply produced, but the cost keeps going up.

If we can't afford to upgrade every three or six months, we sit at the keyboard with egg on our faces while the industry plays to the rich with its never-ending "new" technology for sale! It's upgrade-mania! I feel swamped in a raging river of planned obsolescence! I'm not trying to stifle progress, but it's time to send the message to the computer makers that we, the working-class consumers, deserve more respect!

It's time to let the industry know we

are aware of the scam and it has to stop! Set some standards for industry upgrades! Sell us only remarkable and useful new technology and skip all the petty, harassing little steps and jumps in-between!

—Joe Barby

### Bigger's Not Always Better

Millions of hardcore PC users will be very disappointed by the upcoming wave of Elsa TNT2 cards, as they simply will not fit on most motherboards. The proof is on page 32 of the April issue of *Maximum PC*. The picture of the Erazor III accelerator in the ad is shown next to an average-size man. The card is easily six feet long and four feet high, and the man is forced to carry it like a mattress.

—Jason Pargin



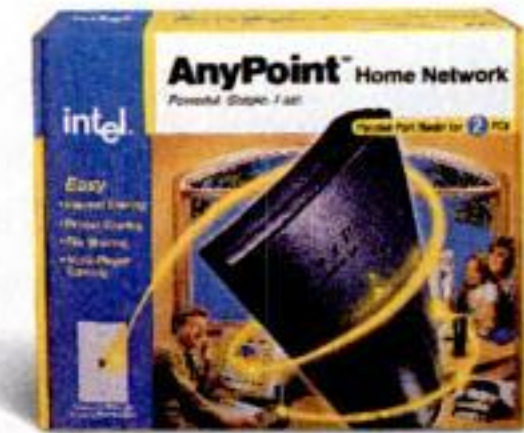
**"The Erazor III accelerator is easily six feet long and four feet high, and will not fit on most motherboards."**

### Burning at Both Ends

Candle12, the author of a recent Comm Port letter ("Miss Ogyntist," April 1999) says *Maximum PC* covers exploit women and pushes them out of the computer world.

I understand how a woman might feel that way. I might feel that way too if there were scantily clad guys draped over the latest hardware. But it's hard to cater to both men and women at the same time. The simple solution would be to ditch the images altogether. Unfortunately, that would also ditch the personality of the mag, and there are already enough dry mags out there. I like *Maximum PC* because it has an attitude and a personality. It's not just a collection of articles and reviews. How do the women on the *Maximum PC* staff feel about the images in the mag? Do they feel that they are basically putting out a magazine for guys? I hope there's a compromise. I don't want women to miss out on such a good magazine simply because of some pictures in it. On the other hand,

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I don't want the mag to change either. Doh! I can't even compromise with myself.

—Kris

As a former member of a rather conservative religious organization (which does not admit women to the ranks of clergy), my stance on feminism is irrelevant. Still, I think all of the pictures depicting women in your magazine are wonderful. I have not seen a photo in your magazine that could, in any way, be considered offensive. Candle12's comments in your April 1999 issue are "ridiculous as well as absurdly anachronistic for any era but especially for this day and age." The idea that your depictions of women are demeaning or degrading is laughable and, quite frankly, offensive.

If there is any kind of ongoing debate as to whether you should or shouldn't have photos of women or men on your covers and in your articles, it should be quashed. The human form is a beautiful thing, and for well over two thousand years we've

celebrated it through art. I wonder if Candle12 is running a campaign to destroy all the nearly naked paintings I've seen of the "son of god" being crucified. I've seen a heck of a lot more skin in religious works than in Maximum PC. A woman wearing a sleeveless dress is more offensive than



**The idea that depictions of women are demeaning is laughable and, quite frankly, offensive.**

genocide? Give me a break. (Note: The slaughter starts in Genesis, chapter 6 for you non-Bible-beaters)

You can't please everybody, but let me cast my vote: I want to see more people (women, men, it doesn't really matter) in your magazine. And if someone's offended at the thought that PCs are used by people, they can stop buying your magazine and shut up. I'm going to stick with Maximum PC, the tech mag for humans.

And I'd really like to hear Associate Art

Director Sherry Monarko's take on this whole issue. Hey, maybe have her on the cover!

—Jennifer Ryoko

**Interim Art Director Sherry Monarko replies:** As a former member of a rather conservative religious organization (which

does not admit women to the ranks of clergy), a female (which makes my stance on feminism obvious), and a member of the media (which means I have responsibility to this issue), I have to say that a true compromise on

this subject will never be found. Searching deep in the production trenches of the magazine all the way to the newsstand, there simply isn't a solution that everybody is going to accept.

Is a woman an appropriate image for a computer magazine? People, being human, want their computer experience to be as human as possible. They name it, talk to it (I swear at mine constantly), install speech software, build AIs, and use it to communicate with other people. Is this the only image for a computer magazine? Apparently not, as not all of our covers run with people on them.

Our magazine's readership is predominately male, but when have you ever read a demeaning comment about women anywhere in the articles? Can you say this of other "men's" magazines? It's all about computers, folks.

This subject has been hotly debated by our staff. Images deemed unacceptable were never seen by any of you. But day-in, day-out, the issue here isn't men vs. women, it's this: We believe we have the most informed, most honest, most hardcore PC magazine anywhere; how do we get as many of you as possible to know this?

We do so by giving the magazine a personality; sometimes it happens to have a face.

And I would gladly appear on our cover, so long as you promise to still buy the mag!

## Explorer Egg

1. Open up *Internet Explorer 5*.
2. From the menu, select Tools > Internet Options > General > Languages.
3. Press Add.
4. Type: "ie-ee" (without the quotes) and click OK.
5. Move "User Defined [ie-ee]" to the top of the list.

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6. Exit back to where you can browse in IE5 again.
7. Click on the Search icon (to pull up the side search menu).
8. Laugh at the new options.
9. Select Previous Searches.
10. In the search window, select Custom.
11. Remember to set your Languages preference back to its original setting.

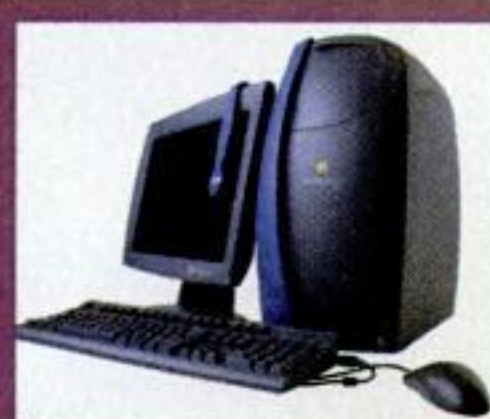
—Joel Wilbanks

## SGI Clarifies

The April 1999 issue featured one of the first reviews of the Silicon Graphics 320

Visual Workstation, receiving a "Maximum PC Verdict 7" rating.

The system reviewed was an early beta, and as such, it did not perform to the same level as systems shipping today. Moreover, the review unfairly compares the Pentium III EIDE-based 320 system against a more powerful Pentium III Xeon SCSI-based system, with a Wildcat graphics card, from Intergraph. As expected, in benchmark tests, the Intergraph system outperforms the 320, but this is based on



**"The review unfairly compares the 320 against a more powerful system from Intergraph."**

the comparison of incomparable systems, both in terms of cost and features. Additionally, the Silicon Graphics 320 systems shipping today are demonstrating performance gains of more than 20%, using new Intel Pentium III processors with optimized SIMD graphics drivers and production-quality hardware, over the beta system originally tested.

Most commonly, users upgrade their workstations to improve application performance. The April review reported that the hardware of the Silicon Graphics 320 is not upgradable. Actually, the unique Integrated Visual Computing (IVC) architecture of the system delivers significant performance improvements with processor upgrades, as well as scalable main

and graphics memory for a cost-effective upgrade path.

When configured to support the high-bandwidth needs of professional graphics and video, the Silicon Graphics 320 performs admirably. The minimum configuration required to achieve uncompressed video capture and playback on a 320 is a set of two 10,000rpm SCSI striped drives. The system reviewed was not equipped with the appropriate peripherals to support this capability.

Support for IEEE 1394 will not be available from Microsoft until Windows 2000, rendering Silicon Graphics 320's IEEE 1394 port inactive. Rather than wait for Microsoft to release support, SGI is working toward offering this to customers later in 1999.

The Silicon Graphics 320 features an advanced memory design that utilizes a 288-bit (32-bit ECC) memory bus that delivers up to 3.2GB per second of memory bandwidth. These fast memory modules leverage standard DIMM components; however, they are packaged uniquely to satisfy this wide data path. Memory for the 320 is priced competitively with other branded workstation manufacturers and is also available through third-party memory suppliers. This high-performance memory design "...widens the number of lanes on the data highway, allowing more simultaneous operations," and breaks through bottlenecks often found in traditional PC architectures.

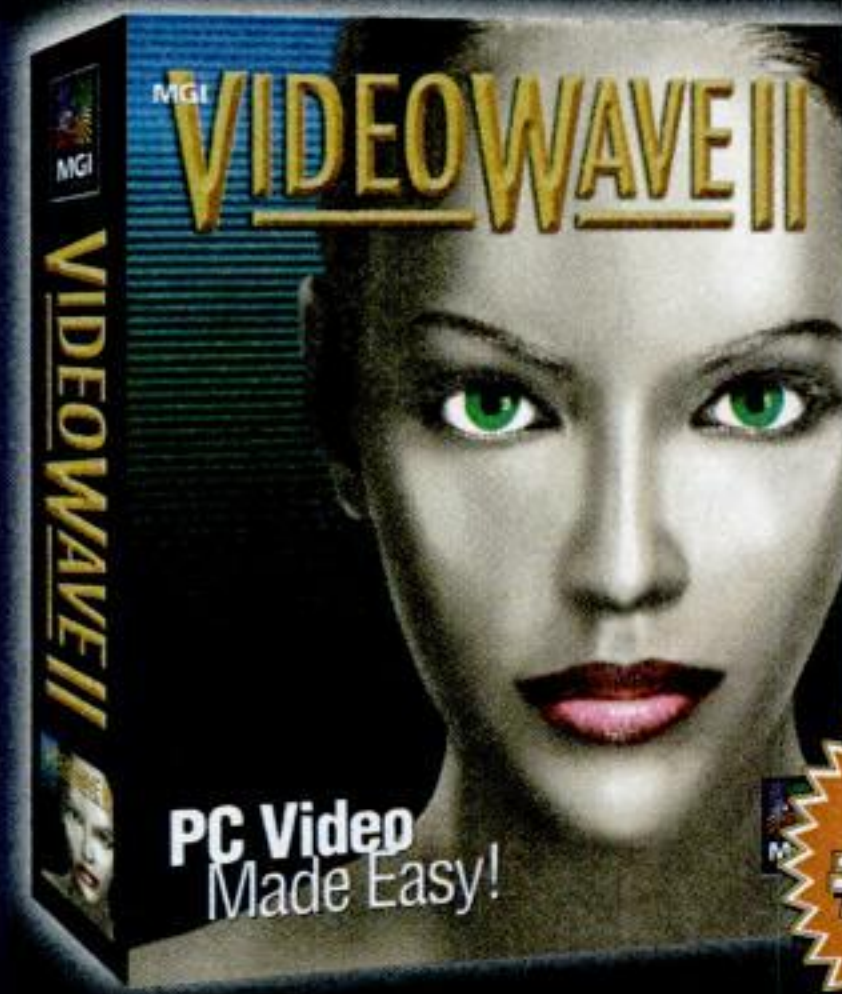
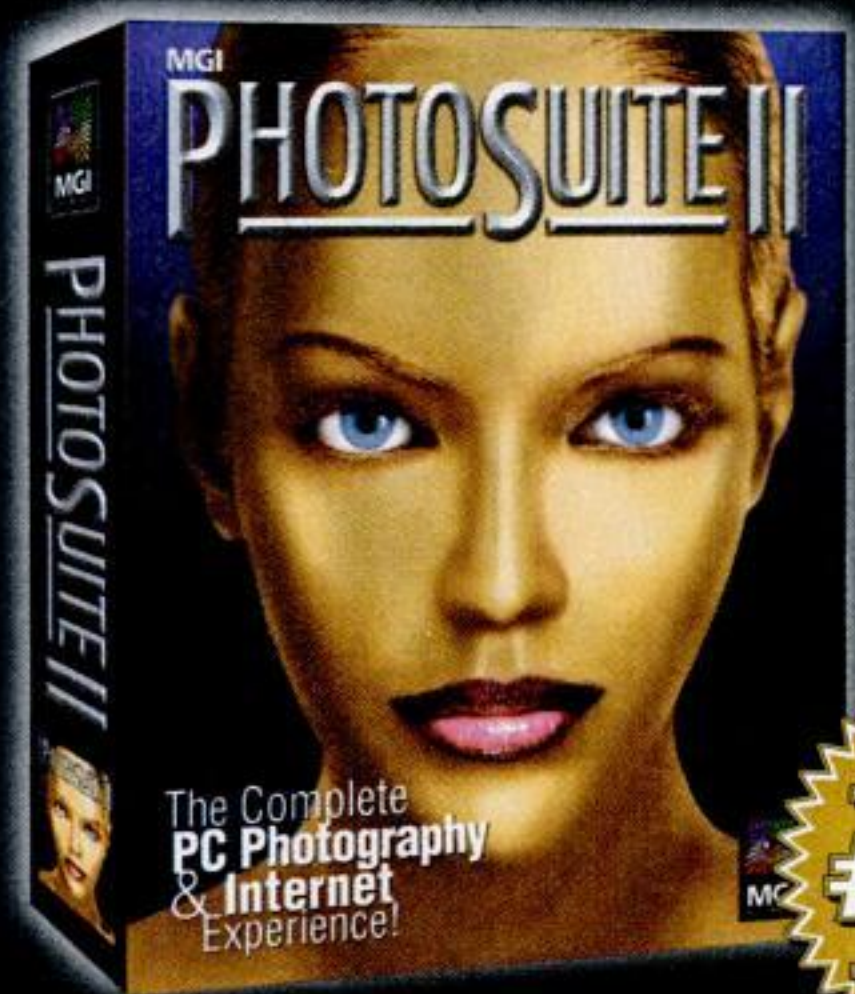
**Pricing for the configuration**  
*Maximum PC* evaluated is now only \$6,393 U.S. list.

—Kevin Connors  
Product Manager  
Silicon Graphics 320

## Cut, Copy, Paste

► In our May issue, the illustration in the "Big Audio" feature on page 57 depicting the discrete sound channels enabled by the EAX and A3D 3D positional sound APIs, we used incorrect color coding. Correct color coding would have depicted two independent, discrete rear channels.

► In our June Interrogation with Diamond Multimedia, we misspelled the subject's name. His actual name is Scott Vouri. We regret the error. ❁



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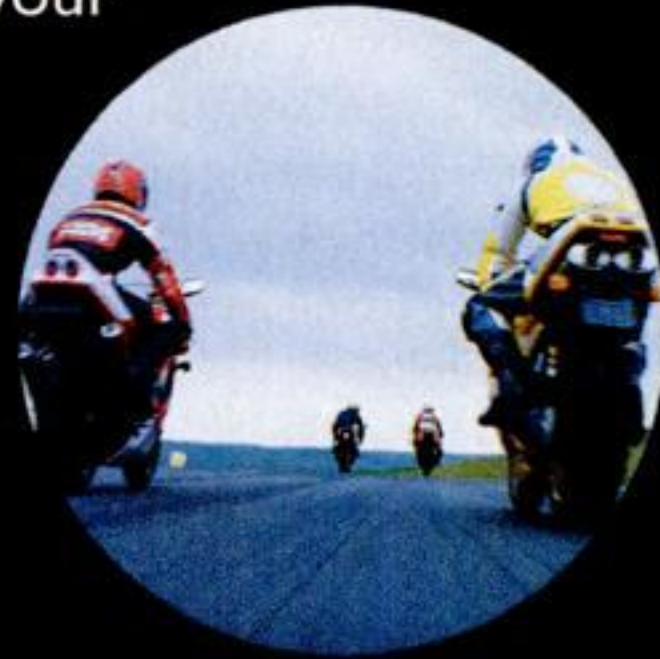
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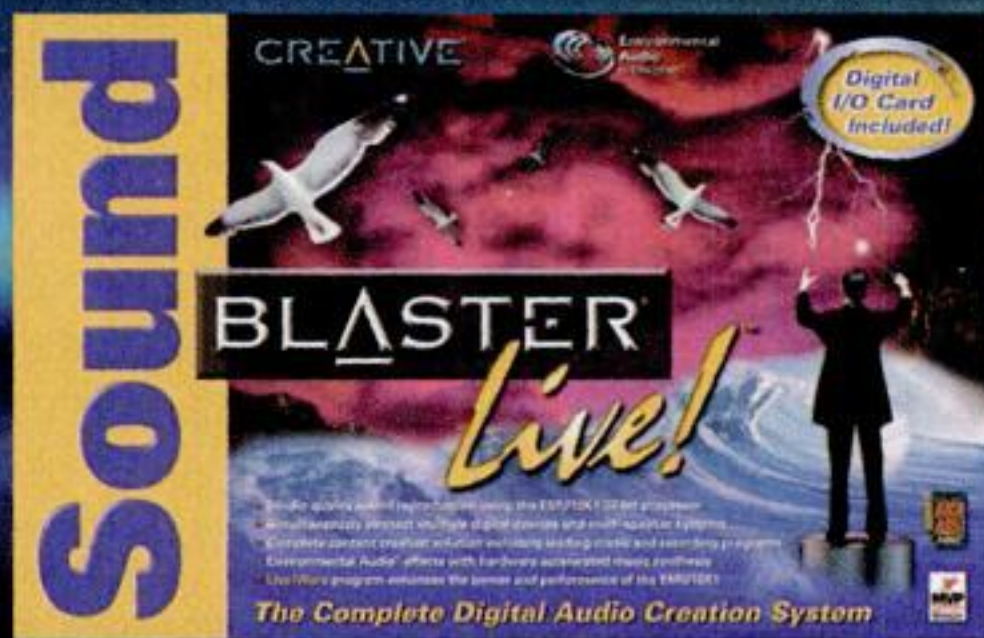


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# Not-So-Free PCs

**Deals feature catches galore, but some may benefit**

It's an offer you can't resist. Sign up with an ISP, use an online auction, or agree to view ads on your desktop full-time and you'll get a "free" PC. Although the deals sound sweet, most have the kind of catches you'd expect from something-for-nothing pitches.

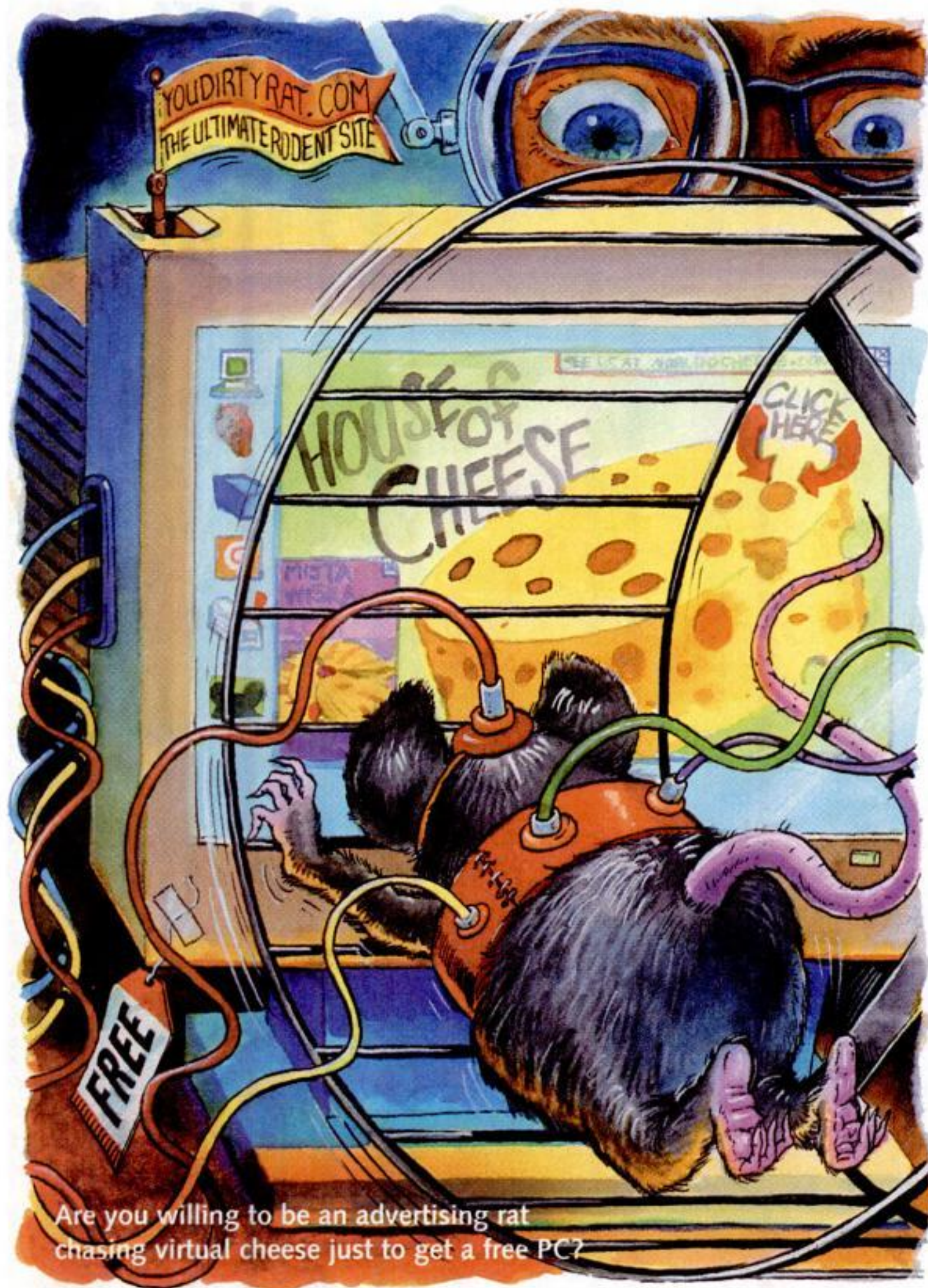
Witness Free-PC.com. To get the "free" PC, you must fill out an extensive survey including birth dates for you and everyone in your house, your interests, income level, what publications you read, and what kind of car you drive. Even then, there's no guarantee you'll get your PC for free. The company plans to eventually give away one million PCs, but in the here and now, only 10,000 customers will get free PCs along with Internet service and mail. If you're lucky enough to score a box, you must agree to keep ads on your desktop whether cruising the Internet or not.

Steve Chadima, Free-PC.com marketing exec, admits attitudes toward computer-based ads are pretty negative, but because Free-PC.com will use the survey information to develop targeted ads, users probably won't mind them. And Free-PC.com believes advertisers will pay big bucks to test ads on these select users before going to the general Internet public.

"These are all big ifs," Chadima says, "but our goal is to turn the computer advertising experience into a real resource instead of an annoyance."

Enchilada.com's offer is more straightforward. Heaping on a printer and office software in its "Grande Enchilada" version, the ISP will give you a machine and even upgrade it every two years for about \$250. Customers must pay \$30 a month for the Grande deal or \$20 for the basic version.

What's the catch? A lengthy contract. Those who bite on Enchilada.com's



deal must remain signed up for 48 months and pay a \$99 shipping and handling fee. That's a total of up to \$1,491. Or you can opt to pay an up-front fee of \$799 (plus shipping and handling) and get four years of Internet access thrown in for "free." For 900 ducats, you get an AMD K6-2 system with 32MB of RAM and a 15-inch monitor. It's

not much of a catch, even according to Enchilada.com's president, Ike Sutton, who doesn't look at the situation as an ISP offering to give away PCs, but rather, people paying monthly and getting Internet access for free. In fact, Sutton believes the future is in people buying PCs to access the Internet for free, similar to TV broadcast networks.

ILLUSTRATION BY SCOTT PECK

## SPIN CYCLE

This month's top stories broken down ►

HEADLINE	NEWS	DETAILS	QUOTE	OUR TAKE
<b>The K7 is a Cool Gig</b>	AMD showed off one of its newest K7 processors recently, super-cooled to run at 1GHz.	Cold enough to frost a brew, KryoTech's "Super-G" was really a technology demonstration designed to tease.	"The Super-G is derived from two years of technical cooperation between ourselves and AMD," said Al Quick, KryoTech's chairman and CEO.	Neither AMD nor KryoTech announced pricing or availability, but hey... at least we know the K7 can be overclocked!
<b>Chernobyl Virus Wreaks Havoc</b>	Like a selective natural disaster the Chernobyl, or CIH virus, laid waste to hard drives and data in some countries and left others mostly intact.	Chen Ing-hau, a computer engineering student in Taiwan, took responsibility for the disease, which he had created while in school. The virus is named after him.	"In my dorm alone, I know of at least four PCs that were affected," said Ken Alverson, a student at Case Western Reserve University.	Although the virus hit more than 240,000 PCs in South Korea alone, infections in the U.S. were remarkably low thanks to raised awareness by a femme fatale, Melissa.

And there are absolutely no other catches. Well, maybe just one more. When logging in, Enchilada users must view the Enchilada.com home page to fulfill their contract. The company is banking on ad revenue from the Enchilada "portal" and a cut of the sales made through the portal.

"I want to give AOL a run for its money," Sutton crows.

Then there's the power question. Most of the free-PC deals offer bottom-feeder machines. As everyone knows, climbing aboard a computer that starts the race at the back of the pack means you're apt to be left in the dust by the hottest 3D game or digital-video-editing software, OS, or quantum leap in browsers. Try running *Internet Explorer 5* on a 486 and see what we mean.

This is why PC makers such as Dell aren't quaking in their boots. Although newbies might think that paying \$2,000 for a PC is insane when you can get one for "free," Dell officials say they know the pattern. "Our customers are continuing to buy the high-end systems," says Dell spokesperson Bill Robins. "We are almost completely Pentium III [in consumer sales] now and the average memory is 128MB. This fits

**"Our goal is to turn the computer advertising experience into a real resource instead of an annoyance."**

—Steve Chadima, Free-PC.com

in with the same pattern: buy as much technology as possible for the dollar. Ultimately, technology makes you hungry for more technology. The more you want to do with it, the more you need."

Free PCs aren't threatening to wipe out high-end PCs, as some predict. Even Enchilada.com's Sutton and Free-PC.com's Chadima say there will still be a great demand for desktop muscle machines. And the free-PC model is in no way a threat to them.

That isn't the view from John Latta, president of research firm 4th Wave. He agrees that high-end PCs will continue, but they'll shrink into the background as useful information appliances come along. And the free-PC model is the pathfinder for future information appliances.

"This idea that [PC sales] can continue to grow at 20% a year

is fallacious. It's just not going to continue. PCs will have a place, but the fact is as other more intelligent devices come along, you won't be using the PC."

Latta believes consumers will trade the power and flexibility for ease of use and convenience if the new devices can make our lives easier without the support and blue-screen nightmares. That's something that powerful PCs and free PCs just don't do well now. Others agree. In May, National Semiconductor abruptly announced it would dump its Cyrix M-II processor, which spawned the low-cost PC that made free PCs possible, to concentrate on information appliances. Why?

"The idea with the information appliance is to strip out the bloatware and let people do what they want," says National's Mike Brozda, and give people an easy-to-use device.

But an easy-to-use embedded device doesn't generate expensive phone support, and this will be a hurdle for the free PC

models, says Christine Arrington, an analyst with research firm International Data Corp.

It's still questionable whether free-PC companies can offer the imperfect Windows PC and Internet service for just \$19 a month when big PC makers are finding themselves being eaten alive by support costs. Industry averages peg the cost of fielding a single call at \$30. Try taking that out of the cost of a "free" PC and you'll discover a major flaw in this plan.

"If the free PC model is done where the user is comfortable with ads or subsidies, then it could take off," says Arrington. "But if someone gets a free PC and it takes ten hours to set it up just to look at ads, that's a real barrier to entry." ❁

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### The Fifth Wave of Computing

A recent 4th Wave report indicates we're now hitting the "fifth era" of computing built around information appliances, of which "free PCs" are the forerunners.

ERA	MAINFRAME	MINICOMPUTER	WORKSTATION	PC	INFORMATION APPLIANCE
Circa	1960-1985	1965-1985	1980-2000	1980-2005	2000+
Physical attributes	Glass rooms	Room	Office	Desktop	Hand or Smaller
Price	\$1M to \$10M	\$10,000 to \$100,000+	\$20,000 to \$60,000+	\$500 to \$4,000	<\$200
Key forces	Calculations/ Time sharing	External interfaces/ Independent programming	Personal MIPS with dedicated applications	Personal computing then Moore's Law	Free MIPS / Pervasive Networking

to the pertinent details.

HEADLINE	NEWS	DETAILS	QUOTE	OUR TAKE
<b>DOS is Not Dead! Really!</b>	Backing off a decade-long push, Windows 2000 Consumer will continue to support DOS and Windows 9X code.	However, two other versions of Windows 2000 will move away from Windows 9X code and use the NT kernel instead.	"We've got to get the consumer computing experience to the place where everything just works," said Microsoft president Steve Ballmer.	No guff! With the upcoming release of Windows 98 Second Edition, is anyone actually waiting with bated breath for Windows 2000?
<b>NT Beats Linux in Controversial Test</b>	An independent test lab has the Linux community up in arms by saying Windows NT 4.0 Server is faster than Linux.	Mindcraft found NT faster during web- and file-server tests using a quad-Xeon Dell server. Accused of bias, Mindcraft retested. A third test will take place in neutral territory.	"What did we do wrong? I think what we did wrong was say the emperor has no clothes," said Bruce Weiner, president of Mindcraft.	Microsoft sponsored the test. Mindcraft has published similar fights, with NT beating Novell NetWare and Sun Solaris. Benchmarks shouldn't lie, but it makes you wonder.

# DVD-ROM: The Unsolved Mystery

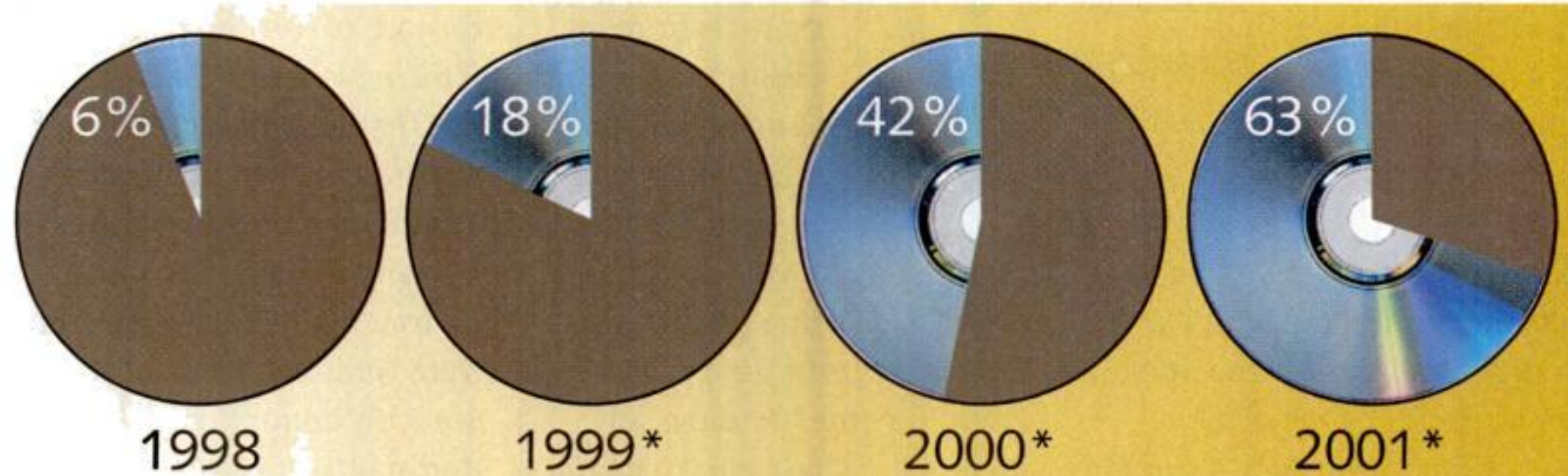
**We've finally got the hardware, but where's the software?**

You splurged on a DVD-ROM drive two years ago to feed your fantasies of a single disc packed with gigabytes of data, high-quality video, and the ability to skip that annoying "insert disk three" message. Fast forward to 1999: you're still sitting there fantasizing.

Well, you're not alone, buddy. Optimistic editors here made the same mistake, proclaiming DVD-ROM "hot" in 1997. Early adopters who bought DVD drives can still do nothing more than play movies. Aside from a few reference programs—such as Microsoft's *Encarta*—you'd be hard-pressed to find more than a handful of titles on store shelves. What's the hold-up? There simply aren't enough early adopters.

"We've had virtually no requests for DVD titles, and CDs have sufficient storage for 95% of the titles we produce," says Rick Overman, Dynamix's senior software engineer. "Even DVD video isn't as appealing as it once was."

The other prediction pundits made years ago of full-frame video changing gaming was, of course, wrong



Total percentage of systems shipping with DVD installed. \*Predicted numbers.

as well. Improvements with polygon graphics have made video obsolete as a story-telling device. Today, 3D is hot and full-motion video is not.

But don't take the lack of DVD titles as a sign the hardware has failed. Although CD-ROM drive sales still dominate, DVD-ROM

**"We've had virtually no requests for DVD titles, and CDs have sufficient storage for 95% of the titles we produce."**

—Rick Overman, Dynamix

is poised to become *the* medium, according to research firm International Data Corp.

"In 1998, DVD-ROM accounted for only 6% of the market, but that number is expected to

climb up to 63% by 2001," says IDC's Wolfgang Schlichting. The lack of content has hurt the

adoption rate, he concedes, but he likens it more to the classic chicken-and-egg scenario.

Still, that hasn't stopped PC makers from offering DVD drives in droves. "DVD is a hot button for our customers," says Mike Ritter, Gateway's director of product marketing. "They realize it's the future of optical storage, and it provides protection against future obsolescence."

The advances made in cheaper software decoding, used to watch DVD movies, have also contributed to sales. "Across our product lines we're seeing DVD account for between 20% and 55% on the desktop, and 25% on notebooks," says Casey Gotcher, Micron's review manager. "To include it is practically a no-brainer, especially now that the cost between CD-ROM and DVD-ROM drives is almost at a wash."

IDC's Schlichting agrees and says the transition in the mobile space will be even quicker, since most travelers can get comfy watching movies mid-air. And with the recent introduction of affordable DVD-RAM drives, it's conceivable that business presentations filled with FMV and six-channel audio tracks could push the format forward.

Still, DVD-ROM won't change gaming on PCs in the near future. Until developers have the budgets and time to use that extra space, the linear nature of video isn't enough to convince companies to use the format.

"DVD-ROM is ahead of where we need to be right now," says David Perry, president of Shiny Entertainment. "Games need to be interactive—not something you eat popcorn to." ■

Source: IDC.

## SPIN CYCLE



◀ 23

HEADLINE	NEWS	DETAILS	QUOTE	OUR TAKE
<b>Pirated Movies a Hit</b>	Pirated movies streamed over a LAN or distributed on CD-R are the latest technology trend. DV cameras and high-compression video formats make distribution easier.	Within days of opening, <i>The Matrix</i> and <i>Phantom Menace</i> copies were being distributed around the world. Copies are made from prints distributed to campuses by studios.	"I get to sit here in the comfort of my own room and watch a new movie without going to the theater and spending \$7.50," said an anonymous college student.	Hollywood needs to move quickly or be fossilized like the music industry, which is still trying to put the MP3 genie back in the bottle.
<b>Whitney Unveiled</b>	Intel has released a new chipset aimed at the casual computer user.	Previously code-named "Whitney," the chipset integrates AGP video, bans the ISA bus, and sports an all-new architecture that cuts cost and boosts overall performance.	"These products demonstrate how Intel is using its manufacturing and system-design expertise to optimize the cost and capabilities of value PCs," said Intel's Paul Otellini.	Where's the beef? No 4x AGP and no full-on Ultra DMA/66 support makes this strictly low-end.



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Who will be left standing?

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Win List **PRESARIO 5600 SERIES**

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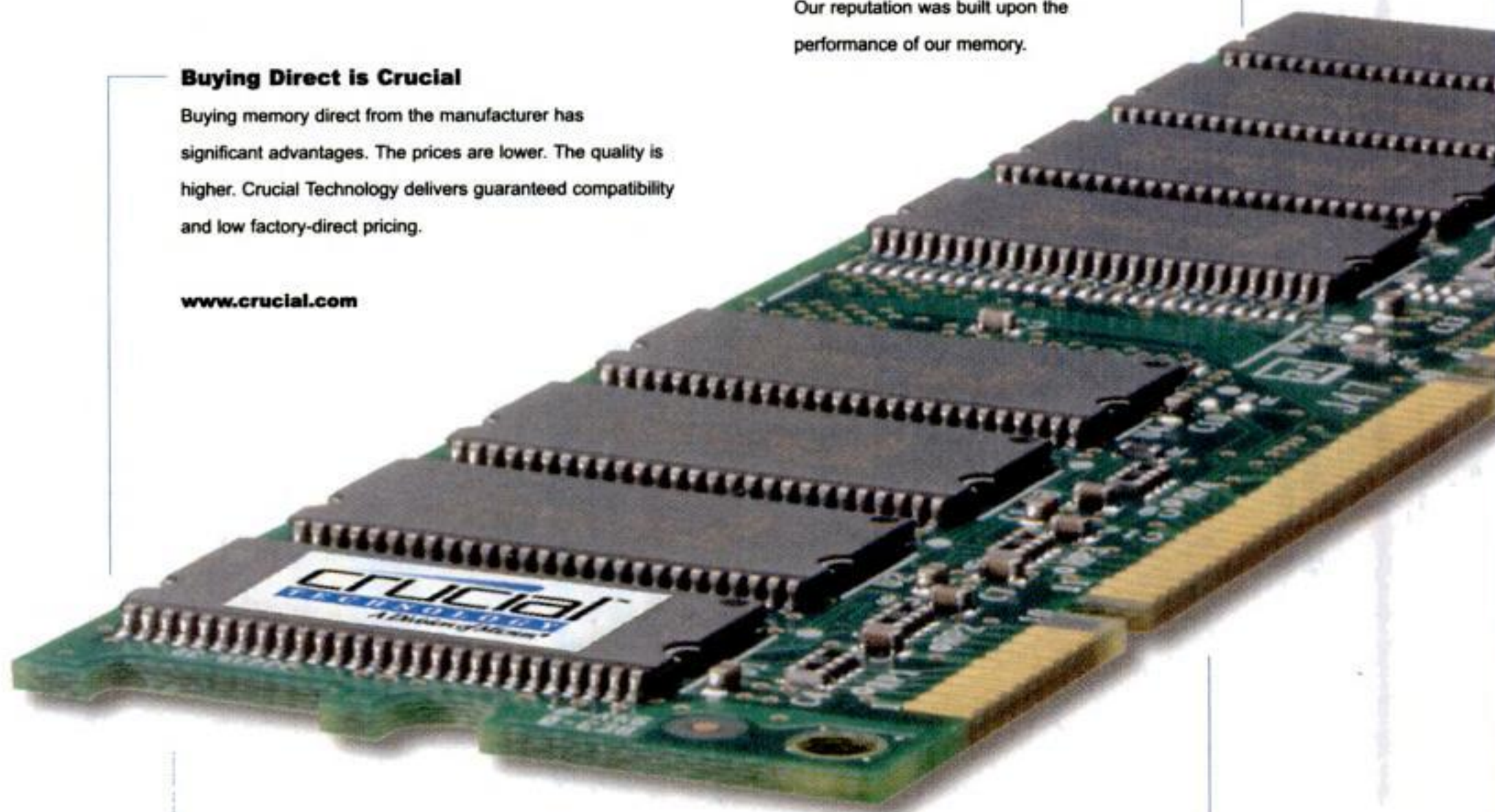
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## ► Maximum PC takes a bite out of bad service and gear

# WATCH DOG



### This month:

- **SecureWin vanishes without a trace**
- **Philips gets sued**
- **Who guards the GuardDog?**
- **USPS cracks down**

## SUE YOUR CD-R MAKER

If your **PHILIPS** CDD2000 or CDD2600 takes a crap after writing only 500MB of data, jump onto the bandwagon of users who have filed a class-action suit against Philips.

The class-action suit, filed in Camden County Superior Court in New Jersey, alleges that "Philips has committed breaches of warranty and made misrepresentations in the marketing and sale of its Compact Disc Recorders, model numbers CDD2000 and CDD2600. Moreover, the 2000 Series Recorders are not 'reliable' or 'trouble-free' since they fail to consistently record and store data during the warranty period."

"It's our allegation that there's an inherent design defect," Jonathan Schub, lead attorney in the suit, told The Dog. "When it gets to the outer tracks of the drive it becomes very unstable. Once it returns an error, you've burned a coaster."

Members in a class-action suit don't have to sign up. Anyone who purchased the drive in a certain time period is included, he says. Even if you don't have a Philips CD-R, you may have a defective drive, Schub says. Philips supplied the 2000 series to other manufacturers who resold the drives under their own brands. Two of those companies are Hewlett-Packard and Memorex.

Information on the suit against Philips is located at [www.shortbusters.com](http://www.shortbusters.com). Readers who feel they've been wronged can sign up to receive updates on the suit and read user comments.

## DOG BITES DOG

**DEAR DOG** I purchased Cybermedia's **GUARDDOG** in June 1998. It was described as an "anti-virus" program that also scanned for dangerous ActiveX components and Java applets. I was able to update the virus definitions in July,

but after that I could no longer obtain updates. I know that virus programs should be updated monthly.

I have repeatedly tried to contact Cybermedia, but didn't hear anything until finally someone with Network Associates, the company that bought Cybermedia, sent this message to me: "We do not post updates for the *GuardDog* anti-virus program. There are updates for *GuardDog*, but you cannot update your virus definitions anymore. We recommend that you purchase a full anti-virus program. Thank you."

*Excuse me!* I bought a full anti-virus program! What's going on here?

—John Ervin

**THE DOG** asked Network Associates managers about the apparent lack of virus updates for GuardDog. The response? Ervin, and another reader who complained about lack of updates, was caught in the transition between Cybermedia and Network Associates, which purchased the company in September 1998.

The technician's information was incorrect. GuardDog was using an anti-virus engine from NAI's competitor, Trend Micro. "Since we feel that our product VirusScan provides far superior protection, we removed the Trend product and replaced it with VirusScan. This update was available in GuardDog 2.01, which was posted to our Oil Change database in November," NAI manager Lisa Citron told the Dog. "The one caveat here is that customers did experience intermittent difficulties reaching the Oil Change database, so there is a very good chance that this customer has never received the transition to VirusScan. And we did stop posting updates to the Trend Micro AV product."

The AV product in GuardDog with the VirusScan engine is fully operational. Citron offered to send the latest GuardDog update by CD (2.05). Citron noted that others who are having similar problems updating virus definitions should use the Oil Change utility to update their AV engine before trying to update the virus definitions.

## INSECUREWIN SOFTWARE

**DEAR DOG** I ordered *SecureWin Desktop 2.0* from **SECUREWIN TECHNOLOGIES** in the summer of 1998

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Philips CDD2600



**"Since we feel that our product provides far superior protection, we replaced Guard Dog with VirusScan."**

and have gone through several phone calls and e-mails. They called to tell me that it would not be ready by the August ship date. Following more calls, it was clear that I would not be getting version 2.0 any time soon, so I accepted the previous version for a reduced rate (\$29.99 rather than \$49.99), and I would receive a free upgrade to version 2.0. In October, my credit card was charged for \$29.99, but I never received the product. I've tried to contact the company, but have received no response.

Have you heard anything on SecureWin that I should've known last summer?

—Jason Hackney

PC security people have always been a little paranoid and hard to reach. SecureWin may have taken it too far. **THE DOG** ran the usual gamut of checks with the local Better Business Bureau and left calls and e-mail with SecureWin. Neither turned up much. There were no complaints on file with the BBB, and company officials refused to return multiple messages left with their answering service. With ears perked up, the Dog started digging a bit deeper. What about SecureWin's 3,700 square foot office in the heart of Silicon Valley? Empty. "They up and left overnight without paying rent," one cat told the Dog. "All they left was an empty office and some garbage."

California state records show SecureWin as a corporation registered out of Washington D.C. The Dog followed the trail inside the beltway and found nothing there. Tenants of the building where SecureWin was located and the front-desk security guard told the Dog they never heard of the company. Makes sense. A former employee of SecureWin told the Dog the company pulled up stakes and moved west last year. The Dog had difficulty obtaining the status of the company. No bankruptcy filings were on record.

Who is behind SecureWin? The Dog's research indicates Kavan Shaban signed the lease for SecureWin and was president and lead developer for the company.

SecureWin's San Jose landlord told the Dog SecureWin had its mail forwarded to a post-office box and that he had since lost track of them but was looking for them to give them a bill for several months rent.

The Dog was able to track down a Kavan Shaban as the admin contact for ISP qBolt Corp. What's the relationship? The Dog doesn't know, as Shaban refused to return numerous phone calls.

What can the Dog do but put SecureWin in the **DOG HOUSE**. Consider the company and its products off-limits and expect the Dog to continue the investigation. Woof. 🐾

Got a bone to pick with a vendor? Get spiked by a fly-by-night operation? Sic the dog on them by writing [watchdog@maximumpc.com](mailto:watchdog@maximumpc.com). The dog promises to get to as many as possible, but only has four paws to work with.

## BEWARE OF DOG ▶

### CANINE CAVEATS

## CALCOMP GOES DOWN FOR COUNT

Long-time digitizer and plotter manufacturer **CALCOMP TECHNOLOGY INC.** has wound down its operations and begun spinning off products after Lockheed Martin Corp. decided to cut off credit. Lockheed Martin held a majority of the shares in the Anaheim company. The company had considered filing for bankruptcy protection but instead opted for a controlled shutdown.



## NET E-FRAUD SKYROCKETS

Think you can't get burned online? Consumer complaints about getting burned at digital speeds climbed 600% last year, according to the National Consumers League, which operates the Internet Fraud Watch. The top hang out for con artists are online auctions. Almost 70% of the complaints fielded came from consumers who lost money to auction scams. The rest of the top ten included: general merchandise sales, computer equipment/software, Internet services, work-at-home business opportunities/franchises, multilevel marketing pyramids, credit card offers, advance fee loans, and employment offers. What's your best protection? Make sure you insulate yourself from swindling by using a reliable credit card company for e-purchases. And of course, do not, **do not** buy with your debit card unless your bank promises to insulate you from scams.

## MAIL BOXES UNCETERA



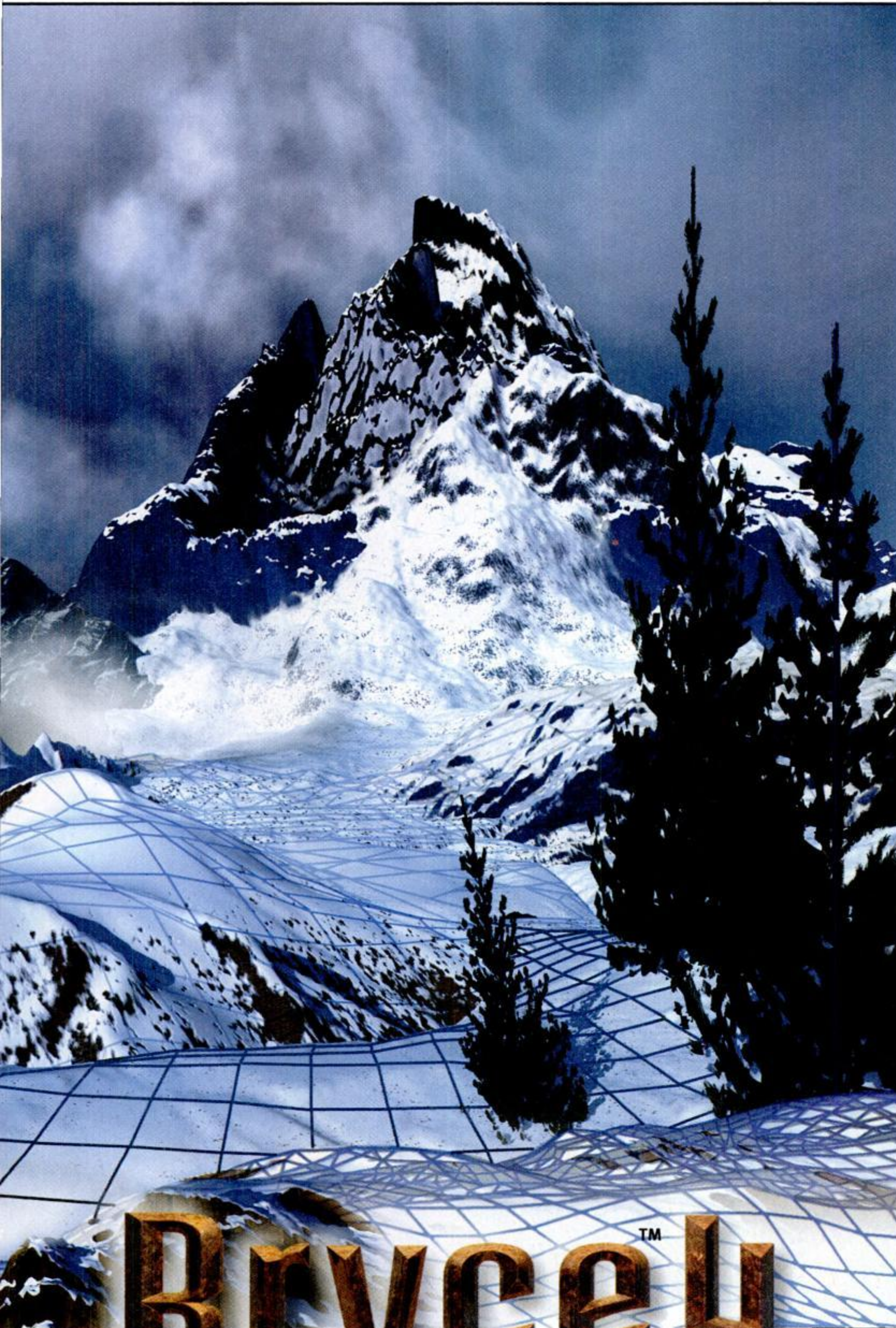
The **U.S. POSTAL SERVICE** has taken steps to stop scammers from hiding behind post office boxes. Beginning in April, people or companies must use the address designation "PMB" or Private Mail Box in order to receive mail at U.S.P.S. post office boxes or even through private companies such as Mail Boxes Etc. The Postal Service made the change because too many scam artists were committing fraud by directing mail to suites or apartments when all they really had was a P.O. box. People have six months to comply with the new rule before the post office stops delivering mail to P.O. boxes that aren't labeled PMB. Adding more bite to the rules, the Postal Service will also require private mail box companies to submit lists every quarter of new, current, and closed boxes from the previous 12 months. Mail box companies previously submitted a list only every year. Give the Postal Service a doggy snack. It's one more tool that'll help beat back scamsters. Woof. 🐾



**What about SecureWin's 3,700 square foot office in the heart of Silicon Valley? Empty.**



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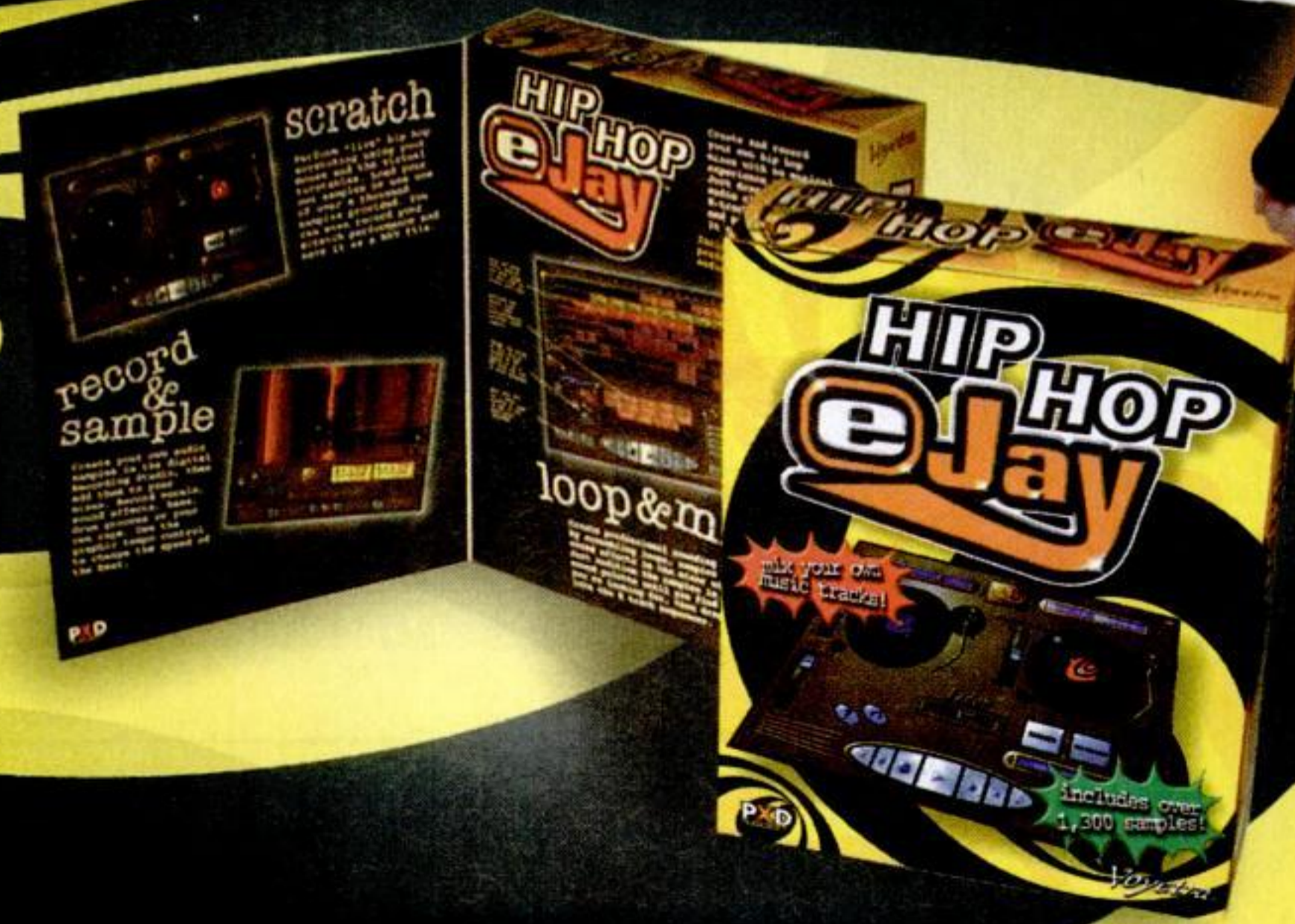
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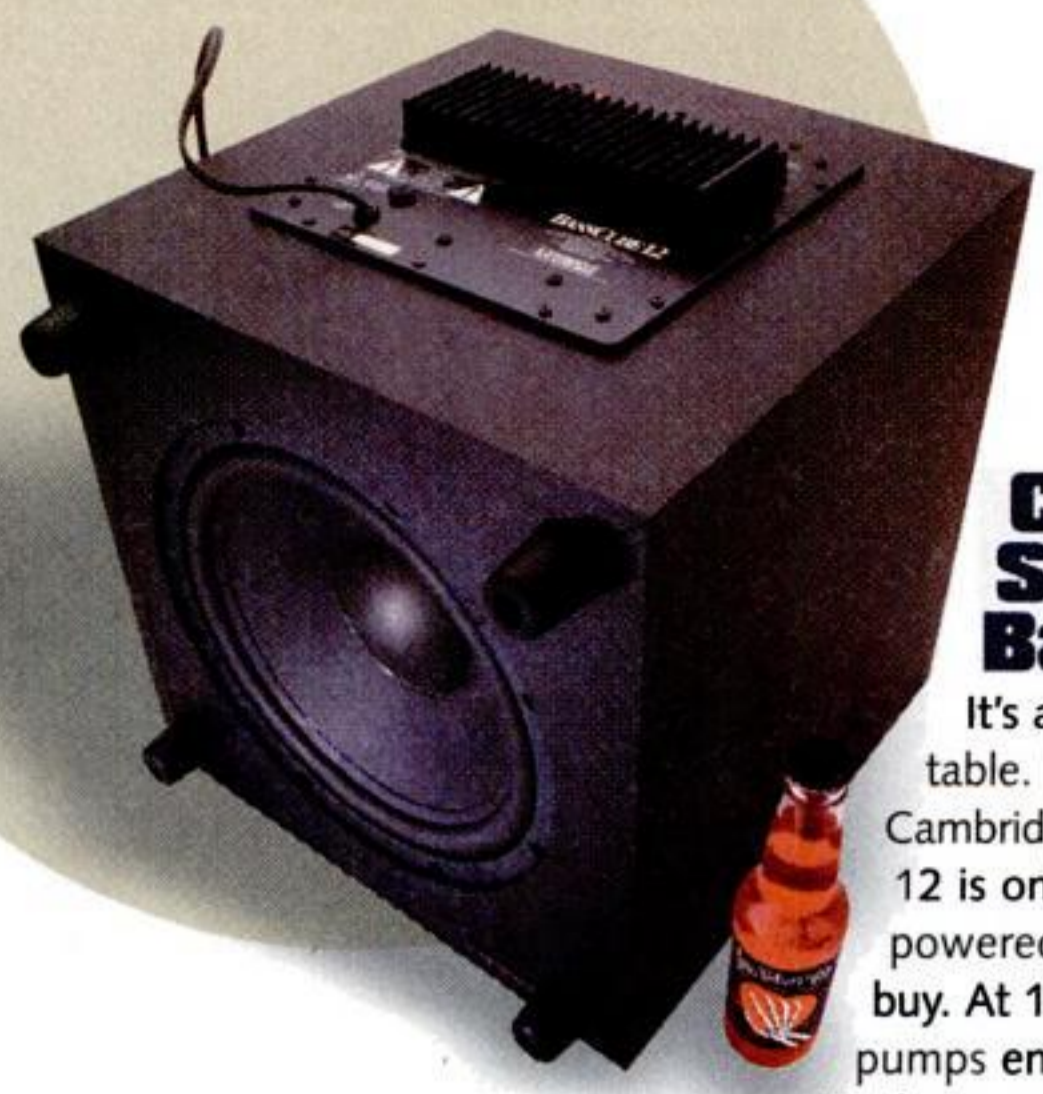
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12-inch cone to rattle your fillings loose... not to mention that funny feeling we got from sitting on the thing while playing *RollCage* in the lab.

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\$450; Cambridge SoundWorks; 800.367.4434; [www.cambridgesoundworks.com](http://www.cambridgesoundworks.com)

### CD Dupe-it!

This unassuming beige box bundles an internal 2GB hard drive (usually Seagate or Maxor) with a CD recorder (a Panasonic CDR-7502B) to create dupes of all your discs, no PC required! From data to audio, CD Dupe-it! creates bit-by-bit backups of all your valuable discs.

The Pro Audio version adds built-in co-axial S/PDIF digital-input and RCA analog line-input jacks for recording audio from external sources. And we were impressed. With its intuitive LCD interface, the Dupe-it! created studio-quality custom compilations of our hardcore mixes with ease. A built-in sample-rate converter automatically converts song samples anywhere from 32kHz to 48kHz to the CD standard of 44.1kHz. It also has studio-quality 16-bit A-to-D converters that give less than .01% distortion and includes loop-back features and high-speed pre-mastering and track selection.

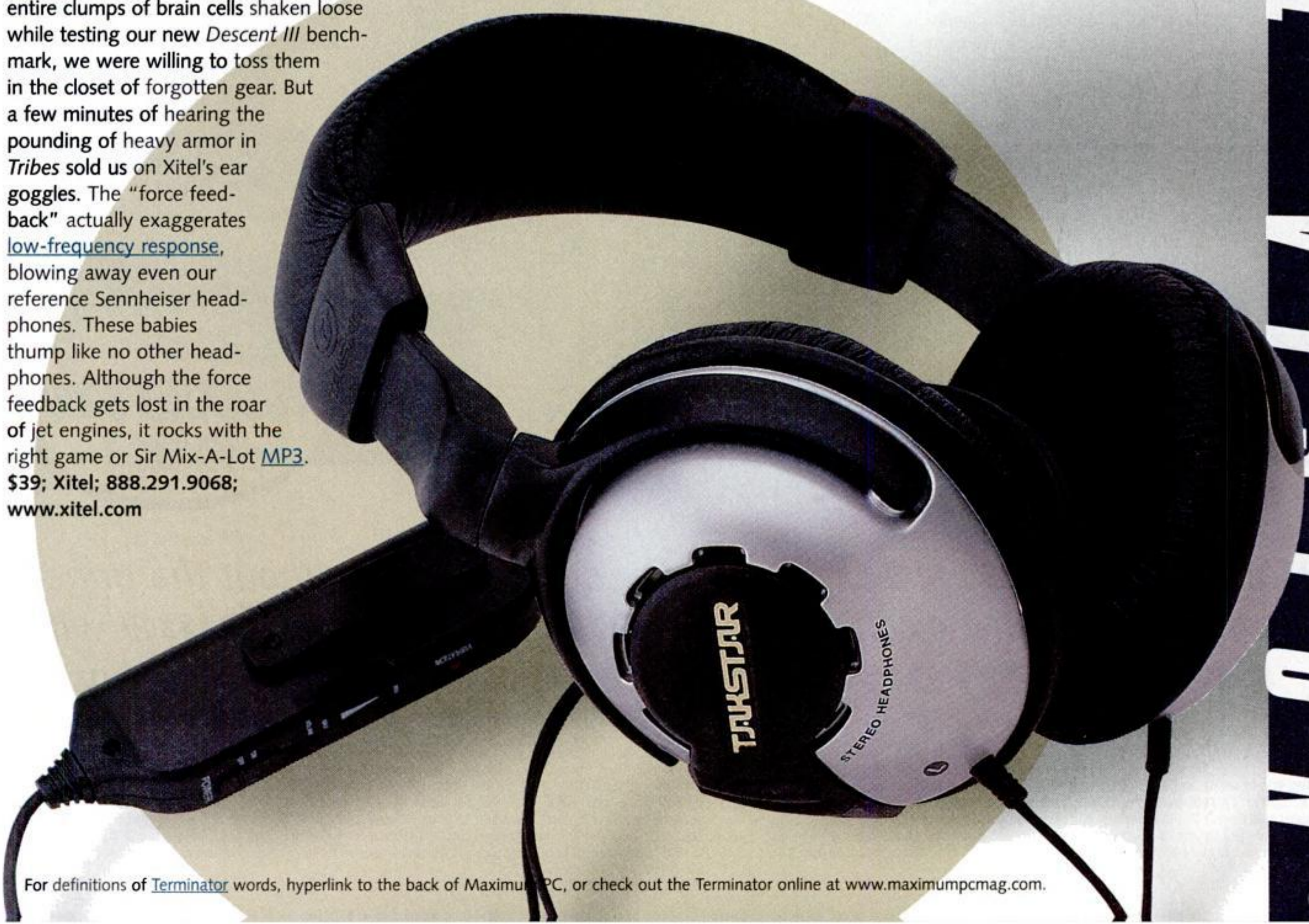
\$1,295 for the Pro version and \$795 for the standard model; Computer Systems Center; 408.588.1110; [www.dupeit.com](http://www.dupeit.com)



### Xitel Force-Feedback Headphones

Initially, we thought the whole idea of force-feedback headphones was the gimmick of the minute. And after having entire clumps of brain cells shaken loose while testing our new *Descent III* benchmark, we were willing to toss them in the closet of forgotten gear. But a few minutes of hearing the pounding of heavy armor in *Tribes* sold us on Xitel's ear goggles. The "force feedback" actually exaggerates low-frequency response, blowing away even our reference Sennheiser headphones. These babies thump like no other headphones. Although the force feedback gets lost in the roar of jet engines, it rocks with the right game or Sir Mix-A-Lot MP3.

\$39; Xitel; 888.291.9068; [www.xitel.com](http://www.xitel.com)



For definitions of Terminator words, hyperlink to the back of Maximum PC, or check out the Terminator online at [www.maximumpcmag.com](http://www.maximumpcmag.com).

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**C**an't the United Nations or NATO do something about this? Microsoft and Sun just won't make peace. While their Java jihad still winds its way through the courts, a new conflict is brewing.

Each company has a different vision for making local-area networks (LANs) as easy to install in your home as ordinary telephones. They want to make networking so easy that someday you'll connect every conceivable device (PCs, laptops, palmtops, TV set-top boxes, videogame consoles, printers, modems, scanners, etc.) and even some smart appliances (cell phones, Internet phones, digital answering machines, pagers, home environmental controls, you name it). Heck, to hear some people talk, someday your Chia Pet and your Tamagotchi will be sending each other e-mail. ("How come they feed you more often than they feed me?")

As usual, industry pundits are trotting out their all-purpose hockey-stick

recent industry conference. But Microsoft has far more influence over the industry than Sun does, so I'd still rate UPnP as the horse to beat.

UPnP and Jini have the same goal. The network should automatically recognize any kind of device and register any services it offers. For example, if the new device is a printer, all other devices on the network that might need to print something could automatically find the printer and know what it can do. Even devices that don't normally have printing capabilities might be able to use the printer by talking through another device on the network (such as a PC) that acts as a proxy.

One of the biggest problems that UPnP and Jini try to solve is the device driver dilemma. A device driver is code that allows a computer to interact with another device. Most drivers are invisible to users, although some have a user interface—such as the window that opens when you click the "Properties" button in a Print dialog. Operating systems come with hundreds of drivers for the most common devices, and the drivers clutter up your

an existing network protocol is HTTP (hypertext transfer protocol). When you access a web site, the web server doesn't need to know what kind of computer you have. It just sends some data over the network using HTTP. Your PC and your web browser also speak HTTP, so they know how to translate that data into a web page on your screen. UPnP relies on similar protocols for other types of interactions. A proposed standard called IPP (Internet printing protocol) would allow any device to send a document to any printer.

Jini takes a similar approach, but uses Java as the intermediary.

Today, any PC with a Java-enabled web browser can download and run a Java applet from a web server without permanently installing the applet's code on your hard drive. In fact, it's so automatic

that you might not be aware you've downloaded and launched a program. Jini uses the same capabilities (platform independence, network mobility, automatic execution) to handle the interactions that normally would require you

## Who Will Wire Your Home?

### MICROSOFT AND SUN SQUARE OFF IN YOUR LIVING ROOM

graphs to show that home networking will soon be a huge market. Forrester Research predicts \$1 billion by 2002; Cahners In-Stat says \$230 million this year in the United States alone, and \$1.4 billion by 2003. My dartboard indicates slower growth until the computer industry overcomes the complexity of networking. Like they say, it's hard to make something foolproof, because fools are so darn clever.

Sun's solution is Jini. Microsoft's answer is Universal Plug-and-Play (UPnP). I spent a few weeks analyzing both technologies, and my conclusion is that both are technically sound and could deliver us to networking nirvana. Sun has a head start—production-ready Jini code is already in the hands of developers—while Microsoft just released specifications for UPnP at a

hard drive, whether you need them or not.

Device drivers are major obstacles to trouble-free networking. Ideally, you should be able to attach a small device such as a handheld computer to a network, quickly use any service that's available

(such as a printer), then detach the device and walk away—without installing and uninstalling a driver. Besides, new types of computing devices are being invented every day. It's not practical to require every new device to have special drivers for every other kind of device.

UPnP tries to solve this problem by using new network protocols as intermediaries between devices. An example of

to install a native device driver. Like an applet, the Jini "device driver" stays on your machine only while you need it, then goes away.

UPnP and Jini can coexist on the same device, but that would add cost. My guess is that marketing savvy and market influence—not just technology—will determine the winner. That's OK. Either solution can get the job done. ❁



**TOM HALFHILL** was senior editor at Byte magazine and is regarded as one of the most knowledgeable experts on processor technology in the industry. Contact him at [thalfhill@maximumpc.com](mailto:thalfhill@maximumpc.com).

**Pundits are trotting out their all-purpose hockey-stick graphs to show that home networking will soon be a huge market. My dartboard indicates slower growth.**

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**T**hough it could drive one mad the way acronyms add up to a modern-day tower of Babel (certain to bring us all down), some are more interesting than others.

WAP. It's fun, catchy, a bright word with a very bright future.

Even before Ericsson, Motorola, Nokia, and Unwired Planet announced plans last summer to define a common "Wireless Application Protocol," dozens of corporations—from Alcatel to Vodafone (Samsung, Unisys, Nissan, and many others in-between)—have been hot on the trail of the emerging industry standard for wireless applications.

According to statistics published on the WAP hub ([www.wapforum.org](http://www.wapforum.org)), "Handset manufacturers representing over 75% of the world market across all technologies have committed to shipping WAP-enabled devices. Carriers representing nearly 100 million subscribers worldwide have joined WAP. This commitment will provide tens of millions of WAP-browser-enabled products to consumers by the end of 2000."

## World Wide WAP Attack

### THE WEB IS GOING WIRELESS

And on September 28 of last year, the WAP Forum published a paper ([www.wapforum.org/docs/WAP-W3C-white-paper\\_v1.1.html](http://www.wapforum.org/docs/WAP-W3C-white-paper_v1.1.html)) to outline the collaboration between itself and the World Wide Web Consortium (W3C). The WAP Forum promises advanced services and applications on mobile wireless devices, i.e., cell phones, and knows that working with the consortium—instead of against it—is the only logical route toward "a unified information space."

But don't we *already* live in a unified information space? I mean, in the face of disappearing cultural traditions, don't we all increasingly speak similar languages and share similar customs? I'm not sure I want a more unified universe (or such quick access to it). I think what the Forum

means to say is that it wants "unified access (for wireless telcos) to revenue potential (from hot Internet frenzy)." But that's just the overbearing opinion that you've grown to expect from me.

To be pragmatic, I don't believe my opinions are going to mean much in a world with billion-dollar telcos teaming up with Wall Street cash cows, bringing day trading to every corner of the world (but you'll still have to turn off your cell phones while the airplane is in flight). Still, I may as well spread what little information there is, so the lot of you can get in while it's still a good idea.

There's surprisingly little information online about WAP. I'm not sure if that's because greedy corporations are trying to keep it for themselves, or if like most new technologies, the standard has risen mostly through individual volunteer efforts, after hours, and with little corporate backing until now. Even so, Search.com came up with a whopping two results on a search for WAP, and Yahoo doesn't even have a subcategory yet. Nokia ([www.nokia.com](http://www.nokia.com)) seems to be

championing the wave with a privately built developer forum and lots of links. Nokia has also developed a royalty-free WAP toolkit that allows developers to write, test, debug, and run applications on a PC-based simulator of a Nokia phone

**Billion-dollar telcos are teaming up with Wall Street cash cows to bring day trading to every corner of the world (but you'll still have to turn off your cell phones while the airplane is in flight).**

(they're no dummies) and is available to download at [www.forum.nokia.com](http://www.forum.nokia.com).

Of course, all this is to support Nokia's "7110 dual-band GSM 900/1800 media phone to bring Internet content and other services to every pocket." Yikes! In February, Nokia announced the world's first WAP-based media phone. It's been designed with a (relatively) large graphics display and features for text input. This is

supposed to be available Q2 of this year. Hey, that's now! Coincidentally, last February CNN Interactive launched (with help from Nokia) "CNN Mobile," the first mobile tele-news and info-service to be available globally. If you have the delivery vehicle, I suppose it's good to get some content.

WAP will have made an even bigger splash (by the time you read this) as a sponsoring organization for the Wireless Developers 99 Conference May 5 to 7, bringing developer workshops and panels to a larger audience. And there will also be forum meetings in San Francisco (June), London (September), and Sydney (December) certain to get the ball rolling.

Though not WAP-specific, AvantGo, maker of web browsers for Palm PDAs and Windows CE devices ([www.avantgo.com](http://www.avantgo.com)), offers an in-depth tutorial for the best way to optimize HTML for handhelds. Several news and financial sources have jumped onto handhelds, including CNN, *The Wall Street Journal*, and Excite. So if you're interested in developing for small monochrome screens, it's not a bad place to check for advice. And be sure to check out the style guide at [www.avantgo.com/webtogo/content/styleguide.html](http://www.avantgo.com/webtogo/content/styleguide.html).

[webtogo/content/styleguide.html](http://www.avantgo.com/webtogo/content/styleguide.html).

And if we can step back and think big-picture convergence for a moment (think back to my column on XML in November 1998), we'll see that it won't be long before we're hearing faxes and e-mail, sending text-typed voice mail, and viewing MTV video clips from cell phones, wristwatches, and implants.

And I can't wait! ●



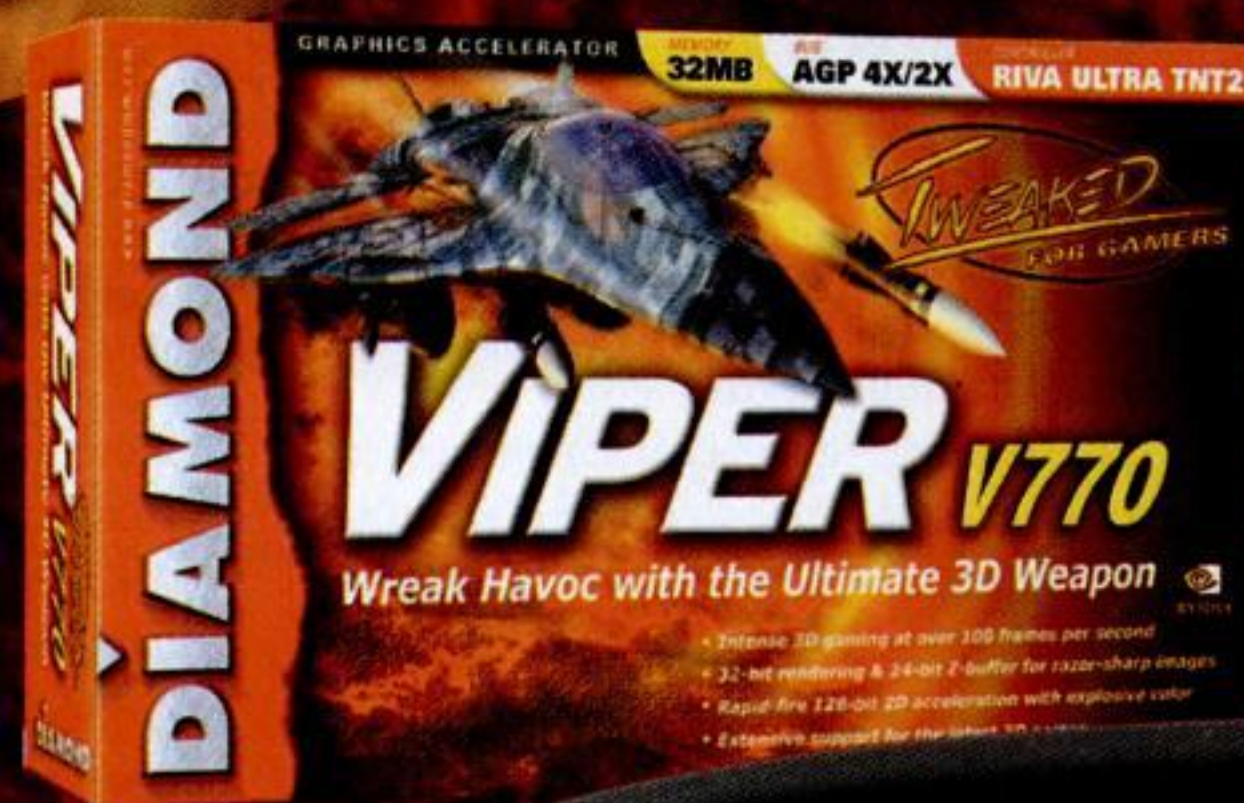
**SHEL KIMEN** has worked in the industry, traveled the world, and covered the Internet for both *The Net* and *boot* magazine. She can be contacted at [skimen@maximumpc.com](mailto:skimen@maximumpc.com).

# What Should You Bring To The Ultimate Deathmatch?

# How About The Ultimate Weapon.

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**Y**ou're in the mood for an action game, so you load up *Doom* and play for hours. And once a year, of course, you play *Loom* or maybe an old AD&D *Gold Box* RPG game for the umpteenth time, enjoying it just as much as you did eight or nine years ago.

Probably not.

It's more likely that all the big games of yesteryear are either long gone in the yard sale or lost in the shadowy recesses of your attic, never to be played again. Like porn stars, computer games don't age gracefully. They are the most expensive disposable entertainment ever produced.

The reason is simple: They are not so much about classic gameplay and design as they are about chrome. Various forms of chess, checkers, backgammon, and Go have histories stretching back thousands of years. Even contemporary perennial favorites such as *Scrabble* and *Monopoly* have been around more than 50 years. The shelf life of an average computer game is about six months for a regular

they remain the same through all the various permutations and sequels. Action games are the most disposable of all, since once finished they offer little cause to return and there's always something fresher and better looking. Good RPGs and adventure games should be like good novels and movies that you pick up again even though you know the ending. But people rarely do, possibly because the many hours involved exhaust any level of interest you had in the characters and story.

If we weren't deluged with new versions of sports games each year, chances are we'd be happy playing the old football and baseball sims and just adding new season stats. Same goes for sims, which tend to age better than most, and strategy games, which age the best of all. If we didn't see how sharp the latest sims looked, most of us would be happily playing and replaying the *Aces* games, *Falcon*, *Su-27*, *Longbow*, and other classic sims. With plenty of configuration options, custom-mission features, good AI and modeling, and

acceptable graphics, a sim can be played for years and years.

Games with a strong visual element are often left behind. The

quest is for an ever-better visual simulation through improved graphics, which only come through new technology. Once we see what the next thing looks like, we quickly abandon the old. Magazines such as *Maximum PC* play an integral

another version of *Civilization*, *Railroad Tycoon*, *SimCity*, *Harpoon*, or *V for Victory*, I'd still play the original. Their sequels change little and are primarily created to generate new sales and make the old designs attractive. Even good, strong strategy games such as *Command & Conquer* and *Total Annihilation* have their limits, since after lengthy play you can find the tricks of the AI and the rules and manipulate them instead of playing against them. *The Operational Art of War* is the only recent game I can think of that I'll still be playing in a few years. Despite its clunky and off-putting title, it's an easily playable yet deeply satisfying strategy game with endless replay potential.

With oblivion looming for almost every game released, is it any wonder the prices remain so high? Of the dozens upon dozens of letters I received about my warez column in the April issue, many used the high price of computer games to justify their piracy and theft. (Have these people heard of demos?) It's no wonder games cost \$40 and \$50 when you consider that they're selling



**T. LIAM McDONALD** is a veteran of PC Gamer magazine and is much bigger than he looks in this picture, so keep that in mind before writing him any hate mail at [tmcdonald@maximumpc.com](mailto:tmcdonald@maximumpc.com).

## Disposable Games

EVEN THE BEST GAMES SOUR WITH TIME

title, maybe a year for a big hit. Only *Myst*—that collision of the dull, the convoluted, and the contrived—continues to roost atop the sales charts four years later.

With the exception of some pop music (I'd like to find people who actually bought that Britney Spears album and see how many times they still spin it a few years from today), computer games are virtually the only medium that suffers this fate. Classic TV shows play for years and years, every single day. I still reread my favorite authors and watch my favorite movies over and over again. But I haven't played *System Shock*—a game I revere—since I reviewed it.

Few computer games can be played for the rest of your life. New versions come out that add some flash or tweak some minor points, but at their core

**All the big games of yesteryear are either long gone in the yard sale or lost in the shadowy recesses of your attic. Like porn stars, computer games don't age gracefully.**

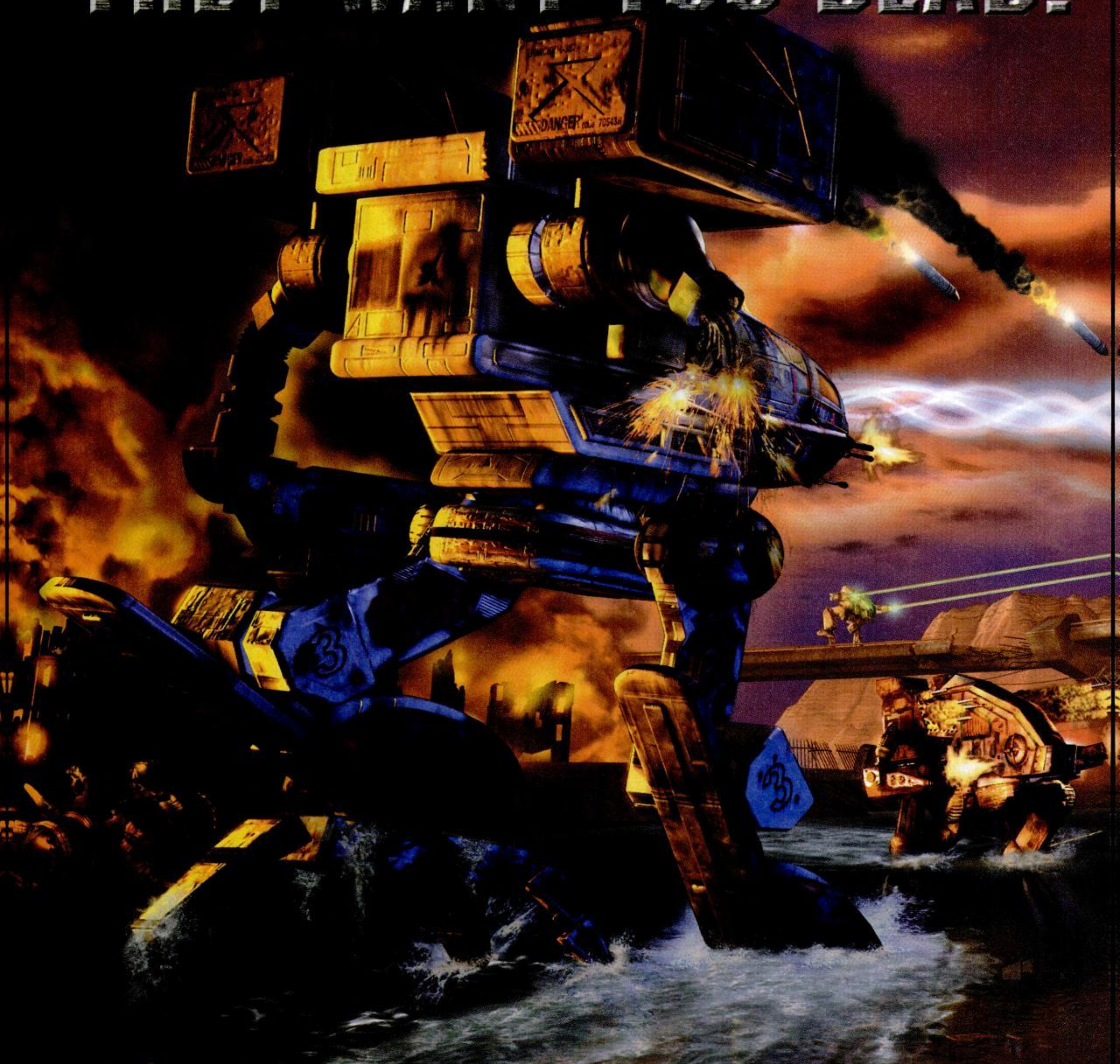
role in this seduction, constantly showing you the next gen of tech and gear. Until we reach the point of absolute three-dimensional photo-realism and environmental simulation, we will continue to chase this goal through new games that are essentially the old games made to look a bit better.

Only strategy games escape this vicious circle. If there had never been

to maybe a couple hundred thousand people for less than six months. Movies reach millions more people, and keep returning revenues year after year for pay-per-view, home video, cable, network TV, and foreign rights.

When a game reaches that magic expiration date, it's just gone for good. There is no afterlife for even the best computer game. ❁

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**Maximum PC** Some of IBM's major competitors, such as Micropolis, have disappeared and shut their doors for good. What's going on?

**Bob Scranton** Two events have dropped disk drive prices significantly. The first was a period of over-capacity when prices came down. And once they come down, it's almost impossible to lift them back up, even as new models with higher capacity and higher performance come out.

The other is, and this is a highly personal view, that a bunch of engineers came out with a low-cost PC. Low-cost PCs mean less good stuff for less money. But what consumers *actually* wanted was *more* good stuff for less money. Since distributors just slap parts together, they turn

Typically, SCSI is implemented on [server-class](#) products with high demands on reliability, performance, and customization. All this tends to drive up the price of SCSI hard drives, although it isn't intrinsically the cost of the SCSI interface. Last year, IBM introduced some 7,200rpm entry-server drives that really lowered the price point for SCSI.

**Maximum PC** You have 10,000rpm SCSI drives. Why no 10,000rpm IDE drives?

**Scranton** Going to a higher RPM is a major technical problem. Grand innovation and invention isn't required, but to get a higher RPM you end up using more power. You have to worry about airflow, you have to worry about vibrations, and

**Bob Scranton,**  
**Director of**  
**Recording Heads**  
**at IBM's Almaden**  
**Research Center,**  
**lays down tracks**  
**about SCSI, Ultra**  
**DMA, RPMs, optical**  
**technology, and**  
**other cool storage**  
**technology.**

around and put the price pressure on their suppliers, whether it's hard disk drives or monitors or whatever. And so drives for lower-cost PCs continue to pressure prices.

**Maximum PC** Will low-cost IDE eventually kill SCSI?

**Scranton** There's lots of opportunity for both to exist. I don't think SCSI is dead, but I find it hard to believe a home PC has a particular need for it. Most consumers don't *really* need SCSI. Certain applications once considered the domain of SCSI can now be handled just as well by IDE. With [Ultra DMA](#), higher performance desktop [actuators](#)—7,200rpm—the performance gap vanishes.

**Maximum PC** So why is SCSI more expensive than IDE?

**Scranton** SCSI chips do cost more to make, but the difference in electronics cost relative to IDE is shrinking.

the head tends to go off-track more. It's just not graceful to the system, and most desktop users wouldn't want to pay that penalty.

**Maximum PC** What comes after 10,000rpm?

**Scranton** People are talking about 12,000rpm and 15,000rpm. As you go up into these speeds, you'd likely reduce air drag by continuing to go smaller. We'd also have to worry about simple things such as ball bearings and additional vibrations. However, there's no indication yet that the market for drives this fast will be anything but niche.

**Maximum PC** How important is it to increase the areal density?

**Scranton** Extremely important. Companies go out of business if they don't increase areal density every year. Capacity, manufacturing costs, function—everything hinges on areal density.

## PROFILE

### And he would be?

Dr. Bob Scranton is the chief of staff at the IBM Almaden Research Center. Most appropriately, Scranton is in charge of researching and testing the latest hard drive head technologies.

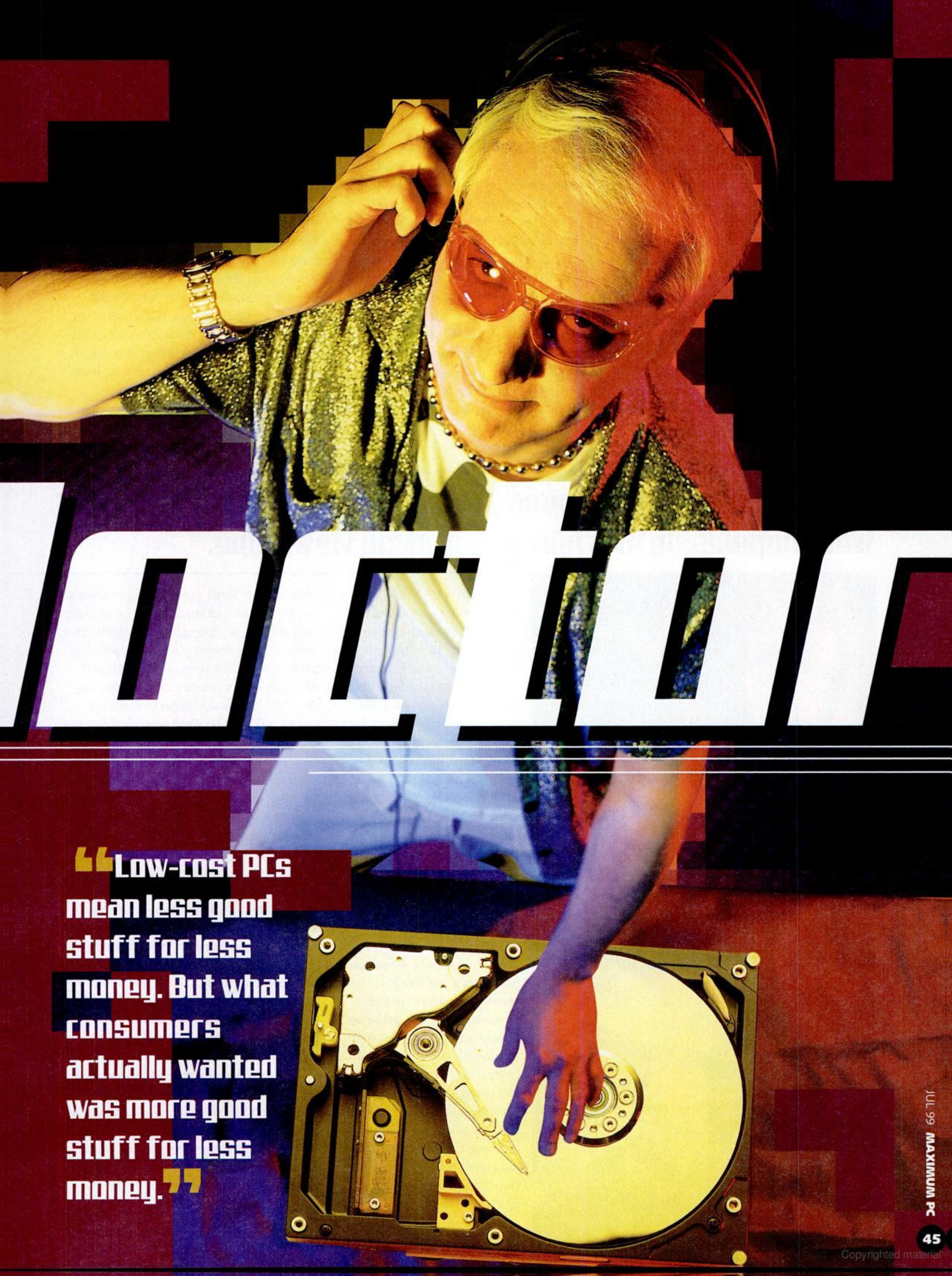
### And I would know him from?

You probably don't. But if you're at all interested in protecting your data, you should know that the drive, or some of its underlying components, were created, developed, or manufactured by IBM.

### And I would care because?

Scranton's role at IBM is to conduct industry-leading research and development to make hard drives faster, more reliable, and less susceptible to problems—issues that are of utmost importance to any self-respecting PC fanatic.





# 100%

“Low-cost PCs mean less good stuff for less money. But what consumers actually wanted was more good stuff for less money.”



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**Maximum PC** IBM has always been ahead in the areal-density game. How did it feel when Seagate announced that it had set a world record by packing more than 16 billion bits of data per square-inch on a hard disk platter?

**Scranton** Well, it's not clear that's much of a breakthrough. I think the demonstrations are nifty because they give people an idea of what *might* come in the future and they help engineers think about some of the technical problems associated with it. The real trick, of course, is to turn those demonstrations into actual higher-areal-density products.

**Maximum PC** Does your typical PC owner really need a 20GB+ hard drive?

**Scranton** If you put a lot of video on your

hard drive, you'd end up rapidly consuming the capacity. My son uses more hard drive space than I do; he's 12 years old and probably has 10GB already full. On a notebook, I wouldn't carry anything more than 10GB—I don't want to carry the weight.

If areal density increases at 60% per year, that means a factor of 10 in five years or 100 in ten years. In five years, this could result in a 34GB hard drive; in ten years a 2.5TB hard drive! What could you do with 34GB or 2.4TB on your home desktop? Digital video. A DV camcorder stores 10, maybe 20 hours of video in 34GB—that's about 2GB an hour. OK, so I take that home, download it into my desktop PC, which immediately starts doing image compression, analyzing every bit I saw, and stores it compressed at

it as long as you could bring the whole thing to market at a competitive cost per part.

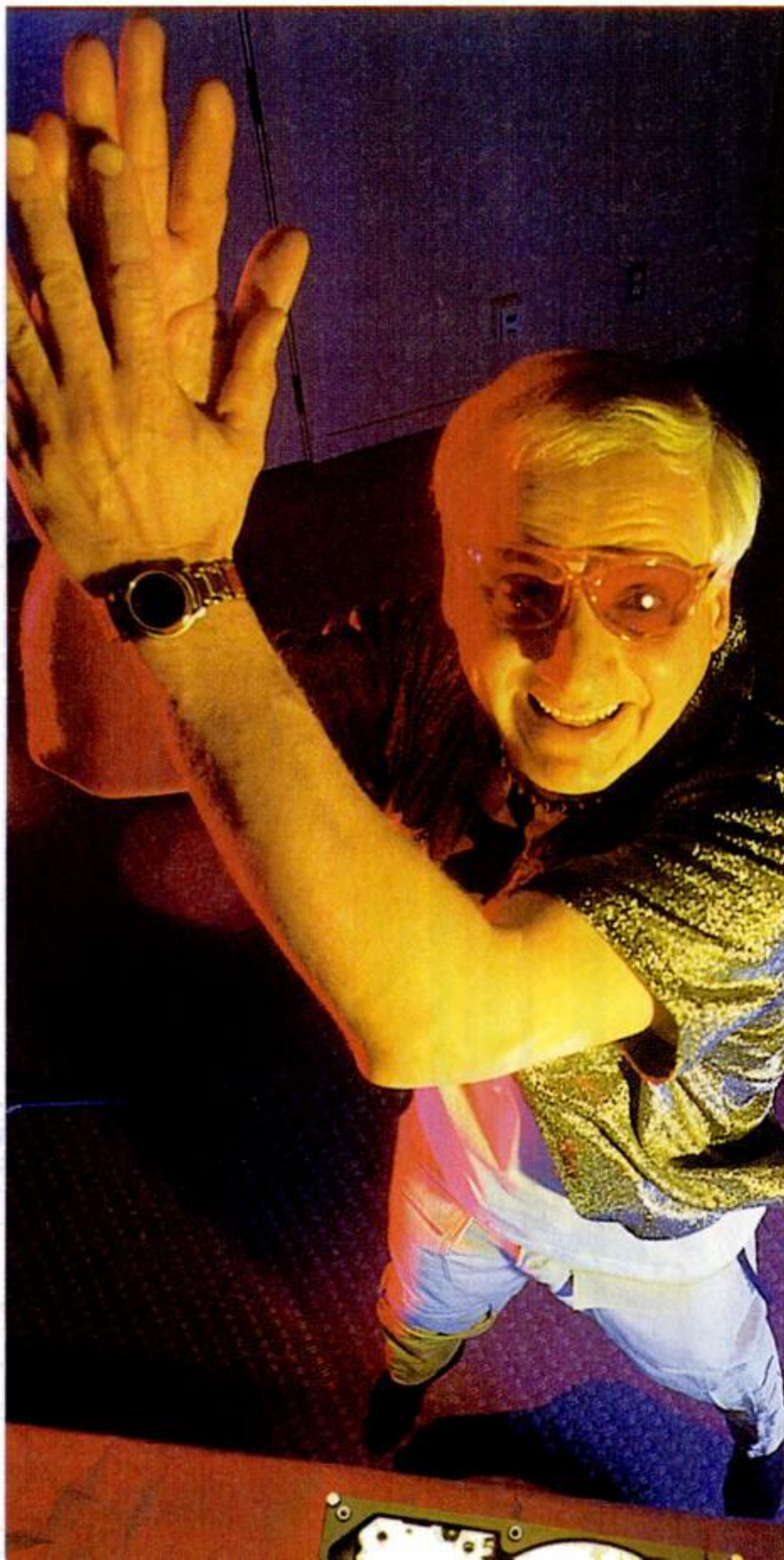
Nobody is holding back. Everybody's rushing along, focused on increasing the areal density.

**Maximum PC** What are the hurdles in terms of increasing the density?

**Scranton** To make a disk platter, you take an almost featureless disk and make little magnetic marks on it. To increase the areal density, you have to make those marks smaller, and the element that writes them, and the element that reads them. It's called scaling, and if you halve a bunch of the critical dimensions, you end up with four times the areal density.

With magnetics, shrinking scales also goes into tolerances. How accurately can you

## “Seagate's initial claims of optically assisted Winchester were hopelessly overblown and, in my view, hype.”



100:1 onto your desktop. With that size hard drive, you could store something like 20 years of your life! Think about that—if you're really old and dribbling, you could use the drive as a memory prosthesis.

You could record your day. You could record your life.

**Maximum PC** So, how long do we have to wait until we can get our hands on a terabyte-capacity hard drive?

**Scranton** Right now we have 32GB hard drives. A terabyte is about 30 times higher—so seven years at the current pace of improvement.

**Maximum PC** Do hard drive companies purposely hold back on their maximum drive space specs to keep the price up?

**Scranton** Boy, wouldn't that be nice! We're in an intensely competitive situation, and if you could achieve a certain capacity on fewer parts, you'd do it just to save the money. For example, if somebody is shipping three disks and you can ship the same capacity on two disks, you'd be foolish not to do

make each of those parts? To improve areal density by 60% per year, you've got to make the parts' linear dimensions smaller by 25% per year and improve your manufacturing tolerances by 25% per year. This is exactly what the semiconductor industry does in the wafer business in order to make more bits on a DRAM. So it's this technology race.

And as you make these bits smaller, the signal that comes back gets tinier. It's actually hard to hear it over the various noise sources. So you want a sensor that reads these tiny bits. And that's the migration from ferrite heads—the thin film-inducted heads—to magneto-resistive heads, and now to giant magneto-resistive heads. Each is more sensitive to those ever-tinier bits.

**Maximum PC** IBM's research team was the first to rearrange individual atoms on a substrate. Is IBM pursuing this as a storage medium or as the ultimate chip fab?

**Scranton** Storage at the atomic level is very far away. Right now we're at  $10^{11}$  bits per square inch. At the atomic level, it's more like  $10^{50}$ .

Besides magnetic recording, there aren't many techniques that both store high density and have high data rates. Whenever somebody claims high storage density, you have to ask what the data rate was. Moving atoms around was probably a few bits per hour by the time you get your data in! So it's not that fast... yet.

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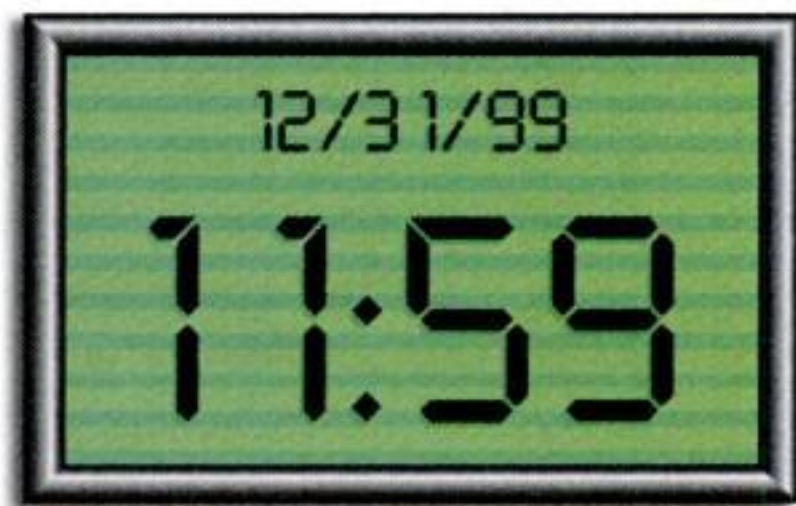
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There's another effect that occurs. It takes a certain energy to make the mark or to read the mark, and at some point a mark is so small the energy can approach the ordinary vibration of atoms at room temperature. And then you have marks spontaneously appearing or disappearing. So in order to store these atoms on disk, you had to cool the entire surface down very close to absolute zero. And this is, today, not practical to carry around in your pocket.

**Maximum PC** We won't hold our breath. What do you think is a good amount of time between the product demo and the actual product?

**Scranton** We used to have six years between a demo and a product. Extrapolating a bit, we're seeing 18 months to two years. Do I think that's a good amount of time? No. It's indicative of how fast the industry is sucking technology in from the research labs. That is not a lot of time between the onesy/twosy stage of making a demo—with a whole bunch of people huddled around a piece of equipment, breathing better when it finally works—to mass production by the hundreds of millions. Doing this in 18 months is a very, very difficult thing, and indicative of the race that the whole industry is in.

**Maximum PC** Is mass storage headed toward solid-state?

**Scranton** There's a difference in the basic cost to manufacture disk drives and semiconductors. We'll see silicon replacing magnetic storage in very low capacity applications, emerging small things—pervasive computing—or in extreme situations where you *really* have to worry about shock or environmental situations. A Palm PDA is perfectly happy with 10MB, but we're not going to make a 10MB disk drive. But if you need a gigabyte, it's probably not going to be silicon any time soon.

**Maximum PC** Is optical technology the panacea for the storage world?

**Scranton** Optical storage has not proceeded at the pace of magnetic storage. Magnetic storage is improving at 60% a year; optical is not.

However, optical has some great benefits. In most implementations, you're focusing below the surface, so you're not concerned with dirt and scratches on the surface. If you were to put dirt and scratches on a magnetic disk, it would definitely crash. Optical technology is much more tolerant and is fantastic for interchangeable media.

But interchangeable media needs to be a standard and deal with all the various



“Companies go out of business if they don't increase areal density every year. ...everything hinges on areal density.”

recording industries and all their concerns about intellectual property, copyright, and all that junk. Media interchangeability and copyright concerns make a medium such as optical recording stagnant. How much has the capacity of CD-ROM improved in the past ten years? None! By definition, a successful interchangeable media standard is technically static. If DVD takes off, what's the definition of a really successful DVD format? Technically stagnant. It's got to be cheap, ubiquitous, pervasive—and it will be stagnant.

In contrast, although there are constrictions on the size of the box, when you buy a disk drive you really don't care if there are two heads or three heads or one head. It has a certain size, a certain capacity, power—you're happy even though you don't know what the heck is in there. The person responsible for heads in disks can improve them without asking your permission, but if he goes and changes the format of the CD-ROM, you'd be pretty upset when you buy it and it doesn't work.

**Maximum PC** A year ago, Seagate announced an optically assisted

**Winchester technology that broke the limitations of traditional magnetic media. What's going on in that arena?**

**Scranton** After carefully evaluating it, we decided it was not an appropriate technique for data storage. Seagate's initial claims of optically assisted Winchester were hopelessly overblown and, in my view, hype. Based on their initial claims, they should already have some marvelously exciting products in the marketplace. They don't.

**Maximum PC** Are there technologies that you wished IBM had invented?

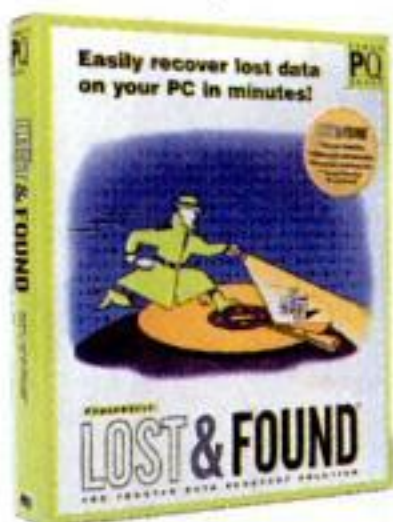
**Scranton** There really aren't. People are pretty much converging on the same set of approaches, the same sort of technical goodies. They're not off on some wild new way to do the same thing, a token bizarre parallel approach or with a different set of performance metrics and attributes. It's more of a rush to take things from the research labs and bring them through high-reliability, low-cost manufacturing processes, and turn them as quickly as possible into high-areal-density disk drives. It's more in execution rather than invention. ●



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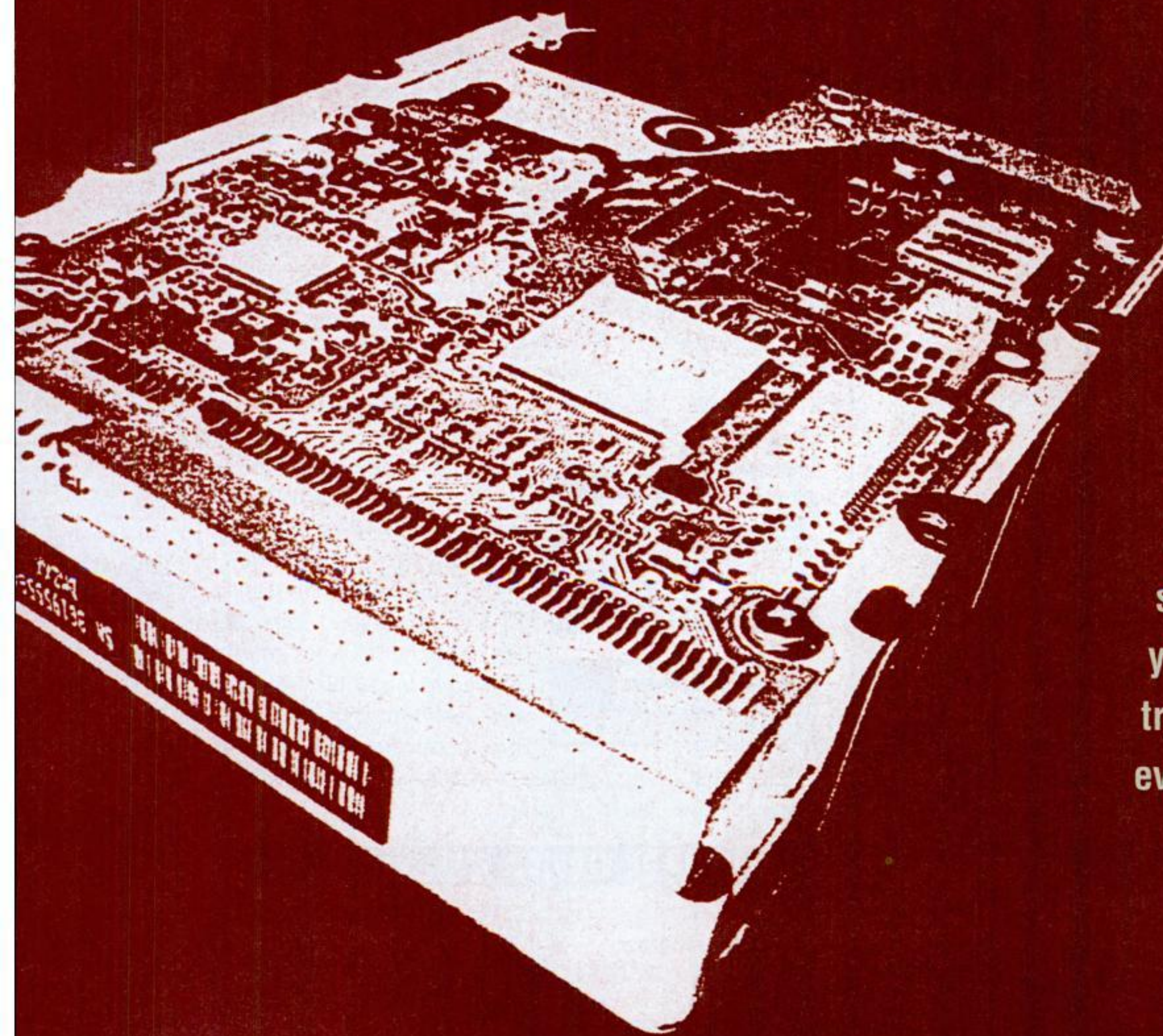
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# hard drive hellions

By Sean Cleveland

A gang of faster, beefier hard drives is speeding your way, sporting a new bus technology called Ultra DMA/66 and delivering read and burst speeds far outpacing any IDE-based drives you currently own. We gathered five brand, spankin' new 66ers from the top hard drive companies and pit them head-to-head on our lab's benchmarking drag strip. Sit down and fasten your seatbelt—these drives travel at speeds that scare even SCSI aficionados. ▶



# IDE STRIKES BACK

Until recently, it seemed IDE hard drives were on the road to extinction. With SCSI firmly in place and USB, 1394, and other technologies showing promise, IDE's demise seemed inevitable. But nothing could be further from the truth. Enter Ultra ATA/66, the next-gen ATA technology from Quantum that widens the data bus to 66MB/sec and extends the life of the IDE bus for yet another generation of hard drives. The new drives are already shipping, but Ultra ATA/66 motherboard support is sadly lacking. For now, you may have to use an add-in controller card (see page 54).

Before we get into how bus bandwidth affects overall drive performance and why Ultra ATA/66 will rock your world, let's explain the nitty-gritty of how hard drives work.

A hard drive contains several round, flat disks called platters that are coated with a substance that allows data to be written to them magnetically. Mounted on a spindle, these platters are stacked on top of each other with just millimeters of space between them—enough space to accommodate the smooth passage of an instrument called a read/write head. These heads use

electromagnetic signals to read and write data on the platters. Most drives use two heads per platter—one above and one below. Data is written in concentric circles (called tracks) that contain a number of sectors. Each sector holds 512 bytes of data.

When a drive is spec'd with a 7,200rpm spindle speed, it means the platters spin at 7,200 rotations per minute. Typically, the drive has a "direct drive" motor, where the motor's shaft serves as the spindle. The spindle speed is considered the mechanical speed of the drive; generally, the higher the rate, the faster the data can be accessed and read. Read speed can also be gained by increasing areal density, or the amount of information packed into a physical space. The higher the areal density, the tighter the bits are packed, the faster the heads can read the data. The measurement used for areal density is gigabits per square inch (Gb/inch<sup>2</sup>). Seagate holds the record for packing the most data on a platter at 16Gb/inch<sup>2</sup>, but consumers won't see drives using this density until 2001.

When talking about data transfer rates, it's best to separate the internal transfer rate of the drive from the external transfer rate. The *internal* transfer rate is the rate at which the heads can read data from the platters and pass that data to the drive's onboard cache memory (also called a read buffer). The *external* transfer rate is the rate at which the drive can send the data from

## FUJITSU DESKTOP 18

### Fast but fatally flawed

Our first few tests showed this drive as the one to beat. Unfortunately, the Desktop 18 has a fatal flaw that kept us from running our real-world benchmarks.

It seems the Desktop 18 has a setup hold-time conflict with Promise's Ultra66 controller (setup hold times are explained in the main story). Even when hooked up with an 80-conductor cable, the drive cannot properly read data beyond UDMA/33 speeds. Other drives worked fine with the Ultra66 controller, and the Desktop 18 worked fine with the VIA Apollo Pro+ chipset.



A major problem kept Fujitsu's Desktop 18 from glory.

Fujitsu said a resistor on the drive needs to be revised to be compatible with the Promise controller. Unfortunately, Fujitsu couldn't send us a revised drive in time. Currently, the drive appears only in fully integrated systems, and only Compaq has experienced the Promise conflict. Fujitsu should have the resistor fixed by the time you read this.

The Desktop 18 appears to be very fast, but its speed may be tied to timing issues, and the revised drive may be slower. Until the drive is fixed, we can't recommend it.

#### THE SPECS

##### MEASUREMENTS

3.5-inch formfactor
<b>DRIVE/BUFFER SIZE</b>
18.2GB/512KB
<b>NUMBER OF DISCS/HEADS</b>
4/8
<b>SPINDLE SPEED/AREAL DENSITY</b>
7,200rpm/3.47Gb/inch <sup>2</sup>

## IBM DESKSTAR 22GXP

### The biggest—but not the best

With the highest areal density available on the desktop, the Deskstar offers more capacity than any other drive in this line-up—but it's also the most expensive drive here. And while the 22GXP is 25% faster than the previous Deskstar generation, it's not the fastest in this roundup.

IBM attributes the 25% speed increase to its third-gen GMR heads, which have a greater sensitivity to magnetic fields and allow smaller bits of data to be read while maintaining stronger signals. In fact, the Quantum, Seagate, and Western Digital drives also rely on this technology.

The bottom line is that IBM, the king of ATA hard drives, holds the crown no longer—this distinction goes to Quantum. Even the Deskstar's beefy 2MB cache couldn't keep IBM on top. We hope the fall from eminence will light a fire under IBM engineers to once again push the limits of hard drive performance. Regardless, we

know that if you purchase a system with this drive, it'll perform reliably over the long haul.



Capacity notwithstanding, price and performance really do matter.

#### THE SPECS

##### MEASUREMENTS

3.5-inch formfactor
<b>DRIVE/BUFFER SIZE</b>
22.6GB/2MB
<b>NUMBER OF DISCS/HEADS</b>
4/8
<b>SPINDLE SPEED/AREAL DENSITY</b>
7,200rpm/3.74Gb/inch <sup>2</sup>

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#### MAXIMUM PC VERDICT

**Price** \$360  
**Company** Fujitsu  
**Phone** 800.626.4686  
**URL** www.fujitsu.com/harddisk.html



the onboard cache, across the drive's bus interface, through ribbon cabling, and to your machine's memory.

The external transfer rate is also referred to as the interface transfer rate, or burst rate. This is the fastest rate, and the one most drive manufacturers like to quote. The term "burst" is used because data sent from onboard cache can easily flood the whole bus regardless of the drive's interface.

Unfortunately, a drive's internal transfer rate can bottleneck the entire data transfer pipeline. The internal rate is relatively slow and can't fill onboard cache fast enough for the system to use. Inevitably, your system must bypass onboard cache and grab required data directly from the drive's platters, lowering the drive's overall speed to the slower internal transfer rate. Generally, this is how most large pieces of data are accessed.

Luckily, as spindle speeds become faster and areal densities become smaller, internal data transfer speeds increase. These technological advancements occur in increasingly short intervals. In comparison, new bus interface standards roll out only every few years and must anticipate the more frequent advancements in internal technology, hence the jump from Ultra ATA/33 to Ultra ATA/66. Indeed, we'd all be up the creek if hard drives could transfer more data than the bus interface could handle.

The first ATA spec contained provisions for PIO (Programmed Input/Output) modes, which are used to transfer data to and from hard drives. PIO data transfers rely heavily on the CPU, and systems can practically lock up during these file transfers. The second ATA spec (ATA-2) addressed this problem by including bus-mastering Direct Memory Access (DMA) support, which allows data transfers between the hard drive and memory to occur without using the CPU; the transfers access memory directly, hence the name. ATA-2—or **EIDE** (Enhanced IDE), depending on the drive manufacturer—supported 16.7MB/sec throughput.

ATA-2 also included a fix for the 2.1GB drive limit in the form of Logical Block Addressing (LBA). LBA is a translation scheme that contains new drive parameter tables that replace the old Cylinder/Head/Sector (CHS) tables used by the BIOS to set drive sizes. The new parameters increased the access limit to 8.4GB by using 24 bits of addressing space. But now we all know that even 8.4GB isn't large enough. Microsoft addressed the problem with a new file system called **FAT32X**, which was shipped with the OEM release of Windows 95 (OSR2), and later with Windows 98.

ATA didn't really take off until Ultra ATA technology was introduced in the ATA-4 spec (not much occurred in the ATA-3 spec except a few power-saving enhancements and timing

54 ▶

## Quantum Fireball Plus

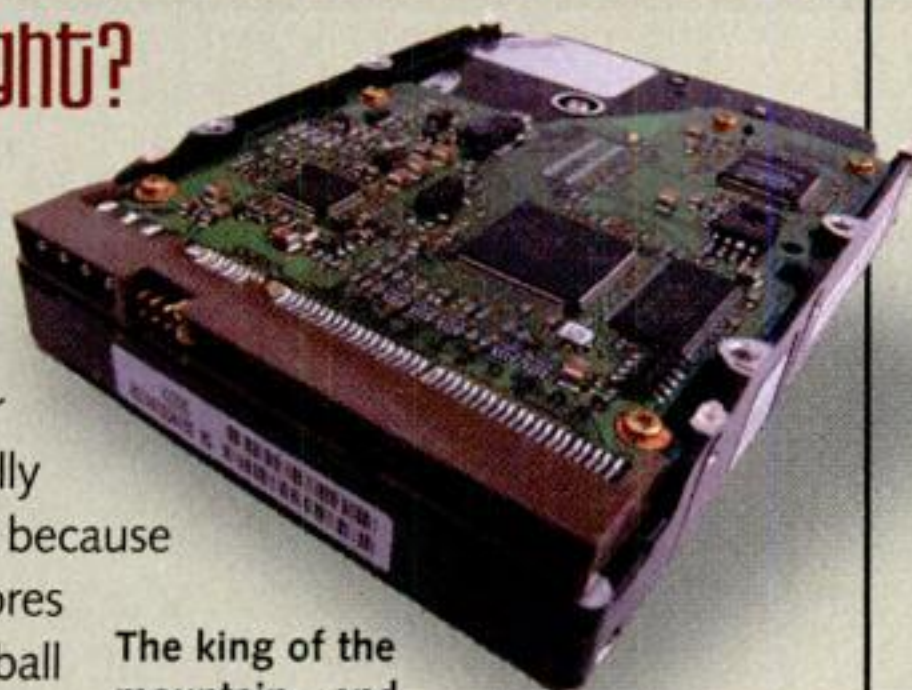
You want speed, right?



Excluding the Fujitsu, the Fireball Plus KA beat every other drive in practically every test. And because the Fujitsu's scores

are questionable, the Fireball gets top honors (for now).

Actually, the Fireball beat the dubious Fujitsu's random access times in both HD Tach and Intel Iometer, which explains why the Fireball was the top performer in the real-world benchmarks—the time it takes to find small pieces of data makes all the difference.



The king of the mountain—and worth the price.

Quantum also sent us its latest 5,400rpm offering, the 13GB Fireball CR. It benchmarked well despite showing what a difference the jump to 7,200rpm can make. The Fireball CR performed on par with Seagate's Medalist, and its burst speeds and random access times were superior, but we have to give Seagate's Medalist honors for the 5,400rpm class. Both drives' kits include cabling, screws,

brackets, and *On-Track Disk Manager* software. The Fireball Plus KA is truly a drive worth crowing about.

### MAXIMUM PC VERDICT

**Price** Fireball Plus KA: \$399 (after \$30 rebate); Fireball CR: \$219 (after \$30 rebate)

**Company** Quantum

**Phone** 800.624.5545

**URL** www.quantum.com

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## Seagate Medalist

The 5,400rpm winner

Seagate's new Medalist drive continues in the 5,400rpm tradition, but Seagate won't be stuck in this spindle category much longer. The 7,200rpm Seagate Barracuda ATA—with capacities up to 27.2GB—wasn't available at presstime but should spawn soon. The 27.2GB drive contains four discs, but hits areal densities greater than 5Gb/inch<sup>2</sup>!

If 5,400rpm is your speed, look no further than the Medalist.



As for the Medalist, it performed well below the 7,200rpm drives, as expected. But compared to Quantum's Fireball CR, it was practically neck-and-neck in most areas. The

Fireball was significantly faster in burst speed, but the Medalist had great real-world benchmarking scores. The Medalist also had the lowest CPU utilization of any drive.

The downside is that Seagate sells the Medalist only in the distribution channel, though resellers may eventually offer it retail. Until this happens, know that the Medalist performed admirably, and although it isn't the fastest drive, its price-to-performance ratio is very compelling.

### THE SPECS

#### MEASUREMENTS

3.5-inch formfactor

#### DRIVE/BUFFER SIZE

17.2GB/512KB

#### NUMBER OF DISCS/HEADS

4/8

#### SPINDLE SPEED/AREAL DENSITY

5,400rpm/3.2Gb/inch<sup>2</sup>

### MAXIMUM PC VERDICT

**Price** \$280

**Company** Seagate

**Phone** 877.271.3285

**URL** www.seagate.com

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modifications). Ultra ATA technology was invented by Quantum, which is also responsible for the Ultra, Ultra2, and Ultra3 SCSI technologies. (In case you're wondering about the difference between Ultra ATA and Ultra DMA, know this: Ultra ATA refers to the actual hard drive that connects to the Ultra DMA bus on the motherboard or add-in controller. To avoid confusion, we'll be using the abbreviation UDMA.)

The first Ultra ATA spec introduced UDMA/33, which increased the maximum transfer rate of the bus from 16.7MB/sec to 33MB/sec. This was accomplished by transporting twice the data per clock cycle. By doubling the rate at which the buffer is emptied, UDMA/33 compensates for command-turnaround and avoids "slipped revs." Also, CPU overhead is reduced further.

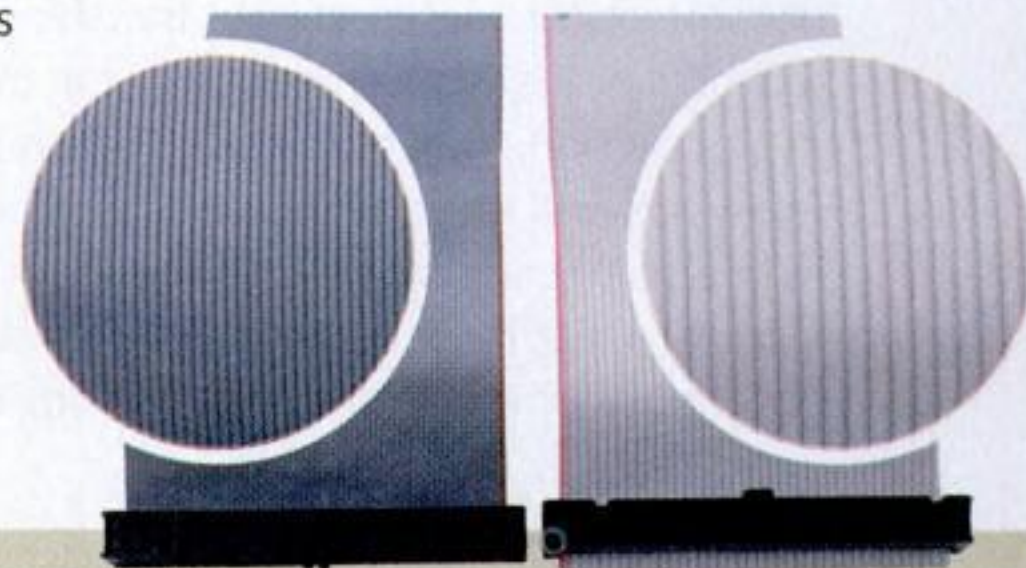
Ultra ATA/66, Quantum's newest technology and the latest addition to the ATA spec, doubles total bus bandwidth to 66MB/sec and extends ATA technology to at least the year 2001. Ultra ATA/66 also requires a new cabling standard. Here's the deal: Before new data can be transmitted across any UDMA pipeline, the controller must first wait for the residue of previously sent data to dissipate; this electronic interference is called cross-talk. Because this cross-talk can be mistaken for data, the UDMA/33 spec introduced a timing margin

called a setup time. It's inserted between transfers and allows for interference to fade away before the controller once again begins detecting ones and zeros.

UDMA/66 hard drives address the cross-talk problem with the introduction of new 80-conductor cabling. This cabling contains 80 conductor lines but still uses only 40 pins on each connector. The new lines are additional ground lines, one for each data line for a total of 80 lines (of the 40 lines in the older cabling, only seven contained ground lines). These ground lines allow the controller to cut the setup time in half, thereby increasing the data transfer rate to twice that of UDMA/33.

Going forward, motherboard chipsets that support UDMA/66 will include the ability to detect whether a 40-conductor cable or 80-conductor cable is being used (new firmware for some older chipsets, including Intel's 440BX and 440GX, will introduce this feature as well). The

To take advantage of the full 66MB/sec you need an 80-conductor cable (on left). The standard 40-conductor cable (on right) won't cut it.



# Western Digital Expert

## A conundrum

Western Digital's new Expert drive had us confused. Physically, it looks identical to IBM's Deskstar. In fact, we called Western Digital to ask what was up. It seems the Expert drive was built by IBM and uses IBM's GMR head

The Expert is a solid drive with an outstanding price.



technology, but uses Western Digital's own drive platters, spindle motors, PCBA connectors, and firmware. And although the Expert uses GMR head technology, it doesn't boast the same areal densities as the Deskstar. This explains the Expert's smaller drive size and lower average read speeds.

Western Digital does shine when it comes to firmware and caching algorithms, though. The Expert's

"time to launch apps" score in the real-world benchmarking suite consistently beat out the other drives in this roundup. But the other scores were some of the slowest. Regardless, the drive is sturdy and very well priced, a full \$135 cheaper than IBM's (though 4GB smaller). The Expert comes with software utilities, cabling, data life-guard, and DFT.

### THE SPECS

#### MEASUREMENTS

3.5-inch formfactor

#### DRIVE/BUFFER SIZE

18.0GB/2MB

#### NUMBER OF DISCS/HEADS

4/8

#### SPINDLE SPEED/AREAL DENSITY

7,200rpm/3.46Gb/inch<sup>2</sup>

### MAXIMUM PC VERDICT

**Price** \$299

**Company** Western Digital

**Phone** 800.832.4778

**URL** www.westerndigital.com

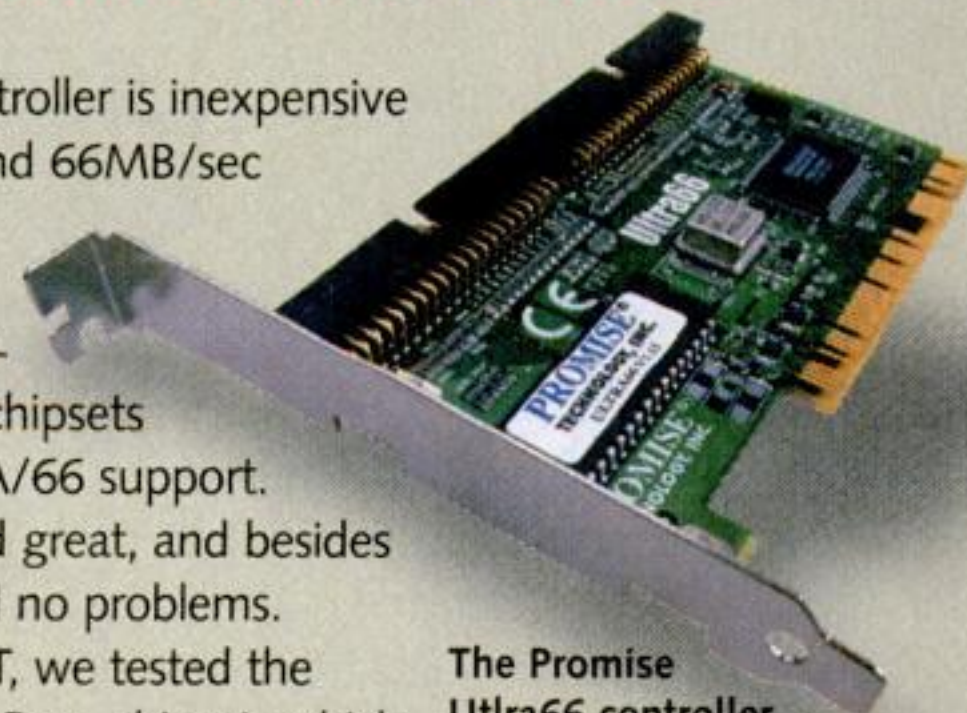


# Promise Ultra66

## The current key to UDMA/66 madness

The Promise Ultra66 controller is inexpensive and offers benefits beyond 66MB/sec support. But one thing you *won't* see is a dramatic performance difference over motherboard chipsets offering the same UDMA/66 support.

The card itself worked great, and besides the Fujitsu fiasco, we had no problems. Under Win98 and WinNT, we tested the card against VIA's Apollo Pro+ chipset, which offers UDMA/66 support as well. The Promise card and VIA



The Promise Ultra66 controller is the only game in town.

chipset ran neck-and-neck, though the chipset seemed to boot faster in Win98.

What we like most are the additional benefits the controller card offers. You get four additional ATA channels, for a total of eight including your motherboard's primary and secondary controllers. You also get support for more than 8GB when running NT on a FAT16 file system (for multibooting with Win98 and data-sharing between the two).

The card comes with an 80-conductor cable and decent instructions. If you're an early adopter and are tired of waiting for UDMA/66 motherboard support, go ahead and buy this card.

### THE SPECS

#### INTERFACES SUPPORTED

UDMA/66 and UDMA/33

#### NUMBER OF DRIVES SUPPORTED

4 (8 total with motherboard connectors)

#### DRIVE MODES SUPPORTED

Ultra DMA 4/3/2

DMA 2/1/0

PIO 4/3/2

### MAXIMUM PC VERDICT

**Price** \$49

**Company** Promise

**Phone** 408.452.0948

**URL** www.promise.com



cable check will prevent UDMA/66 drives from working at full speed across older 40-conductor cables. If the 80-conductor cabling isn't detected, the drive will operate at only 33MB/sec. This feature also prevents pre-UDMA/66 chipsets from attempting to transfer at the full speeds.

UDMA is defined by maximum transfer rates. Mode 0 supports up to 16.7MB/sec (the same as EIDE or Fast ATA-2); mode 1 is 20MB/sec; mode 2 (UDMA/33) is 33MB/sec; mode 3 is 44MB/sec; and mode 4 is the full 66MB/sec of UDMA/66.

Currently, the only chipset that fully supports UDMA/66 is the Apollo Pro+ Socket 7 chipset from VIA; best performance is gained using its VT82C686A Super South Bridge controller as opposed to its cheaper VT82C596A controller. VIA's Slot 1 Apollo Pro+ chipset, called MVP4, is not out yet.

On the Intel front, the 440BX, 440GX, and 440ZX chipsets have all been revved to support UDMA/66 drives—but *only* at mode 2 speeds, meaning the maximum transfer rate is still 33MB/sec. Intel chipsets that fully support UDMA/66 are due later this year and include Intel 810 (Whitney), Intel 820 (Camino), and Intel 840 (Carmel).

If you're waffling about buying into a new bus standard, be aware that ATA drives boasting higher areal densities and

10,000rpm spindle speeds should hit by the end of the year. This will put internal transfer rates somewhere between 20MB/sec and 30MB/sec and faster. Technologies that push the limit further are inevitable down the line. These blazing-fast internal hard drive speeds are de rigueur for high-res digital-video and DVD MPEG-2 encoding projects.

What about other interface technologies? According to recent data from Disk/Trend, a research group that follows the hard drive industry, 85% of all hard drives manufactured are sold with an ATA interface, while only 14% contain a SCSI interface. The remaining 1% of drives use Fibre Channel. With the UDMA bus supporting 66MB/sec, SCSI's current 80MB/sec doesn't seem so impressive. Nor does 1394's current 50MB/sec and USB's pathetic 1.5MB/sec. Even Fibre Channel's 100MB/sec isn't very compelling.

ATA's biggest shortcoming is its limited cable length, which is currently only about 18 inches—unsuitable for external devices. This fact alone forecasts ATA's eventual downfall to the likes of a serial interface such as 1394 or a future, higher-speed USB technology. But until then, find comfort in the fact that drives are getting faster and ATA technology has reached maturity and is giving SCSI a run for its money—at least on the desktop. ✱

# FastTrak66

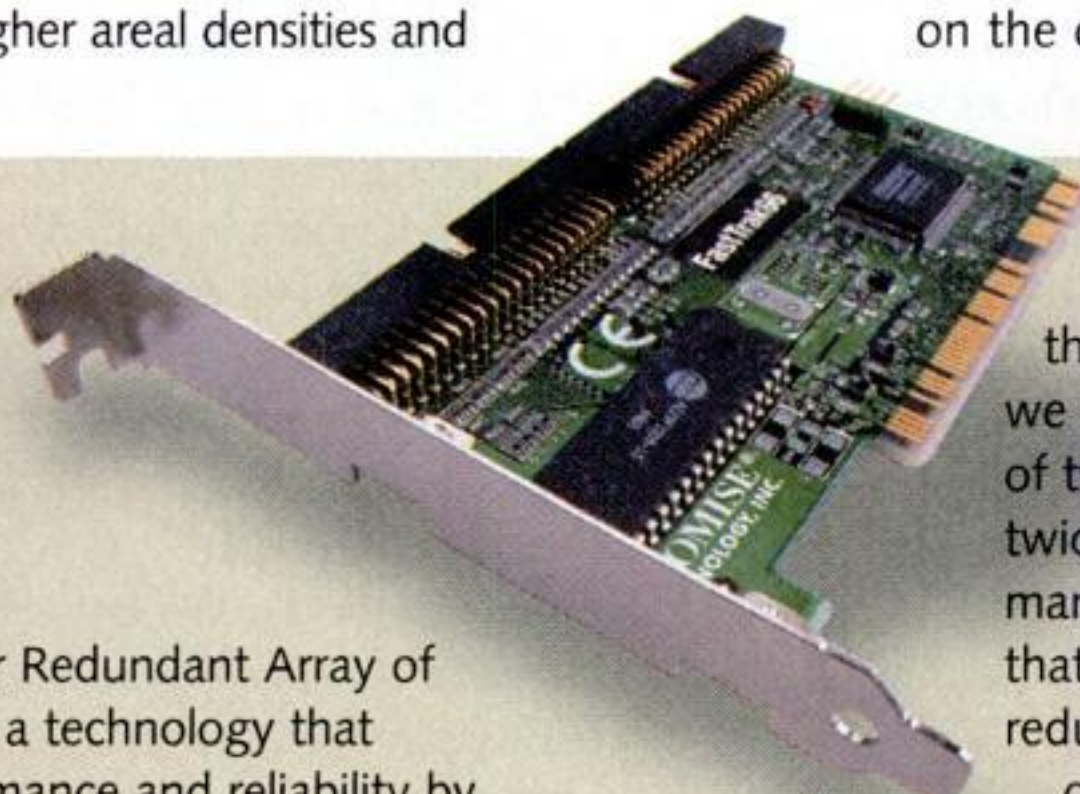
## IDE RAID on the desktop

**85% COMPLETE**

RAID, an acronym for Redundant Array of Independent Disks, is a technology that improves data performance and reliability by reading and writing information across multiple linked drives. Depending on which "level" of RAID employed, data can be interleaved across different drives (increasing overall throughput as all the drives read and write data simultaneously), or simply mirrored on more than one drive (creating a continuously updated backup drive to be used in the event your main drive fails).

Previously, RAID configurations were limited to SCSI-based hard drives and controllers. Promise breaks the SCSI barrier by offering a low-priced RAID controller that uses UDMA and "inexpensive" ATA hard drives.

We cajoled Promise into sending over a beta FastTrak66 RAID controller for preview. The board worked like a charm. We tested both RAID configurations offered (RAID levels 0 and 1) with the IBM and Western Digital drives, and found that drive throughputs doubled with two drives operating together at RAID Level 0.



**Promise's IDE RAID controller**

Using Intel Iometer and the bundled *UltraTune* utility, we squeezed 34.3MB/sec out of two IBM 22GXP hard drives, twice a single drive's performance. We did note, however, that the I/O rate was actually reduced, which is a limitation of IDE technology. Mirroring two drives delivered about the same performance as a single drive, as expected.

We found that 66MB/sec is probably a theoretical limit of UDMA/66; maximum bursts achieved only 58.2MB/sec, which is probably the real limit of UDMA/66. With the internal throughput of current ATA drives, you can fill only about half the UDMA/66 bus with two drives striped at RAID 0, although this will increase with newer, faster drives.

### THE SPECS

#### INTERFACE

Ultra DMA/66

#### NUMBER OF DRIVES SUPPORTED

4 (8 with two FastTrak cards)

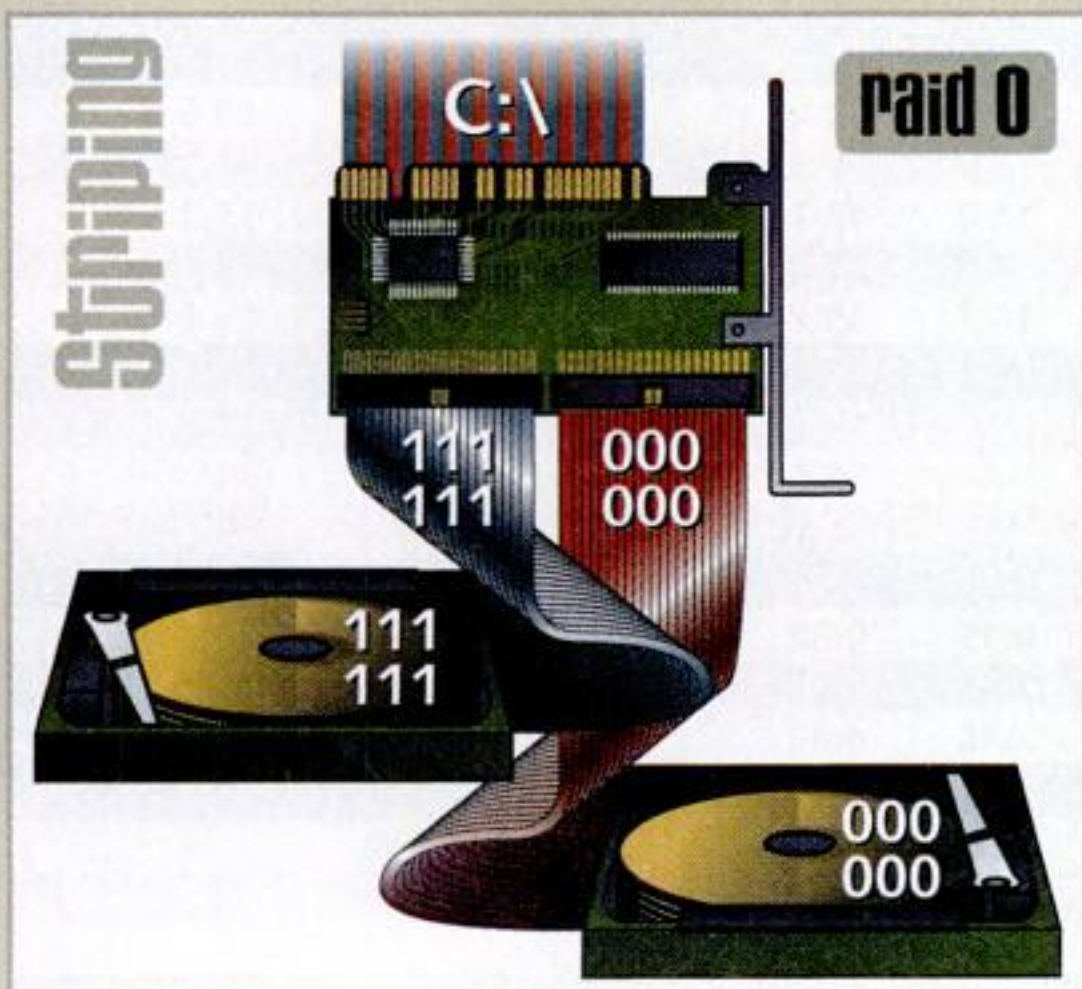
#### TYPES OF RAID SUPPORTED

- RAID 0 (2 or more drives)
- RAID 1 (Even number of drives)
- RAID 0+1 (4 or 8 drives)

### PRODUCT AVAILABLE

**Price** Approx. \$99  
**Company** Promise  
**Phone** 408.452.0948  
**URL** www.promise.com

**07.99**



**RAID 0** ► called Striping, is the fastest RAID level. Data is "striped" across the drives in the RAID array, increasing data speeds by the number of drives used. It offers no redundancy. If a drive dies, your data is lost.

**RAID 1** ► called Mirroring, offers the best data protection. Data is copied in whole to both drives, so if one dies, the other can be used. RAID 1 is more expensive and offers the least performance gains.

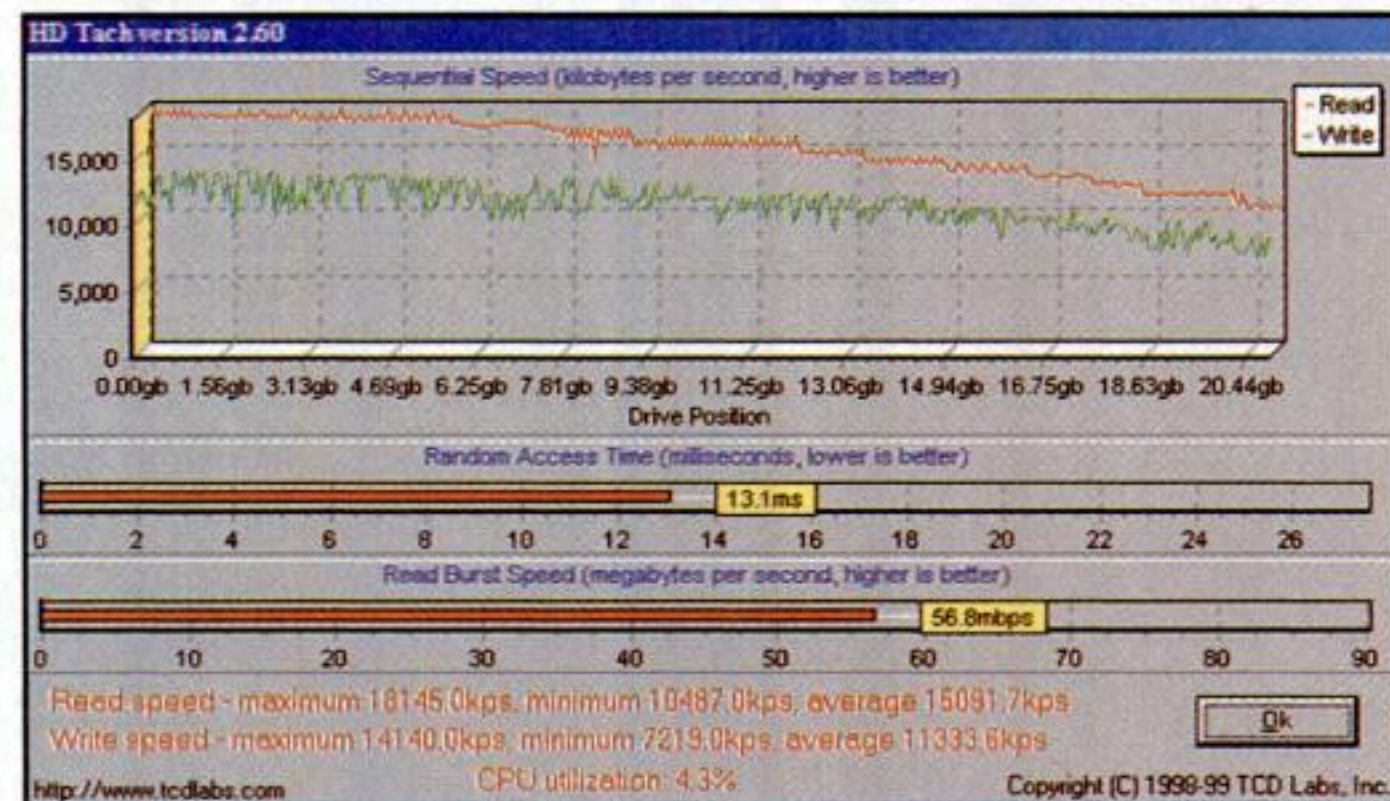
# DARE TO COMPARE

A hard drive's bus interface, cache amount, and spindle speed can tell you a lot about the drive's general performance—but nothing reveals power (and weakness) like hands-on benchmarking. In this section, we'll be looking at write speeds, random access times, CPU utilizations, and I/O rates, all of which reveal a drive's innermost secrets.

We use an exhaustive combination of lab-based and real-world benchmarks to expose subtle mechanical and electronic variances among different hard drives of the same class. For this article, all drives were tested on Promise's Ultra66 controller, which we plugged into our basic Micron P-II 400 testbed. Ultra ATA support is typically handled by motherboard chipsets, but Intel's first Ultra ATA/66 chipset, the Intel 820, won't be ready until the second half of this year. VIA will have Ultra ATA/66-compatible motherboards out before Intel, but at presstime, none were ready for 100%-reliable benchmarking. Now here's a look at our benchmark suite.

## HD Tach

The newest version of HD Tach from Testa CD Labs ([www.tcdlabs.com](http://www.tcdlabs.com)) can be found in the Benchmarking section of



HD Tach displays the drive's read and write throughputs in a chart.

our web site ([www.maximumpcmag.com](http://www.maximumpcmag.com)). HD Tach bypasses all file system caching to isolate a drive's actual performance. Specific tests include:

- ▶ **Average Read/Write Speed (MB/sec):** Sequential reads and writes are measured at multiple locations on the drive (every 32,768K) to illustrate speed variances as the read/write head moves across platters. Overall, this benchmark score is a good indicator of a drive's raw data-handling capacity. The scores we provide are the average of all reads and writes across the whole platter. Speeds may be limited by a slow or improperly configured interface, so if you receive odd scores at home, check driver and [DMA](#) settings in your Windows Device Manger.
- ▶ **Random Access Time (ms):** This is the time it takes the drive to read a random sector on the disc. Most drive manufacturers trumpet random seek times, which is the amount of time it takes to move the head to a requested track. HD Tach's Random Access test actually times the seek along with the time it takes to access nonsequential data. This average is a much more useful indicator of overall drive response.
- ▶ **Read Burst Speed (MB/sec):** The burst rate test measures the maximum data rate between the drive's onboard cache memory and system memory. Many IDE systems will perform at acceptable levels only when DMA is enabled.
- ▶ **CPU Utilization (%):** The percentage of CPU cycles used while the drive is operating at full speed is very important. The higher the score, the less access you have to your machine during large reads and writes; i.e., your CPU won't crunch numbers at full steam when your drive is simultaneously writing a large file.

## Intel Iometer

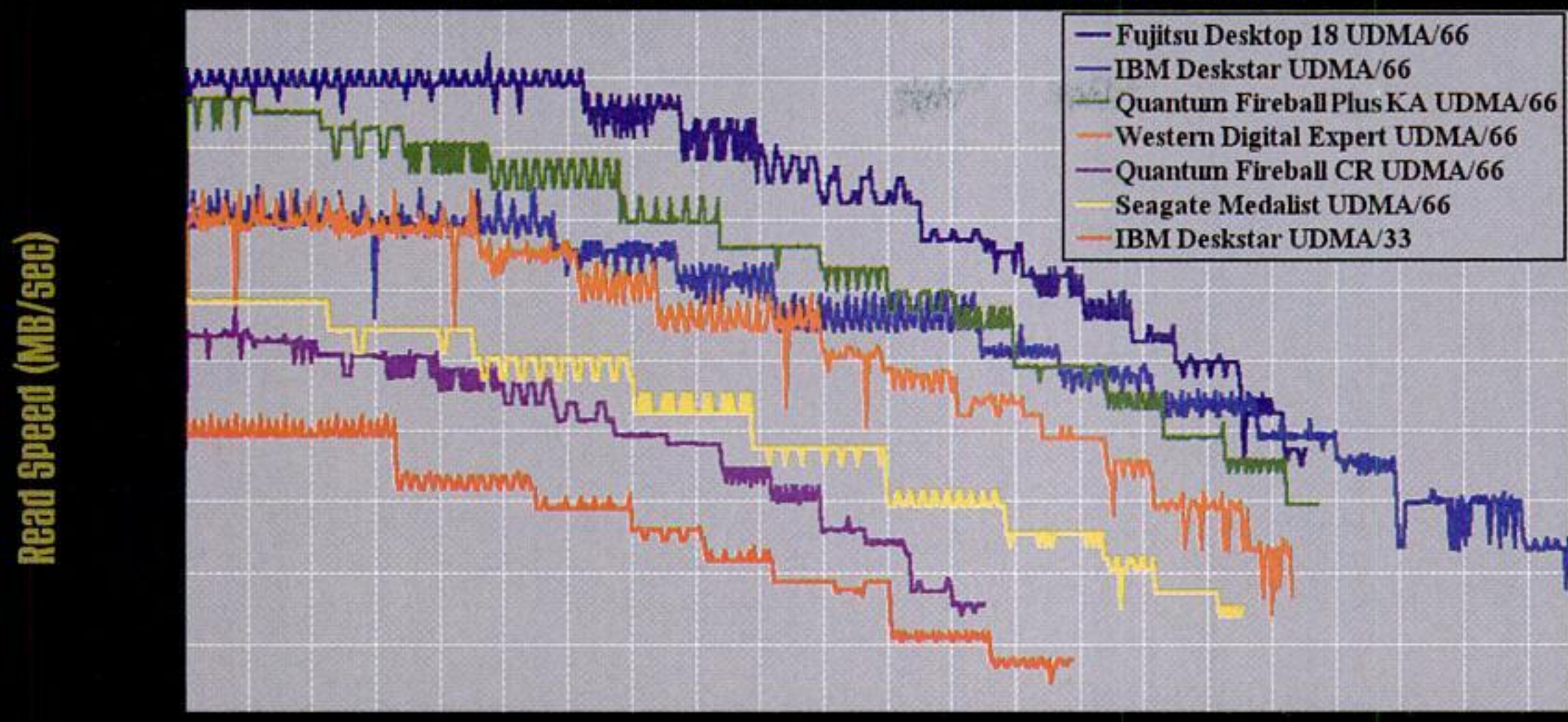
Intel Iometer is a Windows NT-specific benchmark used industry-wide to measure drive I/O performance. Any number of real-world-type scenarios can be created via its interface. More info on Iometer can be found at [developer.intel.com/design/servers/devtools/iometer/](http://developer.intel.com/design/servers/devtools/iometer/).

- ▶ **Maximum Read Speed (MB/sec):** This test performs 64K sequential reads across the whole drive to deliver a maximum throughput rate.

### DARE TO COMPARE

DRIVE	FUJITSU DESKTOP 18 MPD3182AH		IBM DESKSTAR 22GXP		QUANTUM FIREBALL PLUS KA		WESTERN DIGITAL EXPERT AC418000D	
INTERFACE	UDMA/66		UDMA/66		UDMA/66		UDMA/66	
SPINDLE SPEED	7,200RPM		7,200RPM		7,200RPM		7,200RPM	
OPERATING SYSTEM TESTED	WIN98	WINNT	WIN98	WINNT	WIN98	WINNT	WIN98	WINNT
<b>HD TACH BENCHMARKS</b>								
Average Read Speed (MB/sec)	17.8	17.8	14.7	14.7	16.2 <sup>1</sup>	16.2	14.6	14.5
Average Write Speed (MB/sec)	13.6	13.6	11.5	11.5	12.9	12.9	11.0	11.1
Random Access Time (ms)	12.9	12.5	13.1	13.1	11.8	11.7	12.8	13.2
Read Burst Speed (MB/sec)	48.3	48.6	56.3	55.8	58.1	55.7	55.3	55.8
CPU Utilization (%)	9.2	7.4	18.9	17.0	16.7	15.7	18.3	16.6
<b>INTEL IOMETER</b>								
Max. Read Speed (MB/sec)	NA <sup>2</sup>	20.0	NA	17.1	NA	19.2	NA	17.0
Max Read I/O Rate (I/O/sec)	NA	39.8	NA	34.2	NA	38.5	NA	34.1
Random Access Test (trans/sec)	NA	73.1	NA	71.2	NA	85.0	NA	70.1
<b>REAL-WORLD BENCHMARKS</b>								
Time to boot OS (min:sec)	WR <sup>3</sup>	WR	0:20	0:32	0:15	0:32	0:26	0:33
Time to launch apps (min:sec)	WR	WR	1:07	1:15	1:11	1:27	1:05	1:15
Time to copy 1GB (min:sec)	WR	WR	2:55	4:32	2:48	4:00	3:46	5:47
<b>STATS</b>								
Price	\$360		\$435		\$399		\$299	
Capacity (GB)	18.2		22.6		18.2		18	
Maximum PC Verdict	5		8		9/KICK ASS		7	

## Hard Drive Throughputs Across the Platter



Read Speed (MB/sec)

Beginning of Hard Drive

End of Hard Drive

This chart vividly illustrates the slowest portions of each drive. This info is important to digital-video freaks who need to know the slowest transfer rates in order to minimize dropped frames when capturing video.

- ▶ **Maximum I/O Rate (I/O/sec):** This test determines the maximum number of I/Os (inputs/outputs) per second by reading 512K blocks of data sequentially across the whole drive. The score reported is in total number of I/O operations per second.
- ▶ **Random Access Test (trans/sec):** This test performs 2K random reads and writes across the whole drive, representing a typical database workload. Score reported is in transactions per second (a "transaction" consists of a request followed by a reply of the same or different-size piece of data).

### Real-World Benchmarks

We used PowerQuest's *Drive Image 3.0* to copy the contents of a pre-configured hard drive to each drive we benchmarked. The drive was divided into three [FAT16](#) partitions. The first contained Win98, the second WinNT 4.0. The third

- partition was used for our data-copying test.
- ▶ **Time to boot OS (min:sec):** We recorded the time it took to boot into both Windows 98 and Windows NT 4.0, using a stopwatch. The test begins at the shared NT launch menu and stops when the Win98 or NT login screen appears.
- ▶ **Time to launch apps (min:sec):** Using a stopwatch, we recorded the time it took to launch 10 different applications from the Startup menu. The test begins from the login screen and ends when all applications are loaded. This benchmark relies heavily on the drives' onboard cache.
- ▶ **Time to copy 1.89GB (min:sec):** We packed an 18GB Seagate Ultra2 SCSI drive (24MB/sec throughput) with 1.89GB of data. We then recorded the time to copy that data from the front of the Seagate to the third partition of each drive. This benchmark exercises the whole drive and reveals latency during drive copying. ●

QUANTUM FIREBALL CR		SEAGATE MEDALIST ST317242A		IBM DESKSTAR <sup>4</sup> DTTA-371440	
UDMA/66 5,400RPM		UDMA/66 5,400RPM		UDMA/33 7,200RPM	
WIN98	WINNT	WIN98	WINNT	WIN98	WINNT
12.7	12.7	<b>12.8</b>	<b>12.8</b>	10.7	10.7
<b>9.9</b>	<b>9.9</b>	9.7	9.8	7.7	7.7
14.4	14.2	14.9	15	12.7	13
<b>58</b>	<b>55.7</b>	46.4	44.8	30.3	29.9
11.7	11.0	<b>3.6</b>	<b>2.0</b>	14.5	2.6
NA	14.7	NA	15.4	NA	12.6
NA	29.3	NA	31.0	NA	25.2
NA	<b>65.8</b>	NA	61.9	NA	69.2
0:18	0:35	<b>0:18</b>	<b>0:32</b>	0:23	0:39
1:22	<b>1:39</b>	<b>1:21</b>	<b>1:39</b>	1:23	1:33
3:16	5:39	<b>2:52</b>	<b>5:28</b>	4:49	6:51
\$219		\$280		\$455	
13		17.2		14.4	
9/KICK ASS		8		10/KICK ASS	

▶ When comparing hard drives' average speeds, you must consider drive capacities. We tested drives ranging from 13GB to 22GB. Overall average speeds on larger drives can be lower than the average speeds of smaller drives simply because of the way data is read from platters. The fastest portion of a hard drive is at the beginning of the drive, and many benchmark tests will depict read/write speeds using only the first 2GB of the drive. We feel people who buy large-capacity drives want to know what they're buying into. In these cases, it's best to see the whole enchilada.

#### NOTES

- <sup>1</sup>Bold scores denote best in category.
- <sup>2</sup>NA denotes not applicable.
- <sup>3</sup>WR denotes wouldn't run.
- <sup>4</sup>The IBM Deskstar UDMA/33 drive is not reviewed in this roundup; it received a 10 verdict in the Nov. 1998 issue and is included here for comparison purposes.



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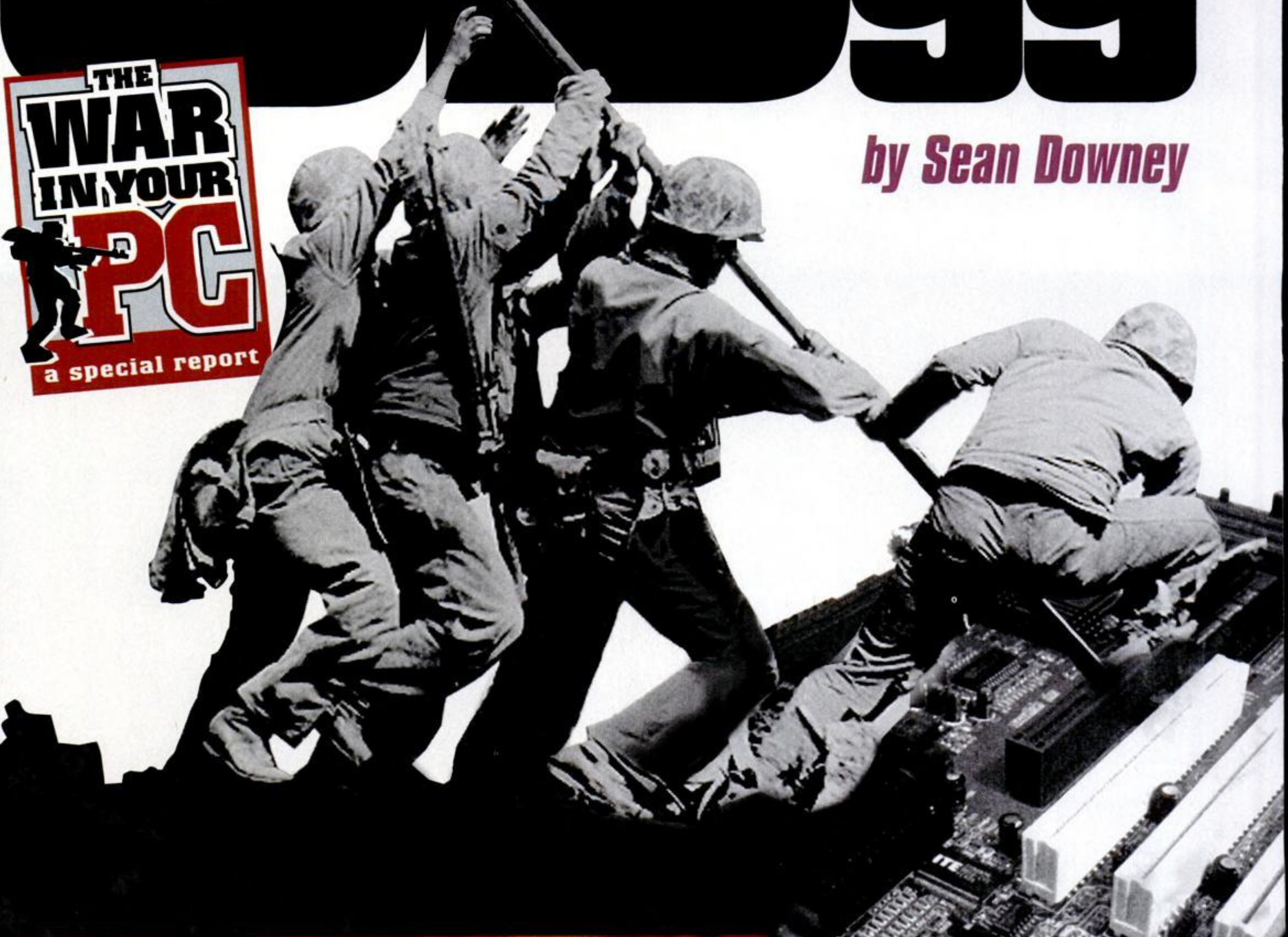
*Five new 3D chipsets are  
Our reconnaissance report  
to enjoy this year's hottest*



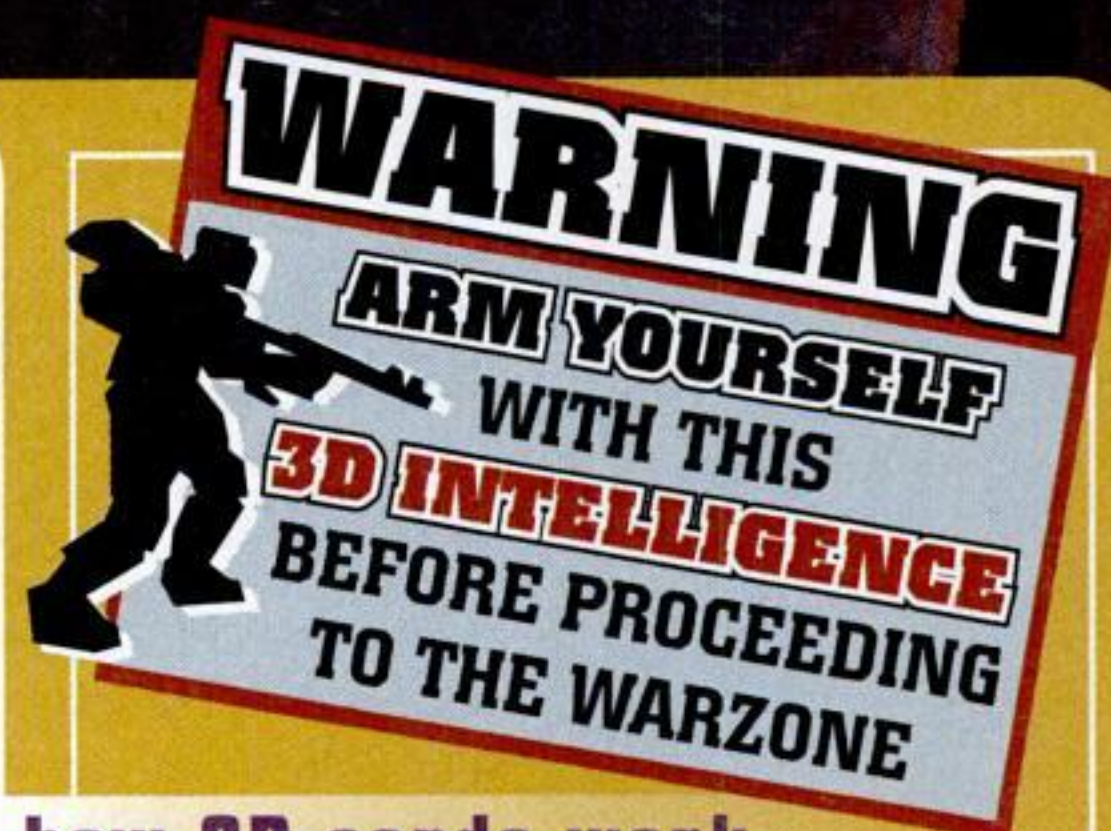
# 3D CARD CRISIS 99

*by Sean Downey*

**THE  
WAR  
IN YOUR  
PC**  
a special report



**battling for a beachhead in your computer. provides all the armament info you'll need 3D games in all their visual glory...**



PRODUCT PHOTOGRAPHY BY AARON LAUER

## how 3D cards work

Raging unabated within your PC, the three-year videocard conflict has just escalated. What began as a border skirmish over simple upgrading has intensified into a holy war over framerates and features—and no end is in sight.

Calmer heads will tell you that 100fps is speedy enough. Pacifists will whine that 16-bit color will suffice. And who needs bump-mapping anyway? But still you stick to your guns and demand more. You know full well that tomorrow's megaton games—such as *Quake III Arena* and *Unreal Tournament*—will require more than this campaign's mid-range weapon. You'll want the incendiary device of tomorrow. This hawkish approach is what drives superpowers such as

3dfx, nVidia, and ATI to fuel the arms race with the biggest, baddest 3D card the poindexters in R&D can come up with.

While the 3D powers fight for a place in your PC, you don't have to live like a refugee. The rapid proliferation of 3D technology has thrown many options into the arms bazaar, but smart tacticians will recognize which features are important. You won't enjoy playing *Half-Life* if your card's OpenGL drivers are buggier than a hot night in Manila. And without a card capable of single-cycle multitexturing, all the latest visual effects will bog down framerates.

Next-generation games are designed to look best in 32-bit color, so your next-gen videocard should be able to handle this color depth. If your 3D card *doesn't* do 32-bit rendering, be prepared for dithering artifacts and banding in textures, lighting, and alpha blends.

True-color rendering shows your 3D in the best light possible with

smooth color transitions and better image fidelity. Also pay attention to AGP payloads. AGP cards that don't leverage the full AGP spec to use system memory for texture storage are a crime against humanity. And your new card must have large-texture support to bring more realism to virtual environments. You deserve all the detail you can get.

New 3D cards launch with increasing frequency, so the battleground will only get more confusing. This fall, all the 3D superpowers will unveil new weapons of destruction. But for now, we give you the current crop of 3D fighters, each much more powerful than what was available during last winter's campaign. First we look at the cards' base technology—the acceleration chipsets in all their raw silicon fury. We then turn to the actual cards selling in armories near you. Unclear on the concept? Read our 3D intelligence report for concise, weapons-grade information.

Now put your finger over the button. It's time to drop the bomb. ▶

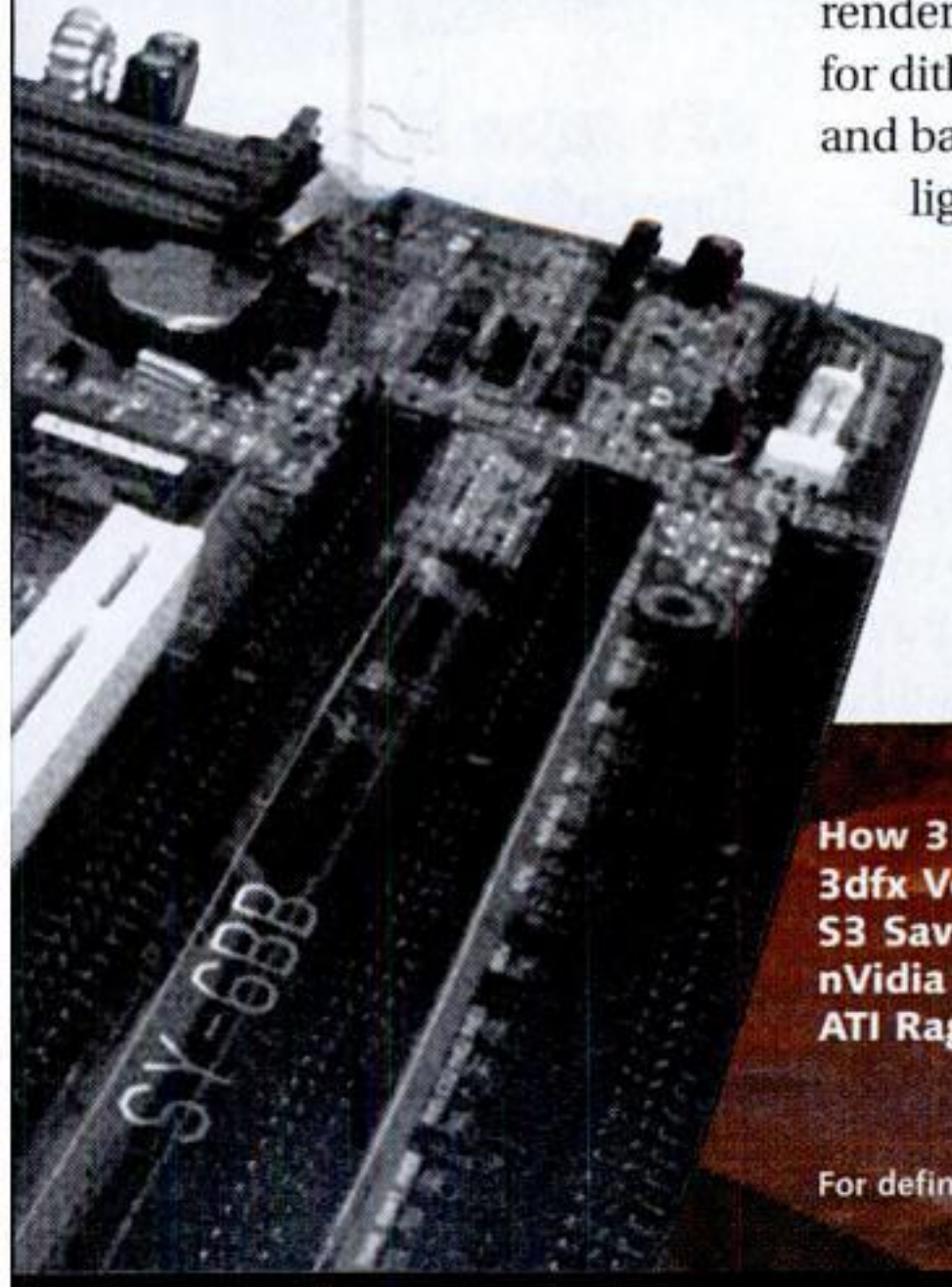
*Half-Life's* immersive worlds and *Quake's* sharply rendered gibbed chunks are the products of thousands upon thousands of calculations that transpire in the blink of an eye. This assembly line of number-crunching is called the 3D pipeline, and it's where the real battle for videocard dominance is fought.

To maintain the illusion of motion in a game, the 3D pipeline processes a new stream of data for each individual scene. When 3dfx boasts of processing 100 billion operations per second, it's making claims on how much data can be shot through the *Voodoo3's* pipeline. Each scene's geometric data is processed by the CPU and handed to the videocard, which converts the data into a grid of pixels that can be displayed on your monitor. All the chipsets in this feature use a vertex-based rasterization process, which works on the corners, or vertices, of each polygon.

The first stop along the 3D pipeline is the transformation stage, in which the CPU crunches the numbers required to create the wire mesh of polygons that forms the skeleton of each 3D object (see *illustration, page 66*). The most CPU-intensive part of the transformation stage is the creation of a geometry database. This database defines the objects in a scene according to the ever-changing perspective of the viewer. An object's position must be re-calculated and re-drawn every time it or the viewer moves, so transformation keeps this info continually updated and constantly flowing to the videocard.



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For definitions of Terminator words, hyperlink to the back of Maximum PC, or check out the Terminator online at [www.maximumpcmag.com](http://www.maximumpcmag.com).

JUL 99 MAXIMUM PC



how 3D cards work

CONT.

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In the lighting stage, the CPU calculates the surface color of each polygon. The lighting calculations resolve how each light source in the scene interacts with each 3D object according to the reflective properties of each surface. This determines the final color of the triangles that make up each polygon. After vertices are computed and colors are calculated, any polygon that isn't currently necessary on screen is clipped and discarded.

The current crop of 3D accelerators leave transform and lighting duties to the CPU; AMD's 3DNow! and Intel's SSE instructions help speed up these particular calculations. However, both 3dfx and nVidia are exploring ways to bring these tasks onboard

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# 3dfx Voodoo<sup>3</sup>

## On the road to Waterloo

With Voodoo<sup>3</sup>, 3dfx has successfully consolidated three cards into one, combining the 2D prowess of its Banshee offering with the brute texturing force of two

### THE SPECS

#### PROCESS SIZE

0.25 micron

#### CLOCK SPEED

143MHz/166MHz/  
183MHz

#### PCI/AGP SUPPORT

PCI 2.1/AGP 2x (no AGP texturing)

#### RAMDAC

300/350MHz

#### LOCAL MEMORY

4MB to 16MB SG/SDRAM

#### APPEARING ON

Voodoo<sup>3</sup> 2000 | Voodoo<sup>3</sup> 3000 | Voodoo<sup>3</sup> 3500 TV

Voodoo<sup>2</sup> boards—all in a single chip. Of course, that's what Banshee should have done, but it sacrificed single-pass multitexturing. It's safe to say Voodoo<sup>3</sup> delivers every drop of performance found in a dual-Voodoo<sup>2</sup> SLI rig with better image quality than any Voodoo that came before.

The Voodoo<sup>3</sup>'s dual-TMU architecture ladles out all the hot visual gravy you've come to expect from 3dfx, with features such as per-pixel, perspective-correct texture-mapping, a 16-bit z-buffer, and single-cycle trilinear

mip-mapping. Notably absent from the Voodoo<sup>3</sup> pot, however, are next-gen features such as single-pass bump-mapping and anisotropic filtering. But these no-shows will be the least of Voodoo<sup>3</sup>'s worries in the long run.

In a gaming world that's increasingly populated with large textures, the Voodoo<sup>3</sup> is an AGP 2x part without AGP-texturing support. On the Voodoo<sup>3</sup>, large textures (such as *Quake III*'s

**The Voodoo<sup>3</sup> takes the tandem texel-tackling power of dual-Voodoo<sup>2</sup> SLI to new heights, but does so with the same limitations.**

512x512 textures) are automatically down-sampled to 256x256. Since the Voodoo<sup>3</sup> can slam textures in and out of local memory at much



# S3 Savage4

## Custer's last stand

S3's Savage4 is everything last year's Savage3D should have been. Its 128-bit rendering pipeline provides

### THE SPECS

#### PROCESS SIZE

0.25 micron

#### CLOCK SPEED

125MHz bus/125MHz to  
143MHz memory

#### PCI/AGP SUPPORT

PCI 2.1/Full AGP 2x and 4x

#### RAMDAC

300MHz

#### LOCAL MEMORY

2MB to 32MB SG/SDRAM

#### APPEARING ON

Diamond Stealth III S540 | Hercules Terminator Beast99 | Number 9 SR9 | Creative Labs 3D Blaster Savage4 | Elsa Winner II

the multitexturing goods sorely lacking in the Savage3D, and the Savage4's full 32-bit color-rendering path brings the full monty to your screen in true-color glory. The Savage4 carries on the 2D video strengths of its predecessor with MPEG-2 motion compensation and high-quality scalar video playback, mixing up a high-grade cocktail for DVD junkies. Add in de rigueur features such as a 32-bit z-buffer with an 8-bit stencil buffer, single-pass bump-mapping (embossing), anisotropic filtering,

and full-scene anti-aliasing, and you have a Savage sequel that's cleaned-up and ready to meet the folks.

To separate itself from the crowd, the Savage4 also offers full-speed trilinear filtering and MPEG-2 video textures, as well as S3's much-vaunted hardware texture compression (S3TC). Built into DirectX 6.0 (and available as an OpenGL extension), S3TC's 6:1 compression ratio takes full advantage of AGP

**S3's sequel to the Savage3D pulls together all the pieces that didn't make it into the original.**

texturing by allowing larger, high-quality textures to be peeked and poked in and out of system memory.



100% COMPLETE



VISUAL QUALITY



Quake III | 640x480

higher speeds than AGP texturing allows, 3dfx figures the chipset's 256x256 texture limitation is a small price to pay for faster framerates.

Also cutting into the life span of the Voodoo<sup>3</sup> is its lack of a full 32-bit rendering pipeline. The Voodoo<sup>3</sup> follows in the steps of its ancestors by rendering internally at a 32-bit color depth and dithering down the output to a tame 16-bits. Even though the Voodoo<sup>3</sup> makes great strides in image quality by banishing banding artifacts with a post-processing filter, true 32-bit rendering backed by a 32-bit

z-buffer would do a lot to remove a big question mark in front of Voodoo<sup>3</sup>'s future.

The Voodoo<sup>3</sup> is currently shipping in two flavors, the 143MHz Voodoo<sup>3</sup> 2000 and the 166MHz Voodoo<sup>3</sup> 3000. Defining the high end of the Voodoo<sup>3</sup> line is the multimedia-rich Voodoo<sup>3</sup> 3500 TV. This 183MHz AGP/PCI part adds video capture (including MPEG-2 encoding on the fly), a TV tuner, high-quality video-out, an FM stereo tuner, and DVD-playback support. You can expect to see the Voodoo<sup>3</sup> 3500 TV in the July timeframe.

3DFX VOODOO<sup>3</sup> 3000

Sure the Voodoo<sup>3</sup> 3000 isn't all that Voodoo<sup>3</sup>'s capable of, but it's still enough to put it in the pole position in our Unreal and Half-Life timedemos. But framerates aren't everything, especially when the Voodoo<sup>3</sup> can't run any of our 32-bit benchmarks.

Even though the Voodoo<sup>3</sup> is a framerate dynamo, 16-bit rendering is so last year. Voodoo<sup>3</sup>'s 16-bit limitation results in ugly dithering in the Quake III test's textures and smoke effects.

REAL WORLD BENCHMARKING

FORSAKEN 1024x768 fps	97.4	<div style="width: 97.4%;"></div>
BATTLEZONE 1024x768 fps	53.6	<div style="width: 53.6%;"></div>
QUAKE II 800x600 fps	82.0	<div style="width: 82.0%;"></div>
HALF-LIFE 800x600 fps	48.3	<div style="width: 48.3%;"></div>
EXPENDABLE* 1024x768 fps	NA	<div style="width: 0%;"></div>
UNREAL 1280x1024 fps	27.6	<div style="width: 27.6%;"></div>

As always, V-sync is enabled. \*Test done in 32-bit color. Voodoo<sup>3</sup> doesn't support 32-bit color.

96% COMPLETE



VISUAL QUALITY



Quake III | 640x480

With compression engaged, Savage4 can move more textures across the AGP bus per clock cycle than any other 3D chip. Since the Savage4 is also an AGP 4x part. This feature will come to the fore as Camino opens up AGP's 1GB/sec peak transfer rate. In short, the Savage4 will easily bandy about 2048x2048 textures.

While not a rendering powerhouse on par with Voodoo<sup>3</sup> and TNT2, the Savage4 isn't a second-class 3D part. Its biggest strength is high image quality without a significant performance hit.

The promise of large textures being employed in S3TC-enhanced titles such as *Unreal Tournament* and *Quake III Arena*, combined with the Savage4's sturdy 32-bit rendering performance, should be enough to keep other 3D superpowers at bay.

The Savage4 comes in two varieties, both with the same bus clock speed. The Savage4 Pro differentiates itself from the more docile Savage4 chipset with a 143MHz memory clock (Savage4 runs 125MHz memory). Both cards reviewed in this feature are 32MB Savage4 Pro boards.

HERCULES TERMINATOR BEAST99

While the Hercules Terminator Beast99 has driver issues to resolve, it's still a good representation of what you can expect from the Savage4. And its OpenGL ICD still needs a lot of work.

Visual quality in the Quake III test is pretty good—the yellow texture along the gunstock shows the mottled details, and the Savage4 gets a great boost in framerates when using compressed textures. It does, however, have a nasty texture-shifting problem when lightmapped lighting is turned on.

REAL WORLD BENCHMARKING

FORSAKEN 1024x768 fps	60.3	<div style="width: 60.3%;"></div>
BATTLEZONE 1024x768 fps	38.3	<div style="width: 38.3%;"></div>
QUAKE II 800x600 fps	56.7	<div style="width: 56.7%;"></div>
HALF-LIFE 800x600 fps	38.3	<div style="width: 38.3%;"></div>
EXPENDABLE* 1024x768 fps	19.8	<div style="width: 19.8%;"></div>
UNREAL 1280x1024 fps	11.2	<div style="width: 11.2%;"></div>

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

how 3D cards work

cont.

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the videocard.

The 3D chipset's current job is to render the geometric data processed in the transform and lighting stages. Rendering connects the dots of the vertices and applies effects such as shading, texture-mapping, and alpha-blending to construct a lush 2D representation of a 3D scene on your monitor. To facilitate faster rendering, the chipsets in this feature are dual-pipelined, meaning they can apply two effects in a single pass.

Chipsets are made or broken by the speed and quality of their rendering. To sustain the illusion of seamless motion, the 3D chipset must be able to process thousands of polygons for each frame and continually update the

66 ▶



# nVidia TNT2

## Storming the beach at Normandy

The TNT2 is a highly clocked cruise missile with a radar lock on

first-rate image quality and ultra-fast rendering. Armed with a dual-pipelined multi-texturing warhead and loaded up with a radioactive mixture of 32-bit color and full AGP texturing support, the TNT2 should have 3dfx checking the integrity of its fallout shelters.

Besides upping the clock speed of its second-generation 128-bit Twin Texel processor, nVidia optimized the chipset's processing pipeline (to complement the faster clock). The TNT2 is stocked with the same dictionary

of 3D features as its predecessor. Important items such as single-pass bump-mapping (embossing) and trilinear and anisotropic filtering make the list, as well as order independent full-scene anti-aliasing, and per-pixel perspective-correct lighting and mip-mapping.

The primary knock against TNT2 is on the 2D side. TNT's sub-par 2D performance never

did much to light the fuse of die-hard video-files, since image quality dropped off at higher resolutions (1152x864 and above).

Although TNT2 addresses its predecessor's

### THE SPECS

#### PROCESS SIZE

0.25 micron

#### CLOCK SPEED

125MHz to 150MHz bus/  
150MHz to 183MHz memory

#### PCI/AGP SUPPORT

PCI 2.1/Full AGP 2x/4x

#### RAMDAC

300MHz

#### LOCAL MEMORY

4MB to 32MB SDRAM

#### APPEARING ON

Diamond Viper V770 | Elsa Synergy II | Guillemot Maxi Gamer Xentor32 | Hercules Dynamite TNT/2 | Creative Labs 3D Blaster TNT2 Ultra | Asus AGP-V3800 | Leadtek Winfast S320 II



**nVidia does just about everything right with the highly combustible follow-up to its Twin Texel graphics processor.**

# ATI Rage 128 GL

## Charging up Hamburger Hill

When it was introduced earlier this year, the Rage 128 brightened the 3D landscape with excellent true-color performance. Built around a 128-bit dual-

graphics pipeline, the Rage 128 was the new kid on the block with the shiniest duds—namely, a beefy triangle setup engine and ATI's new-fangled Dual Cache Architecture, featuring 8K pixel and 8K texture caches for keeping data closer to the graphics processor. Add in a 128-bit memory interface and a 32-bit z-buffer with an 8-bit stencil buffer, and you have a chipset built with 32-bit color rendering in mind. Unfortunately, the Rage 128 has been dogged with glaring visual deficiencies, particularly

when it comes to rendering at 16-bit color depths.

Since its introduction, the Rage 128 has been slow to mature into the rendering powerhouse it was designed to be. Sure it does single-pass bump-mapping (embossing), single-cycle trilinear filtering, full-scene anti-aliasing (albeit with a big performance hit), and per-pixel perspective-correct mip-mapping, but the Rage 128 doesn't pull the fill

**While the Rage 128 doesn't match the speed of the TNT2, it makes up ground with its rich 2D features.**

rates it takes to be king of the hill. While ATI stumbled, the other 3D superpowers caught up to the Rage 128's high-

### THE SPECS

#### PROCESS SIZE

0.25 micron

#### CLOCK SPEED

100/105MHz bus,  
100/120MHz memory

#### PCI/AGP SUPPORT

PCI 2.1/Full AGP 2x

#### RAMDAC

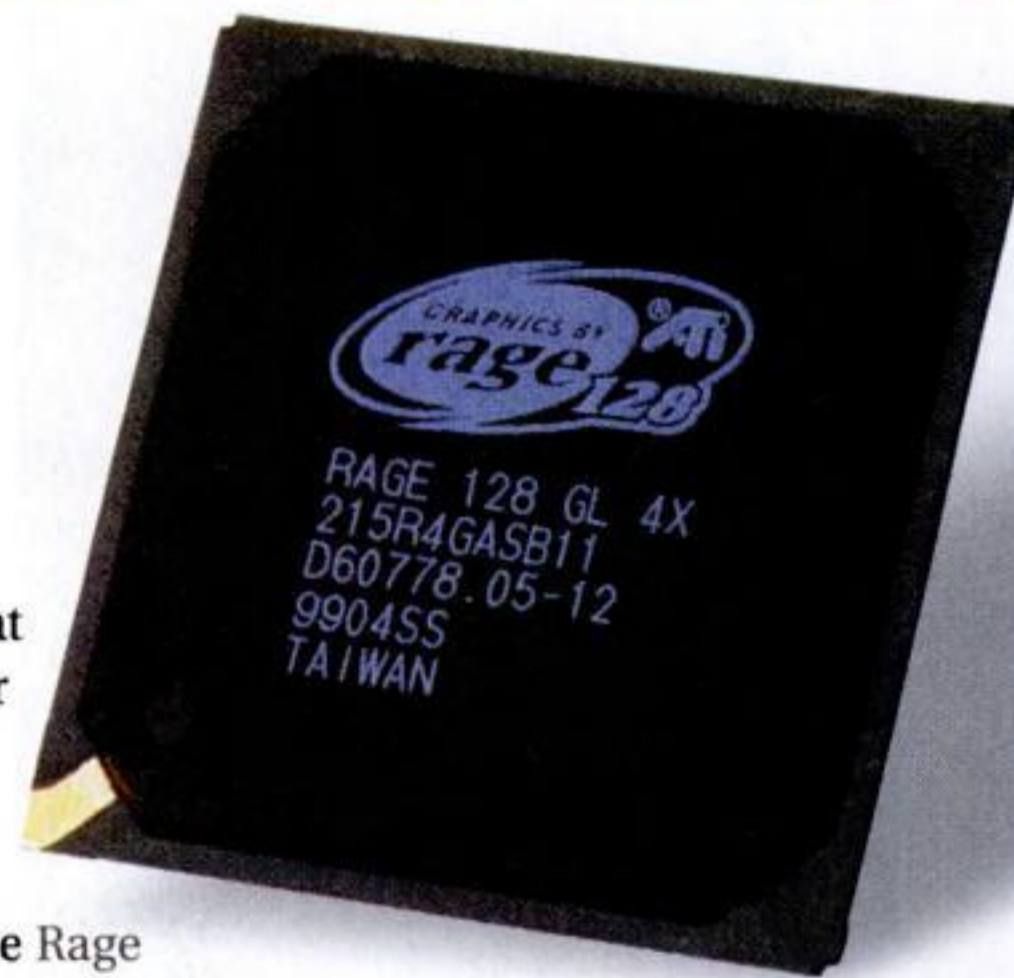
250MHz

#### LOCAL MEMORY

16MB to 32MB SDRAM

#### APPEARING ON

Expert 128 | Rage Magnum | Rage Fury | All-in-Wonder 128



99% COMPLETE



VISUAL QUALITY



Quake III | 640x480

weakness, it does only enough to bring high-res image quality to average; Matrox and ATI are still the 2D image-quality kings. And while the feature set lists MPEG-2 motion compensation, DVD playback on the TNT2 is far from up to snuff.

Clock speed and memory configurations vary widely between board manufacturers, but most cards will clump around the regular TNT2 mark (125MHz bus/ 140MHz memory) and the high-end TNT2 Ultra mark (150MHz bus/183MHz memory). The two cards

reviewed in this feature represent the mid- and high-end of TNT2.

Although it looks as if TNT Ultra is the bomb that will end the 3D jihad between nVidia and 3dfx, don't count out the ultra-fast, multimedia-rich Voodoo<sup>3</sup> 3500 TV due this July. And, yes, TNT2 cards clocked higher than nVidia's recommended high-end speed will be appearing in the next few months, so you can expect the sectarian violence between the 3dfx and nVidia factions to heat up as the summer does.

DIAMOND VIPER V770

Diamond's Viper V770 Ultra really shows off what TNT2 can do. TNT2 brings good color quality in the textures and visual effects to your screen, but it tends to wash out shadows, as illustrated in the column above the grunt's head.

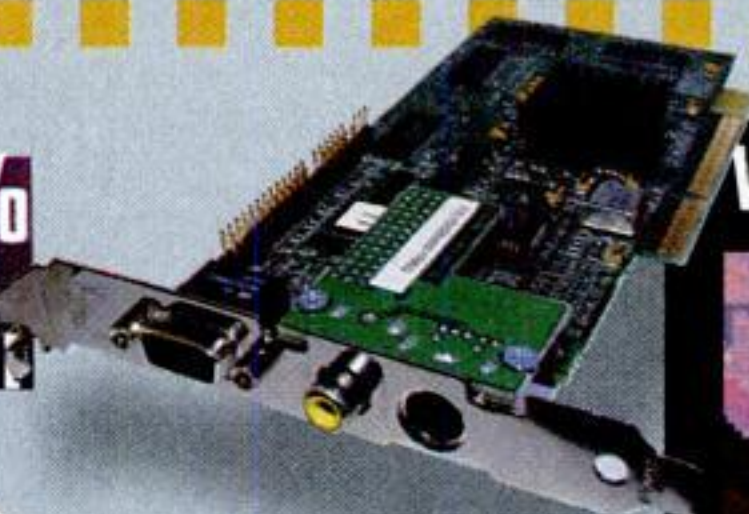
The big question mark with TNT2 is the reliability of the final product. With board manufactures over-clocking their parts and shipping a hodge-podge of different versions of nVidia's reference drivers, TNT2 quality depends heavily on the company delivering it.

REAL WORLD BENCHMARKING

FORSAKEN 1024x768 fps	108.7	
BATTLEZONE 1024x768 fps	65.3	
QUAKE II 800x600 fps	84.3	
HALF-LIFE 800x600 fps	37.5	
EXPENDABLE* 1024x768 fps	45.9	
UNREAL 1280x1024 fps	20.8	

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

100% COMPLETE



VISUAL QUALITY



Quake III | 640x480

color image quality and surpassed it in performance. But where other chipsets—such as TNT2—sacrifice 2D features to focus on 3D rendering performance, ATI relishes its role as the top dog of 2D video playback.

The Rage 128's excellent hardware support allows you to get funky with DVD playback without having to resort to a dedicated MPEG-2 decoder. While most 3D chipsets offer MPEG-2 motion compensation acceleration, ATI does them one better with built-in iDCT (inverse Discrete

Cosine Transform) for ultra-low CPU utilization and high-resolution decoding.

ATI serves the Rage 128 on four different boards. The entry-level Expert 128 and the OEM-designed Rage Magnum are stocked with 16MB and 32MB SDRAM, respectively. The high-end Rage Fury comes equipped with 32MB and both S-Video and composite-out. The All-in-Wonder 128 comes in both 16MB and 32MB versions, and features a TV tuner and all the video in and out I/Os you can pack onto one PCB.

ATI RAGE FURY

ATI's top-of-the-line Rage Fury card represents the Rage 128 name. We reviewed this card in our May issue, but ATI addressed the alpha-blending dithering problem mentioned in the review with new drivers and sped up the board a wee bit.

The Quake III test's color consistency is strong, showing off the Rage 128's excellent true-color support, but the chipset still doesn't spew the kind of framerates TNT2 can. You can see how ATI improved its alpha blends in the smoke swirling above the grunt's head.

REAL WORLD BENCHMARKING

FORSAKEN 1024x768 fps	67.6	
BATTLEZONE 1024x768 fps	54.7	
QUAKE II 800x600 fps	60.1	
HALF-LIFE 800x600 fps	27.0	
EXPENDABLE* 1024x768 fps	24.0	
UNREAL 1280x1024 fps	16.8	

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

# Matrox G400

## Mounting the Tet Offensive

The G400 arrives locked and loaded with a new 256-bit dual graphics pipeline that guns John Woo-style through independent, 128-bit buses. While 2D performance benefits the most from the G400's two-fisted, pixel-tossing action, 3D

rendering gets its mojo running as well, bringing playable 1280x1024, 32-bit resolutions to 3D junkies everywhere. Enhancing Matrox's new 256-bit DualBus is a spiffy new Rendering Array Processor that brings with it the single-cycle multitexturing capabilities that the G200 lacked, as well as a 128-bit memory interface to speed through data bottlenecks that get between you and your texels.

Since high-res rendering doesn't mean much without visual candy (a lesson Matrox learned a long time ago), the G400 lays out the goods with

perspective correction, trilinear and anisotropic filtering, and per-pixel mip-mapping. In order to improve on the G200's high-color rendering process, Matrox added alpha-blending units to the G400's internal pipeline to maintain color vibrancy throughout games packed to the gills with alpha-blended effects and multitexturing. Bring on board a 16- or 32-bit z-buffer and an 8-bit stencil buffer, and the G400 is ready to take on all comers.

The G400 is also the first 3D chipset to support environment-



**The G400 is a highly innovative chipset that doesn't skimp on visual quality or rendering speed.**

mapped bump-mapping in hardware, allowing surface detail to be increased through an extra "bump" layer without a big performance hit. As opposed to the embossing bump-mapping supported by

the other chipsets in this feature, the G400's environment-mapped bump-mapping is more versatile and visually appealing, since all the height, depth, and lighting calculations in the bump layer are done on a per-pixel basis.

There's a hell of a lot of innovation going on under the hood of the G400, such as built-in support for dual displays—a handy feature for creative types

**THE SPECS**

**PROCESS SIZE**  
0.25 micron

**CLOCK SPEED**  
Spec unavailable

**PCI/AGP SUPPORT**  
Full AGP 2x/4x, no PCI

**RAMDAC**  
300/360MHz

**LOCAL MEMORY**  
8MB to 32MB SDRAM

**APPEARING ON**  
Millennium G400 I  
Millennium G400 MAX

### how 3D cards work

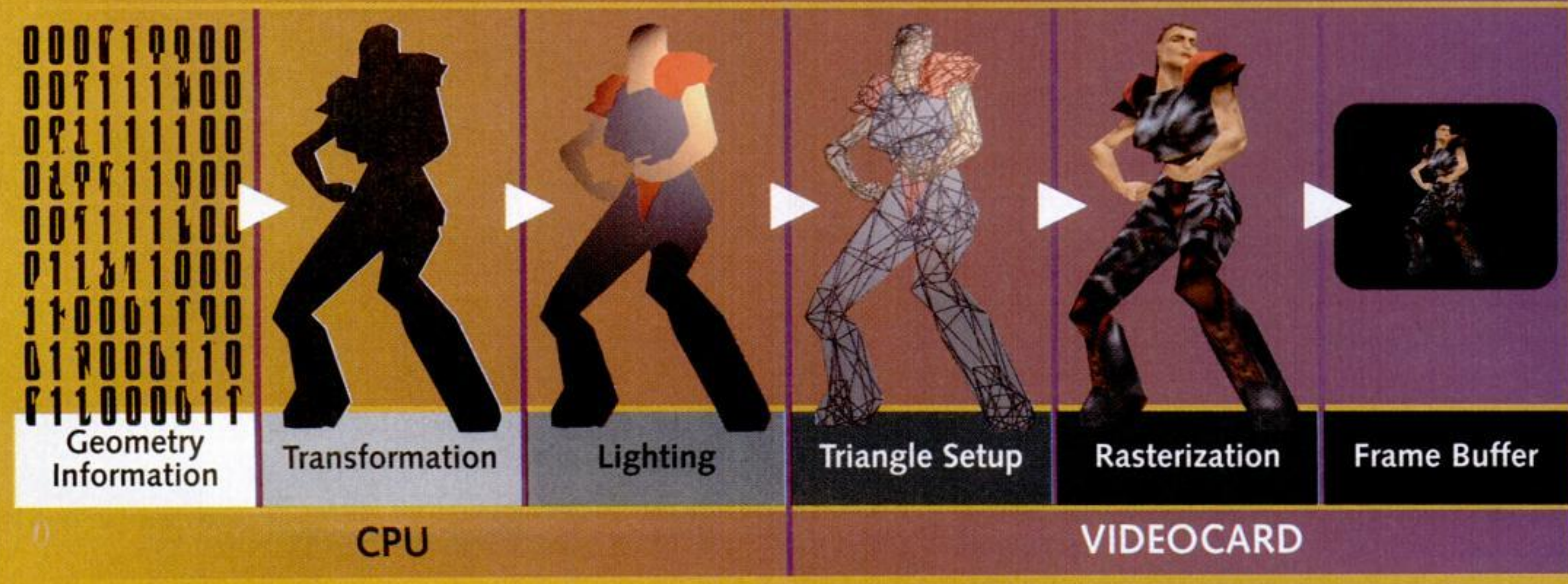
cont.

◀ 64 screen with the new data coming down the pipeline. The all-important gauge of rendering speed is framerate, or the number of times each second that a scene

can be redrawn. The rendering path starts at triangle setup. The first stage of triangle setup applies the color information passed down through the lighting process. While this

may seem simple, it's made more complex through texture-mapping. Texture-mapping wraps an image over an object's surface, adding more detail and realism without increasing the number of

### 3D card pipeline ▶



90% COMPLETE



and gamers who need to bathe themselves in extra monitor emissions. Matrox pulls off this trick by packing two separate CRT controllers onboard and allowing each to independently fetch display data from different locations in the frame buffer or directly from AGP memory.

Enhancing the G400's DualHead features even further are new display tools that allow you to select a portion of the screen on one monitor and zoom in close on the other. For 2D video, the G400 offers MPEG-2 motion compensation to aid DVD playback, as well as a

realtime aspect-ratio conversion so you can view letterbox movies full-screen without the black borders.

The G400 will make its initial appearance in the final Millennium boards to be released this millennium. It will be available in a mildly clocked version and a super-clocked version, dubbed the G400 MAX. Shipping in June, the Millennium G400 will come in 16MB and 32MB configurations, and the Millennium G400 MAX will be a 32MB-only part. You can also bet that Matrox will release a TV-tuner/video editing version of the G400 later this year.

### MATROX MILLENNIUM G400 MAX

The Matrox Millennium G400 MAX is all the G400 you should ever need. It kept up with TNT2 through most of our benchmarks and produced stunning visuals. When it comes to color vibrancy the G400 is king. Its tonal quality shows off the color variations of the gunstock texture that the other cards wash out.

Keep in mind that the benchmarks were done on beta hardware with beta drivers. You can expect the final shipping version to be a little faster. Expect a review as soon as Matrox is ready to roll.

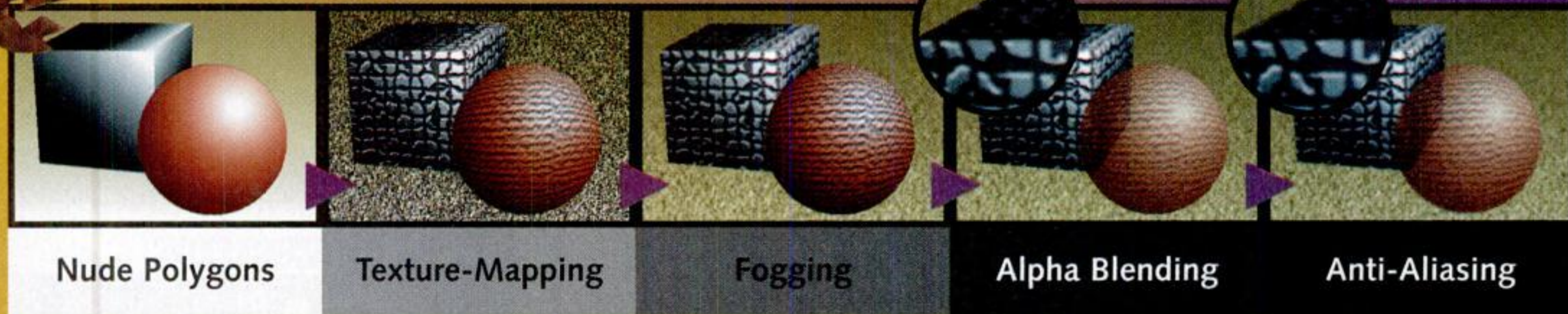
### VISUAL QUALITY



FIRST LOOK BENCHMARKING	<b>FORSAKEN</b> 1024x768 fps	<b>117.6</b>	
	<b>BATTLEZONE</b> 1024x768 fps	<b>51.1</b>	
	<b>QUAKE II</b> 800x600 fps	<b>66.6</b>	
	<b>HALF-LIFE</b> 800x600 fps	<b>26.7</b>	
	<b>EXPENDABLE*</b> 1024x768 fps	<b>51.4</b>	
	<b>UNREAL</b> 1280x1024 fps	<b>23.5</b>	

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

## rendering effects ▶



Fogging creates an illusion of distance by blending the pixels in a scene with a fog effect. The amount an object in a scene is blended depends on its z depth. Alpha blending uses the 8 alpha bits available in 32-bit color to create translucency layers and combine them for advanced lighting effects. Anti-aliasing smooths out the stair-step effect that crops on polygon edges when they're translated into pixels.

polygons on screen. Multitexturing ups the ante further by blending two or more textures on one surface to achieve special lighting or bump-mapping effects (a bump map adds to the object surface an embossed grain that can react with environmental lighting).

The second stage of triangle setup is basically a flattening process. Here, the floating-point x, y, and z vertex coordinates for each polygon are converted into fixed x and y points that correspond to

on-screen pixels. Since displays are 2D only, the z values are fed to a z-buffer, which keeps track of the depth of each rendered pixel. The z-buffer helps determine whether a pixel needs to be drawn, based on what else lies in front of it along the z-axis. If the pixel is hidden behind another object and doesn't need to be displayed, it isn't rasterized, thus saving rendering time.

The rasterization process takes everything handed down to it through the 3D

pipeline and generates the final pixels that will be loaded into the frame buffer, the onboard memory that temporarily stores the image sent to your monitor. Don't think of this as a one-way process, because data stored in the frame buffer can be read back and combined with new data coming down the pipeline. The interaction between the rasterizing process and the frame buffer enables pixel-specific effects such as alpha-blending, fogging, and anti-aliasing. ●

3DFX VOODOO3

## 3dfx Voodoo<sup>3</sup> 3000



The Voodoo<sup>3</sup> 3000 incorporates everything you could want from the Voodoo architecture, but its limits keep it from greatness.

With a 166MHz core, the Voodoo<sup>3</sup> 3000 is a powerful 16-bit renderer that easily surpasses the pixel-pumping prowess of a dual-Voodoo<sup>2</sup> SLI configuration. Last year's games shine on the

Voodoo<sup>3</sup> 3000, thanks to the 16MB of SDRAM working at the same speed as the processor core. And Voodoo<sup>3</sup> delivers better color consistency than the Voodoo<sup>2</sup>'s over-filtered rendering.

The Voodoo<sup>3</sup> 3000 sports a 350MHz RAMDAC for excellent 2D visuals at

resolutions up to 2048x1536 at a 60Hz refresh rate. The card's TV-out capabilities are handled through a Rockwell video encoder, which pipes its signal through an S-video port. While video-out support is relatively good, the image quality isn't on par with ATI's All-in-Wonder 128. We were surprised, however, at the 3000's high-quality DVD playback.

While the Voodoo<sup>3</sup> 3000 is a solid performer, it's hard to recommend a card that doesn't support 32-bit rendering or AGP texturing, especially since TNT2 Ultra boards support

these features and edge out the 3000's performance marks.

### MAXIMUM PC VERDICT

**Price** \$180  
**Company** 3dfx  
**Phone** 888.367.3339  
**URL** www.3dfx.com

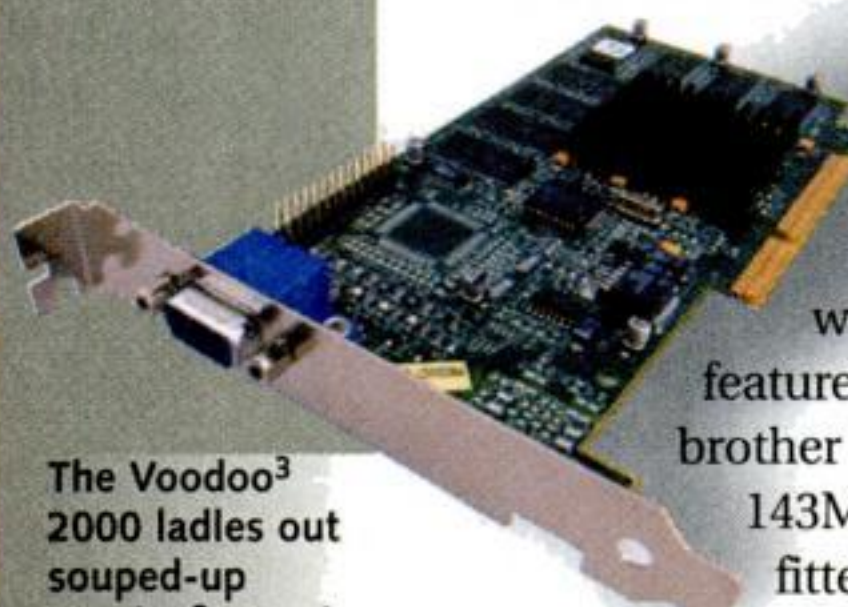


### REAL WORLD BENCHMARKING

QUAKE II 1024x768 fps	56.9	
HALF-LIFE 800x600 fps	48.3	
EXPENDABLE 1024x768 fps	47.9	
DESCENT 3* 800x600 fps	NA	

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

## 3dfx Voodoo<sup>3</sup> 2000



The Voodoo<sup>3</sup> 2000 ladles out souped-up Voodoo<sup>2</sup> visuals with aplomb, but not at speeds that make it a must-have upgrade.

Defining the low end of Voodoo<sup>3</sup> is the 2000, which is packed with the same features as its big brother but is clocked at 143MHz. It comes outfitted with a 300MHz RAMDAC, which

takes it to the same high-res realms as the 3000. And while the Voodoo<sup>3</sup> 2000 is loaded with 16MB SDRAM and delivers the same multitexturing mojo as its sibling, it does so at a lower fill rate. In fact, the 2000 offers

only marginal improvements over a dual-Voodoo<sup>2</sup> SLI rig.

If you're wed to your Glide-only games and would like to free up a PCI slot by ditching your dual-Voodoo<sup>2</sup> rig, the PCI version of the 2000 may make sense. Since the Voodoo<sup>3</sup> architecture doesn't take full advantage of AGP, the performance difference between the PCI and AGP versions is pretty slight. Of course if you're planning on running a Voodoo<sup>3</sup> 2000 PCI board alongside your AGP card, you'll need Win98's multiple monitor support, since

Voodoo<sup>3</sup> doesn't work with pass-through cables.

### MAXIMUM PC VERDICT

**Price** \$130  
**Company** 3dfx  
**Phone** 888.367.3339  
**URL** www.3dfx.com



### REAL WORLD BENCHMARKING

QUAKE II 1024x768 fps	53.5	
HALF-LIFE 800x600 fps	46.4	
EXPENDABLE 1024x768 fps	45.6	
DESCENT 3* 800x600 fps	NA	

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

S3 SAVAGE4

## Hercules Terminator Beast99



Poor drivers keep the Terminator Beast99 from discovering its inner beauty.

Even though it's equipped with 32MB of 143MHz SDRAM, the Terminator Beast99 doesn't quite do the Savage4 Pro justice. The pre-release drivers provided for our review produced funky visual deficiencies in several of our benchmarks (such as odd triangle artifacts

in *Expendable's* multitextured explosions) and generally constrained the hardware's full potential. If you really want to know what the Savage4 Pro can do, check out the Stealth III S540,

which posted marginally better scores on every test and displayed much better visual quality, except in OpenGL games.

2D performance on the Beast99 is a little stronger thanks to the 300MHz RAMDAC kicking out clean 1600x1200 resolutions at a 60Hz refresh. Stronger still is the Beast's DVD playback, displaying full-screen video with nary an artifact to be seen. Sadly, Hercules doesn't provide a DVD player with the Terminator Beast99, so you'll have to dig one up on your own if you want

some DVD lovin' piping through your videocard.

### MAXIMUM PC VERDICT

**Price** \$130  
**Company** Hercules  
**Phone** 800.532.0600  
**URL** www.hercules.com



### REAL WORLD BENCHMARKING

QUAKE II 1024x768 fps	36.0	
HALF-LIFE 800x600 fps	38.3	
EXPENDABLE 1024x768 fps	24.5	
DESCENT 3* 800x600 fps	23.1	

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

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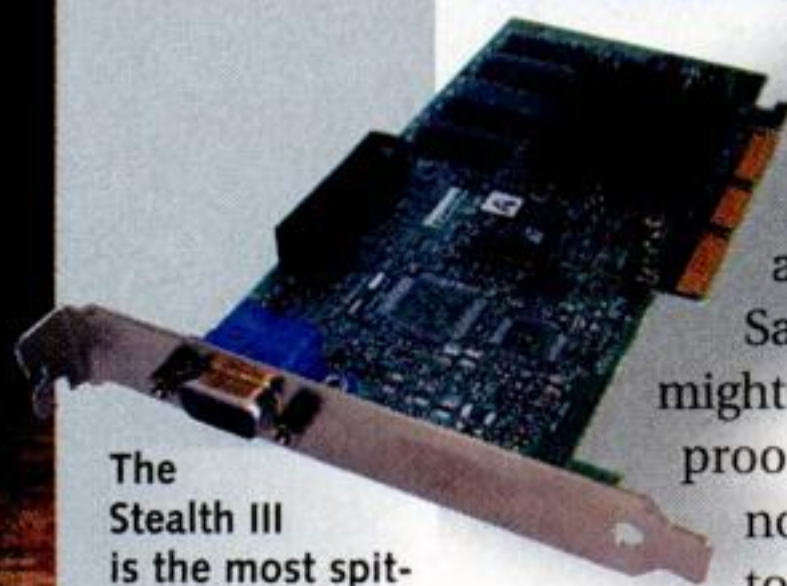
Features advertised are for retail products only and may not apply to bulk versions. Please refer to original retail packaging for details. For performance comparison, visit [www.matrox.com/mga/microbench](http://www.matrox.com/mga/microbench). \*The 3dfx Voodoo3 3500 does not support 32-bit rendering.

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S3 SAVAGE4

# Diamond Stealth III S540



The Stealth III is the most spit-shined version of the Savage4, but there just isn't enough spit available to increase the chipset's performance.

The Stealth III arrives with 32MB of 143MHz SDRAM and an itch to prove the Savage4 Pro chipset's might. On the 2D side, no proof is necessary. We notched our display up to 1920x1200 at 60Hz, thanks to the Stealth III's 300MHz RAMDAC. And the Stealth III played crisp video using Diamond's bundled Zoran SoftDVD player.

Unfortunately, the Stealth III is an underpowered 3D board. Diamond, however, complements the chipset

with strong drivers and the InControl Tools 99 utility, which enables V-sync and fog table features, and customizes gamma, brightness, and contrast for each game. Tweaked settings apply only to the game running.

While the Stealth III didn't have the same visual problems in Direct3D games as the Terminator Beast99, it did display the same nasty texture shimmering in OpenGL mode (particularly in *Half-Life*). Given the visual glitches and generally poor performance from Savage4 boards in OpenGL,

it looks like S3's OpenGL ICD still needs a lot of work.

MAXIMUM PC VERDICT

Price \$130  
Company Diamond  
Phone 800.468.5846  
URL www.diamondmm.com



REAL WORLD BENCHMARKING

QUAKE II 1024x768 fps	36.2	<div style="width: 36.2%;"></div>
HALF-LIFE 800x600 fps	38.4	<div style="width: 38.4%;"></div>
EXPENDABLE 1024x768 fps	23.5	<div style="width: 23.5%;"></div>
DESCENT 3* 800x600 fps	23.6	<div style="width: 23.6%;"></div>

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

NVIDIA TNT2

# Diamond Viper V770



The Viper V770 Ultra is a versatile powerhouse that's primed and ready for the next generation of games.

Stocked with 32MB SDRAM and conservatively clocked at nVidia's recommended 150MHz, the Viper is the texel-tossing titan. Its only black mark is poor image quality in DVD playback.

The final version of the Viper V770 Ultra isn't clocked as high as the pre-production board in our May TNT2 preview. Diamond shied away from 175MHz for stability reasons, and given the problems we encountered with other highly

clocked TNT2 boards, we understand why.

While the jury's still out on the clocking decision, Diamond does compensate for it with an overclocking tool built into the new InControl Tools 99. Core and memory clocks can be bumped up in 5MHz increments in specific games—when the game's over the clocks fall back. Unlike other overclocking sliders we've seen, Diamond's is limited to a 175MHz core and 200MHz memory.

In its push to get the Viper to market, Diamond based its drivers on an older version of nVidia reference

drivers. Expect a big performance jump as Diamond incorporates speedier nVidia drivers into its updates.

MAXIMUM PC VERDICT

Price \$250  
Company Diamond  
Phone 800.468.5846  
URL www.diamondmm.com

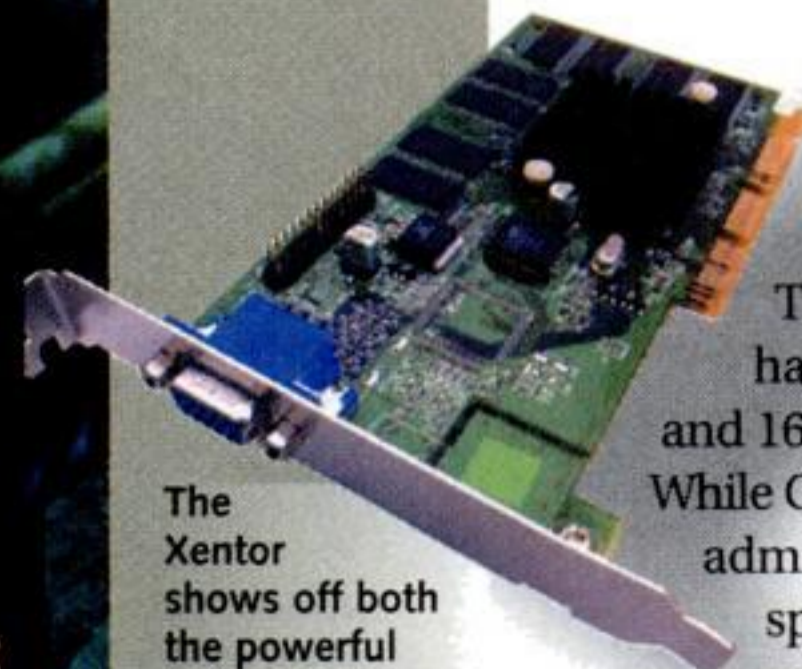


REAL WORLD BENCHMARKING

QUAKE II 1024x768 fps	61.3	<div style="width: 61.3%;"></div>
HALF-LIFE 800x600 fps	37.5	<div style="width: 37.5%;"></div>
EXPENDABLE 1024x768 fps	55.9	<div style="width: 55.9%;"></div>
DESCENT 3* 800x600 fps	37.4	<div style="width: 37.4%;"></div>

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

# Guillemot Maxi Gamer Xentor



The Xentor shows off both the powerful performance and the unreliability of an overclocked TNT2.

Guillemot wraps up a lethal bundle of TNT2 in the Xentor. Otherwise based on the regular TNT2 specs, the Xentor has a core clock at 135MHz and 16MB of 166MHz SDRAM. While Guillemot's ambitions are admirable, the higher clock speed combined with pernickety drivers makes for an unreliable videocard.

Powered by a 300MHz RAMDAC, the Xentor should hit 1920x1440 with at least a 60Hz refresh rate, but when we set the resolution that high we

ended up with a blank screen. The card repeatedly locked up the screen when recovering from Direct3D games. Other visual defects cropped up in *Half-Life*, making any weapon held in the foreground flicker, but this problem went away after we rebooted.

The performance marks on the Xentor are damn good, thanks in part to Guillemot's decision to base its drivers on newer nVidia reference drivers. Unlike other TNT2 boards, the Xentor doesn't come with an overclocking slider, but since it's unstable

at its current frequency, cranking up the clock would be a disaster.

MAXIMUM PC VERDICT

Price \$150  
Company Guillemot  
Phone 888.893.2648  
URL www.guillemot.com




REAL WORLD BENCHMARKING

QUAKE II 1024x768 fps	56.1	<div style="width: 56.1%;"></div>
HALF-LIFE 800x600 fps	36.8	<div style="width: 36.8%;"></div>
EXPENDABLE 1024x768 fps	52.8	<div style="width: 52.8%;"></div>
DESCENT 3* 800x600 fps	37.9	<div style="width: 37.9%;"></div>

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

# ABOVE ALL, ELSA.

Be honest, you ever see what 16 megs of frame buffer and a 32-bit color Twin-Texel pipeline does to 3D? Check out the new ELSA **ERAZOR III** graphics accelerator with the  processor. It runs 3D at an unheard of 2048 x 1536 resolution and 2D that makes all the other stuff a dream. Is it fast?...heh...heh...heh.

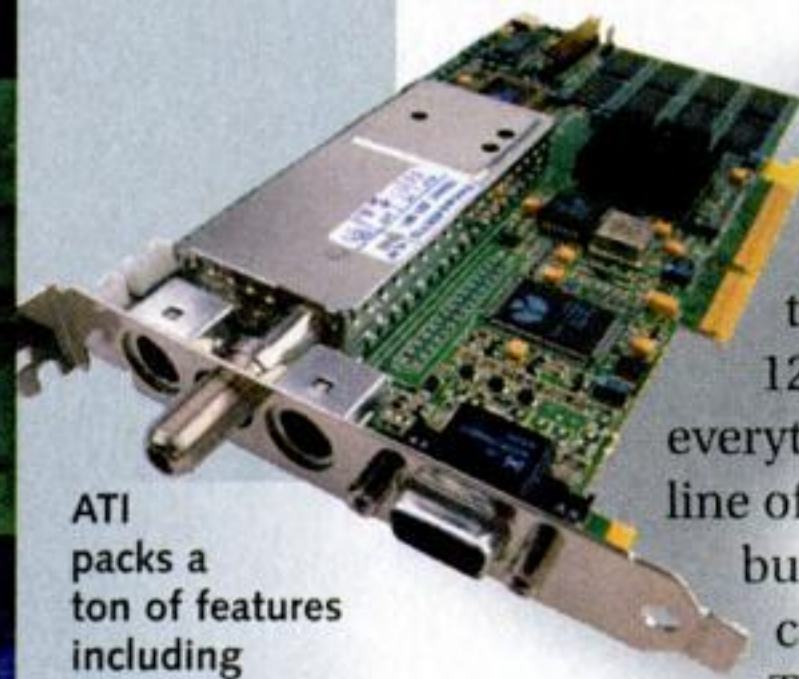


# ELSA

800.272.ELSA or [www.elsa.com/AMERICA](http://www.elsa.com/AMERICA)

ATI RAGE 128

# All-in-Wonder 128



ATI packs a ton of features including competent 3D onboard the All-in-Wonder 128.

Armed with 16MB of 105MHz SDRAM and a 250MHz RAMDAC, the All-in-Wonder 128 updates ATI's everything-to-everyone line of videocards. This burly board packs a cable-ready stereo TV tuner, a Brooktree video decoder, and ATI's own ImpacTV2 chip for high-quality TV-out. All the audio/video inputs have been moved to a breakout box that connects to the back of the card, while a DIN cable takes care of TV-out and audio-out to your soundcard.

While the All-in-Wonder's 3D rendering abilities put it solidly on middle ground, it dominates the 2D world. ATI's new multimedia center has cool new features, including a DVD player that kicks out crisp, full-screen video playback, an intelligent TV tuner with instant replay and zoom control, and a digital VCR that does on-the-fly video-capture and compression, including MPEG-2—the first videocard we've seen that does this. Of course, you need a Pentium III to pull this off, and the card couldn't actually capture at 320x240 without dropping frames. We had to drop to 176x144 to get reliable MPEG-2 captures.

## REAL WORLD BENCHMARKING

<b>QUAKE II</b> 1024x768 fps	<b>41.1</b>	
<b>HALF-LIFE</b> 800x600 fps	<b>27.3</b>	
<b>EXPENDABLE</b> 1024x768 fps	<b>13.7</b>	
<b>DESCENT 3*</b> 800x600 fps	<b>33.7</b>	

As always, V-sync is enabled. \*Indicates test done in 32-bit color.

Standard AVI capture is strong, however, sucking down 640x480 resolutions without a single hiccup.

## MAXIMUM PC VERDICT

**Price** \$191  
**Company** ATI  
**Phone** 905.882.2600  
**URL** www.atitech.com



# CHIPSET SHOWDOWN

Our benchmarks are based on real games that post real framerates—not abstract numbers spit out by simulation software. And in staying true to the real-world gaming experience, we leave on sound and V-sync.

Armed with the latest drivers, each 3D card was placed in the same test system—500MHz Pentium III, 440BX AGPset, 128MB SDRAM, and Win98. Benchmarks were run at the highest refresh rate the videocard would allow to alleviate any V-sync

bottlenecks. The higher of two scores was recorded for accuracy. Since the 21-inch Sony F500 monitor we used allows triple-digit refresh rates, we didn't hit a framerate limit on a single benchmark.

For this feature, we limited our tests to the Pentium III platform. However, we'll include numbers from different platforms in reviews posted to our web site.

This feature marks the last appearance of our old Direct3D benchmarks and the introduction of new tests. Say goodbye to Forsaken and Battlezone, and say hello to Descent 3 and Expendable. Our two new Direct3D tests take advantage of the true-color rendering and multitexturing capabilities of the latest wave of 3D cards. Our OpenGL benchmarks consist of Quake II and Half-Life timedemos. Since the timedemo feature of the Quake III test is currently broken, we've limited ourselves to just screenshots.

## DARE TO COMPARE

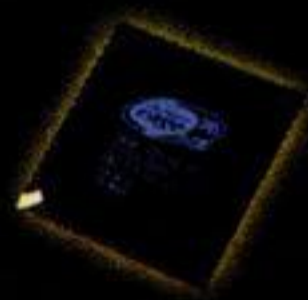
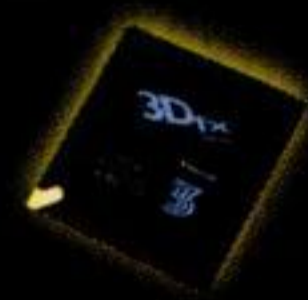
3DFX VOODOO<sup>3</sup>

S3 SAVAGE4

NVIDIA TNT2

ATI RAGE 128

MATROX G400



	3DFX VOODOO <sup>3</sup>	S3 SAVAGE4	NVIDIA TNT2	ATI RAGE 128	MATROX G400
Bus support	PCI/AGP 2x	PCI/AGP 2x/AGP 4x	PCI/AGP 2x/AGP 4x	PCI/AGP 2x	AGP 2x/AGP 4x
Max texture size	256x256	2048x2048	2048x2048	2048x2048	2048x2048
Size of processing path	Dual 64-bit (128-bit)	128-bit	Dual 64-bit (128-bit)	Dual 64-bit(128-bit)	Dual 128-bit(128-bit)
Local memory	4MB-16MB SDRAM	2MB-32MB SG/SDRAM	4MB-32MB SDRAM	16MB-32MB SDRAM	8MB-32MB SDRAM
RAMDAC	300/350MHz	300MHz	300MHz	250MHz	300/360MHz
Max. 2D resolution	2048x1536	1920x1440	1920x1200	1920x1440	2048x1536
z-buffer	16-bit	32-bit/8-bit stencil	32-bit/8-bit stencil	32-bit/8-bit stencil	32-bit/8-bit stencil
32-bit color rendering	No	Yes	Yes	Yes	Yes
Trilinear filtering	Yes	Yes	Yes	Yes	Yes
Anisotropic filtering	No	Yes	Yes	No	Yes
Single-pass multitexturing	Yes	Yes	Yes	Yes	Yes
Bump mapping	No	Yes	Yes (single-pass)	Yes	Yes (environment mapped)
MPEG-2 motion comp.	Yes	Yes	Yes	Yes + iDCT <sup>1</sup>	Yes
Supported APIs	Glide/Direct3D/OpenGL <sup>2</sup>	Direct3D/OpenGL	Direct3D/OpenGL	Direct3D/OpenGL	Direct3D/OpenGL <sup>2</sup>

<sup>1</sup> Inverse Discrete Cosine Transform

<sup>2</sup> Both the 3dfx and Matrox OpenGL ICDs are still in beta and most likely will stay that way for the foreseeable future.

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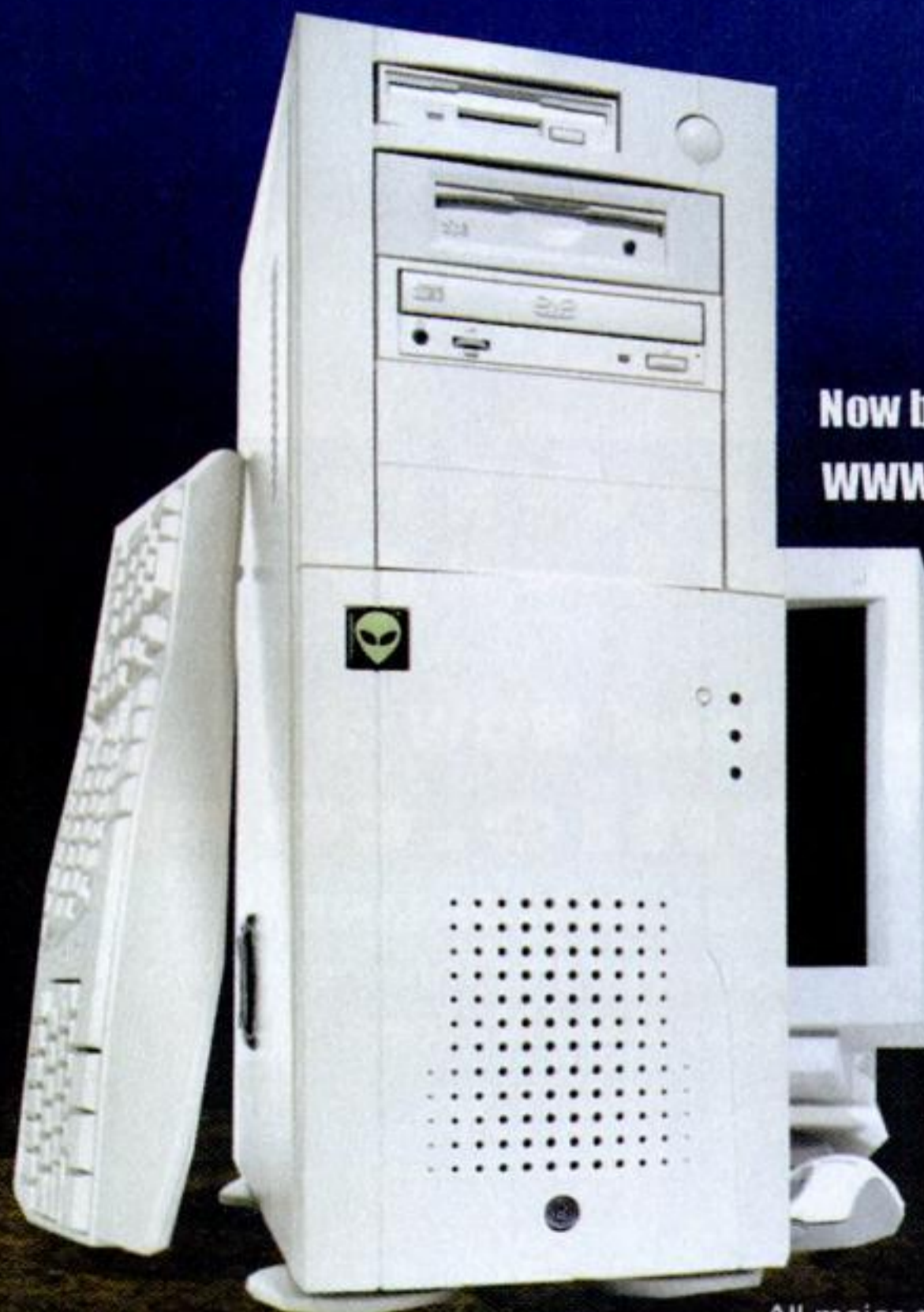


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## Logo A-Go-Go

I want to edit my MSDOS.SYS file in Windows 98 to lose the Windows startup screen. Using Windows Explorer, I located the hidden file and removed the check mark. However, when I tried to open the file to edit, nothing happened. What should I do?

—Steven Wheeler

```
msdos.sys - Notepad
File Edit Search Help
[Paths]
WinDir=C:\WINDOWS
WinBootDir=C:\WINDOWS
HostWinBootDrv=C
[Options]
BootMulti=0
BootGUI=1
Logo=0
;The following lines are required for compatibility
;Do not remove them (MSDOS.SYS needs to be >1024 by
```

Just add the syntax circled in red.

Call me Kevorkian—it's time to euthanize that Windows startup logo:

- ▶ Locate the correct file by doing a find for MSDOS.SYS. You'll want to play with the file that sits in the root C:\ directory.
- ▶ Right-click on the file icon, and choose Properties from the submenu. Uncheck the Read-only and Hidden boxes. Hit OK.
- ▶ Double-click the file icon, and open the file with Notepad.
- ▶ Under the Options list, add in the logo-blasting syntax `Logo=0`
- ▶ Save your changes and reboot. You should find the Windows logo missing. Its absence is quite breathtaking, really.

## Get the Red Out

I got a new HP Ergo Ultra VGA monitor at a local computer show for \$60, but I can't get it to display any red at all. All red things appear black. I was sitting there thinking about the situation, and the red momentarily kicked in for about a half-second. Now I'm sitting here wondering what the problem is: the monitor, the Matrox Mystique videocard, or the drivers? Any advice would be appreciated, because playing games with black flames is really lame.

—Noah Kasudyo

**Whenever Windows 95 boots up, the dialup networking goes into action and logs onto the Internet.**

**The Doctor's** gut diagnosis is that you've lost your red electron gun and only your green and blue guns are firing—which is what you should expect for \$60. But just for giggles, let's talk troubleshooting and try to isolate the problem. First, run the monitor on another system. If you experience the same problem, you know your new display is dust. If the problem goes away, turn to the videocard: Is it firmly installed in its slot? Have you installed the latest drivers? Is it possible you misadjusted your color or gamma controls? Peck around—but chances are you've been had by the old "local computer show" gremlin (why doesn't this little bastard cheat people at "remote" computer shows, too?).

## Mixing Memory

I have a 430TX motherboard with two DIMM slots and four SIMM slots. I have 32MB of EDO SIMMs in my computer right now. Can I put a piece of 32MB SDRAM in my DIMM slot and use it with my SIMMs at the same time?

—Jason Yang

Because they have different voltage requirements, memory modules shouldn't be mixed. Plus, most dual-memory boards allow only one type to be used at a time. For the definitive answer you should really check your motherboard manual.

## Auto-Net Annoyance

For some strange reason, whenever Windows 95 boots up, the dialup networking goes into action and logs onto the Internet. I don't want that to happen. Ideas?

—David F. Shupp

If it's logging in without asking for information, check "Prompt for information" in the Settings menu of your Dial-Up Networking folder. Also uncheck the "Connect to Internet as needed" box in your Internet Control Panel. You might also have software installed that loads upon boot-up and automatically tries to go online. Check your startup folder and the RUN section of your Registry for any Internet clients that may be firing up your connection.

# Ask the Doctor

## This month:

- ▶ **86ing the Win98 logo**
- ▶ **Ending spontaneous net connections**
- ▶ **Can I mix memory types?**
- ▶ **Fixing nasty screen slant**

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## I Went Zig, My Monitor Went Zag

I'm using a Matrox Millennium G200 alongside a Diamond Voodoo<sup>2</sup> card. The problem is that my Mag DX715T monitor displays characters slanting to the right across the entire horizontal plane. I consulted the vendor where I got the monitor, and he said it's probably the Matrox drivers. Customer support at Mag told me to send the monitor to one of its service depots for a check-up. Do I have a bad driver or a bad monitor?

—Bill Chong

**The Doctor's** never heard of bad drivers causing this problem. I've never heard of videocard silicon causing this problem. I've never heard of a bad monitor tube causing this problem. I'd like to know more about the severity of the problem and whether it really only happens to text characters, but my guess is your monitor's geometry is set improperly.

Do you have Key Balance and Rotation controls? Key Balance adjusts your picture's tilt with respect to a level horizontal plane. The Rotation control literally rotates your entire picture on its central axis, up to about three to five degrees in either direction. If you have these controls, adjust them and see if the problem goes away. If you don't have these controls, you're at the mercy of your monitor's internal circuitry, which seems to be out of wack. Indeed, it's possible Mag could fix this at the service depot, or at least send you a new display.

## The Lowrider's Lament

I have a P200 MMX running on a Tyan Titan Turbo S1571 AT-2 motherboard with 64MB of EDO memory. Whenever I run the Norton System Information benchmark, I only get a score of about 57.2. Am I missing something, because it seems awfully low to me?

—Heath Summerlin

Actually, your score is excellent. **The Doctor** has seen different P200 MMX machines hit 49, 55, and 57 on the old Norton benchmark. Granted, these boxes only had 32MB of memory, but your system is still on the high-end of the P200 spectrum.

Norton System Information—which we use to test basic CPU, cache, core-logic-chipset, and memory performance—times how long it takes to execute a variety of

repeating instructions and then spits out an arbitrary score. The benchmark can be downloaded from our web site. With pre-Pentium II and -Celeron chipsets, scores

don't improve when you add memory beyond 64MB. MMX support also has no effect on the benchmark scores. Go to [www.symantec.com](http://www.symantec.com) for the full story. ●



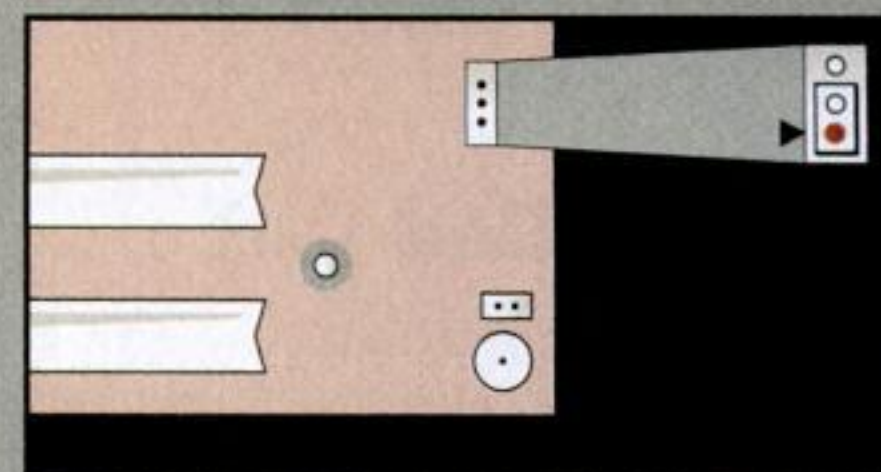
## overclocker's CORNER

### Colin, Get to Know Your Mobo

I have a Dell Dimension XPS D233 that I bought in January 1998. I'd like to know who makes the motherboard so that I can flash the BIOS with a full-featured version. Dell disables many options, and I believe that they disable the ability to overclock the CPU. I tried to bump it up one bin, and it just sat there, no activity at all.

—Colin Bembridge

You're wandering down the wrong path by looking for answers in a BIOS update. Like most motherboards of its ilk, the D233's mobo includes a jumper in the lower-right hand corner (to the right of the ISA slots) that toggles between Normal and Maintenance mode. Normal mode denies bin jumps; Maintenance mode allows the manufacturer—and wily overclockers—to set the BIOS anywhere from 200MHz to 333MHz. You can get into Maintenance mode by moving the jumper's plastic clip to cover the top two pins. Many Pentium II motherboards use this very same jumper, so this advice should help many people, regardless of which companies made their systems.



This jumper is still in normal mode.

I found all this information in the support section of Dell's web site. Words of wiz: Before buying a new system, check the manufacturer's web site for its breadth of technical information. Does it provide motherboard schematics? Some do, some don't. But as you get into nitty-gritty upgrading, you're going to want a web site that treats you like an engineer instead of a dreaded "end user."

By the way, the Dell web site has a BIOS update from 01/14/99. ●

### Is It Me, or Does It Feel Hot in Here?

I have a P-II 350 on an MSI 6119 BX mobo. I am conservative in my overclocking, going 3.5 x 103. I also have a 7,200rpm Seagate hard drive, Matrox G200 videocard, and a Voodoo<sup>2</sup>, so it gets pretty warm. I'd like to go to a 112MHz bus, but heat is a concern. My motherboard comes with a utility called *Soft Cooler*, and I use a utility called *Waterfall*, as well. I suppose I can add more fans, but I hate noise. I'd just like to know what is the safe temperature of a CPU. I heard it was about 50° Celsius.

—Hubert Wong

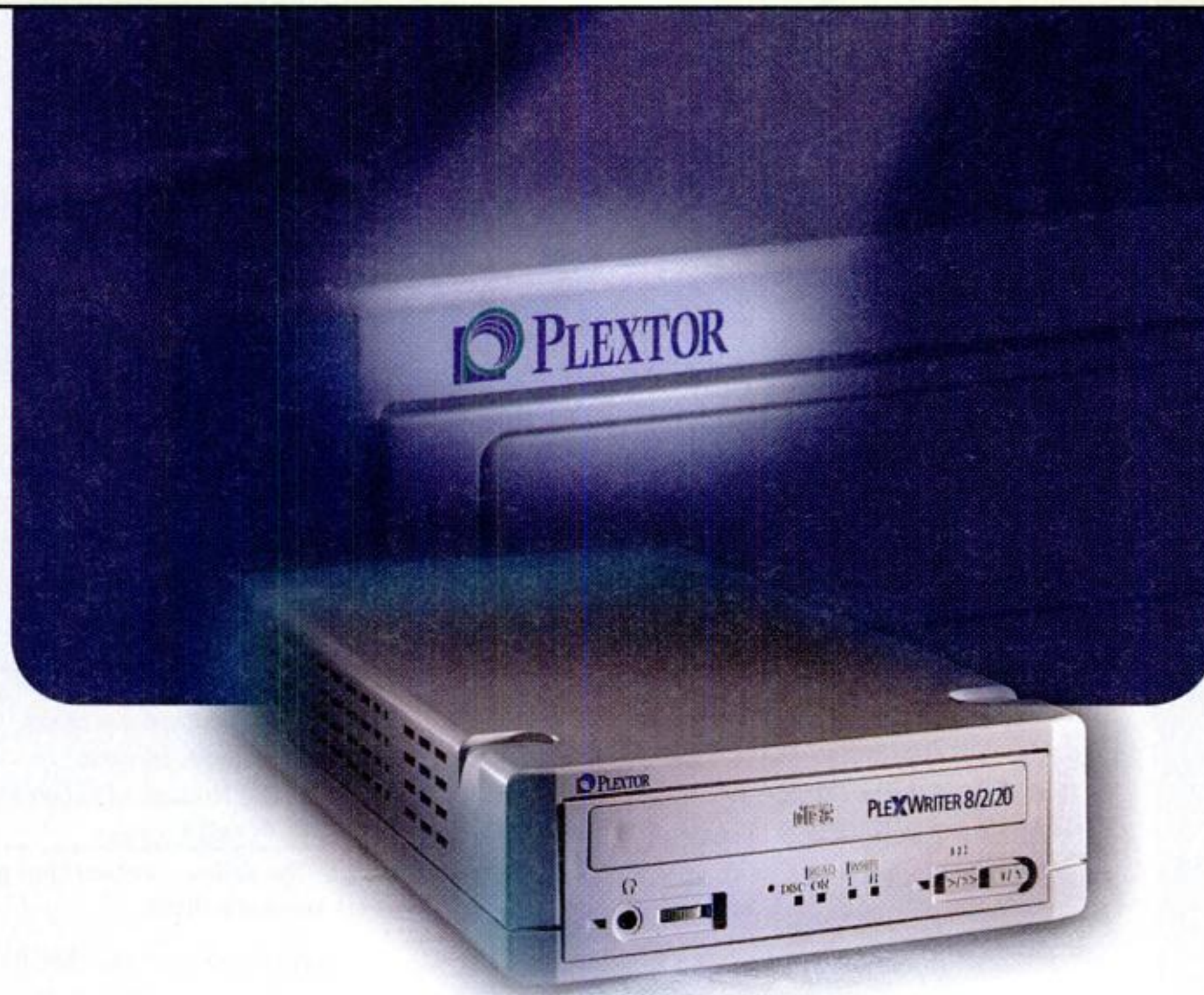
Can I put a piece of 32MB SDRAM in my DIMM slot and use it with my SIMMs at the same time?

Your P-II 350 is spec'd for a 75° Celsius maximum temperature; 50° Celsius would certainly be a nice operating temperature. Keep in mind that Intel CPUs ranging from 333MHz P-IIs to 550MHz P-IIIs share a 0.25-micron manufacturing process, and heat dissipation for these processors is achieved via basic fan/heatsink solutions of varying intensity; no "cooling" utilities or extra case fans are necessary. To wit, a 350MHz Pentium II should have a lot of room to grow. The only caveat is with CPUs fabbed before all the kinks of the new manufacturing process were worked out.

Methinks you should avoid utilities such as *Waterfall*—they introduce dubious HLT instructions that replace heat-generating idle cycles when the CPU is in suspend mode. I haven't heard of any HLT-related horror stories, but common sense tells me to leave the processor's work routines alone. Instead, go with the fan/heatsink solution that's appropriate for a 400MHz P-II. And if you're really antsy about heat, install an extra case fan—solid ball-bearing models should run quietly.

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# 12

Dealing with your PC obsession by breaking it down into 12 easy steps.

# Faster Internet Connections

Everyone wants more speed from their Internet connection. The one-step setup programs provided by ISPs insulate users from advanced settings to prevent incompatibilities and save on support time, while robbing you of performance-enhancing options that may speed up your connection. Establish a baseline by downloading a few files or playing an Internet deathmatch or two, then follow the guidelines and recommendations below. Take back the bandwidth that's yours; after all, you paid for it.

—Fabian Echevarria

## STEP 1

### Choosing your modem

First, choose a modem that'll serve your needs. External or internal doesn't matter, since the speed difference is negligible. The true distinction lies between corporate versus consumer modems. Corporate modems are designed for mission-critical applications, whereas consumer modems are designed with less lofty (and more price-cutting) goals in mind. As such, corporate modems are more robust both in capability and stability with regard to connections.

Since your ISP's equipment is probably corporate-quality (such as U.S. Robotics Total Control rackmount modems, Ascend modem pools, etc.), you'll get more performance when using a similar modem. Until recently, the price difference was prohibitive, but even then it was worth it. You may need to look beyond your local store, but your effort will ultimately be rewarded.

Stay away from controllerless modems, whose command interpretation and control functions (including error correction and data compression) are handled by your CPU. They're cheap but best left for web browsing. Controllerless WinModems use incredible amounts of CPU time. CPU-intensive operations (such as online gaming and streaming audio/video) bring controllerless modems to their knees. Almost all PCI-based modems are controllerless, and using one is a waste of a PCI slot because even the fastest modem will never touch 133MBps.

## STEP 2

### Connecting your modem

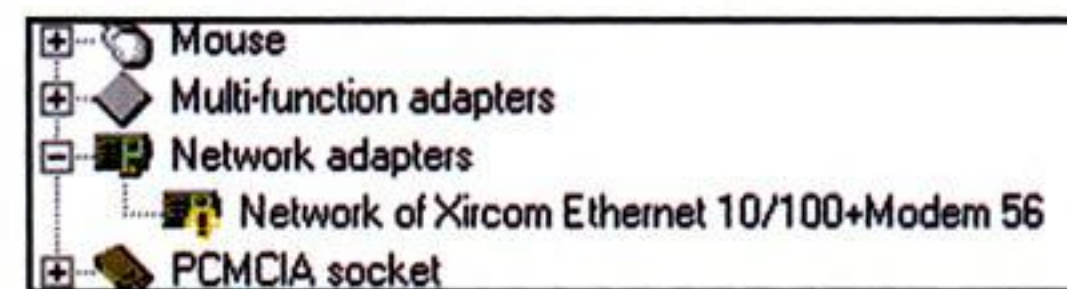
Line conditions can be improved with high-quality cable, such as the Category 5 patch cable used in high-end networking. Using CAT-5 to connect your modem to the wall jack can make all the difference. Homeowners might consider running it directly to the phone company's breakout box. Also, connect external

modems to your machine using a properly shielded serial or USB cable.

## STEP 3

### Resolve all hardware conflicts

Resource conflicts can greatly hamper connection stability. Use your BIOS and Windows Device Manager (located in the System control panel) to seek them out.



3.1: The yellow exclamation point denotes a system resource conflict.

You'll know a conflict by the yellow exclamation point (Figure 3.1) present next to an offending resource. Pay special attention to any that appear next to your serial port.

If you find one, enter its Properties and look under the Resources tab for an explanation. It's usually caused by a memory address or interrupt resource being used by another device. Often, changing the resource manually to an unused value will fix it. Also, try changing the resource of the conflicting device (it should be listed). If you can't, consult your manual or the manufacturer's web site.

## STEP 4

### Choose your ISP carefully

All ISPs are not created equal. Ask several ISPs for bandwidth info and total number of dial-up ports available. Make sure they support your modem's highest speed and match your modem's chipset with theirs. Most ISPs have guest accounts you can use for an evening or two for testing. Connect several times and use TRACERT, which comes with Windows, to look for slow-downs to your favorite destinations. Type TRACERT at a DOS-prompt for instructions (see Figure 4.1).

```
Options:
-d          Do not resolve addresses to hostnames.
-h maximum_hops  Maximum number of hops to search for target.
-j host-list  Loose source route along host-list.
-w timeout    Wait timeout milliseconds for each reply.

C:\WINDOWS>tracert www.maximumpc.com

Tracing route to www.maximumpc.com [209.143.228.123]
over a maximum of 30 hops:
  0  1 ms  <10 ms  1 ms  node-18-1.imaginedia.com [206.57.18.1]
  1  179 ms  15 ms  4 ms  s5-0-2.cr1.EMB.globalcenter.net [207.218.126.209]
  2  361 ms  10 ms  436 ms  hss15-0.br1.SJC.globalcenter.net [206.165.111.17]
  3  39 ms  14 ms  7 ms  pos5-2.cr1.SNV.globalcenter.net [206.132.150.106]
  4  225 ms  6 ms  100 ms  pos1-0-0-155M.hr3.SNV.globalcenter.net [206.251.0.113]
  5  33 ms  11 ms  124 ms  www.maximumpc.com [209.143.228.123]

Trace complete.
```

**4.1: TRACERT shows the number of hops to your favorite web site and how long it'll take to get there.**

TRACERT sends a packet of info to each "hop" or node between you and your destination. It measures responses from each hop three different times (don't add them all up), listing them in milliseconds. This tells you the total hops between you and your destination and what kind of response you're likely to expect. Of course, the fewer hops, the better. Response times below 200ms are considered good, up to 400ms marginal, and anything higher is lousy.

## STEP 5

### Update Windows

Microsoft has released a bunch of updates that improve the performance of your Internet connection under Windows 95. The two with the most connection-improving power are Dial-Up Networking 1.3 and Winsock 2.2.

Even seemingly unrelated updates can correct memory leaks and other problems in the TCP/IP stack or other components. Install the updates available. Microsoft has included them as standard Windows 98 components.

You can grab DUN 1.3 from [ftp.microsoft.com/softlib/mslfiles/msdun13.exe](http://ftp.microsoft.com/softlib/mslfiles/msdun13.exe), and the updated Winsock 2.2 release version can be found at [www.microsoft.com/windows/downloads/bin/w95ws2setup.exe](http://www.microsoft.com/windows/downloads/bin/w95ws2setup.exe). More links to files can be found at <http://home.inreach.com/echevarr/pingpage.htm>.

## STEP 6

### Update your modem drivers

Unless Windows knows how to handle your modem properly, the Modem control panel options may not work correctly. Users of the original retail version of Windows (4.00.950) should install the UniModem (a.k.a. voice modem) drivers released by Microsoft before proceeding any further. Windows OSR2 (4.00.950 B or C) and Windows 98 users can skip the UniModem installation, since it's included in those versions. In any case, obtain the latest modem driver from your modem's manufacturer. WinDrivers.com is a great resource ([www.windrivers.com/scripts/](http://www.windrivers.com/scripts/)).

## STEP 7

### Optimize your modem & serial port

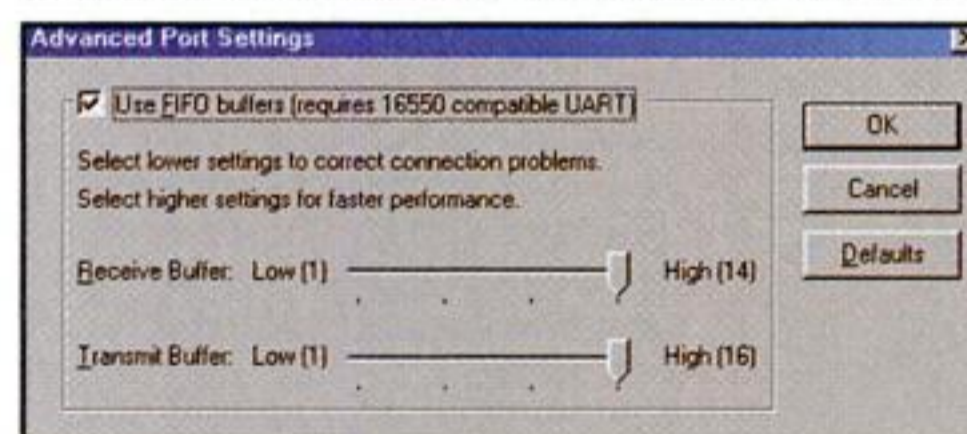
Modems use two different speeds: computer-to-modem speed (DTE) and the speed between your modem and your ISP's modem (DCE). For optimal performance, DTE speed

should be set faster than DCE speed to give your modem time to buffer data and, if possible, compress it.

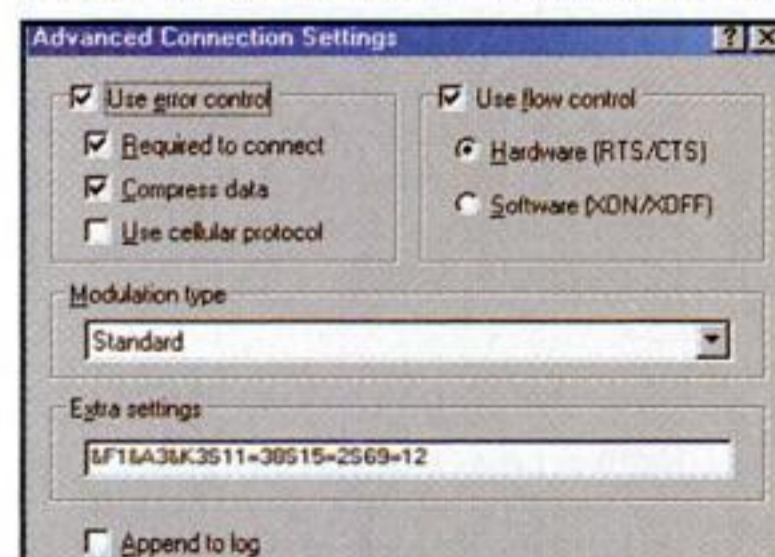
Of course, Windows defaults to archaic settings no matter what speed your modem and serial port are capable of attaining. To straighten this out, venture into the Modem control panel

Change the Maximum speed field to 115200 for 56K modems and 57600 for 28.8/33.6K modems and make sure you disable the "Connect only at this speed" box (shown in Figure 7.1). Confirm that the "Data bits," "Parity," and "Stop bits" fields are properly set for your ISP (default settings are shown in Figure 7.2).

Under the Advanced Port Settings, enable the FIFO buffers and move the Receive and Send buffer sliders to their maximum values



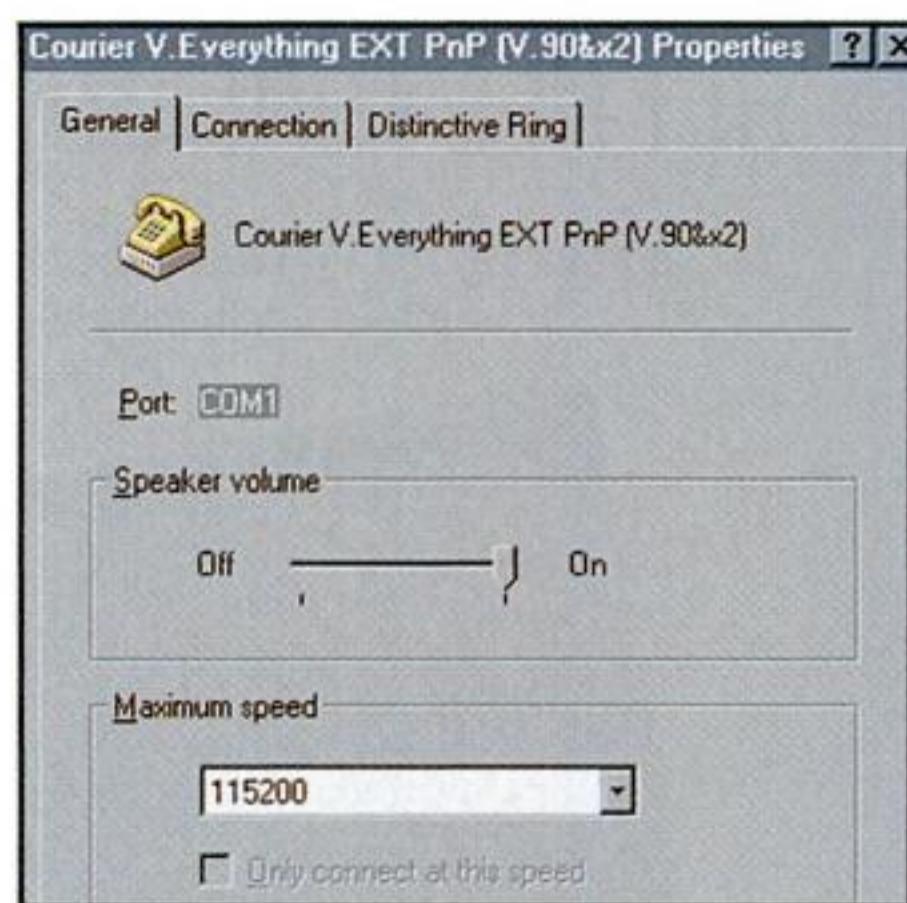
**7.3: Crank that receive and send buffers to maximum and enable FIFO buffers.**



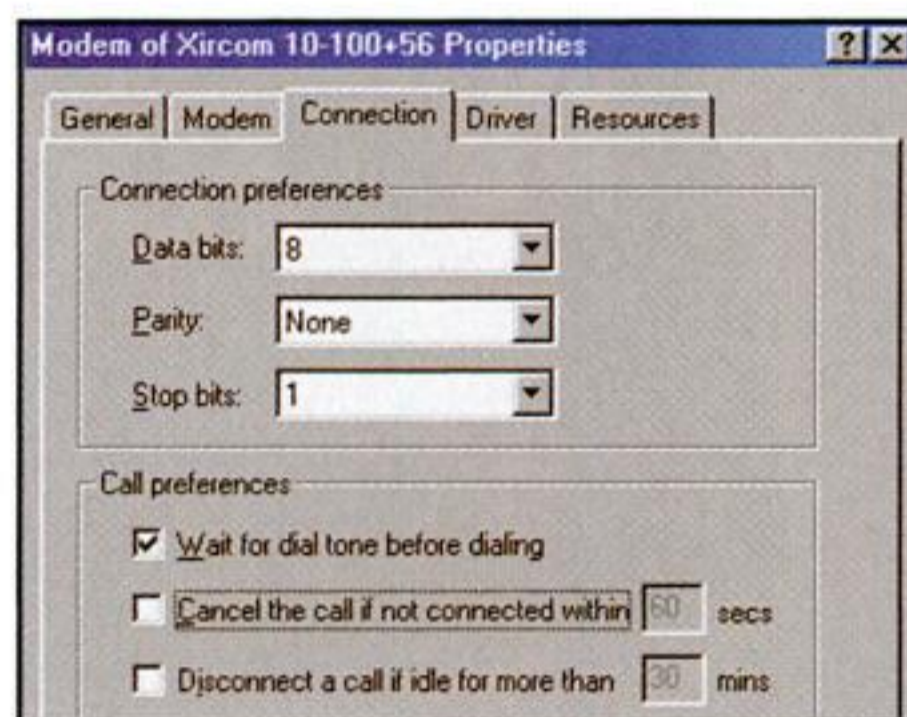
**7.4: Customized settings such as v.42bis over MNP5 may help your speed.**

Under the Advanced option of the Connection settings. It's important to put an initialization string in the Extra Settings field that allows your modem to perform up to its maximum capability and match the options you just set. Consult your modem's manual and/or manufacturer for specific commands when creating your initialization string. Your string should enable hardware handshaking (specifically RTS/CTS), but disable retrains and MNP 5. Both MNP 5 and v.42bis compress data; however, v.42bis is 30% faster and does not add latency to the data stream while MNP 5, an older compression scheme, can add latency. Disabling retrains prevents long time-outs due to total-line renegotiations (instant death in the middle of a death-match). Just leave upshifts/downshifts enabled so your modem can still adjust to adverse line conditions on-the-fly without full-line renegotiation.

To set the serial (COM) port, open Device Manager and select the Properties for your modem's COM port. Set the "Bits per second" to



**7.1: In the Modem control panel, set the Maximum speed to 115200 for your 56K modem.**



**7.2: Make sure your parity and stop bits match your ISP's.**

(14 and 16, respectively). This allows your serial port to properly buffer incoming and outgoing data while reducing CPU overhead. Use the settings in Figure 7.4

under the Advanced option of the Connection settings. It's important to put an initialization string in the Extra Settings field that allows your modem to perform up to its maximum capability and match the options you just set.

Consult your modem's manual and/or manufacturer for specific commands when creating your initialization string. Your string should enable hardware handshaking (specifically RTS/CTS), but disable

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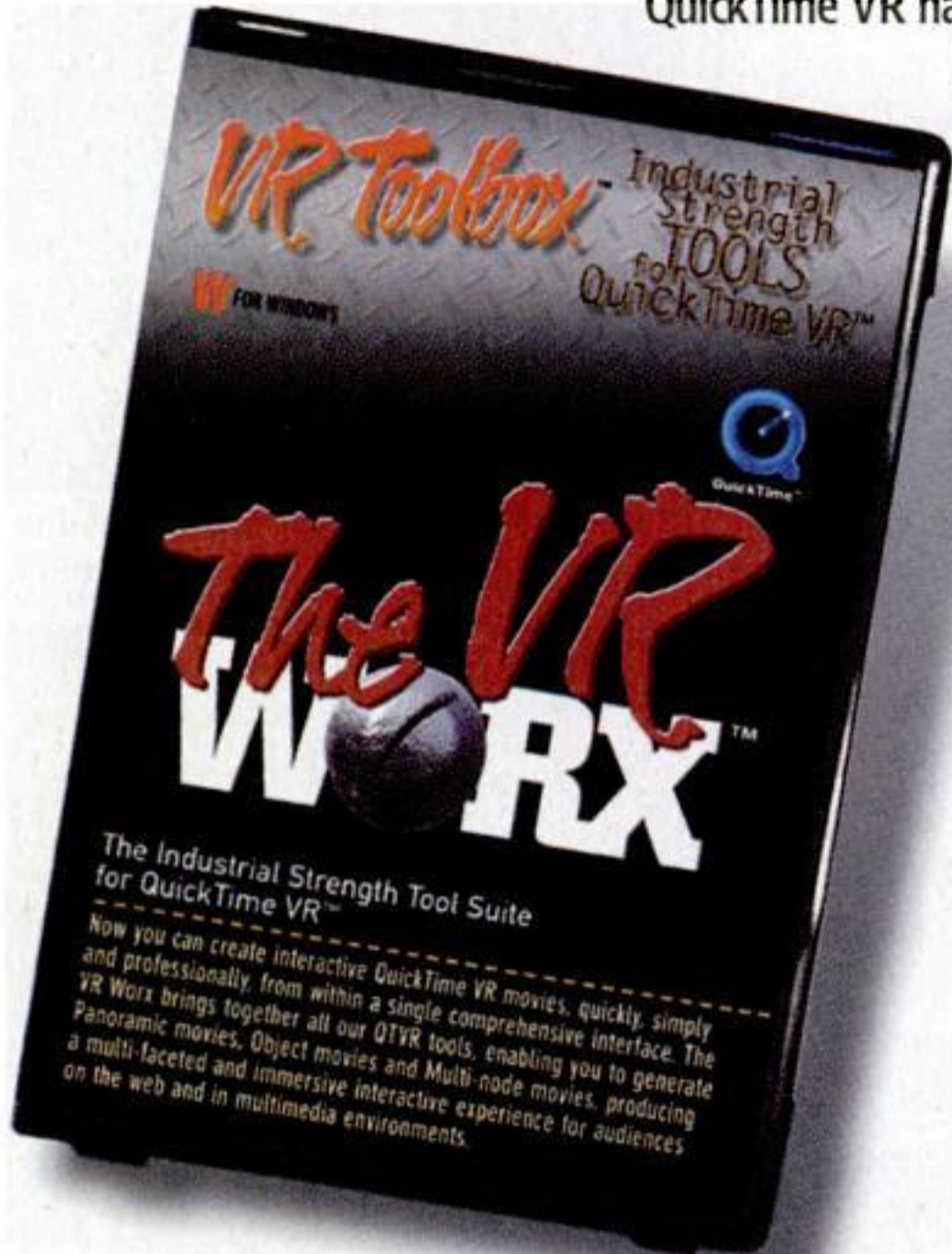
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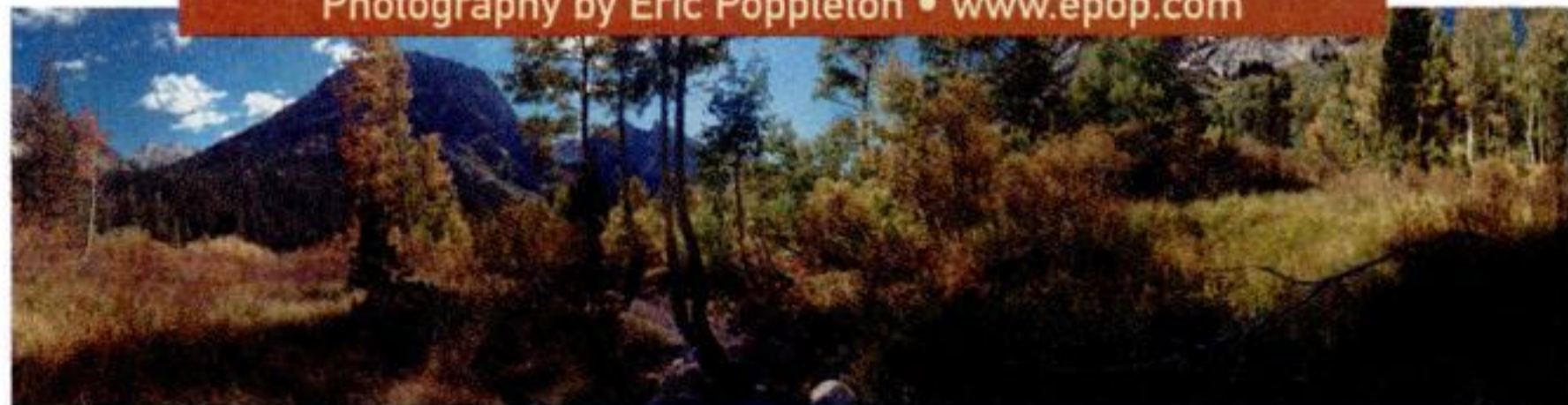
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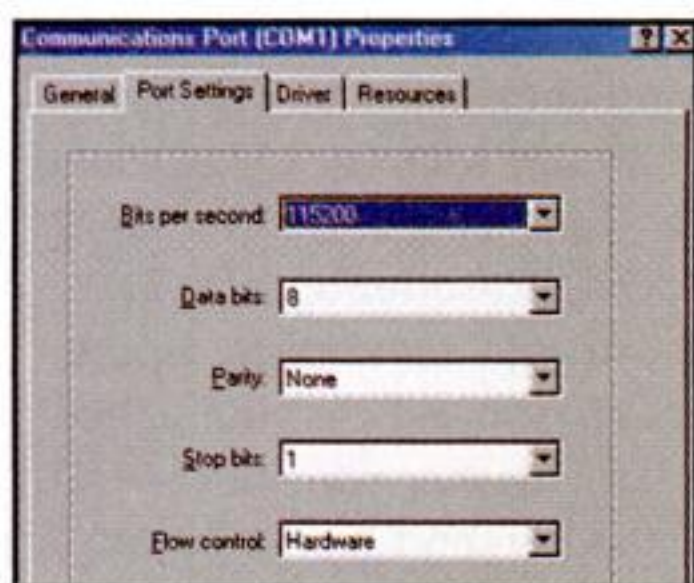
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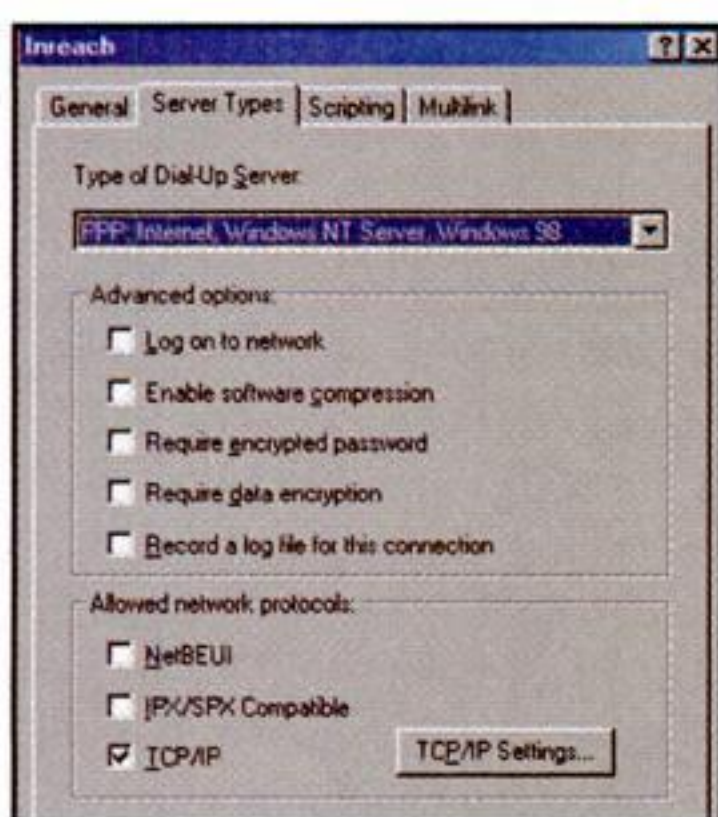


**7.5: Match your Comm port settings to your modem.**

match the response set in the Modem control panel (57600 for 28.8/33.6K modems, 115200 for 56K modems). Then change the other settings to match the screen in Figure 7.5. If you have an internal modem, its COM port may not show up in Device Manager, so make the changes manually in the Ports section of the WIN.INI file in your \Windows directory.

## STEP 8

### Optimize dial-up networking

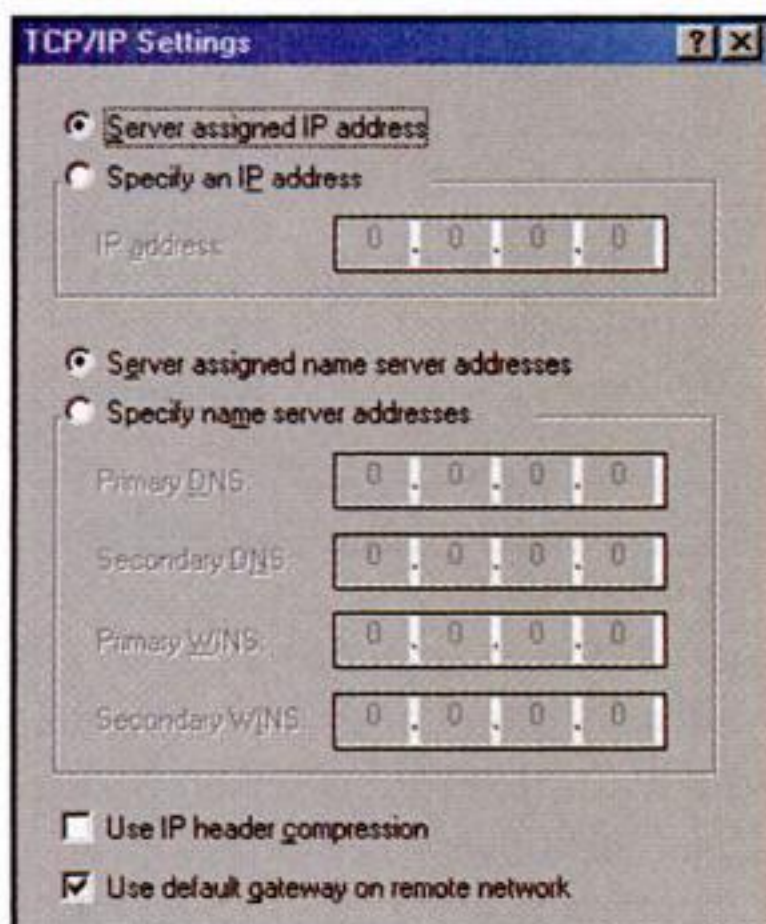


**8.1: Too many protocols slow your login time. TCP/IP should be enough.**

Windows takes a shotgun approach to network settings by assuming everyone connects to Windows NT hosts and not an ISP. Correct this oversight and simplify the logon process at the same time. In the Dial-Up Networking folder, select the properties for your Internet connection. Change the settings to match the screen in Figure 8.1. Logon speed will be greatly improved because Windows will stop trying to logon to a network host in

addition to your ISP. Deselecting software compression allows your modem to handle all compression in hardware, saving CPU cycles and system resources for more important tasks.

If you have installed Dial-Up Networking (DUN) 1.3 or use Windows 98, two additional options ("Require encrypted password" and "Require data encryption") appear under the Server Types tab of the Dial-Up Networking Properties; leave them at the default settings (unmarked). Enabling them needlessly ties up system resources (unless you need encryption). If after installing DUN 1.3 additional options don't appear, you'll need to remove and then reinstall the Dial-Up Adapter (keep newer files during the reinstall process, if notified of any). Reinstalling will return things to normal should something go wrong.



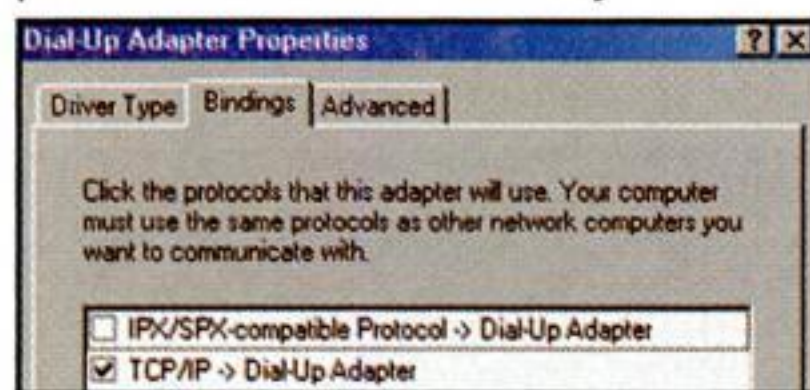
**8.2: Uncheck Use IP header compression to save CPU cycles.**

Under TCP/IP Settings, select "Use default gateway on the remote network," but deselect the "Use IP header compression" option to save CPU cycles (see Figure 8.2). If your ISP allows automatic IP addressing and DNS determination, mark "Server assigned IP address" and "Server assigned name server address." But, if your ISP requires a specific IP address or DNS setting, select "Specify an IP address" or "Specify name server addresses" and complete as required by your ISP.

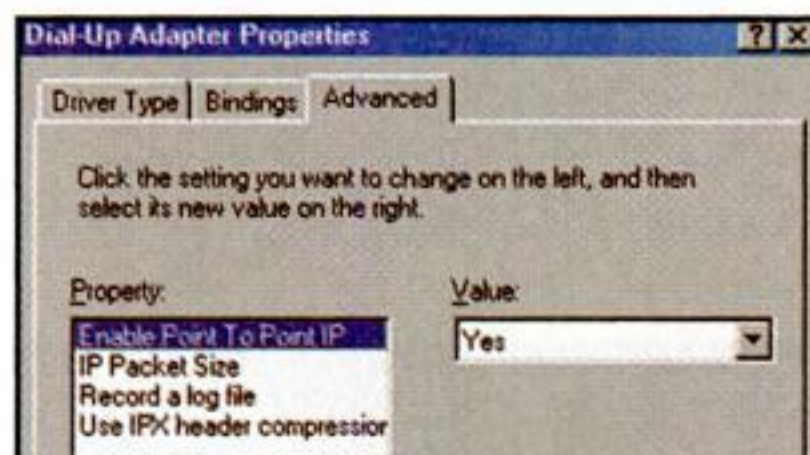
## STEP 9

### Optimize your network settings

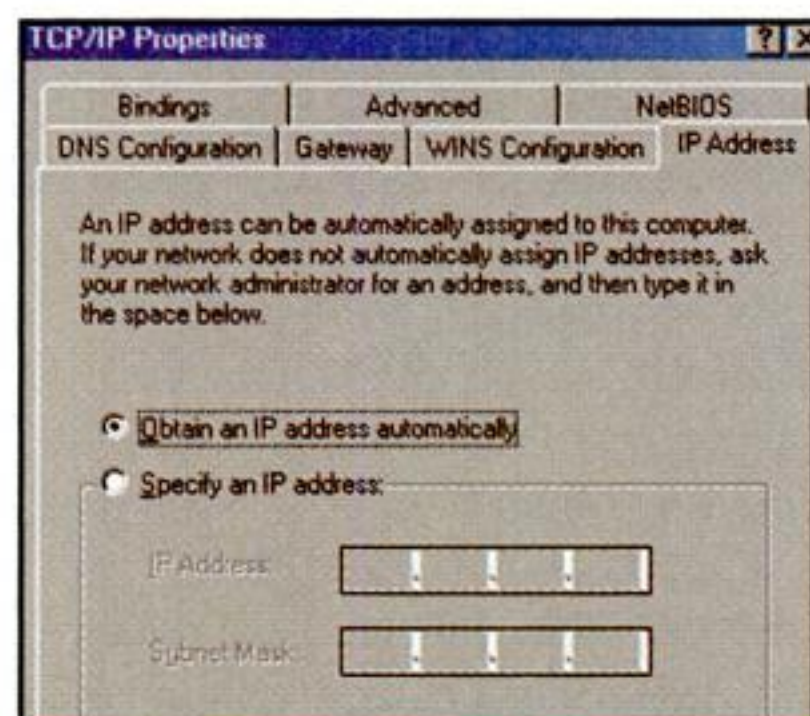
You need only Dial-Up Adapter and the TCP/IP protocol to connect to the Internet. If you don't use other protocols, adapters, or services, remove them using the Network control panel. Keep in mind, if you install DUN 1.3 afterward, you'll need to remove unused network protocols/adapters/services again. The instructions for DUN 1.3 state not to remove individual network components via the Network control panel; however, removing them individually doesn't harm your system or the new components as long as you keep newer files when notified. In Windows 98, if only Dial-Up Adapter and the TCP/IP protocol are installed, subsequent visits to the Network control panel cause Windows 98 to display the error message "Your network is incomplete." Ignore this; Internet connection components are complete and will work flawlessly.



**9.1: If you dial-up, you only really need TCP/IP checked. Shed extraneous stuff like IPX/SPX.**



**9.2: Just say no to IPX Head Compression and "record a log" for speed's sake.**



**9.3: Your ISP probably assigns an IP to you when you log in. Make sure settings match that.**

Select the TCP/IP Properties in the Network control panel. Under the Bindings tab, unmark everything for optimal TCP/IP performance. Under the NetBIOS tab, unmark "I want to enable NetBIOS over TCP/IP," it's unnecessary for Internet connections. Under the WINS Configuration tab, select Disable WINS Resolution; it's useless since we disabled NetBIOS over TCP/IP. Under the DNS Configuration tab, select Disable DNS. If your ISP requires specific DNS settings, put them in the TCP/IP Settings section of the Dial-Up Networking properties for your Internet connection instead of making a global DNS setting here. Under the IP Address tab, select "Obtain an IP Address Automatically," as shown in Figure 9.3. If your ISP requires a specific IP address setting, put the IP address under the TCP/IP Settings section of the Dial-Up Networking properties for your Internet connection instead of making a global IP address setting here.

In the Network control panel, select the Dial-Up Adapter properties. Under the "Bindings" tab, select TCP/IP and deselect everything else (see Figure 9.1).

Under the Advanced tab, setting "Use IPX Header Compression" to No allows the modem to handle all compression in hardware. Set the "Record a log file" property to No, otherwise you'll needlessly slow down your connection. If you install DUN 1.3 or use Windows 98, two additional options appear in the Dial-Up Adapter properties: Point-to-Point IP and Packet Size; leave them at their default settings (Enabled and Automatic, respectively, as shown in Figure 9.2).

Select the TCP/IP Properties in the Network control panel. Under the Bindings tab, unmark everything for optimal TCP/IP performance. Under the NetBIOS tab, unmark "I want to enable NetBIOS over TCP/IP," it's unnecessary for Internet connections.

## STEP 10

## Setting the right benchmarking mood

Windows provides a plethora of TCP/IP Registry settings. The most famous, the Maximum Transmission Unit (MTU) specifies the largest amount of data (including TCP/IP header information) that can be sent per packet. The receive window (RWIN) specifies how much packet data (minus header information) should be buffered before Windows acknowledges receipt. A small MTU allows quick retransmissions should errors occur. If you mainly web browse, a small MTU should suit you. But if you're a bandwidth-intensive user (online games, streaming audio/video, large downloads, etc.), the largest MTU your ISP can provide would maximize your bandwidth and system resources (less packets being formed, transmitted, and received).

Your ISP's help desk or connection response (visible in a terminal window) may provide your MTU value. If not, open an MS-DOS Prompt and PING your ISP with the -F (don't fragment packets) and -L (packet size) options, as shown in Figure 10.1.

```
C:\WINDOWS>ping -f -l 1473 www.maximunpc.com
Pinging www.maximunpc.com [209.143.228.123] with 1473 bytes of data:
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.
Packet needs to be fragmented but DF set.

Ping statistics for 209.143.228.123:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

10.1: Your ISP may tell you the MTU you should have, if not, prepare to ping.

Place packet size values after the -L option until you find the highest value where the PING command no longer responds with: "Packet needs to be fragmented but DF set" (see Figure 10.2). Start at around 2,000.

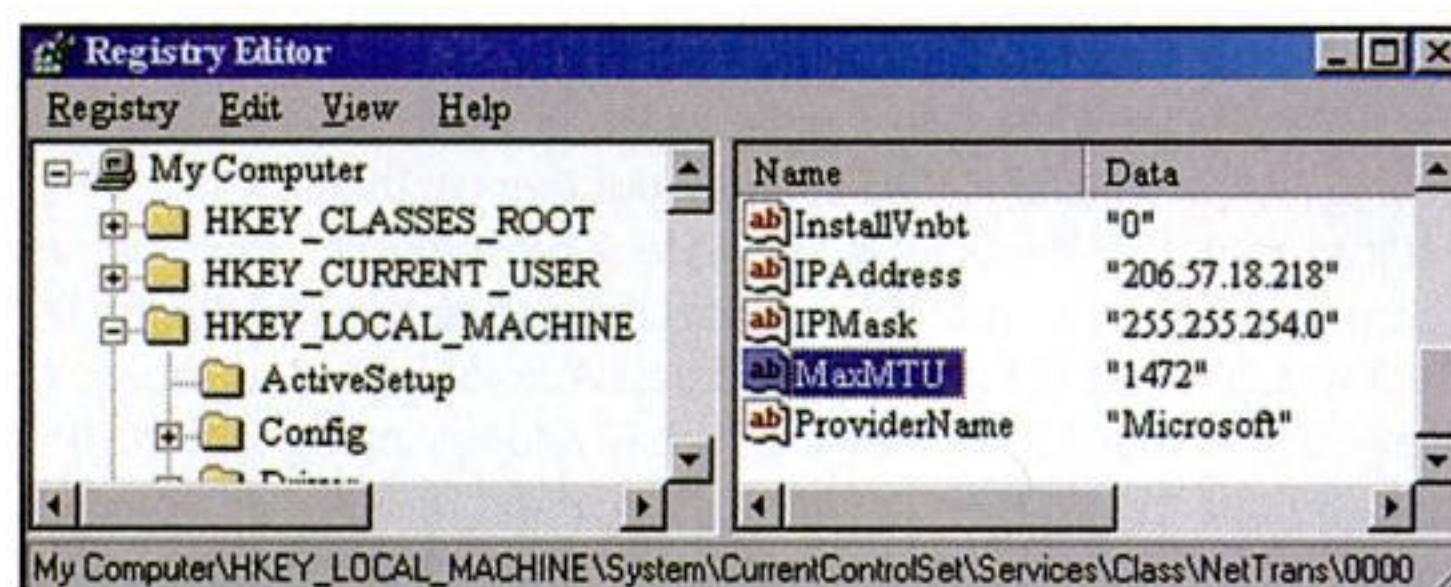
```
C:\WINDOWS>ping -f -l 1472 www.maximunpc.com
Pinging www.maximunpc.com [209.143.228.123] with 1472 bytes of data:
Reply from 209.143.228.123: bytes=1472 time=23ms TTL=249
Reply from 209.143.228.123: bytes=1472 time=23ms TTL=249
Reply from 209.143.228.123: bytes=1472 time=23ms TTL=249
Reply from 209.143.228.123: bytes=1472 time=23ms TTL=249

Ping statistics for 209.143.228.123:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 23ms, Maximum = 23ms, Average = 23ms
```

10.2: Increase MTU until you no longer get "fragmented" messages.

**WARNING:** If you repeat this step after your MTU has been set, the PING command will incorrectly report an even lower packet (MTU) size. 576 is the minimum MTU all TCP/IP routers must support. If your MTU value is less than 576, your MTU was previously set or your ISP only supports an MTU of 576.

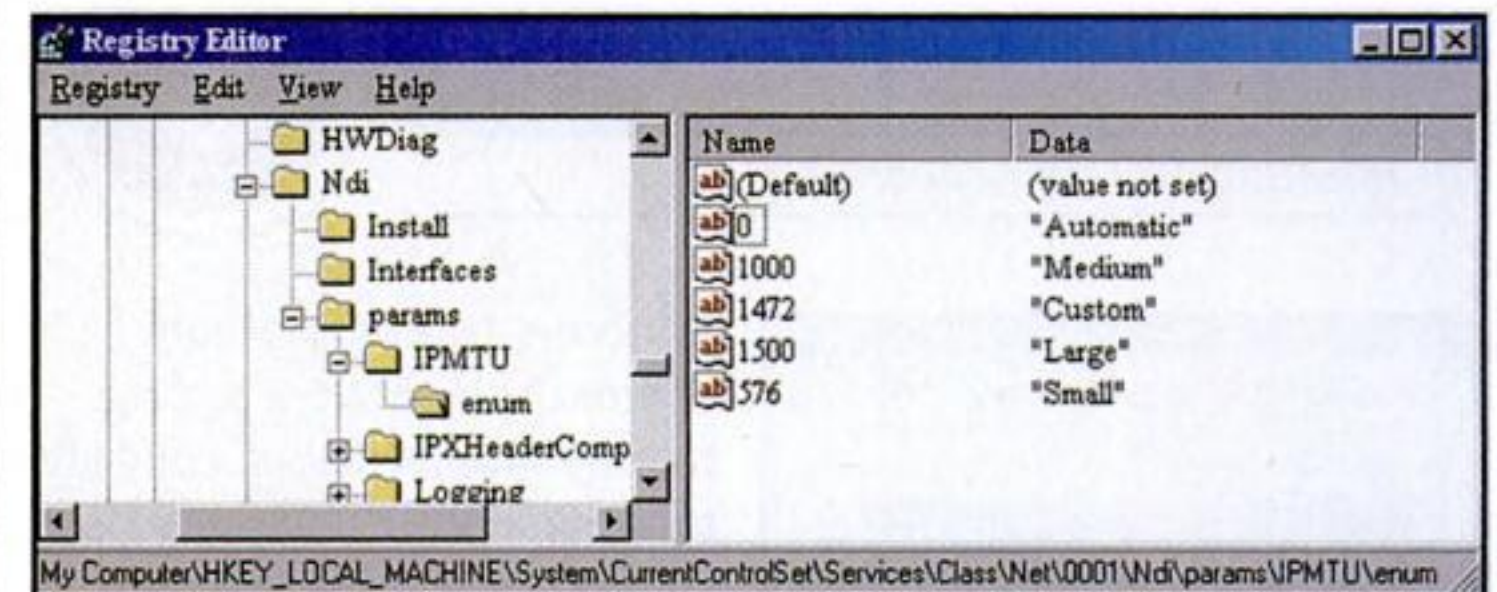
All versions of Windows 95 without DUN 1.3 can use a tweak program to set the MTU to match your ISP's. Or, as shown in Figure 10.3, you can manually set it using the Registry editor at location HKEY\_LOCAL\_MACHINE\System\CurrentControlSet\Services\Class\NetTrans\000x\MaxMTU. Search for the specific 000x listing



10.3: A Registry hack may be in order to set your MTU correctly.

that corresponds to your active Dial-Up Adapter and add the MaxMTU string value manually if it's not already there.

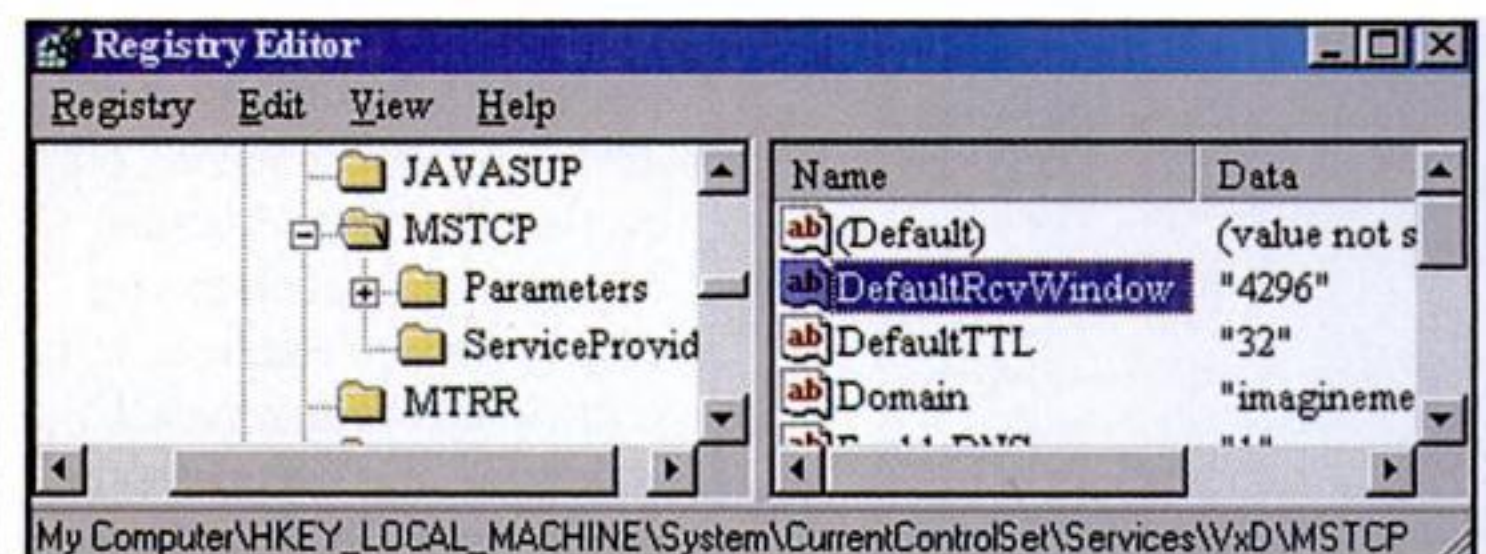
If DUN 1.3 or Windows 98 automatically set your MTU, manually change your MTU value to match your ISP's using the Registry Editor at HKEY\_LOCAL\_MACHINE\System\CurrentControlSet\Services\Class\Net\000x\Ndi\Params\IPMTU\enum (see Figure 10.4). Search for the 000x listing that corresponds to your active Dial-Up Adapter, add a string value named after your new MTU value, double-click the newly created string, and type "Custom" in the Value data field. Then, head back to the Dial-Up Adapter property sheet in the Network control panel and change the Packet Size setting from "Automatic" to the "Custom" option you just created.



10.4: Windows 98 may require you to manually override your MTU setting.

**NOTE:** If you have trouble determining which Dial-Up Adapter entry is active, use RegEdit to look at the 000x entries in the HKEY\_LOCAL\_MACHINE\Enum\Root\Net section of the Registry. The 000x entry whose DeviceDesc (device description) key reads Dial-Up Adapter will point to the active Dial-Up Adapter entry.

Remember, you want an RWIN high enough so your system doesn't waste time acknowledging every packet received, but low enough where lost or corrupt packets can be requested and retransmitted within a timely manner. Use the average download range (in Bps) for your particular connection. For example, you might use 3,000 (28.8/33.6K) on the low end and 5,000 (56K) on the high end. You need that room to work so your RWIN can be a multiple of your packet size (MTU) minus TCP/IP header information (40 bytes). In the example shown in Figure 10.5, an RWIN of 4296 is an MTU of 1472 minus 40 multiplied by 3. Algebraically, the equation is  $x(\text{MTU}-40)=\text{RWIN}$  or  $3(1472-40)=4296$ . Please note RWIN directly affects throughput—do not set it below 3,000 for bandwidth-intensive applications. Most MTU tweak programs also allow you to set your RWIN, but you can opt to do it manually using the Registry editor at location HKEY\_LOCAL\_MACHINE\System\CurrentControlSet\Services\VxD\MSTCP\DefaultRcv Window.



10.5: You'll also need to tweak RWIN in the Registry.

The time-to-live (TTL) value specifies how many hops a packet can travel before expiring (it could theoretically go on forever). Leave the TTL (HKEY\_LOCAL\_MACHINE\System\CurrentControlSet\Services\VxD\MSTCP\DefaultTTL) at its default Windows value of 32.

Lastly, some people recommend setting the Maximum Segment Size (MSS), but since neither Windows 95 nor 98 supports it, setting it is futile. (Windows NT supports setting the MSS.)

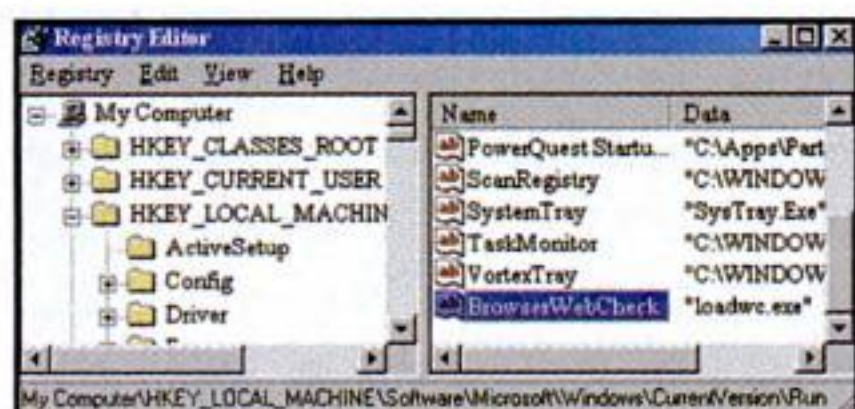
## STEP 11

Clean your system

Microsoft is infamous for bloat, much of which can be removed to improve online performance.

The Active Desktop portion of *Internet Explorer 5* is a resource hog, so disable it using the Display control panel. If you installed it via *IE5* in Win95, uninstall it using the Add/Remove Software control panel. When you reinstall *IE5*, choose to exclude Active Desktop.

*Internet Explorer 5* and *Outlook 98* both update Internet connection components, but add a new background task (Browser Web Check) to monitor your Internet connection, automatically connecting/disconnecting upon browser activation/deactivation. If you normally use apps other than a browser, this automation may drive you crazy. Remove it using the Registry editor at location HKEY\_LOCAL\_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run. Delete the BrowserWebCheck value. This will free up some memory in the process.



**11.1: Nuking IE5's browser web check in the Registry will free resources.**

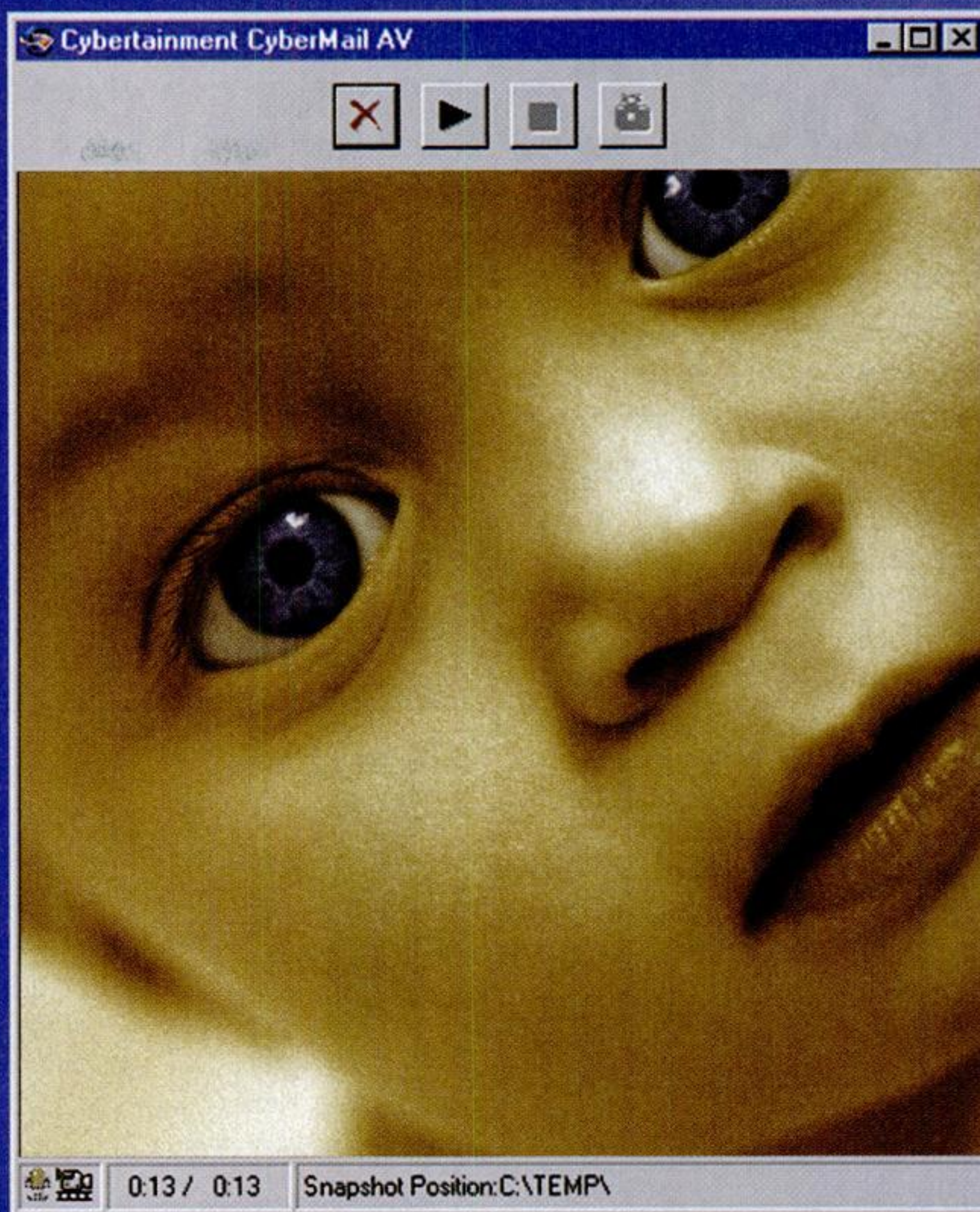
You can free up even more resources by deleting values you don't need. Also check the RunOnce and RunServices Registry locations, as well. A completely clean system contains only SysTray in the Run entry and nothing in the others.

Finally, refrain from using ICQ and/or other e-mail notification programs, since they use the same connection you do.

## STEP 12

Test it

Load your favorite online game or download that file you've been putting off for comparison. You should see a more stable connection, faster response times, less lag, and of course, more kills in that next deathmatch. ✪



# Miss the last flight, and you still have a ticket home.

Sometimes pictures speak softer than words. Which explains why audio/video e-mail is becoming so popular. And why Cybertainment's CyberMailAV™, in particular, is becoming a household name. Compatible with all regular PC e-mail programs, it comes complete with high-quality video camera, PCI card and easy-to-install software. And offers a super-high compression ratio (900 to 1) for faster upload and download time. CyberMailAV. When business keeps you away, it's the next best thing to a pinch on the cheek.



To place a phone order, call CIN Services toll-free at 1(800) 847-8507. For web orders, visit [www.venture-tec.com](http://www.venture-tec.com).

# Cool Computer Upgrades.

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John Dvorak, *PC Computing*, August, 1997.

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With one enclosure, build either an AT or ATX computer! Our popular **Personal Mid-Tower** case features rigid construction, 6 drive bays (upgradable to 8), and easy-access side panels.

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- DELUXE CHROME TOWER ..... \$449

## HARD DRIVE COOLER

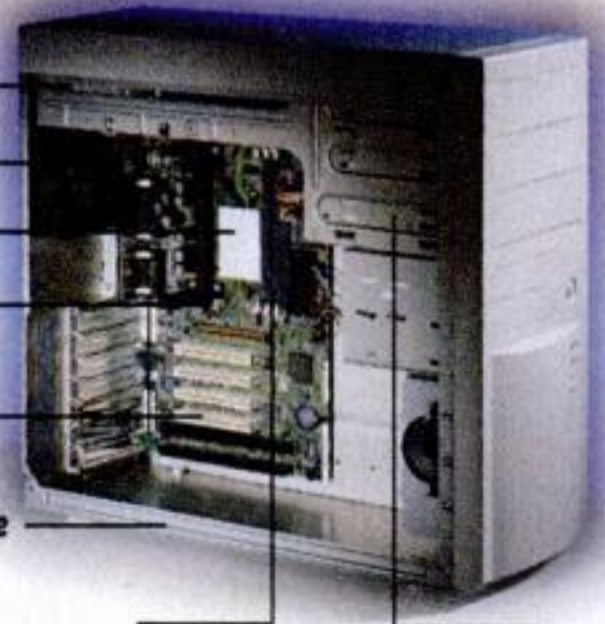
Heat *distorts* hard disk platters! Protect your data with our dual-fan, solid-steel **Bay-Cool**.



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- Turbo-Cool 300 ATX
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- Intel SE440BX-2 M/B
- Accepts 233-500 MHz Pentium II, III (not incl.)
- 2 ISA, 4 PCI, 1 AGP slots. 100 MHz Bus
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- 3-year warranty



3 DIMM sockets (ØK, 768 MB max.)

6 drive bays (add \$5 for 8)

- Have fun, save \$\$, and build a better Pentium II, III computer. It's easy with our foundation system! P2MT300B (Intel Seattle; mid-twr.; 300W) ..... \$349

## SYSTEM COOLER

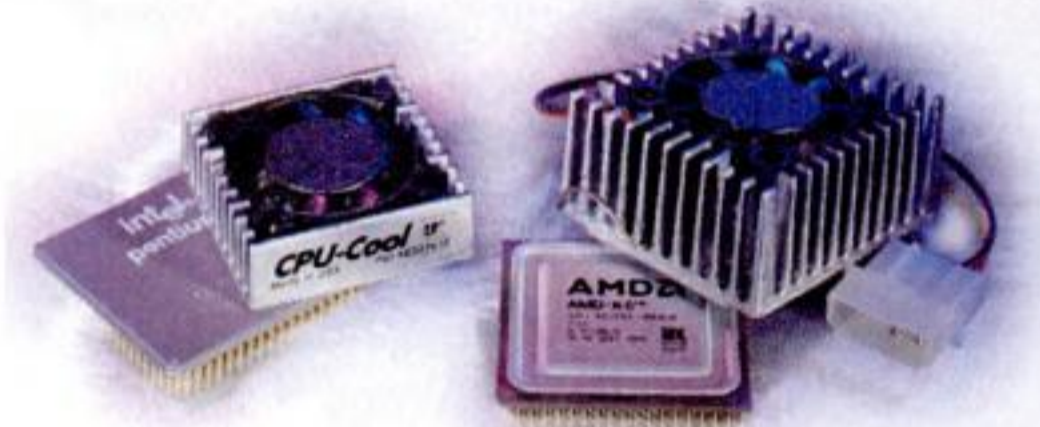
The heat generated by a high-end PC can overwhelm its ventilation capacity. Boost system air-flow velocity by 100% - 200% with our



**Turbo-Cool 2X**. Keeps components **10°F-50°F cooler**, protects against fan faults, cools +5VSB circuits, prevents thermal spiking! Closed-case installation! **TURBO-COOL 2X (Air Propulsion System) ..... **NEW** \$59**

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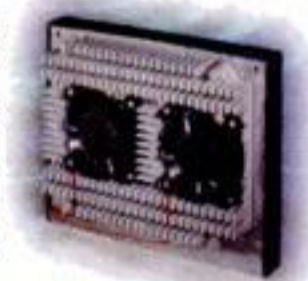


Processors run hot, often over 230°F! Cool'em by 90°F-140°F with genuine **CPU-Cool**™ coolers. Their long-life, ball-bearing fans are *integrated* into patented, die-cast heat sinks. **Last 10 times longer** than cheap imitations! USA-made. 5-year warranty.

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- CPU-COOL Z1-C (Celeron, PGA 370 skt.) ..... **NEW** \$19
- CPU-COOL Z1-H (AMD K6-2, K6-3) ..... **NEW** \$22
- DUAL CPU-COOL (Pentium Pro, Redundant) ..... \$27

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- CPU-COOL M1 (Pentium II, III, SECC2) ..... **NEW** \$19
- DUAL CPU-COOL X2 (Xeon, Redundant) ..... \$37

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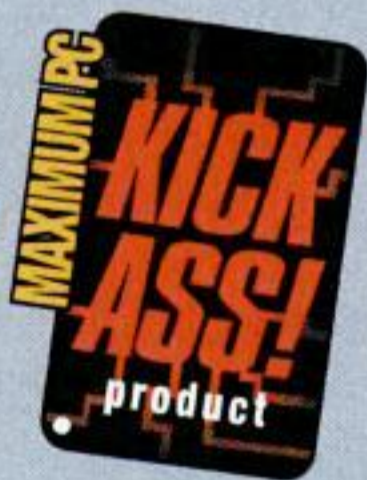
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## Testing Policy

Our product evaluation process is built on down-and-dirty, hands-on testing. All hardware benchmarking is conducted in the Maximum PC lab by Maximum PC editors, and, whenever possible, we use real-world applications to gauge performance. Our final verdicts are based on benchmark results and a subjective appraisal of product features.

### EDITOR'S CHOICE AWARD:

Only 9 and 10 verdicts are even eligible for the coveted Kick Ass award, the mark of PC excellence.



## Online Guide to Benchmarking

Go to [www.maximumpc.com/benchmarking](http://www.maximumpc.com/benchmarking) for the complete explanation of Maximum PC's benchmarking policies.

REAL WORLD BENCHMARKING		DESKTOP SYSTEM		
CPU/MOTHERBOARD	boot/Mark	250	100	175
WINDOWS APPS	SYSmark 98 official score	600	50	150
HARD DRIVE	HD Tach MB/sec	18	1	9
CD-ROM	CD Tach98 drive rating	40	10x	20x
3D RENDERING	Newtek Inspire3D sec	10	1000	500
DESKTOP PUBLISHING	Adobe Photoshop 5.0 sec	45	105	75
DIRECT3D	ForsakenMark fps	110	10	60
OPENGL	Quake2 v3.15 fps	110	10	60

The mid-point denotes "acceptable performance"—or what obsessive power-users consider good but not great.

The specific score achieved by the product.

The zenith, the limit, the living end. The highest score we expect to see for a while.

The lowest score possible. Any lower, and the performance (or lack thereof) doesn't even register on our radar.

KICKIN' THE TIRES ON THE LATEST HARDWARE AND TAKIN' THE LATEST SOFTWARE OUT FOR A SPIN

Hardware Photography by AARON LAUER



# Dell Dimension XPS T550

Superlative power has become passe



**There's really nothing wrong with this ultimate power box—except the price.**

**PLUSES**

- Fastest CPU available
- Excellent videocard
- Speedy hard drive
- Awesome four-channel soundcard
- Booming home theater speakers
- Great CD-RW

**MINUSES**

- Refresh rate locked at 85Hz
- "Only" 128MB RAM
- Relatively expensive

The T550 is stuffed with so many category-leading components, it's actually boring. Oh, what we'd give for the chance to complain about something—anything—plugged into this sucker's motherboard. But Dell has left us little to criticize, so let's talk about how the T550 improves upon the T500, which received a 9/Kick-Ass in the March issue.

First, the Pentium III processor. It's 50MHz faster, now humming away at 550MHz. And the speed increase improved performance across all benchmarks save Direct3D. The bootMark? Up 15 points. SYSmark? Up 19 points. 3D rendering? The faster processor shaved off 36 seconds. The T550 also upped hard drive speed, care of a Maxtor 20 gigger. The drive includes 1MB less onboard cache than the T500's IBM Deskstar (and offers 2GB less capacity), but somehow pushes its 7,200rpm spindle to squeak out another 1MB/sec of throughput.

The T500 came with the obligatory 100MB Zip drive. The T550 ups the removable storage ante with a 250MB version, or, in the case of the configuration we reviewed, a Sony CRX100E CD-RW drive. This CD burner pulled a 9 verdict in our February issue. Zips are convenient, but once you enter the world of CD recording and all the mad archiving and MP3 cataloging it entails, you can't go home again.

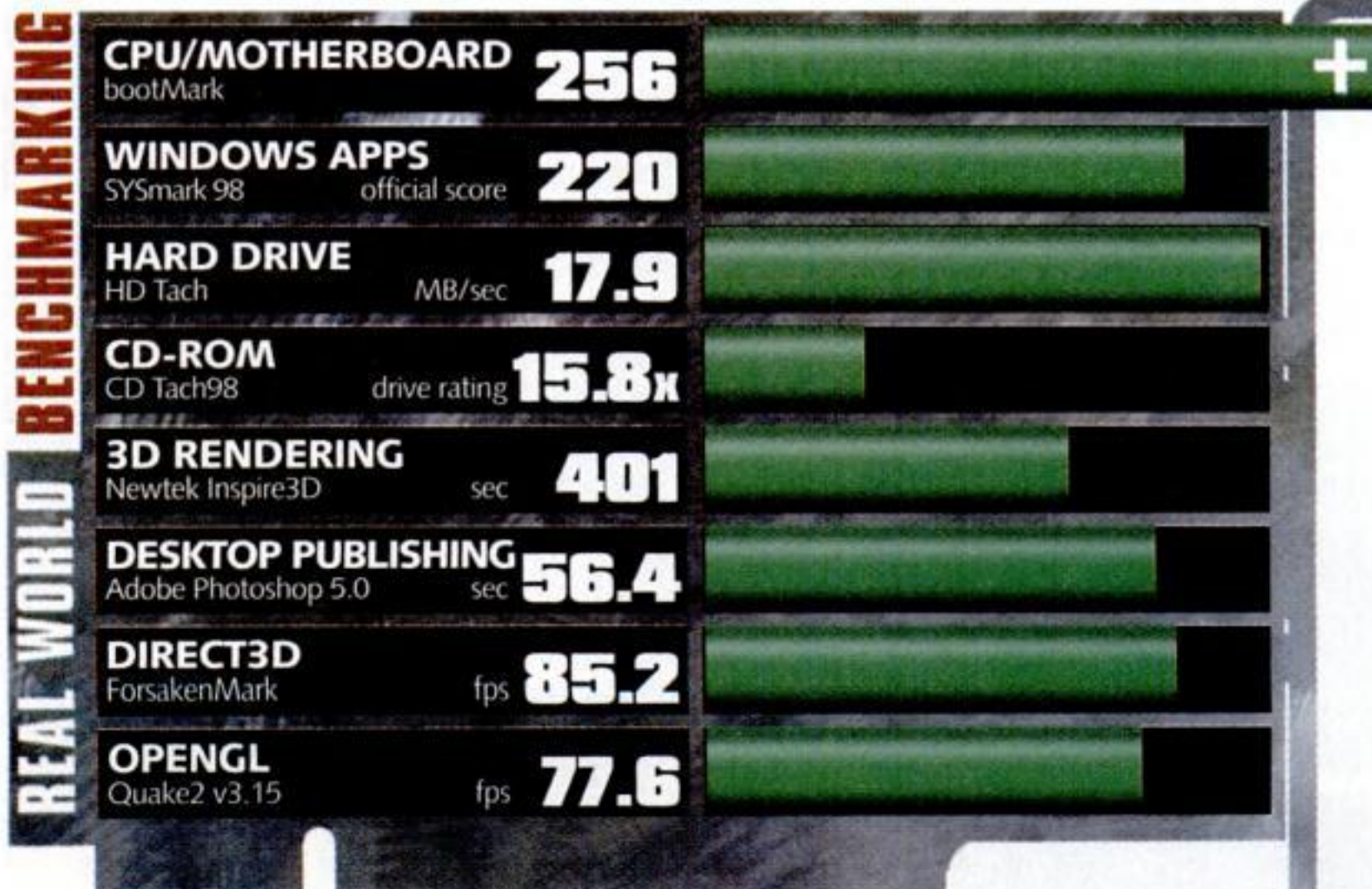
Dell wisely ditched the dumbed-down Turtle Beach Montego II for Creative Labs' Sound Blaster Live! value edition. Argue the merits of A3D versus EAX 3D sound positioning until you're duly frothed, but only the Live! offers dual stereo-out jacks for true four-channel 3D sound effects in games. Also, the Quadrant International DVD decoder card carries Dolby Surround Sound to the five-piece Altec Lansing speaker system, giving you home-theater madness via a discrete rear-effects channel. Pipe DVD movies from the decoder card to your own big-screen TV, and you'll say goodbye to the local multiplex forever.

The T550's 32MB Diamond TNT2 videocard replaces STB's 16MB TNT offering, and outfits the Dimension line with one of the best overall videocards currently available (the nVidia TNT2 chipset and Diamond V770 card are profiled in this month's cover story). We can't argue with Dell's videocard choice, but we are disturbed by its implementation: To ensure that high refresh rates don't cause visual-quality problems, Dell

has locked the videocard to limit refresh rates to 85Hz. Whether high refresh rates cause inordinate fuzziness and herringbone moirés is debatable. Regardless, the refresh lock keeps 3D framerates below an 85fps ceiling. This pegged the T550's Direct3D score at 85.2fps. If you buy this machine and aspire to the 100fps+ *Forsaken* score that the Diamond V770 can achieve *without* a refresh-rate governor, you'll have to update a Registry key (check the Re:Print section of [maximumpc.com](http://maximumpc.com) for details).

There's really nothing wrong with this kick-ass machine, but because the Quantex on page 90 offers similar performance—and 128MB more RAM—for a lower price, we just can't give the Dimension T550 a 10.

—Jon Phillips



**UNDER THE HOOD**

**THE BRAINS**

CPU	Pentium III 550MHz
L2 Cache	512K closely coupled, half core speed
RAM	128MB 100MHz SDRAM (768MB max)
Motherboard	Intel Seattle III, 440BX chipset
Drive Bays	Two 5.25-inch, four 3.5-inch (three free)
I/O Ports	Two USB, one serial, one parallel, one MIDI, Composite video-out, S-Video-out, S/PDIF

**DISPLAY**

Video	32MB Diamond Viper V770D (nVidia TNT2)
Monitor	19-inch Dell P990 (Sony Trinitron, 18-inch viewable, 0.26 grille pitch)
Res/Refresh	1600x1200/75Hz

**STORAGE**

Hard Drive	20GB Maxtor DiamondMax Plus 5120 Ultra DMA (7,200rpm, 1MB cache)
CD/DVD	Toshiba SD-M1212 DVD drive
Removable	Sony CD-RW CRX100E (2x4x24)
Fax/Modem	3Com U.S. Robotics V.90 telephony modem

**SOUND**

Sound	Sound Blaster Live! (value version)
Speakers	Altec Lansing ADA880 Dolby Digital speakers with subwoofer

**OTHER**

Quadrant International CineMaster DVD Decoder Card (with C-Cube Ziva PC chipset), 200-watt power supply

**BUNDLE**

Windows 98 | Microsoft Works Suite 99 | Microsoft Money 99 Basic | P-III-optimized Power Game Pack: Expendable, Descent Freespace (both are special OEM versions with fewer levels)

BOOT 0:58 DOWN 0:05

**MAXIMUM PC VERDICT**

**Price** \$2,559 (\$3,035 with 19-inch monitor)  
**Company** Dell  
**Phone** 800.388.8542  
**URL** www.dell.com



**EXPANSION NOTES**

As is the case with all Intel Seattle design motherboards, DIMM accessibility is a dream (and you have two free module slots). Drive-bay opportunities are slim—all the 5.25-inchers are filled—but the machine is already stacked with fancy components. Same goes for PCI slots. With just a 200-watt power supply, you may want to think twice before adding much more to this already-loaded system.

**EXPANSION MAP**

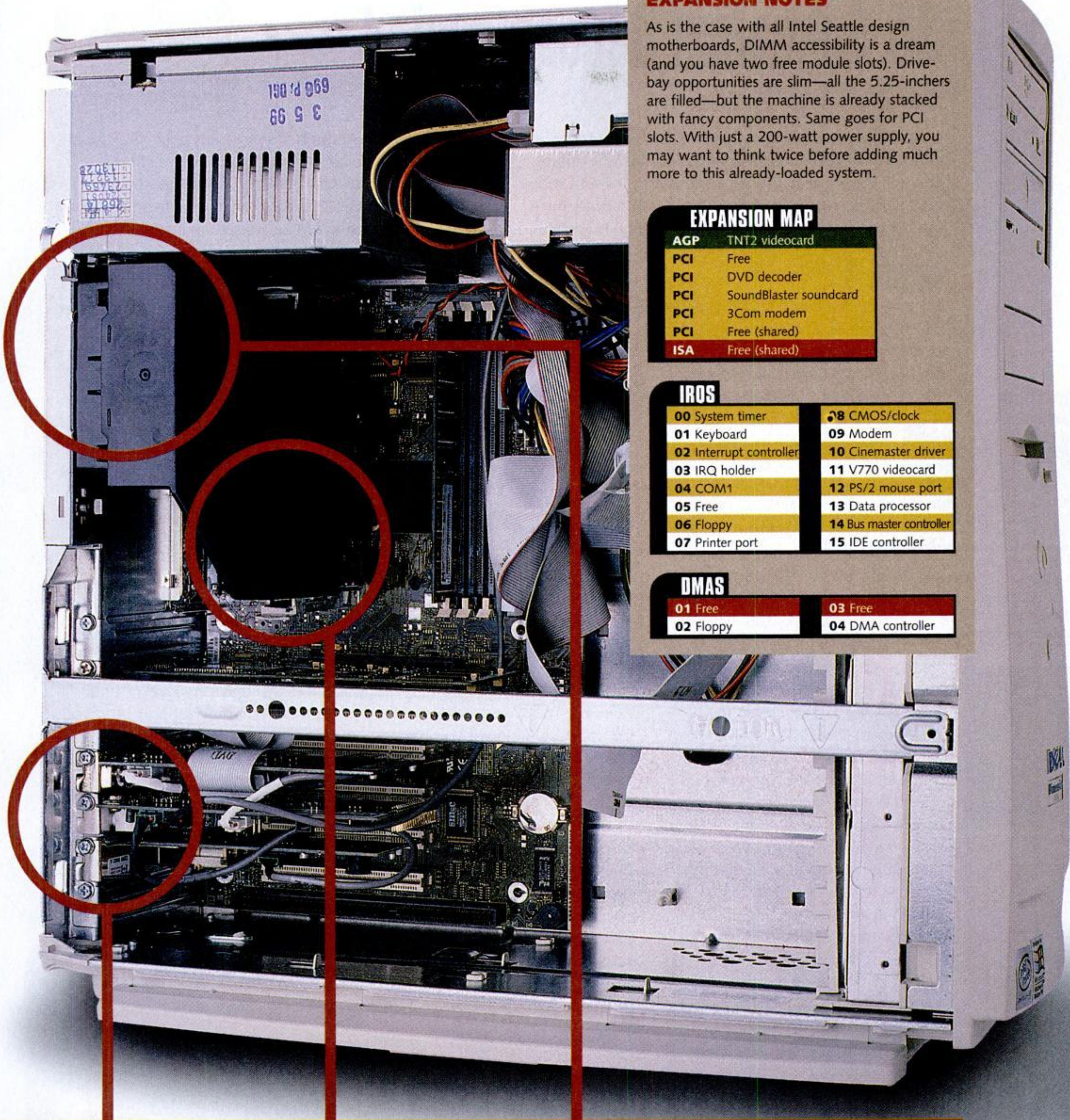
AGP	TNT2 videocard
PCI	Free
PCI	DVD decoder
PCI	SoundBlaster soundcard
PCI	3Com modem
PCI	Free (shared)
ISA	Free (shared)

**IROS**

00 System timer	08 CMOS/clock
01 Keyboard	09 Modem
02 Interrupt controller	10 Cinemaster driver
03 IRQ holder	11 V770 videocard
04 COM1	12 PS/2 mouse port
05 Free	13 Data processor
06 Floppy	14 Bus master controller
07 Printer port	15 IDE controller

**DMAS**

01 Free	03 Free
02 Floppy	04 DMA controller



**Outlandish!** You'll never run out of fun output jacks. The Sound Blaster Live! soundcard gives you a digital-out in addition to two stereo analog outs, and the QI DVD decoder card comes with composite video-out, S-video-out, and a S/PDIF.



**Nope, it is the heat** That P-III 550s run decidedly hot, pushing the limits of Intel's 0.25-micron process. This plastic wind tunnel keeps cool fan air from dispersing before it can hit the processor.



**Push me, pull me** Here are the fans themselves. The top fan blows cool air on the top of the proc. The wind tunnel keeps the breeze on point, while the bottom fan sucks heated air out of the case.



**Me ears are bleeding!** While the Altec Lansing 880s don't offer six discrete channels, they do provide a single rear-effects channel for ricocheting bullets and circling helicopters overhead.

# 3D Animation Deconstructed

CHECK IT OUT  
**Online**  
www.maximumpcmag.com

Find a finished Bryce.AVI in the Re:Print section

## EZ 3D 4 U & Me

Cool 3D animations are not easy. If they were, entry-level animators at ILM and Imageworks wouldn't be pulling down \$100 Gs a year. Industry-standard 3D applications such as *Lightwave*, *3D Studio Max*, and *Softimage* have interfaces that require months (if not years) to learn and

are intimidating enough to scare most of us away from 3D. But thanks to user-friendly apps such as Play's *Amorphium* and MetaCreations' *Bryce 4*, getting your feet wet in the basics of 3D is now easier than heading down to the latest Spike and Mike animation festival.

## Bryce 4

*Bryce 4*'s fractal-based terrain generator, 3D modeler, and animation tool creates and animates incredibly surreal landscapes and objects. By including the ability to export QTVR with

embedded links, and export textured terrain models to *Lightwave*, *Ray Dream Studio*, *Infini-D*, and *MetaStream* (a protocol for 3D interactivity over the web), MetaCreations wants to convince people its app is really a professional tool. But even with new features such as the Sky Lab, which gives you greater control over

creating starfields and clouds, and the ability to preview your animations, *Bryce* is still just a really fun toy.

Unfortunately, *Bryce* is still as slow as slug on a salt lick. A 720x480 frame with minimal environmental attributes took 6 minutes to render on the Quantex Pentium III 550MHz with 256MB of RAM (reviewed on page 90). It doesn't take a mathematician to figure out that a 30-second animation (running at 30fps) will take some two days to render.

The good news is that version 4 now has three new scene-status gauges that let you analyze a work

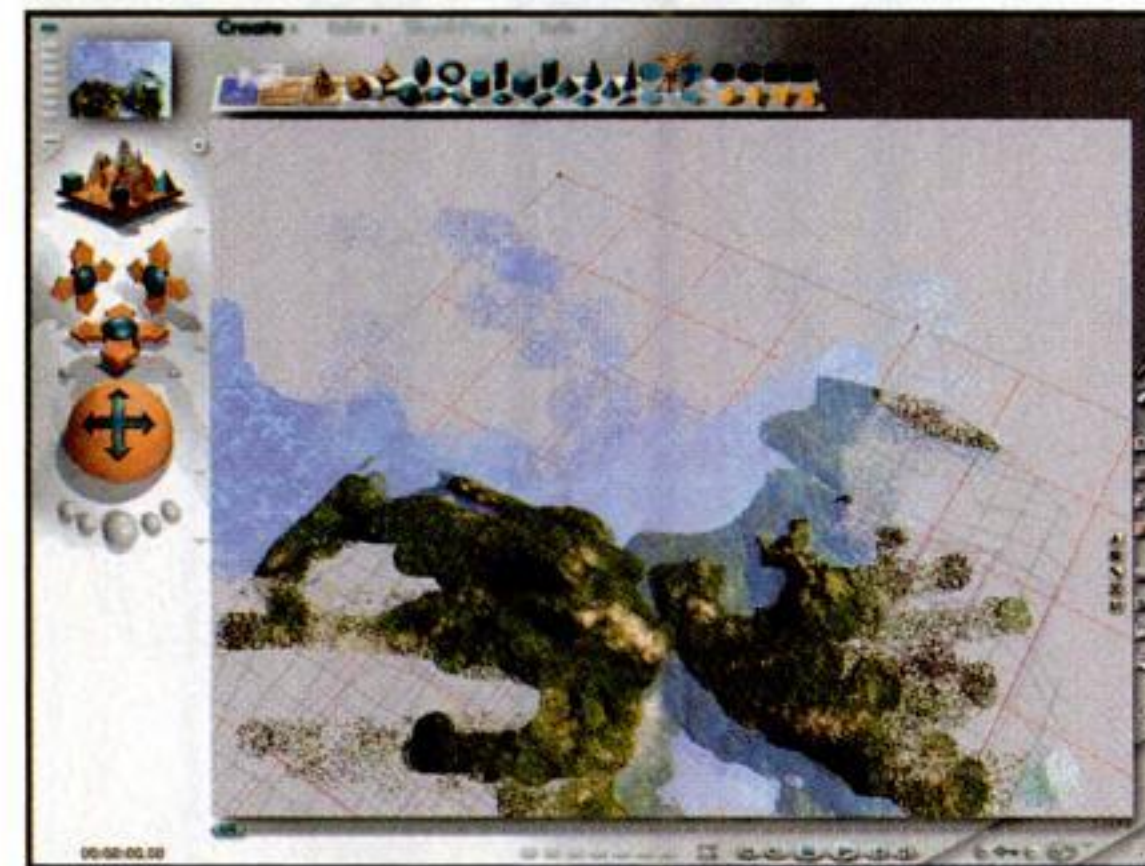
frames of your animation next to each other. Double-clicking on a frame takes you right to that keyframe in the main project window.

But *Bryce* still needs work. Grabbing the camera and moving it around is not easy, and while the rendering quality is good, we found major anti-aliasing glitches when looking through

reshaped objects such as the included donut model. Also, *Bryce* still has no right-mouse-button shortcuts, only one level of undo, and no multiproc support. And you can't see texture maps on your wireframe without rendering first.

MetaCreations needs to consider these important things to go after professional designers. Still, there's no denying this application is a lot of fun.

—Rick Popko



The new spray-can feature lets you render a particular area in your image without having to render the entire image.

in progress without having to render the entire frame or movie. The first is Spray Can, which lets you gradually reveal what your final product will look like. This works great, but it's still unbearably slow if you have several things going on in a scene, such as fog, clouds, glass, and metal.

The other preview features include an animation monitor window and the frame layout window. The thumbnail-sized preview screen gives you a vague idea of what your final animation will look like. While this is better than rendering the entire animation only to find out you screwed up, the window is tiny and doesn't show much detail. The frame layout window lays key

### THE SPECS

#### IMPORT FORMATS

Lightwave (.lwo, .lws) | TrueSpace (.cob) | USGS (.dem) | VRML1 (.vsa) | 3D Studio Max (.3ds) | Wavefront (.dxf)

#### EXPORT FORMATS

Ray Dream Studio (.rds) | AutoCAD (.dxf) | Infini-D (.id4) | Lightwave (.lws) | Wavefront (.obj) and MetaStream (.mts)

### PLUSES

- Three new ways to preview your animation
- Exports QTVR
- Affordable
- Easy to learn
- Cool results

### MINUSES

- Slow to render
- No mouse shortcuts
- Not multithreaded
- One level of undo
- Kai interface

### MAXIMUM PC VERDICT

**Price** \$199, \$99 for upgrade  
**Company** MetaCreations  
**Phone** 800.846.0111  
**URL** www.metacreations.com



### LET'S GET SPHERICAL

**Step 1** ▶ Drop a sphere into your scene.

**Step 2** ▶ Under the File menu, go to Edit 2D pictures, click on Load in the far-left window, and bring in a cool picture (such as a TIF with an alpha background).



Create a texture map from scratch.

**Step 3** ▶ From the middle window, load in a black and white matte. The matte can be created in MS Paint. You should now see an update of what your texture map looks like. Experiment with different images in window 1 and different maps in window 2.



Combine that texture with an alpha matte.

**Step 4** ▶ Click on the checkmark at the bottom of the screen and see your creation updated in the monitor window. To see your work in all its glory, you have to render the whole scene.



Salvador Dali would be beside himself.

# Amorphium

Amorphium is an extremely powerful 3D modeler that's incredibly cheap and easy to use.

Aimed at new 3D users, Amorphium eschews normal modeling tools and interfaces in favor of simple tools that sculpt and mold virtual objects. But while this package has enough power to attract high-end users who want to simply create high-quality, organic models, it is not a substitute for a full-fledged animation application such as Discreet's 3D Studio Max 3.

Amorphium's interface takes over your whole screen and presents an array of tools, menus, and options scattered around a medium-sized workspace. Though it's easy to understand and fairly simple to use, the next rev needs to include some sort of context-sensitive help to identify tools and modifiers.

You begin modeling by selecting one of the program's nine primitives or by

## THE SPECS

### IMPORT AND EXPORT FORMATS

FACT, DXF, 3DS, LWO, OBJ, BMP, JPEG, PNG, GIF, TIFF, PICT, and MOV

## PLUSES

- Intuitive interface
- Well-designed 3D painting tools
- Excellent performance
- Good documentation

## MINUSES

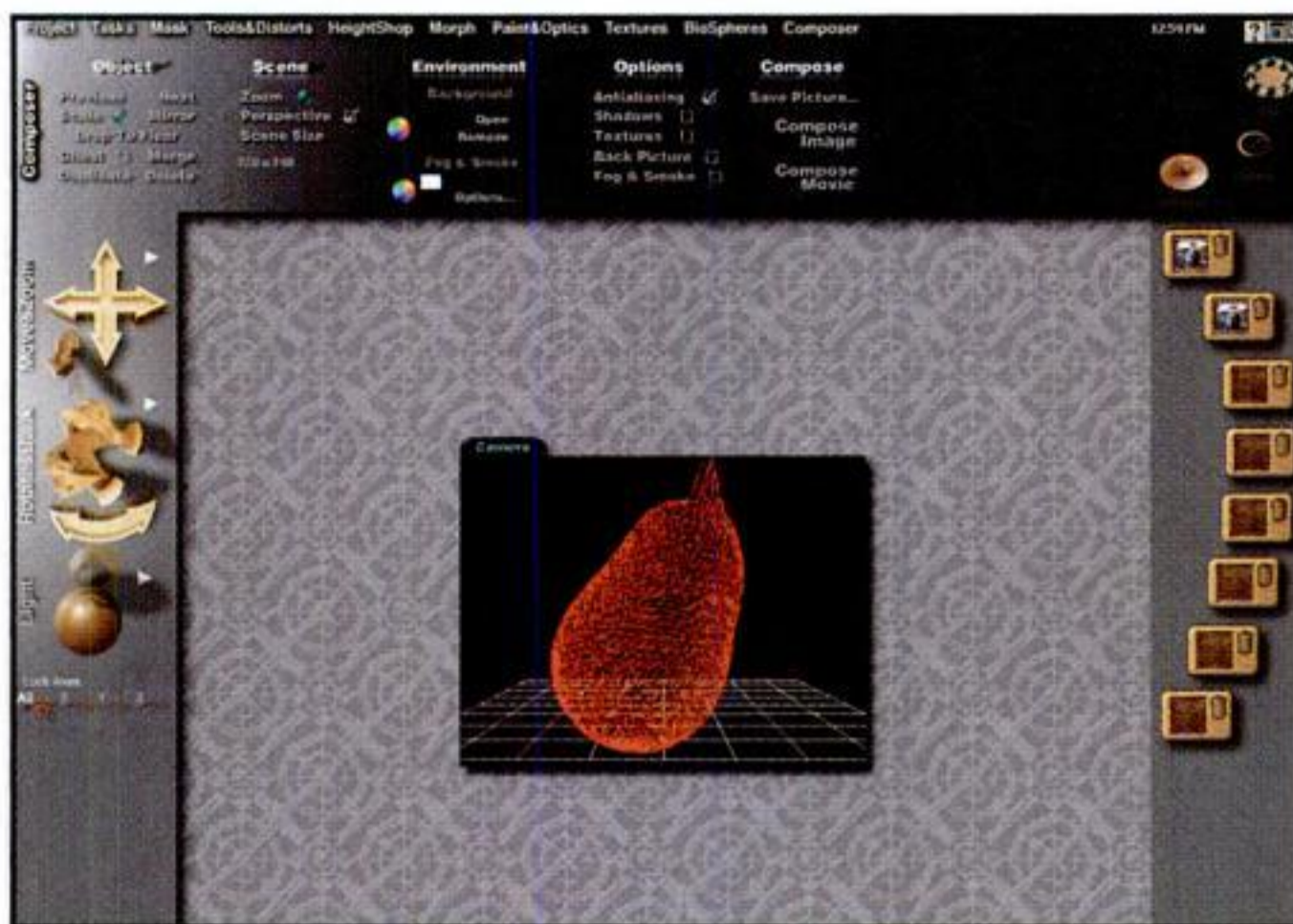
- Difficult to make models that aren't blobby and clay-like
- Thin, sinewy shapes are tough to make

importing an existing model. Your model appears in the workspace window as a fully shaded object, textured and lit in

realtime. This type of performance would normally require a 3D-accelerator card.

Models and shapes in Amorphium function as big blobs of clay. You mold and shape an object by painting on it with brushes, which push or pull the object's surface. At first this seems odd, but Play has provided excellent tools to take the 2D painting approach into the third dimension.

Numerous automated modeling tools are provided,



You define animation keyframes in Amorphium's Composer by positioning objects in your scene and clicking on a keyframe.

including twirl and twist, and the ability to add surface features such as spikes. These tools create fairly complex models quickly. Others include morphing tools, metaballs, and the ability to add height maps for creating terrains. While these are far from new or revolutionary, many are found in 3D apps costing thousands of dollars more.

You can paint the surface of any object in realtime using the surface paintbrushes, but the program lacks hard-edge brushes. Built-in masking eases your painting chores, and simple sliders control diffuse, ambient, and specular attributes.

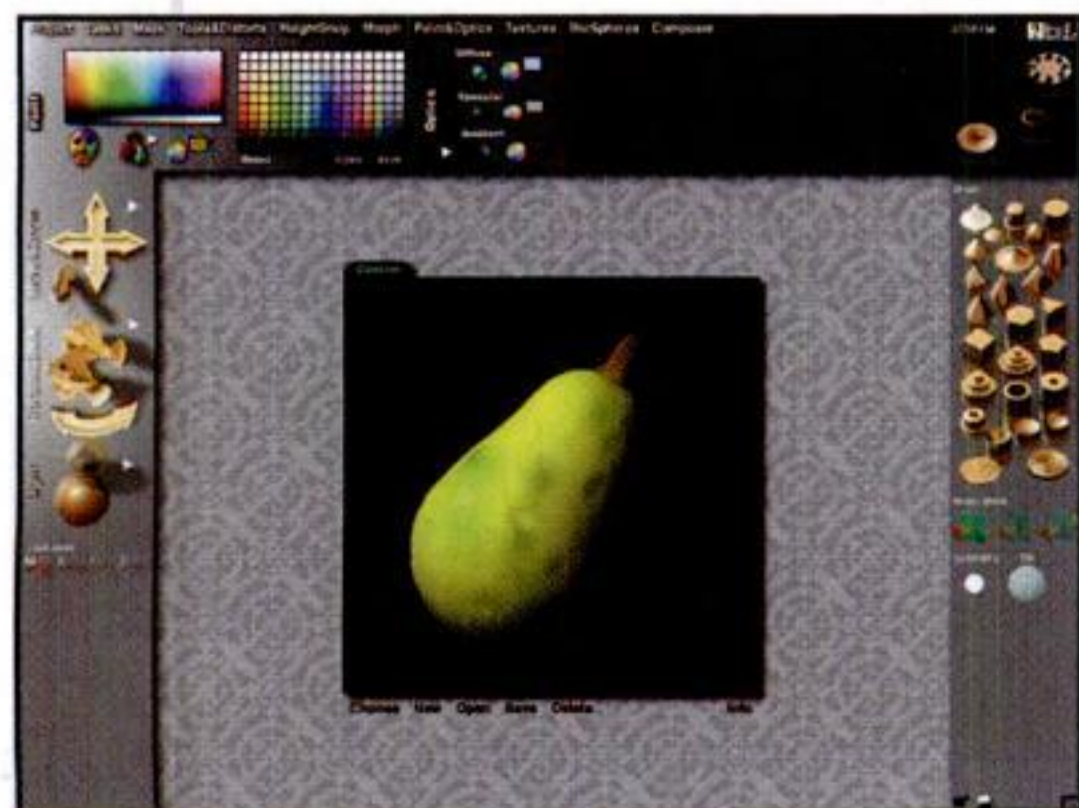
Amorphium also provides good texture-mapping controls, but you can't apply a texture to just one part of an object. Finally, a keyframing animation interface lets you output simple animations as a QuickTime movie at resolutions up to 4096x4096. Just keep in mind you're limited to only eight keyframes, and there's no way to preview your animation before rendering.

Amorphium also has a killer rendering engine that's been passed down from Play's high-end Electric Image. EI was used at ILM extensively for many of the effects shots in the new Star Wars movie. Faster than most raytracers or phong shaders, Amorphium rendered a 30-frame, 640x480, 10,000-polygon animation with textures, fog, and four keyframes in just under 15 minutes. Even when we threw numerous geometry distortions into the mix, Amorphium didn't slow down.

At \$159, it's incredible to see this much power. It's important to note that the program is for creating organic-looking models. You'll have a hard time creating architecture or zippy spaceships. Also, creating fine, sinewy shapes is difficult. To ease the creation of more complex models, we'd like to see the ability to paint in transparency or stencil maps.

In the end, though, whatever your level of use, Amorphium is a must-have 3D package.

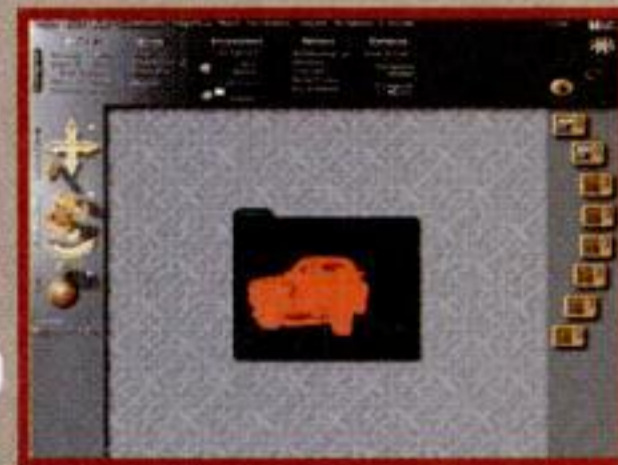
—Ben Long



Subtle dents can be easily applied with Distort brushes, while color and shading can be applied with normal paintbrushes.

## FENDER BENDER

Import a model of a car using the Import command located under the Project file Paint the model to your current taste in Porsches, in this case, a Porsche 911.



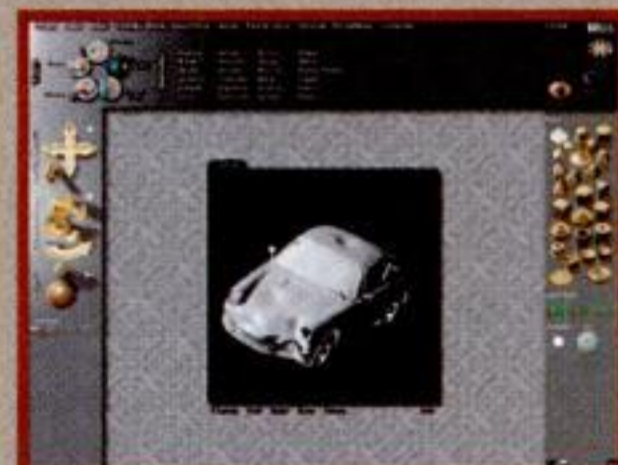
Click on the Composer button, position the model prominently on the screen, and click the first keyframe button.

Now click the Tools & Distort button and select a large radius brush with a lot of pressure. Smash in the front of the car. With a smaller brush, add some dents to the hood and door.



Using the distort brushes, bang up the front of the car.

Click on the composer button again. Click on the second keyframe and generate the animation.



With the car dented up, use the Composer to set a second keyframe. Amorphium will animate the geometry change.

When it's finished, Amorphium will fill in the frames between keyframes to show the car denting and twisting. Amorphium actually keyframes the geometry of the model as well as its position information!

## MAXIMUM PC VERDICT

**Price** \$149  
**Company** Play Inc.  
**Phone** 800.306.7529  
**URL** www.play.com



# Quantex GX550

**A great PC at an even better price**



**For sheer power and features, the Quantex GX550 is one of the best values around.**

### PLUSES

- Great value
- Good flat-screen monitor
- Impressive 3D graphics
- Fast as hell
- Clean software DVD playback
- Comprehensive software bundle
- Good USB speakers
- Killer CD-RW drive

### MINUSES

- Horrible TV out
- Two (plus shared) ISA slots

The Quantex GX550 is a perfect computer for students and gamers alike. It's extremely powerful and competitively priced, and comes with a comprehensive software reference library.

While serious computer geeks will appreciate the GX550's Pentium III 550MHz proc, 256MB of 100MHz SDRAM, and huge 21GB hard drive, hard-core gamers will revel in the awesome power of 3Dfx's latest Voodoo<sup>3</sup> graphics, which can handle 2D resolutions up to 1600x1200 at 75Hz and 32-bit color depth.

The GX550 has done everything right. It's as though Quantex read every system review we've done and built a piecemeal machine using everything we love. It includes Altec Lansing's ADA 305, a three-piece **USB** speaker setup that actually delivers, dare we say it, decent **pseudo-surround sound**. The speakers worked like a dream when compared to the now defunct Digital 80s from Microsoft, a squirrely USB speaker set that received a 7 in our May 1999 issue.

In what seems to be a trend among PC makers, the GX550 includes both a CD-RW and a DVD-ROM drive. For the CD-RW, Quantex chose Sony's CRX100E, which garnered a 9 in our February 1999 issue. The Toshiba 6x DVD drive is so new, we have yet to review it, but it was fast and worked

great with QI's latest software **MPEG-2** player. In fact, QI's DVD software delivered the best software-decoded picture quality we've seen to date. The only drawback is that QI's software doesn't decode true 5.1 audio.

The most disappointing feature of the GX550 was the Voodoo<sup>3</sup>'s TV out. In short, it bites. The graphics to the TV were abominable, and DVD movies played through it were unwatchable.

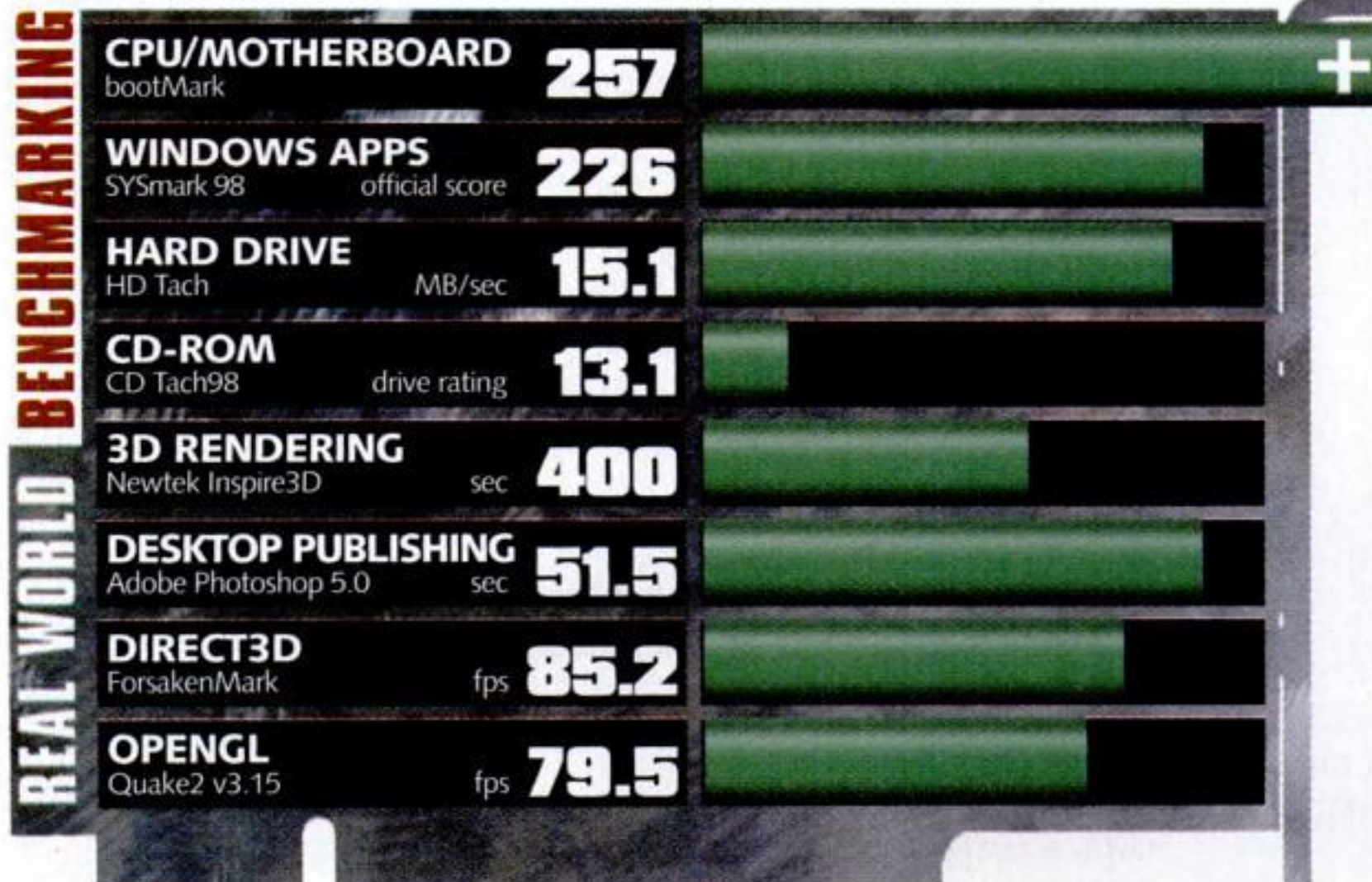
We also didn't like the two **ISA** (plus a shared PCI/ISA) slots lingering inside. One ISA slot is perfectly acceptable, but two? Plus a shared? Let's get with the 20th century here, folks.

On the performance tip, we compared the GX550 to Dell's 550MHz Dimension XPS (reviewed on page 86). In a close race, the GX550 edged out Dell's XPS in all but two benchmarks. It lost only in CD Tach and HD Tach. The extra 128MB of RAM Quantex stuck in the GX550 helped beat the XPS in the *Photoshop* test by a good 5 seconds. And in our 3D benchmarks,

it came down to a battle between Riva's TNT2 (in the Dell) and 3Dfx's Voodoo<sup>3</sup> (in the Quantex), both awesome cards in their own right. In the *Quake II* benchmark, the Voodoo<sup>3</sup> beat the TNT2 by 2fps. In *Forsaken*, Voodoo<sup>3</sup> beat TNT2 by a mere 1fps. Both cards could have put out higher framerates in the *Forsaken* test, but were limited by the refresh rate of their respective monitors.

Overall, we were impressed with the performance the GX550 brings to the table. Even more surprising is that Quantex could put out a system of this caliber at such a competitive price.

—Rick Popko



### UNDER THE HOOD

#### THE BRAINS

CPU	Intel Pentium III 550MHz
L2 Cache	512K closely coupled, half core CPU speed
RAM	256MB 100MHz SDRAM (upgradable to 768MB)
Motherboard	Biostar M6TLC
Drive Bays	Four 5.25-inch (two free), five 3.5-inch (three free)
I/O Ports	Two USB, two serial, one parallel, joystick, mic in, out, through

#### DISPLAY

Video	3Dfx Voodoo <sup>3</sup> with 16MB RAM and TV out
Monitor	19-inch Mitsubishi Diamond Tron 2 flat-screen CRT, 18-inch viewable
Res/Refresh	1600x1200/75Hz

#### STORAGE

Hard drive	IBM DJNA 372200 21GB Ultra DMA
Removable	Sony CRX100E CD-RW, floppy
DVD	Toshiba SD-M1212 6x DVD
Fax Modem	U.S. Robotics 56K

#### SOUND

Sound	Aureal Vortex AV8830
Speakers	Altec Lansing ADA 305 USB three-piece

#### OTHERS

Microsoft SideWinder joystick

#### THE BUNDLE

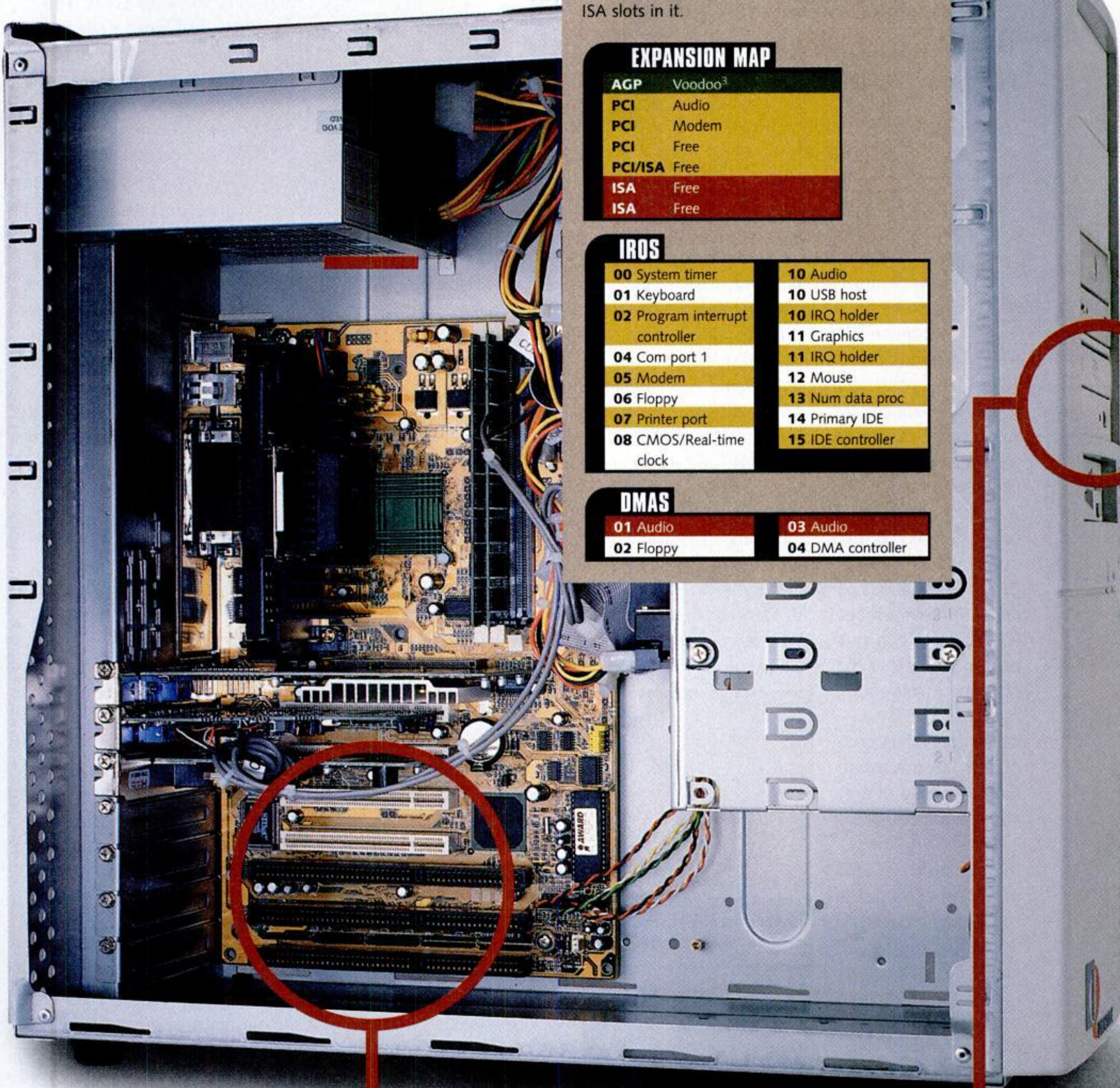
Corel WordPerfect 8 | Windows 98 | Amazon Trail II | Compton's American Heritage Talking Dictionary | Adaptec's Easy CD Creator | The Learning Company's Body Works | Compton's Interactive Encyclopedia | Reference Collection and World Atlas

BOOT 0:37 DOWN 0:02

### MAXIMUM PC VERDICT

**Price** \$2,399 (\$2,749 with 19-inch monitor)  
**Company** Quantex  
**Phone** 888.312.1166  
**URL** www.quantex.com





**EXPANSION NOTES**

The GX550 has plenty of room for drive expansion, but we had to wonder what such an awesome machine was doing with two ISA slots in it.

**EXPANSION MAP**

AGP	Voodoo <sup>3</sup>
PCI	Audio
PCI	Modem
PCI	Free
PCI/ISA	Free
ISA	Free
ISA	Free

**IROS**

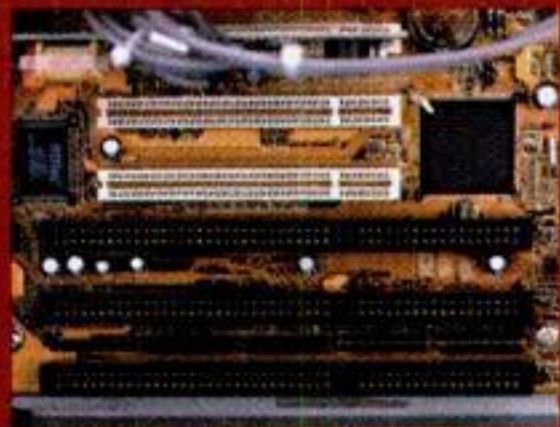
00 System timer	10 Audio
01 Keyboard	10 USB host
02 Program interrupt controller	10 IRQ holder
04 Com port 1	11 Graphics
05 Modem	11 IRQ holder
06 Floppy	12 Mouse
07 Printer port	13 Num data proc
08 CMOS/Real-time clock	14 Primary IDE
	15 IDE controller

**DMAS**

01 Audio	03 Audio
02 Floppy	04 DMA controller



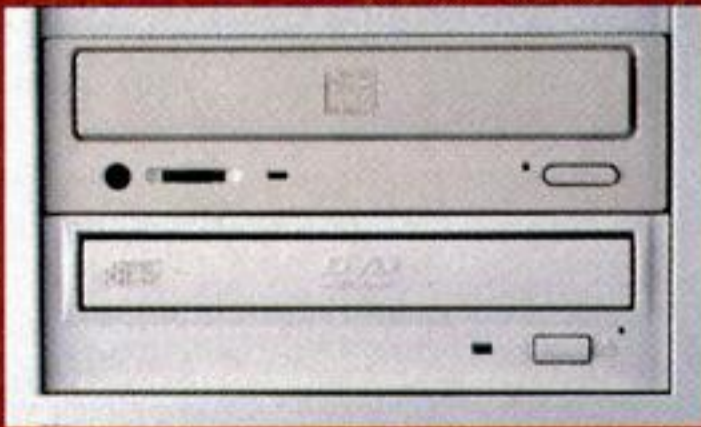
**We can see clearly now** The 19-inch Mitsubishi flat-screen monitor delivers crisp, clean graphics all the way up to 1600x1200/75Hz@32-bit.



**It's a long slot** What the hell are two ISA slots doing in there? Quantex should have dropped in two PCI slots, instead of saving money on the motherboard.



**Listen up** The Altec Lansing USB three-piece setup puts out great sound and can be controlled via software from your desktop.



**Learn to read and write** This isn't the first time we've seen a system manufacturer include both a DVD-ROM drive for playing movies and a CD-RW for playing games and backing up files. We hope this trend continues.

# Starsiege

## Rock 'em sock 'em robots duke it out

*Starsiege*, the latest Mech combat sim from Dynamix, follows the skirmishes of the Imperial resistance forces across the solar system. With a variety of vehicles to pilot and a

### THE SPECS

#### 3D CARD SUPPORT

Glide and OpenGL

#### MULTIPLAYER

TCP/IP

IPX

Internet

### PLUSES

Engrossing campaign

Cool vehicle options

Great multiplayer engine

### MINUSES

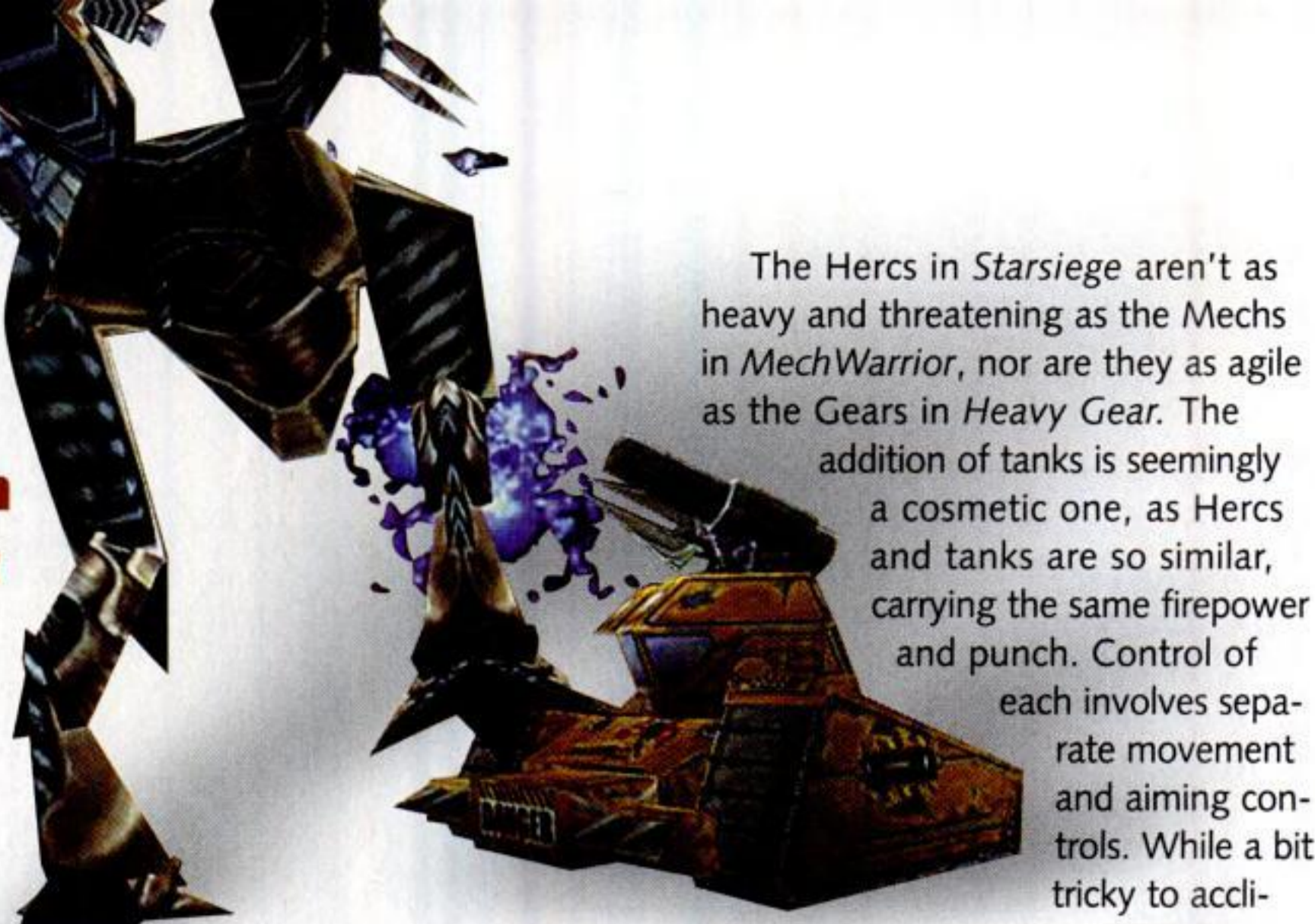
Weak graphics  
Limp AI

host of technological components to outfit your squad, *Starsiege* has all the elements that make for great Mech combat. But despite its slick and polished feel, *Starsiege* is only a mediocre Mech game with weak graphics and poor AI.

Graphics are silky-smooth, supporting both Glide and OpenGL. At 800x600 with a TNT or Voodoo<sup>2</sup> board (1024x768 if you're sporting dual Voodoo<sup>2</sup>s), even a mid-range CPU can crank out admirable frame-rates. Our biggest beef with *Starsiege* is its low polygon count. While lower-poly models allow characters to run faster on lower-end machines, the downside is characters and objects feel insubstantial, composed of only about 250 polygons. Missiles are nothing more than flat-shaded polygons, and most of the energy weapons are simple sprites.

Ugly trees lack mip-mapping and filtering, turning them into blocky green messes.

But there is some goodness in the game. The well-implemented fogging prevents polygon pop-up and allows the engine to push out expansive



vistas. Handsome graphical amenities, such as lens flares, Herc footprints, and tank treads, give a cinematic feel to the game. Alpha-blended, multicolored explosions are pretty cool, too.

The A3D-enhanced sound in *Starsiege* is decent. Atmospheric elements such as squad chatter and enemy taunts are realistic, and—along with the thundering footsteps of your Herc—complement the environment.

With multiple weapons and a fistful of skins at your disposal, you can ensure your Herc is loaded for bear. Besides a variety of weapons and armor, cool technological toys such as cloaking units and improved targeting computers play a large part in a successful campaign. For example, you can use a special transmitter that lets you target enemy structures for heavy artillery outside the combat zone. Target an enemy city, signal the artillery units, and watch them fire volleys of shells from afar at the doomed structure. City sieges have never been more fun.



Cornball missiles and other weapons are flat-shaded polygons. Whatta gyp!



The low-polygon Mechs help jack up framerate on lower-end systems, but they end up looking cheap on high-end hardware.

### Hercs straight outta Robocop wage war across the planets in Starsiege.

The Hercs in *Starsiege* aren't as heavy and threatening as the Mechs in *MechWarrior*, nor are they as agile as the Gears in *Heavy Gear*. The

addition of tanks is seemingly a cosmetic one, as Hercs and tanks are so similar, carrying the same firepower and punch. Control of

each involves separate movement and aiming controls. While a bit tricky to accli-

mate to, controls are responsive and quick.

Unfortunately, *Starsiege* suffers from thin AI. Combat usually dissolves into

two Hercs squaring off and running circles around each other. Enemies will take fire without moving, and your squad mates will blindly rush into combat before you've shelled enemy towers.

Supporting TCP/IP, IPX, and Internet connections for up to 32 players, *Starsiege* has all the multiplayer bases covered in spades. With 25 multiplayer arenas, deathmatch competitions, and team-ups, gamers with itchy trigger fingers can frag long into the night. The networking engine is based on *Tribes*, so expect rock-solid performance, even on a V.90.

*Starsiege* could have been a contender if the graphics had bigger muscles and the AI had been craftier. However, with a bevy of vehicles to pilot, a strong and engrossing campaign, and some fast shoot-'em-up action, *Starsiege* has its moments of greatness. It's just a little behind the times.

—Dan Simpson

### MAXIMUM PC VERDICT

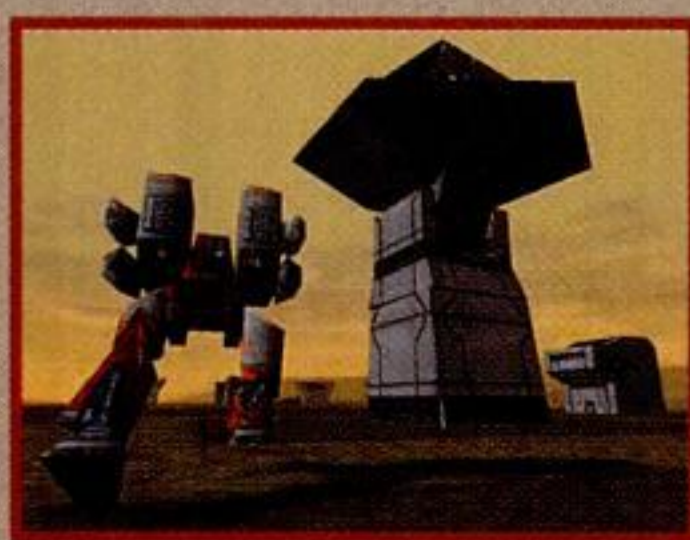
**Price** \$55  
**Company** Dynamix  
**Phone** 310.369.1000  
**URL** www.dynamix.com

6

### ARM YOURSELF

Laying siege to entrenched troops in a city is easy when you have the right tools and firepower. Just be sure to outfit your Herc appropriately before the mission.

► Always remember to bring a Laser Target



Towns are much easier to scout when the turrets are knocked out.

Designator to take out enemy tower turrets. It's a cheap shot, but there's nothing more satisfying than targeting towers from afar and having artillery shell the bejezus out of it.

► Cloaking is a great ability when the

balance of power is against you. Cloak and snipe from afar. Once you lure some of the Hercs out of their guard posts, call your squad mates in to tear 'em up. Once a majority of the guards have been picked off, charge in full-bore and clean up house. And make sure you keep a tight reign on the rest of your squadron, because they're not very intelligent and will charge into combat before you're ready.

# Microtek ScanMaker 4

## It's all about the tray

Microtek's ScanMaker 4 is a little gray around the temples these days, but it still pulls its weight as an all-around scanner for consumers with more demanding graphic needs.

The key feature that sets the ScanMaker 4 apart is a slide-out drawer for transparencies. While other scanners need expensive or cheesy transparency adapters, the ScanMaker's drawer does the job for both medium- and (if your PC has the memory) large-format transparencies. Optional adapters are available to hold down different-sized film.

Microtek claims the drawer eliminates some of the problems associated with transparency adapters and other flatbed scanners. When you push film against glass, you risk the two surfaces creating a moiré pattern in your image. By using the tray, you forgo the glass scan bed, and the scan head passes directly over your film's emulsion for allegedly better image quality.

While the tray sounds great on paper, it does something you wouldn't expect. It opens up the internals of the scanner to dust. It doesn't take long for a nest of dust bunnies to multiply in your scanner. Microtek addresses this by making the glass bed removable—something every scanner maker

should do—for servicing and cleaning. Still, unless you work in a clean room, you should keep this in mind when considering the ScanMaker 4.

The tray is very convenient for transparencies, but the inherent limitations of the scanner's resolution left us reaching for *Photoshop's* sharpen filters. The ScanMaker simply doesn't hold up when put against a real negative scanner, such as Nikon's LS-2000. This certainly isn't a fair contest, but those hoping for first-rate scans from 35mm negs without spending ducats on a separate negative scanner will have their hopes dashed. Weekend or web warriors will be more than happy with the output, especially when the film size is bumped up. On a 2 1/4-inch slide, the results were more usable, albeit not as sharp as we would have hoped.

When not using the transparency tray, the ScanMaker 4 more than holds its own. What better test is



**The ScanMaker 4's excellent pull-out tray eliminates the need for a transparency adapter.**

there than scanning the new \$20 bill? Here, the ScanMaker 4 turns in tack-sharp scans. We compared the results to Epson's

much beloved Perfection 636 and found the ScanMaker 4 surprisingly sharper to the eyeball. The ScanMaker 4 also proved to be significantly faster than the Perfection 636, and we found its rendering of colors more pleasing, with color saturation and image quality very good overall.

The only things that may put some off are the possible dust problem, the sheer bulk of the scanner, and the need for a higher resolution when scanning small film.

—Gordon Ung

### THE SPECS

#### MAXIMUM RESOLUTION

600x1200

#### INTERPOLATED RESOLUTION

9600x9600

#### COLOR DEPTH

36-bit

#### BUNDLE

TWAIN drivers for Windows 9X, Windows NT, Macintosh | Adobe Photoshop LE 4 | MetaCreations Painter 5 | Caere OmniPage Limited Edition OCR | DocuMagix PaperMaster SEC | Adaptec AVA-2902E PCI SCSI-2 card

### PLUSES

Neat scan tray  
Fast puppy  
Good image quality

### MINUSES

Scan tray exposes interior to dust  
Cartman-like bulk  
Unfriendly TWAIN driver

### THE NEED FOR SPEED

	8X10 PHOTO 36-BIT COLOR @ 600DPI	4X6 PHOTO 36-BIT COLOR @ 600 DPI	20 DOLLAR BILL 36-BIT COLOR @ 600 DPI
ScanMaker 4	2:23	0:46	0:25
Perfection 636	6:25	1:03	0:33

### MAXIMUM PC VERDICT

**Price** \$699  
**Company** Microtek  
**Phone** 800.654.4160  
**URL** www.microtek.com



### SCAN QUALITY



Epson



Microtek



Epson



Microtek



Microtek

Mr. Wiggum's red fur gave the 636 a hairball.

The Microtek turned in a near purr-fect image.

The 636 produced a visibly less sharp image.

A sharper image overall, but a slight color shift.

On medium-format film, the tray shines, but 35mm film leaves you wanting more.



# Office 2000

## It's all about the web

Where Microsoft *Office 97* was about personalization and customization, *Office 2000* is about bringing it all to the Internet. In fact, the suite of applications in this rev are so

web integrated, it quickly becomes hard to tell where *Office* ends and the Internet begins.

Whether you need this upgrade depends on your job function. If you export documents, charts, and databases to your company's web site all day, you'll marvel at the way Microsoft has simplified and streamlined those operations. If you're Joe Schmo, who just drafts letters and calculates an occasional spreadsheet, you can probably wait out this release and jump aboard the next one. While Microsoft has incorporated more than web improvements in this release, those enhancements don't warrant the \$200 upgrade price.

### THE SPECS

#### IMPORT FILE SUPPORT

**Word:** Excel, HTML, Lotus 1-2-3, Rich Text Format, ASCII Text, WordPerfect 5.x & 6.x, Works, Word for Mac

**Excel:** Excel, HTML, Lotus 1-2-3, Quattro Pro, Works 2.0, dBase

**Access:** Access, HTML, Excel, dBase, Lotus 1-2-3

#### EXPORT FILE SUPPORT

**Word:** HTML, ASCII Text, WordPerfect 5.x, Works, Word for the Mac

**Excel:** Excel, HTML, dBase  
**Access:** Access, HTML, Excel, dBase, Lotus 1-2-3, Paradox, RTF

### PLUSES

Tight Inter/intranet integration  
Highly customizable  
Refined intelligence  
More shortcuts

### MINUSES

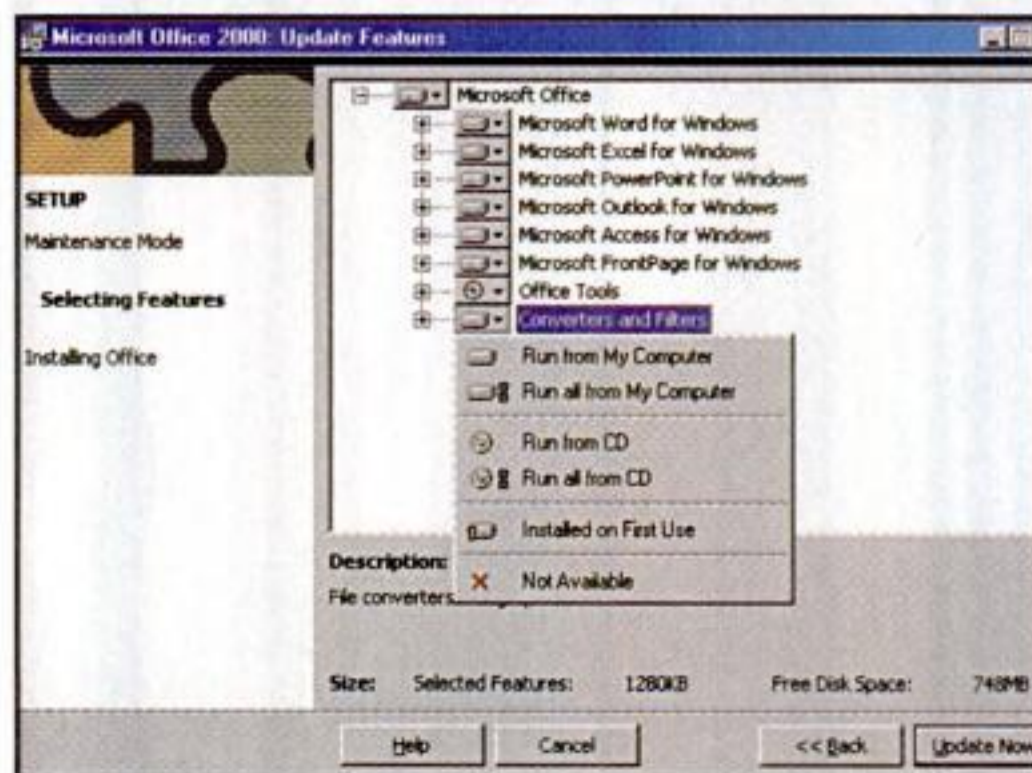
Upgrade too much for home users and non-web-dependent businesses  
Older Access files need to be converted  
Premium edition is a space hog

### Tailored for You and You and You

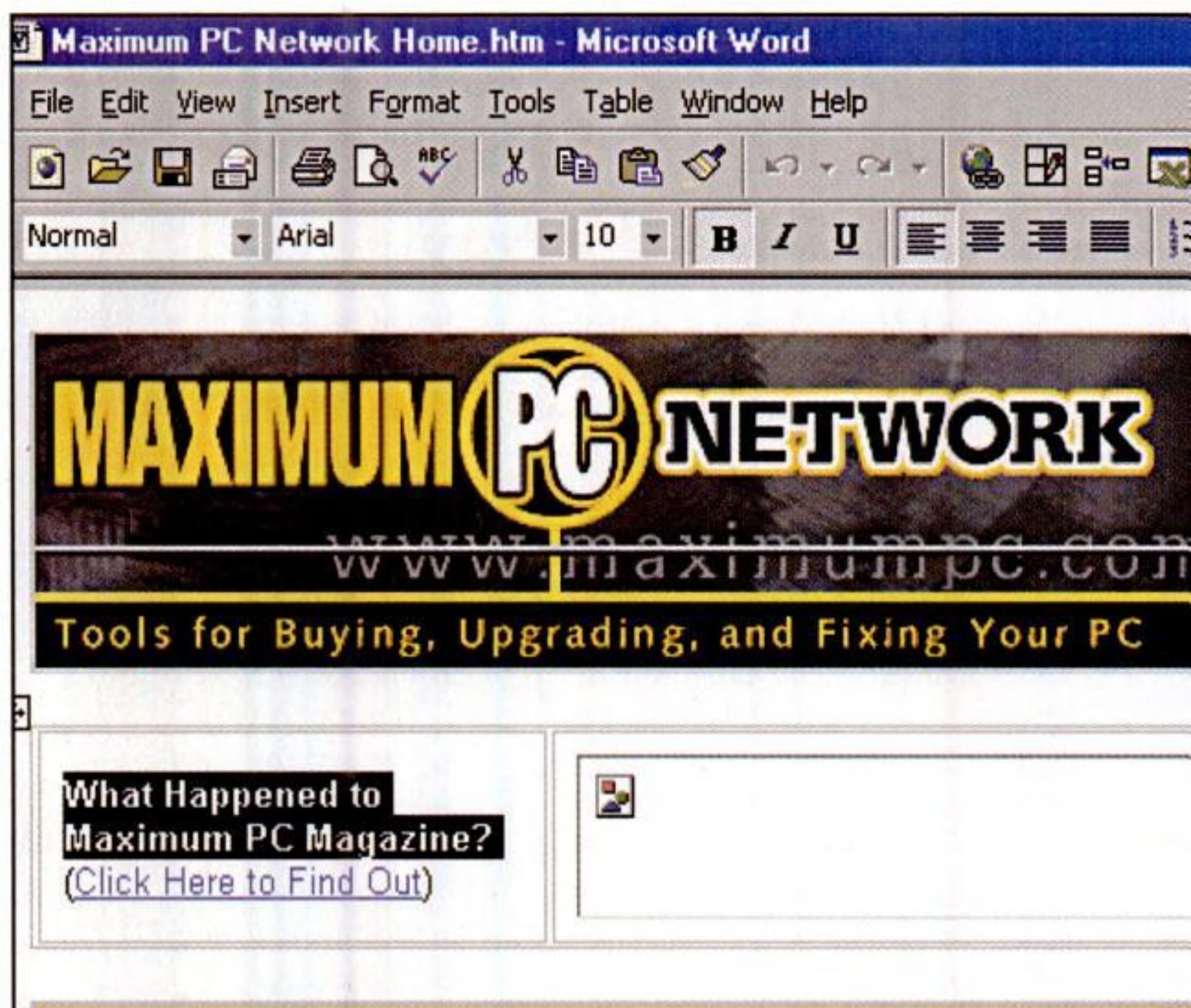
*Office 2000* comes in four flavors to satisfy every level of need. The Standard Edition comes with the 2000 versions of *Word*, *Excel*, *Outlook*, and *Powerpoint*; the Small Business Edition ships with *Publisher 2000* and *Small Biz Tools* as well; the Office Professional Edition comes with *Access 2000*; and the Premium Edition ships with all the above plus *Frontpage 2000* and *PhotoDraw 2000*. It also takes up more hard drive space than any previous version, or pretty much any application on the market. While the Standard Edition clocks in at a "measly" 189MB, the Premium Edition fills an ungodly 536MB.

Unlike previous upgrades, almost all the apps in *Office 2000* are backward compatible with *Office 97*, with the surprising exception of *Access*, whose files require a complete conversion if you want to amend the database at all. Windows' Installer now gives you more control over installation. From a single dialog box, you can pick which features to install and select features that should be installed only when you first use them or that should run from the program CD.

While it seemed odd to us to have a Removal Wizard that lets you keep the *Office 97* applications you want while removing and



A wonderful installation wizard lets you choose the products you want installed, which you want to run from the CD, and which you'll install later.



**Word 2000 can now import, edit, and save HTML files for easy web page management.**

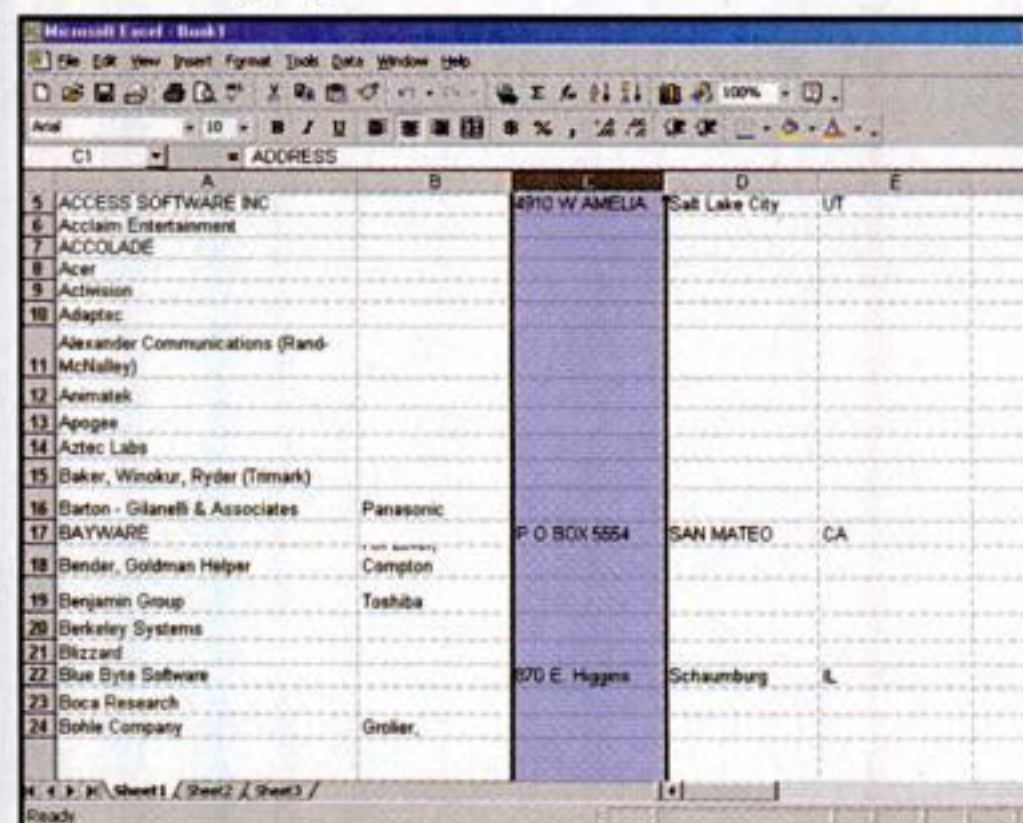
updating the ones you don't (why waste the money?), we appreciate the ability to automati-

cally pick up all your *Office 97* settings and preferences and apply them to the new version. For example, if you've told *Word 97* not to AutoFormat numbered and bulleted lists, *Office 2000* will keep those preferences.

We were also impressed with the self-repairing feature, wherein *Office 2000* checks to see whether any critical files are missing whenever you launch an application and then automatically reinstalls them, whether they're EXE files or simply templates and fonts. And if you use more than one PC, you'll appreciate a new feature for synchronizing *Office 2000* installations. For example, when you get a new laptop, you can pack up all your *Office 2000* preferences on your desktop and transfer them to the new system.

### Ch-ch-changes

We were surprised by the little changes. Multitasking has become more difficult from a purely aesthetic point of view now that *Word's* taskbar colors are virtually identical to *Internet Explorer's*. More than once we pulled up a *Word* doc when we were trying to access our browser.



With *Office 2000*, you can now drag and drop your *Access* files right into *Excel*.

Another peculiar feature is Quick File Switching, where each open *Office* document is easily accessible via the Windows Taskbar. Instead of one button representing *Word* or *Access* (each with several open documents contained within), each open document gets its own button on the taskbar. So if you have three *Word* documents open, you'll have three separate buttons to deal with. And with *Access*, you get not only the button for the database itself, but also a button for the open file. This can make things easier to a degree when working on a few documents, but when you have many going at once for whatever reason, it can be easy to get lost with each button's diminished size making identification nearly impossible.

*Office 2000's* menus and toolbars now adapt to your work habits. For example, all *Office 2000* applications (except the odd *PhotoDraw*) display only a subset of their most commonly used commands on the top-level menus (you can reach the

other commands by clicking arrows at the bottom of the menus). But as you access hidden items, they're automatically promoted to the list of visible commands. After a few weeks, the top part of each menu will display only the commands and icons you use regularly.

Other personal-productivity enhancements include the new Collect And Paste function, which lets you copy up to a dozen data chunks from one or more *Office* apps and from web sites before you paste any of them. This proved more difficult and frustrating in practice than it read on paper, though. Also, the spell checker now recognizes mid-sentence language switches. And the *Office* Help system now appears tucked nicely alongside your document window—not atop it—so you can follow directions more easily.

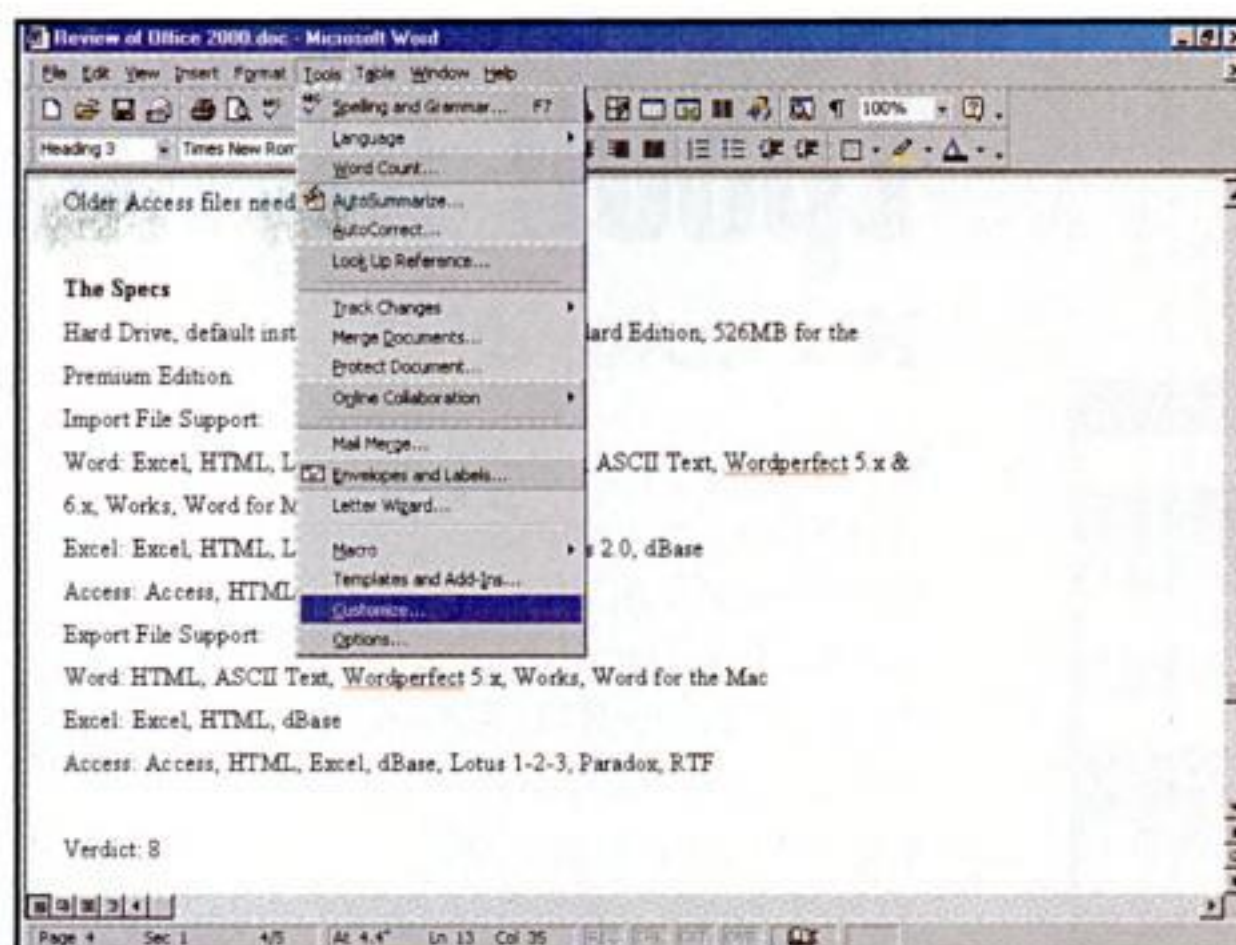
### It's a Web, Web, Web, Web World

Make no bones about it; *Office 2000* is all about the web. While *Office 2000* applications still use their traditional file formats, they now also treat HTML as a "native" file format. By using special XML tags, *Office 2000* can convert existing documents to HTML without sacrificing the formatting found in traditional *Office* files.

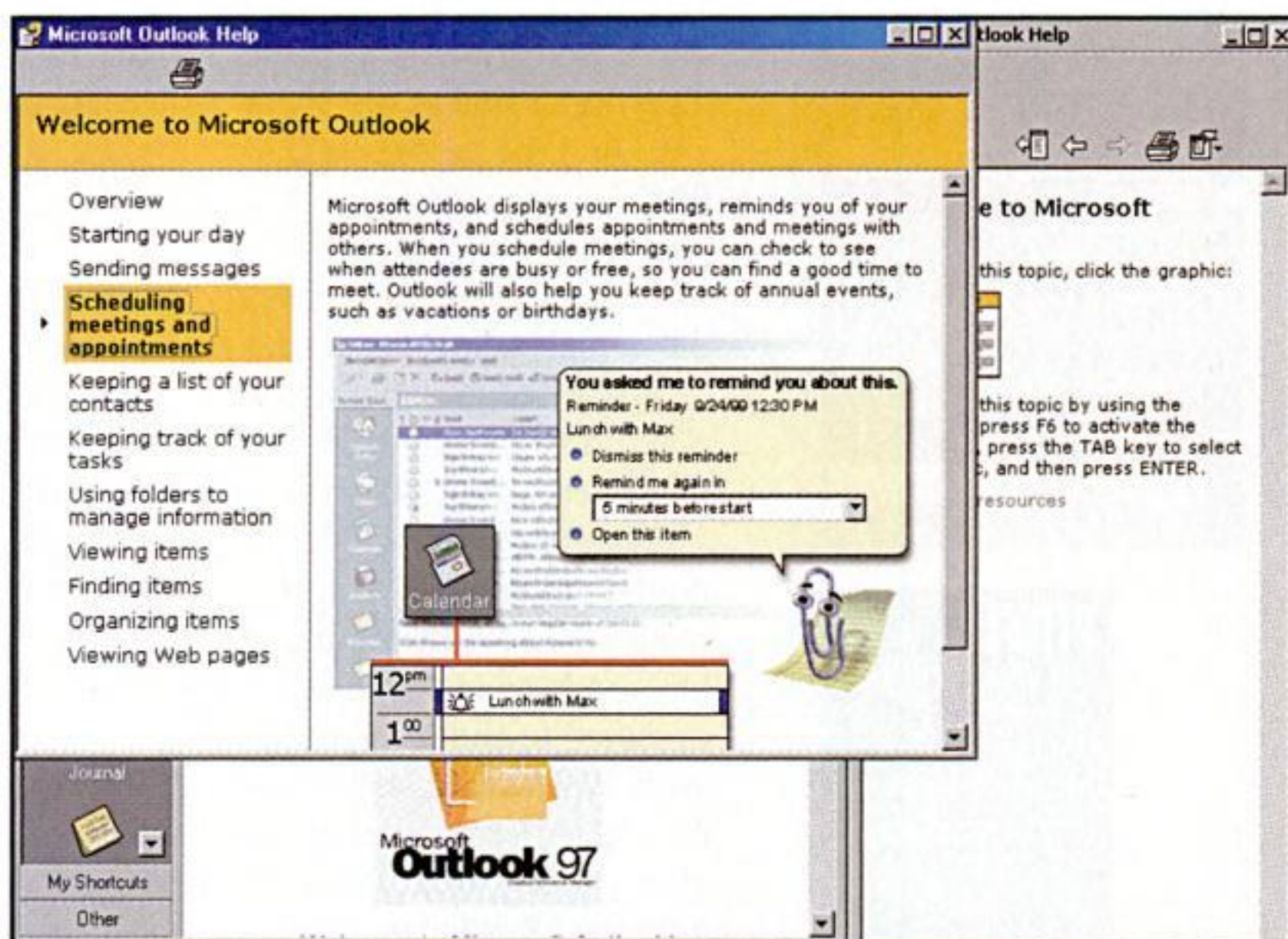
When you reopen HTML documents in the *Office 2000* applications used to create them, all the properties remain intact. In fact, if your web server has *FrontPage* Server Extensions, you can edit *Word* or *Excel* files right in *Internet Explorer 5*.

If you use *Office 2000* to create HTML documents from scratch, you'll find that *Word 2000* has become quite the web-authoring tool. This version includes a simple frames editor, better handling of graphics, and design templates that match those in *FrontPage*, making it easy to create consistent-looking web sites. *Microsoft PowerPoint* has a new "Publish As Web Page" option that lets you target specific versions of browsers for the best results. And you can now export your *Outlook* calendar to HTML.

*FrontPage* has been overhauled, as well. Now it displays the page editor and site manager in the same window, and it does a better job of importing HTML



**Office 2000** tries to adapt to each individual user by displaying in its drop-down menus the actions you use most often and then hiding the ones you don't use.



The new **Outlook 2000** comes with a host of new and improved features, including an excellent tutorial and the ability to publish a calendar in HTML.

documents. The new Database Results Wizard lets you add dynamic database queries to web pages that connect to any ODBC-compliant database—such as *Access*—on a web server or network server.

In short, the latest version of *Office* is built for those dependent on the web and exchanging information through the Internet or an intranet. And for individuals who make a living designing web sites, *Office 2000* is the ideal application. But for the rest of the population who depend on the Internet to get sports scores and are happily content with *Office 97* or even *95*, you can stand to wait until the real Y2K passes before you give in to the inevitable upgrade.

—Shane Mooney

### MAXIMUM PC VERDICT

**Price** Standard Edition (\$209 upgrade, \$499 new); Small Business Edition (\$209 upgrade, \$499 new); Office Professional Edition (\$309 upgrade, \$599 new); Premium Edition (\$399 upgrade, \$799 new)

**Company** Microsoft

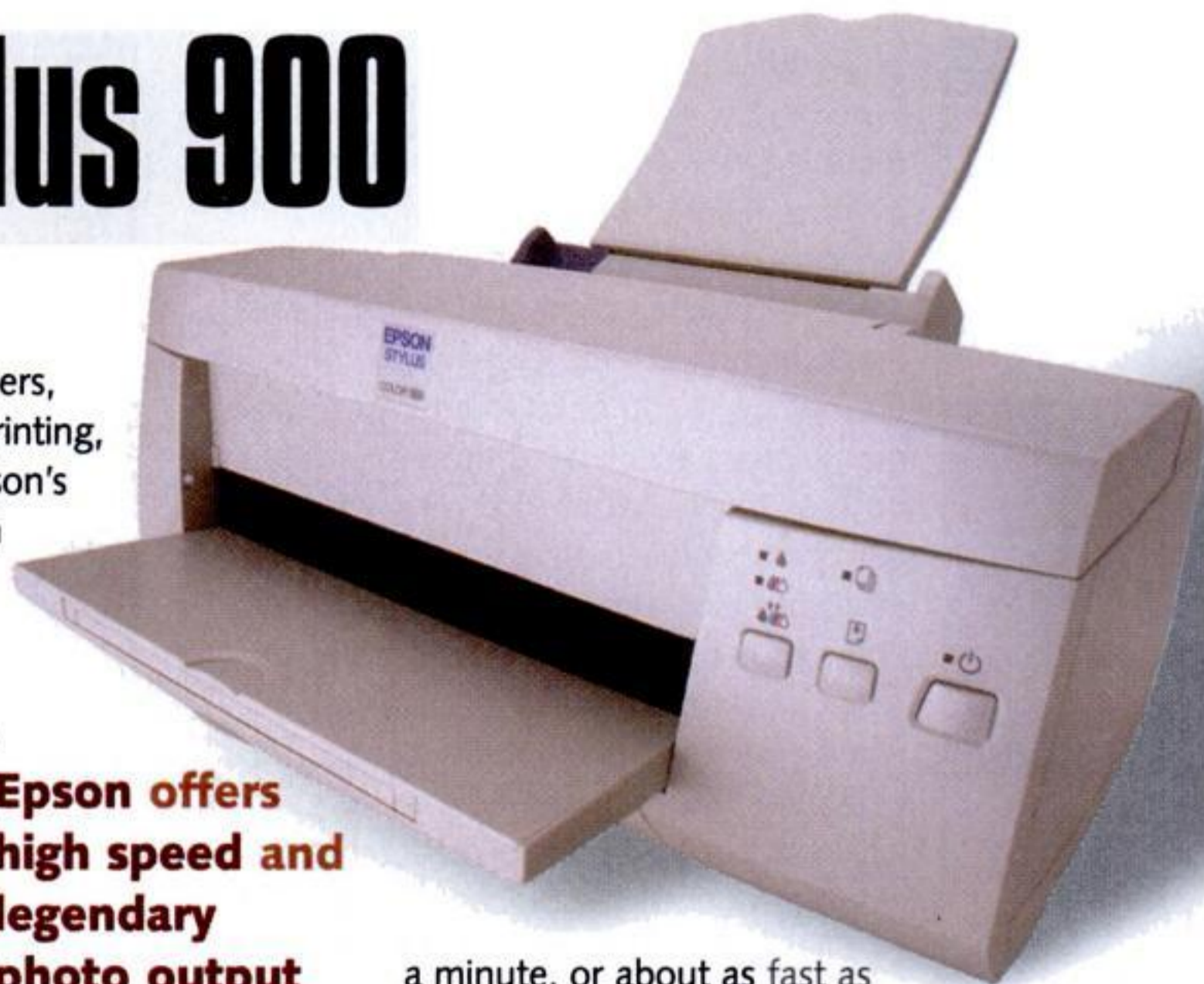
**Phone** 425.882.8080

**URL** www.microsoft.com



# Epson Stylus 900

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<b>RATED SPEEDS</b>	12ppm black 10ppm color
<b>PAPER TRAY CAPACITY</b>	100
<b>INTERFACES</b>	Parallel USB Mac serial
<b>DRIVERS</b>	Windows NT, 9X, 3.1 Mac OS 7.5.1+
<b>BUNDLE</b>	Polaroid PhotoMax I Choose from Ventura Publisher 7, Lotus Organizer 5.0 or CorelDraw SE
<b>COST OF INK</b>	Black \$29.64 Color \$34.29

### PLUSES

- Smallest droplet size yet
- PostScript and network options
- Kick-ass photo output
- USB, parallel, and Mac interfaces

### MINUSES

- Chugs ink like an SUV sucks gas
- Text quality lacking at high speed
- Only 100-sheet paper tray

When you think about inkjet printers, you think compromise: slowpoke printing, color bleeding, and smudging. Epson's out to disprove those notions with its new Stylus 900. Aimed at the small workgroup and SOHO segment, the Stylus 900 fulfills almost every aspect of its mission.

Improvements to Epson's patented micropiezo inkjet technology get the ink-droplet size down to one of the smallest in the industry. At 3 picoliters, it's twice as fine as the Stylus 740. And the proof is in the 900's photo output: printed photographs of *Maximum PC's* digital-camera gal showed excellent skin tones and sharp details, and dithering was invisible to the naked eye.

Epson's top priority was speed, and the 900 purports to hit 12ppm in black and 10ppm in color. In our tests, the 900 was very speedy overall. A 17-page *PowerPoint 97* presentation mixed with typical graphics and text took 4:42 in the "speed" mode, fair considering the 360dpi resolution and low-grade plain paper. There were obvious signs of dithering and some banding. The speed went away, however, when we upped the ante and printed with the "microweave" feature on. On photo-quality inkjet paper, the time quadrupled to just over 18 minutes. Of course, the image quality increased drastically, with the banding and dithering all but gone. The plain-paper output was more than good enough to hand out, but if you're outputting to transparency or need higher quality to duplicate on a color copier, be prepared to wait.

For text output, we printed a seven-page *Acrobat PDF* document. At 360dpi on plain paper with microweave off and the printer set for speed, the Epson 900 spit out the document in just over

### Epson offers high speed and legendary photo output with the Stylus 900 inkjet.

a minute, or about as fast as most low-end consumer lasers. We fired the same document through an older HP OfficeJet 1150c in a comparable mode and

found the Epson 900 faster by almost a third. However, this may be the Epson's weakest point. Text quality at high speed on plain paper was typical inkjet: you won't want to output your resume at high speed on the 900. It took turning on microweave and using higher-quality paper to achieve "laser like" text quality.

By claiming the 900 is suited for small workgroups or "anywhere a laser goes," Epson is clearly exaggerating. Don't expect to get laser speed without sacrificing text quality. For those still kicking around an older inkjet, the 900 is a great choice. It's also a good choice to supplement an existing laser printer. With its USB input, as well as simultaneous support for parallel and Mac interfaces, the 900 is easy to integrate into a desktop without a parallel-port converter.

—Gordon Ung

### MAXIMUM PC VERDICT

**Price** \$449  
**Company** Epson  
**Phone** 800.463.7766  
**URL** www.epson.com



<p><b>PRINT QUALITY</b></p> <p>the the</p> <p>360dpi</p>	<p>the the</p> <p>720dpi</p>	<p>360dpi</p>	<p>360dpi</p>	<p>360dpi</p>	<p>1440dpi</p>
--	------------------------------	---------------	---------------	---------------	----------------

Print Time: 1:09  
Text quality suffers on the 900 at high speeds.

Print Time: 7:41  
Even laser bigots may be fooled by the 900's text output, though.

Print Time: 4:42  
Plain-paper mode output suffers on the 900.

Print Time: 18:04  
Dithering almost disappears in inkjet paper mode.

Print Time: 0:56  
A dithered mess up close, the fast mode is still good for proofs.

Print Time: 4:30  
Is it continuous tone or not? The 900 makes you wonder.

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## Protect yourself from blackouts

The nemesis of all computer users is loss of power. This reality-jerking nightmare costs us time, money, and sanity, but this scourge can be held at bay with a good uninterruptible power supply (UPS). These battery-backed beasts kick in instantly when power is cut, guaranteeing that your system still runs when all else is dark. UPSes used to be large, heavy, ugly, and downright expensive. No longer.

New designs and techno-leaps have brought this much needed product to the working class.

UPSes are rated in volt-amps (VA). Standard machines with 200- to 235-watt power supplies with 17-inch to 19-inch monitors need a UPS with a 300VA to 500VA rating, while those with 21-inch monitors need a 500VA to 600VA UPS.

—Sean Cleveland

### APC Back-UPS Pro 350VA and 500VA



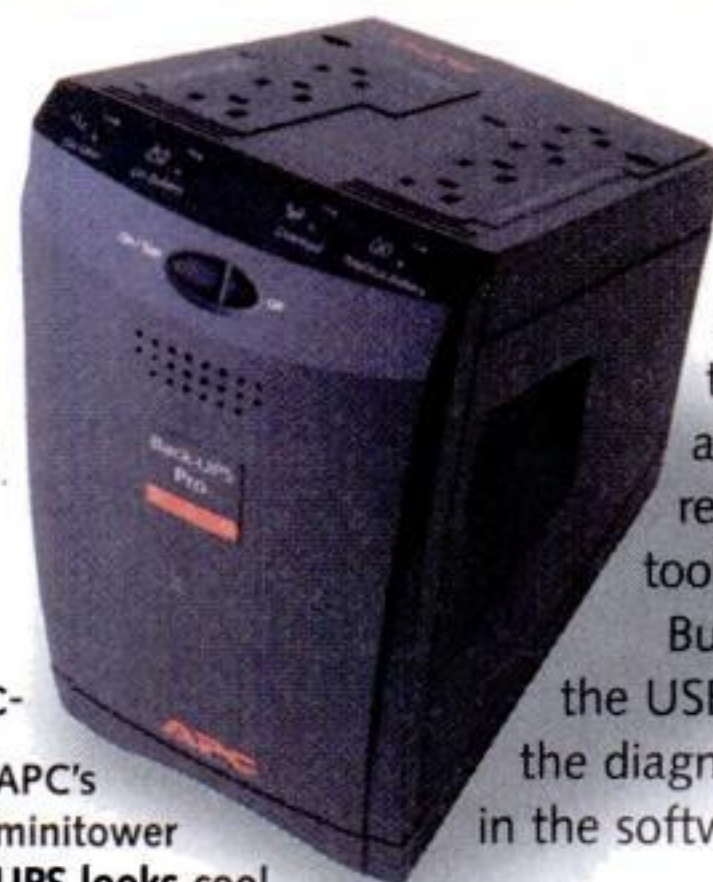
APC's latest creation is designed solely for Windows 98 and takes a drastic design leap away from standard brick-like boxes to an upright monolith design. This

UPS exudes power and looks cool; we'd rather keep it on top of the desk than hidden below.

Its thoughtful design sets the Back-UPS Pro apart. At 9.4x4.7x7.9-inches, it's a mini-tower. The left four plugs offer battery backup plus surge, and the right three plugs provide surge protection only.

Four indicator lights show when the UPS is online, when the battery is running, when the UPS has been overloaded, and when the battery needs replacement. A phone/fax/modem surge protector is also built in.

When power is cut, the Back-UPS Pro beeps five times every 30 seconds until three minutes from full discharge. It then beeps constantly until drained. The 350VA lasted 12:56 with a 19-inch Hitachi monitor and 20:06 with a 17-inch Sony monitor. The 500VA lasted about five minutes



APC's minitower UPS looks cool and lasts long.

more. APC uses lead-acid sealed batteries, which last three to five years and cost \$75 to replace. A full recharge took us only five hours.

But the coolest part is the USB connectivity and the diagnostic info provided in the software.

#### MAXIMUM PC VERDICT

**Price** \$230 for 350VA; \$300 for 500VA

**Company** American Power Conversion

**Phone** 800.800.4272

**URL** www.apcc.com



### Guardian On Board PowerCard 420VA

Guardian tosses the bulky imprint of traditional UPSes out the window with an internal UPS that's no cheap knock-off. In fact, this card's powerful.

About 80% smaller than traditional UPSes, the PowerCard combines patented transformer technology and special Ni-Cad batteries into a highly efficient UPS. The

PowerCard contains phone- and data-line protection, surge suppression, and EMI/RFI noise filtering. Since everything is mounted via a ISA or PCI

connector, no wires are used, explaining its 94% efficiency. Also, the transformer operates at more than 1,000 times the frequency of normal UPSes (50KHz), making it quiet. Patent-pending WaveGuard electronic circuitry also guarantees no skipping in the current and reducing heat. The software receives diagnostic info via a 9-pin serial cable (not the slot) and adds shutdown scripts and logging. The ISA or PCI slot provides only a mobo location and a 5-volt "jumpstart" when the machine's powered on. It's this engineering that garnered the PowerCard the highest certified safety rating of any UPS (UL1950).

The PowerCard emits a beep every five seconds until one minute from full discharge, when it emits a

continuous tone. In our tests, the ISA version lasted 9:30 with a 19-inch Hitachi monitor and 10:20 with a 17-inch Sony monitor. Full recharge takes at least 10 hours. The PCI version should perform on the same par. Guardian says its Ni-Cad batteries reduce "memory effect" and last twice as long as lead-acid batteries (around four to six years). Replacement battery packs run \$49.

The PowerCard Split, a PCI version, includes a separate battery pack and USB docking station.

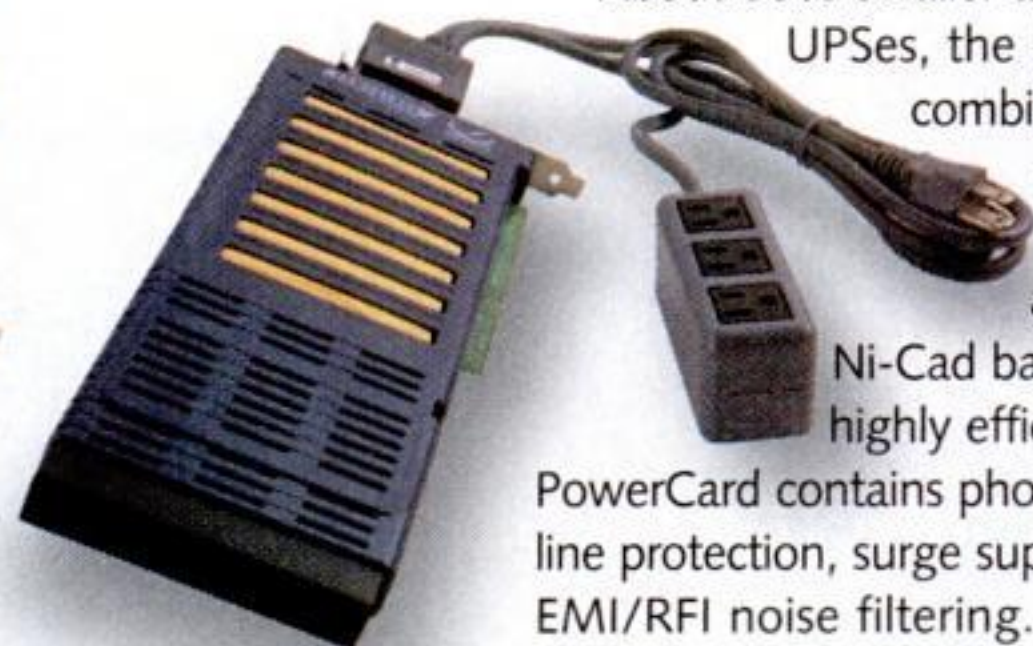
#### MAXIMUM PC VERDICT

**Price** \$199

**Company** Guardian

**Phone** 877.367.6976

**URL** www.guardian-ups.com



The Guardian On Board PowerCard gets a jumpstart through an ISA or PCI slot.

#### DARE TO COMPARE

MANUFACTURER MODEL	APC BACK-UPS PRO 350VA	APC BACK-UPS PRO 500VA	GUARDIAN ON BOARD POWERCARD 420VA
Full discharge (19-inch Hitachi monitor)	12:56	16:30	9:30
Full discharge (17-inch Sony monitor)	20:06	25:22	10:20
Battery recharge	5 hours	5 hours	10 hours
Normal-mode clamping response time	Ons, instantaneous	Ons, instantaneous	2-4ms

TEST SYSTEM: Micron Millennia PII-400 with 64MB RAM, 6GB WD hard drive, Diamond Viper 330, SoundBlaster AWE64, 3COM 10/100 NIC, Pioneer 32x CD-ROM drive, Iomega Zip drive, floppy, and 200-watt power supply

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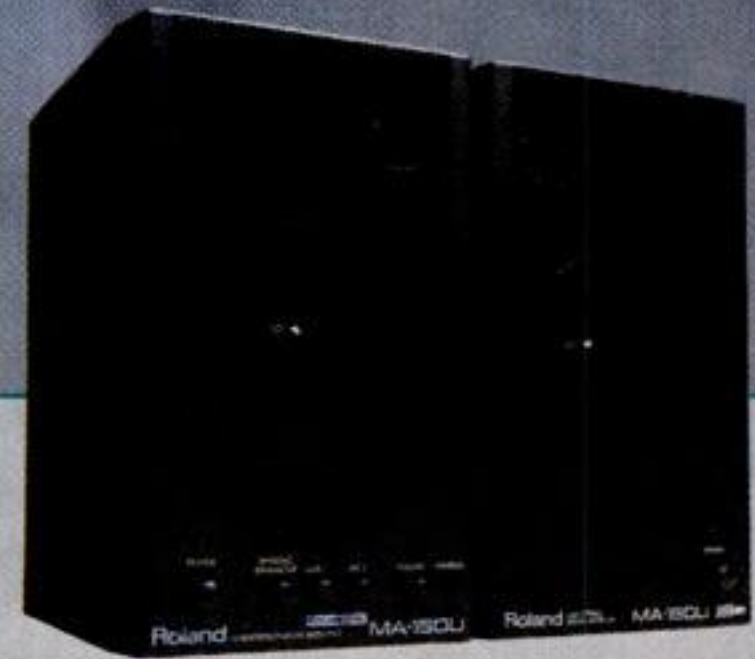
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# Redline

## Mad Max in South Central

The best part of this new blast-fest, which mixes a hefty dose of vehicle combat into a fair first-person shooter, is its fierce originality. Unfortunately, *Redline's* execution fails on as many levels as it succeeds.

First off, shame on Beyond Games for *Redline's* skimpy hardware support. It's guilty on three counts: the designers ignored the recent deluge of force-feedback equipped devices, opting for vanilla [DirectInput](#); they pooh-pooed [EAX](#), [A3D](#), and even [DirectSound3D](#), and went for—gasp!—plain stereo sound; and don't even think about [OpenGL](#) or native chip support—[Direct3D](#) is the only 3D API on this vehicle. The programmers did a hell of a job with it, though. The levels look fabulous and are the biggest locales we've seen since *Unreal*. The game runs smoothly all the way up to 1280x1024, and using every checkmark in Microsoft's 3D API, it packs some of the tastiest explosions ever.

The gameplay zigzags between totally engrossing and maddeningly difficult. When your gangsta-wannabe character is on foot, *Redline* plays like a passable first-person shooter—it's not *Half-Life*, but it beats *SiN*. Hop into a heavily armed jalopy,

### PLUSES

Biggest locations we've ever seen in a first-person shooter

Outstanding use of D3D

Smooth multiplayer even over slow connection

Lots of gameplay variety

### MINUSES

Skimpy support for current gaming technology

Uninspired level design

Single-player game too difficult to be fun

### THE SPECS

#### 3D CARD SUPPORT

Direct3D

#### MULTIPLAYER

TCP/IP | IPX

12 players max

#### 3D SOUND

None

#### CONTROLLER

DirectInput-compliant devices



**Redline's rocket-fuel graphics don't make up for its unleaded hardware support.**

though, and *Redline* takes off. Vehicle physics don't even wink at realism; as such, they're perfect for the furious car combat the dev

team was going for. Be sure to save often, because there are portions of the game that seem downright impossible.

Multiplayer *Redline* is infinitely more satisfying than solo play. Though it's not as smooth as *Tribes*, it handles high (200 to 300) pings forgivingly.

—Joel Durham Jr.

### MAXIMUM PC VERDICT

**Price** \$39

**Developer** Beyond Games

**Publisher** Accolade

**Phone** 800.245.7744

**URL** www.accolade.com

6

For definitions of [Terminator](#) words, hyperlink to the back of Maximum PC, or check out the Terminator online at [www.maximumpcmag.com](#).

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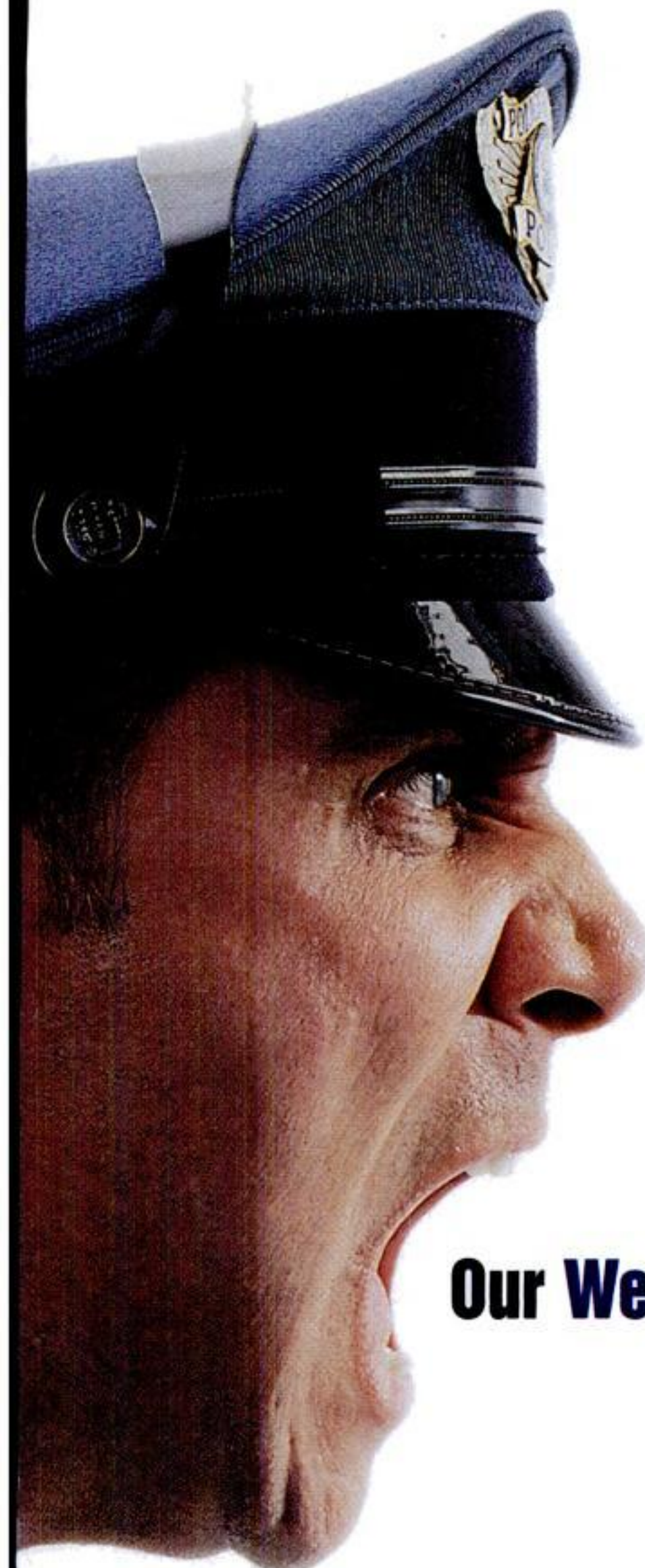
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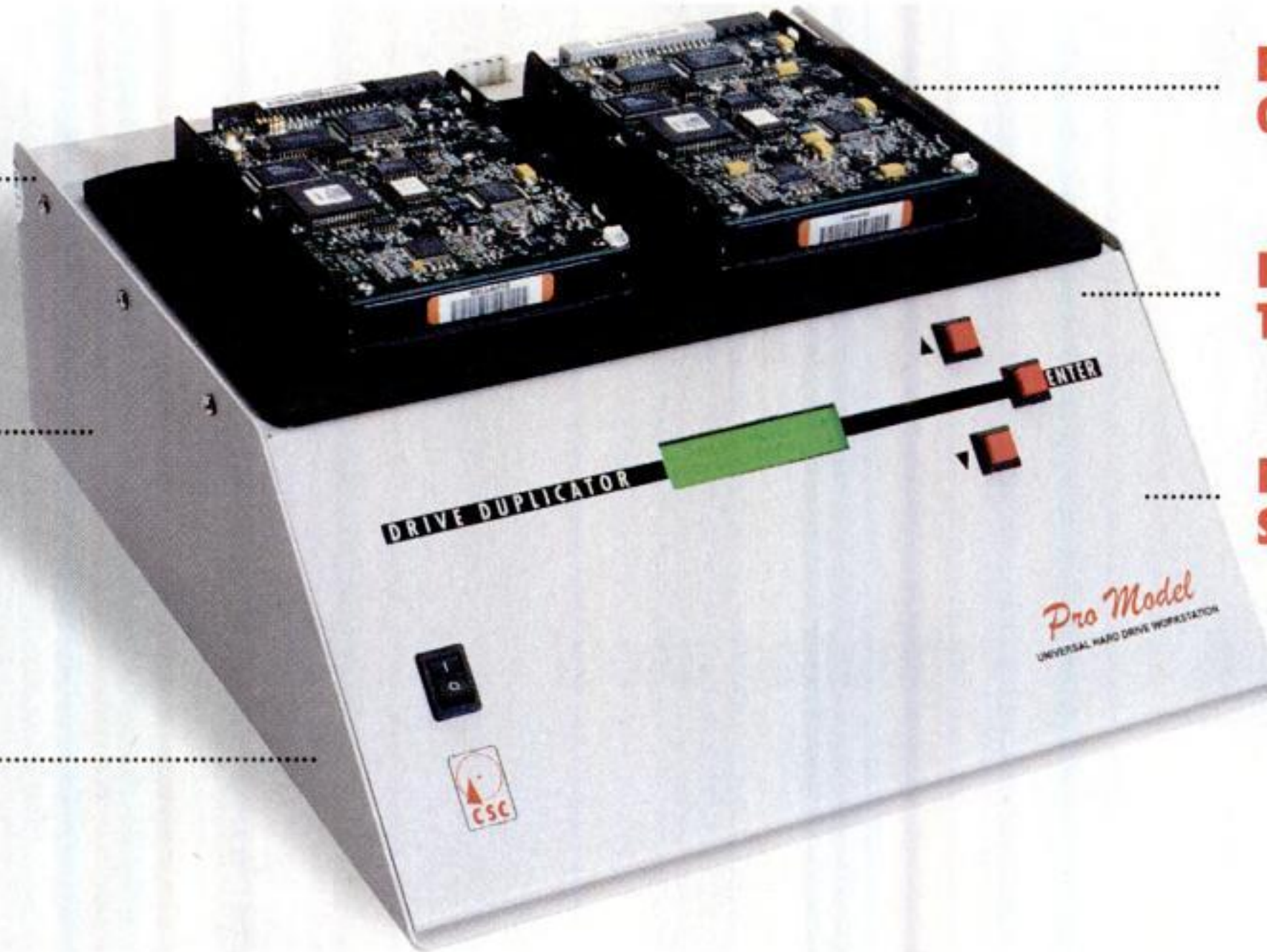
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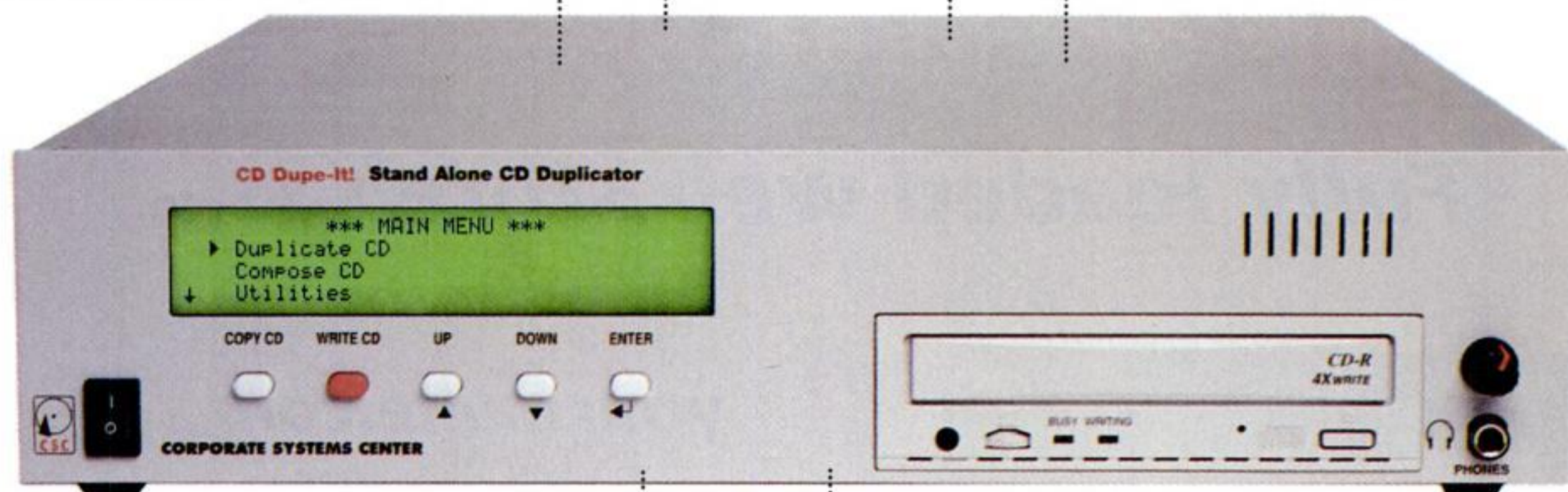
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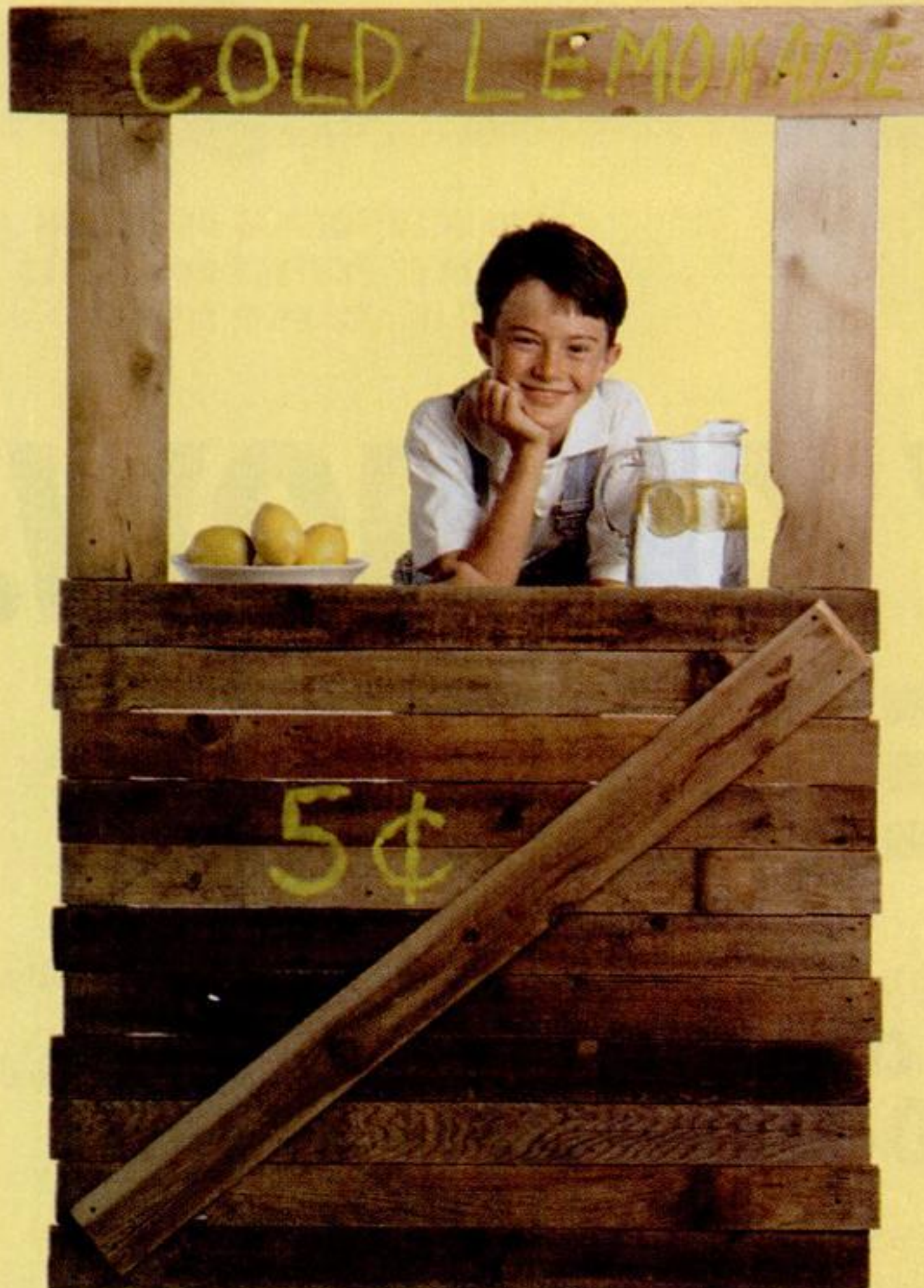
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Here are six specialized distance training programs offered by ICS, plus another program for beginners. If you wish to find out more about ICS training, contact ICS at the phone number or address listed at the end of this page for a FREE information package.

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## 7. PC Fundamentals

If you're a complete beginner with PCs, or know someone who is, this personal enrichment program is for you. The training includes instruction about software applications, hardware components, and more. Plus, at the end of your training you receive CD-ROM tutorials that teach you Microsoft® applications like Windows® 95 and Excel.

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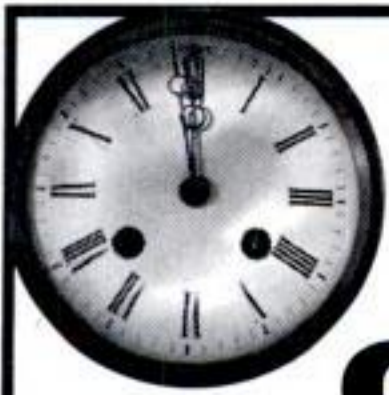
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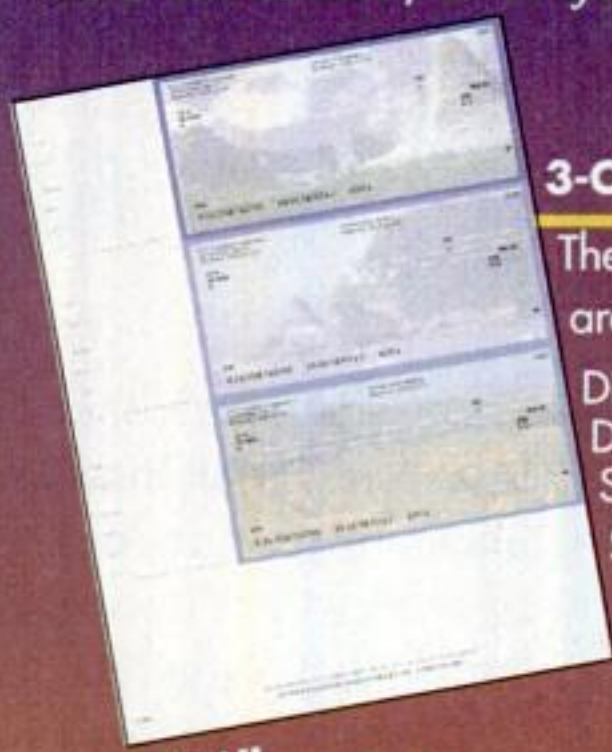
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# TERMINATOR

## Tech Terms Revealed ▶

Technical terms found throughout MAXIMUM PC are underlined and in blue. Hyperlink back to here for revelation and further explanation. Terms appearing in **blue** within the Terminator are updated definitions of previously explained concepts.



### A

**Accelerated Graphics Port** AGP is an expansion bus developed by Intel specifically for the video-card subsystem. It operates independent of the PCI bus and normally runs at 66MHz (i.e., 1x). When you see multipliers attached to AGP, such as 2x or 4x, they refer to how much faster the bus will run—2x means 66MHz x 2, or 133MHz.

**acoustic-suspension** Also called air suspension, acoustic-suspension was patented in 1949 by Harry Olsen. In the 1950s, the design was elaborated upon by Acoustic Research. Acoustic-suspension speakers are held inside a sealed enclosure. The speaker's inward and outward movements control the air inside the box, giving low sounds, such as from subwoofers.

**actuator** The mechanism within a disk drive that positions the read/write head over the correct track on the disk.

**AGP 2x** see Accelerated Graphics Port

**alpha-blend** The ability to give a pixel a value that will render it solid, invisible, or partially transparent. The process is often used in games to depict special effects, such as explosions. When mapped onto polygons, alpha-blending can simulate semi-transparent objects, such as water and glass.

**anisotropic filtering** Conventional texture filtering techniques do not compensate for anisotropy—the elongation of the screen pixel when it is mapped into texture space. This results in either blurring or aliasing, depending on the choice of texture level-of-detail. To achieve sharp textures, a card can use anisotropic filtering, a process that involves an elliptical kernel whose shape and orientation depends on the projection of the destination pixel onto the texture map.

**API** Application Programming Interface. A collection of subroutines—usually part of an operating system—that application programs call upon to perform common tasks. For example, a program might call an API routine to display a window on the screen. APIs reduce the amount of code programmers have to write.

**areal density** The amount of data that can be packed onto a storage medium. Areal densities are generally measured in gigabits per square inch. Generally, the higher areal density, that is, the more data that can be packed into a single square inch, the better.

**A3D** see Aureal3D

**A-to-D converters** A shortened name for an analog-to-digital converter that converts audio from analog sources such as tape players to digital sources such as CD players.

**Aureal3D** A proprietary API for handling 3D positional sounds and Doppler effects. A3D simulates 3D positional sounds on two speakers. A3D will support four or more speakers, but is optimized for two.

### B

**BIOS** Basic Input/Output System. Software that contains your computer's most rudimentary instructions on how the operating system

communicates with hardware. Your BIOS runs at startup, configures devices, and boots the OS. Because the BIOS is so integral to starting your computer, it's stored on a separate ROM chip, not your hard drive, to isolate it from crashes.

**buffer** see cache

**bump-mapping** A visual trick that simulates a texture's roughness or smoothness, depending on how the texture reflects lights. In 3D, this is usually accomplished by laying two textures onto a polygon—a base texture for the graphics, and a second displacement texture that is mapped on the object. This second texture determines how "rough" the surface will appear.

**bus** An electrical pathway over which the components inside a computer communicate with each other. There are many types of buses, including the PCI bus (which supports PCI slots) and the system bus (through which the microprocessor communicate with the rest of the system).

### C

**CGDC** Computer Game Developers Conference. An annual gathering of electronic entertainment companies, gaming hardware vendors, and the developers that love them.

**co-axial S/PDIF** see S/PDIF

**command turnaround** The turnaround time a computer takes between the commands it issues to the drive. This command turnaround time—during which the bus remains idle—is essentially overhead and constitutes a very significant portion of the overall time available on the bus.

### D

**data rate** The amount of raw data transferred over the pipeline. Generally, data rates in hard drives are referred to in MB/sec. The higher the transfer rate the better. Because data is stored in a buffer on the drive, it is important to know both the data rate the recording head is capable of as well as the "burst transfer rate" at which data is sent from the drive to the outside world.

**DIMM** Dual Inline Memory Module. A DIMM is a RAM module configuration that allows dual channels to be used in a single interface. On a motherboard's, that would be dual 32-bit memory paths forming a single 64-bit path. Before DIMMs, RAM modules came in SIMMs (Single Inline Memory Modules), which provided a single 32-bit path. With most SIMM motherboards, memory modules needed to be installed in pairs. DIMMs can be installed individually. DIMMs tend to be faster and hold more memory than their SIMM counterparts.

**Direct3D** A subset of Microsoft's DirectX API. This interface allows developers to use hardware acceleration for 3D graphics, which helps games run faster by offloading the 3D processing onto a dedicated piece of hardware.

**DirectInput** Falls under the umbrella of Microsoft's DirectX, an API used by developers to create great games. DirectInput in particular allows for better mouse and joystick interactivity.

**DirectSound3D** Microsoft's API for handling 3D positional sound. Plagued by problems when originally introduced, it has improved greatly and is beginning to generate more developer support.

**DirectX** A collection of APIs developed by Microsoft. This driver model helps create a unified multimedia platform on PCs. Parts include Direct3D, DirectSound, DirectInput, DirectDraw, and DirectPlay. Multimedia developers can write to the standard DirectX API instead of writing to individual hardware APIs and know hardware that supports DirectX will work. It also allows graphics apps to take advantage of hardware acceleration supported by graphics accelerators.

**DMA** Direct Memory Access. A method used to speed up data transfers between peripherals (such as hard drives) and RAM. DMA avoids the delays imposed by the CPU's data-flow regulation, accessing RAM directly.

**Dolby Surround Sound** A digital audio spec defined by four discrete sound channels: independent left, middle, and right channels positioned in front of the listener, and a single rear effects channel emanating from two rear speakers positioned on the left and right behind the listener.

**dual-pipeline** Refers to the number of processors in a graphics engine. See single cycle for more information.

**dual-TMU** Refers to the Dual Texture Management Units that handle the multi-texturing duties in the Voodoo architecture.

### E

**EAX** Environmental Audio. Creative Labs' proprietary 3D sound algorithm based on reverb.

**EDO** Extended Data Out Random Access Memory. Low-cost memory that loses data if it's not recharged regularly (known as refreshing).

### F

**FAT16** A 16-bit DOS and Windows file system that varies cluster sizes based on hard drive size. Cluster sizes range from 4K (for drives up to 127MB), 4K (255MB drives), 8K (511MB drives), 16K (1GB drives), to 32K (for drives up to 2GB). The ultimate capacity of a FAT16 partition is 2GB.

**FAT32X** An extended version of FAT32, the 32-bit file system introduced with Windows 95 OSR2 that uses 4K cluster sizes. FAT32X allows partitions larger than 8GB.

**ferrite (inductive) heads** Early magnetic hard-disk heads consisted of thin copper wire wound around a ferrite core with a tiny gap cut out of it that defined the size of the data bits that could be written and read. By passing bursts of electrical current in one direction or the other, electrical induction in the coil created patterns of magnetic fields of one polarity or the other emanating from the gap that wrote bits onto the hard disk that spun just below the head. When reading, the magnetic fields from the passing bits induced a pattern of currents in the opposite direction. For years, the coils in ferrite heads were meticulously hand-wound.

**Fibre Channel** A storage connection technology that resembles SCSI. Targeted at corporate solutions, fibre channel supports transfer rates up to 126 devices with a total bus throughput of 100-200MB/sec at distances ranging from 30 meters (for copper wire) to 10 kilometers (with fibre optic cabling). Fibre Channel can be configured for point-to-point via a switch topology or in an arbitrated loop call Fibre Channel Arbitrated Loop (FC-AL). FA-CL has made it possible for Fibre Channel to be used as a direct disc attachment interface, opening whole new levels of I/O performance up to designers of high-throughput, performance-intensive systems.

**force-feedback** Basically vibrating joysticks, wheels, and devices that help create immersive environments in games. Smash your race car into a wall and feel the force-feedback wheel shudder. Take off in a helicopter and a force-feedback stick thrums in unison.

**frame buffer** A block of memory for temporarily storing information displayed on the screen. Graphics cards usually have a few megabytes of fast memory for this purpose. The larger the frame buffer, the more resolution and colors a computer can display. 3D graphics cards may also store 3D objects and textures in a frame buffer.

**frames** A way of dividing a browser window into two or more parts. This allows the reader to scroll through one part while leaving another part—the equivalent of the menubar—available at all times.

### G

**giant magneto-resistive** In 1988, scientists in France and Germany discovered that certain thin-film sandwiches had very large magneto-resistance, which they termed "giant magnetoresistance." But their structures were laboriously built and required extremely low temperatures and high magnetic fields. IBM scientists discovered ways to use standard manufacturing techniques to make GMR structures that had much greater MR at room temperature and low fields than the sensors used in MR heads. In 1997, IBM introduced the GMR head, in which a GMR sandwich replaced the MR element and continued the spectacular increase in disk drive densities and capacities.

**Glide** 3dfx's proprietary programming interface (API) for its Voodoo family of video-card accelerators. It's usually faster and easier to program for than Direct3D.

### H

**head** The device that both writes data on a disk drive and reads it back. In magnetic hard-disk drives, the head is attached to an aerodynamic "slider," which is in turn attached to a suspension arm whose position is controlled by the actuator.

**HTML** HyperText Markup Language. A standardized set of tags that defines how the contents of a web page should appear in a web browser. Most of the tags describe the appearance of text and the position of graphics. HTML standards are defined by a committee called the World Wide Web Consortium (W3C).

### I

**IDE** Integrated Drive Electronics. The most popular hard drive interface, whose controller functions are built into the drive's circuitry. All motherboards today come standard with two IDE channels that can each control up to two devices. Hard drives connect to these interfaces via a 40-pin connector.

**interleave** Interleaving, or the staggering of sectors, gives the hard drive time to read all the sectors it needs to in a single rotation. By allowing the drive to read sectors #1, #7 and #13 and then picking up sectors #2 and so on, the drive is able to eliminate wasted rotations.

**IPX/SPX** Internet Packet Exchange/Sequenced Packet Exchange. Closely linked protocols that help data get from Point A to Point B across a network. IPX routes data packets to the appropriate network node. Because data packets can sometimes get lost while traversing a network, SPX ensures that all the packets belonging to a single file get to the node intact.

**ISA** Industry Standard Architecture. Hailing from the early days of the PC, the ISA bus runs at from 8MHz to 10MHz with a maximum throughput of 8MB a second. Think slower than a Yugo.

### K

**know** To perceive and understand makes us human.

### L

**LAN** Local Area Network. A private computer network within a building or a local group of buildings. Most LANs are wired with cables hidden in walls and ceilings, although wireless connections are also available.

**linear dimensions** The external dimensions (WxDxH) of a given product.

**low-frequency response** Call it bass or the thump you get in the 3Hz to 120Hz range.

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The extended Terminator (with terms not found in this issue of the magazine) is found 24/7 online.



**low-pass frequency** In a three-piece speaker system that consists of two satellites and a sub-woofer, the setup generally has two types of filters embedded in it (one high-pass and one low-pass). The filters take in the audio signal and split it into high-pass and low-pass frequencies. The tweeters receive the high-pass frequencies and the sub receives the low-pass frequencies.

## M

**magnetoresistive heads** They use separate read and write elements for optimized read and write capabilities. The read element is composed of a thin-film material whose resistance changes when near a magnetic field. This in turn produces a stronger signal that allows for greater areal densities and larger disk capacities.

**mip-mapping** Technique used to generate scaled texture maps that involves creating sub-images sized for every inverse power of two, i.e. 1/4, 1/16, 1/32, etc. The process of creating a mip-map takes time, and larger textures require longer.

**motion compensation** An algorithm that reduces shearing in DVD video playback.

**MPEG 1, Layer 3** a.k.a. MP3. A compression scheme optimized for music audio and the current lingua franca of Internet music.

**MPEG** (Moving Picture Experts Group) The name of a family of standards used for coding audio-visual information (movies, video, and music) in a digitally compressed format. MPEG-1 was the first standard developed by the group and coded an audio-visual signal at a bit rate around 1.5Mbps, about the same as VHS. It's primarily used for CD-ROMs and VCDs (Video CD). MPEG-1 provides a resolution of 352x240 at 30fps in 24-bit color. Audio is CD quality with a format of 256Kbps at 48Hz in two channels (stereo). MPEG-2 was designed to produce higher-quality images at higher bit rates (3 to 10Mbps). It delivers true broadcast-quality video at a resolution of 720x486. It's also the standard specified for DVD. MPEG-2 supports AC3 Dolby Digital audio with surround sound, providing up to six separate channels.

**MPEG-2** A widely supported audio/video standard formulated by the Moving Picture Experts Group. It defines methods for compressing and decompressing audio and video data to conserve resources in computers, digital TVs, and other multimedia devices.

**magnetoresistance** Lord Kelvin discovered magnetoresistance in 1857 when he noticed the slight change in the electrical resistance of a piece of iron when he placed it in a magnetic field. In 1991, IBM introduced the first MR head, which used a strip of magnetoresistive material to detect bits, permitting the ferrite/coil structure to be optimized for simply writing. Because strength of the inductive signal when reading depended on the speed with which the bits passed beneath the head, its performance suffered as disk diameters decreased. The response of the MR read element had no such dependence. Because it was sensitive enough to detect smaller and smaller bits, the MR head permitted increases in data storage densities that have exceeded 60 percent a year. Earlier, MR heads were used in less demanding applications of price-tag and badge readers (read-only) and magnetic tape (1985).

**multitexturing** The process of applying multiple textures to polygons in a model.

## N

**noise** Not quiet. PCs are a hotbed of noise. Many electronic processes generate electromagnetic interference and are said to be "noisy."

## O

**onboard cache** On a hard drive, the memory (usually between 512K and 2MB) that serves as a bridge between the drive's mechanical platters and the bus interface on the system's motherboard. By storing some of the platters' data on high-speed onboard cache, the hard drive can keep the system fed with a steady stream of fast-moving data. If the system can't find the necessary information on onboard cache, it will next turn to the mechanical platters, a much slower proposition.

**OpenGL** Open Graphics Language. An easy-to-use (for programmers anyway) graphics API created by Silicon Graphics. It's generally

accepted in the high-end workstation market. In the Windows 9X world, OpenGL plays David to Microsoft's Direct3D Goliath or vice versa. It's a Chevy versus Ford debate with both sides locked and loaded.

**orgy** Secret ceremonial rites held in honor of an ancient Greek or Roman deity and usually characterized by ecstatic singing and dancing. Frequently involving drunken revelry and/or excessive sexual indulgence.

## P

**PC100** A stringent memory specification used in the current top-of-the-line x86 machines. It calls for such things as six-layer boards, basically higher quality, and separate traces for power.

**per-pixel** As opposed to per-polygon, this technique applies effects to the scaled textures of a 3D polygon model on a pixel-by-pixel basis, creating more natural results. An example would be a light ball traveling down a hall. With per-pixel mip- or texture-mapping, the light cast on the walls has a smooth gradient. With per-polygon, the vertices of the polygons define the effect.

**perspective correct** Correctly applying bitmap graphics (textures) onto a polygon that will appear in 3D space, regardless of position or perspective. Without perspective correction, textures shimmer and dance about the polygon, causing visual deformation and general unhappiness.

**pipeline** An assembly line for program instructions. A pipelined function unit in a microprocessor separates the execution of a program instruction into multiple stages. Instructions flow through the pipeline like cars on a factory assembly line: instructions are in various states of completion.

**platter** A round magnetic plate that constitutes part of a hard drive. Most platters require two read/write heads, one for each side.

**polygon** A 2D figure (usually a triangle or rectangle) that's the building block of a 3D screen object. It usually takes hundreds or thousands of polygons to form the skeleton of a 3D object.

**processing pipeline** The path through which data passes in a CPU or graphics processor; The larger the bandwidth (i.e., 128-bit versus 64-bit) the more data the processor can handle.

**protocol** A formally defined way to perform an action. Diplomatic protocols specify how to greet foreign dignitaries; computer protocols specify interactions between computing devices and programs. For example, HTTP (hypertext transfer protocol) defines how web servers and browsers should exchange data over the Internet.

**pundits** So-called experts who frequently offer (presumably knowledgeable) opinions on their special subjects. Many pundits are analysts who make a full-time living by studying, writing, and talking about a specific subject.

## R

**RAMDAC** Random Access Memory Digital to Analog Converter. The chip on a videocard that converts the bits of a digital image into an analog signal. It maintains the color palette and determines refresh rates. The faster the RAMDAC MHz, the higher the refresh rate your system can handle.

**refresh rate** The rate at which a monitor redraws the image on its screen; measured in hertz (Hz). Refresh rates below 75Hz (75 redraws per second) typically create a flickering effect, which causes eyestrain.

**root** The base directory in hierarchical file systems.

## S

**S/PDIF** Sony/Philips Digital Interface. A standard interface for sending digital audio data. Soundcards with S/PDIF jacks let you use your computer as a mini recording studio. S/PDIF uses co-axial connectors.

**sample-rate** This is the frequency that audio samples are taken and converted into digital form (also called digitizing). CDs use a sampling rate of 44.1KHz, which means that music digitized to this rate is updated 44,100 times per second.

**scalar video playback** Allows free resizing of the video window without creating artifacts. Considered more advanced than integer scaling, which restricts window resizing to specific scaling factors (1x, 2x, full-screen).

**SCSI** Small Computer System Interface. Pronounced "Scuzzy." A standard high-speed

parallel interface defined by the X3T9.2 committee of the American National Standards Institute. It is an interface that allows up to seven peripheral devices to be linked to a single controller. It is perfectly suited for true multi-tasking environments such as Unix and Windows NT with its ability to manage large storage devices such as hard drives and access its devices concurrently. It comes standard on most Macintoshes, but requires an expansion board, or host adapter, in most PCs.

**SDRAM** Synchronous Dynamic Random Access Memory. A faster type of memory that synchronizes with the CPU. Its architecture allows it to handle the 100MHz system bus.

**server-class product** A computer whose specs and technologies—such as Alpha or Xeon processors—are ideally suited for use as a server. Servers can provide many functions from managing file allocations and file sharing over a network or Intranet, or singular tasks such as managing network printers or databases.

**SIMM** Single Inline Memory Module. A RAM module that provides a single 32-bit path. See DIMM.

**single cycle** Usually associated with 3D rendering. Think of pixel processing as being like a conveyer belt, where the pixel data goes down the line and is given attributes along the way (such as color, level of transparency (alpha), positioning in the z-axis, lighting, and so forth). A single rendering cycle is just such an operation, with the final output being sent to a rasterizer, where it is displayed on screen. Certain attributes, such as bump mapping, environmental reflections, or lighting, may require a second run through this pipeline before heading off into the rasterizer for display. This second run down the conveyer belt is time-consuming and processor-consuming. If a 3D accelerator has a second processor that applies that second attribute alongside all the other attributes during that first cycle, the pixel can be processed in a single-cycle, thus speeding up the process.

**single-pass** see single cycle

**SLI** Scan Line Interleave. A term used when two videocards work in tandem, with one videocard rendering the odd lines of a video output, while the other card renders the even lines. It dramatically increases speed but at the cost of more hardware. With the 3dfx Voodoo<sup>2</sup>, the slave 3D card will send its rendered output via a ribbon cable into the master videocard, where the combined output is then generated on screen by the master card. Having two videocards work as one raises overall rendering performance, and in the Voodoo<sup>2</sup>'s case, allows a higher rendering resolution to be obtained.

**slipped revs** When the drive rotates a desired sector across the head a second time to allow the host machine reading the data to drain the buffer.

**solid-state memory** Data-storing devices that are based purely on semiconductor-type technology. With no moving parts, solid state memory can be compact (DRAM), fast (SRAM) or non-volatile (Flash memory). A variant of the GMR read sensor is currently being considered for use in a radically new type F solid-state memory that could combine all three desirable quantities in a single device, permitting energy-efficient, instant-on computers with superior performance.

**spindle** On a hard drive, the mechanical part around which data platters rotate. The faster the spindle rotates its platters, the faster data can be read from, and written to, the drive.

**sprite** A small computer graphic that can be moved about with a mouse or keyboard. While most sprites are found in computer games, the most familiar sprite is that of your mouse's cursor. Also a lemon-lime soft drink distributed by the Coca-Cola company.

## T

**TCP/IP** Transmission Control Protocol/Internet Protocol. These are international standards that govern how computers can send information over data networks. The Internet is an example of a network that uses TCP/IP. Local-area networks (LANs) often use different standards.

**terabyte** One terabyte (TB) is equivalent to 1000 gigabytes (GB). 2 to the 40th power (1,099,511,627,776) bytes, or approximately 1 trillion bytes.

**texel** Short for TEXTure Element. Refers to the individual pixel that makes up a bitmapped graphic that is used as a texture when it's applied on a polygon.

**thin-film head** Pioneered in 1979 by IBM, the thin-film head used photolithographic techniques from semiconductor processing to make the head structures, including the magnetic core and coil. The added precision permitted designs that could read and write smaller bits.

**triangle setup engine** The processing that occurs before a triangle can be rendered. It's a significant amount of processing. 3D hardware off-loads this from the CPU.

**trilinear filtering** A method to make textures appear less pixelated. It involves applying a bilinear filter to two mip-maps on either side of a texture. The resulting filtered texture is then filtered again, hence the "tri" in trilinear. Trilinear filtering is processing intensive, but results in a smoother overall look.

**trilinear mip-mapping** see trilinear filtering.

## U

**Ultra ATA/66** Ultra Direct Memory Access.

The fastest IDE protocol for connecting hard drives and removable storage devices. The UltraATA/66 bus has a total bandwidth of 66MB/sec. It's also known as Ultra DMA/66 and UDMA/66.

**Ultra DMA** Ultra Direct Memory Access. The fastest IDE protocol for connecting hard drives and removable storage devices. Capable of 33Mbps throughput.

**USB** Universal Serial Bus. A new, faster, digital I/O port proposed by Intel for motherboards. Taking up far fewer resources, this port can act as a serial, parallel, mouse, keyboard, joystick, and even speaker interface. Unlike other communication ports on a PC, USB can be daisy-chained up to 127 devices.

## V

**V.90** A 56K modem designed for connections that are digital at one end and only have one digital-to-analog conversion.

**V-sync** Vertical Synchronization. Also known as the vertical retrace signal. A term referring to the signal that redraws the vertical display of a CRT. How fast this signal is redrawn is referred to as the refresh rate. Usually given in Hertz (Hz), the refresh rate synchronizes buffer swaps with videocards, so framerates under these circumstances will never go past the refresh rate. Some videocards allow buffer swaps to happen without syncing to the refresh rate. This will almost always result in faster frame-rate results, at the expense of visual quality. When a videocard renders without syncing to the refresh rate, visual anomalies, such as tearing and shearing of the image, will occur.

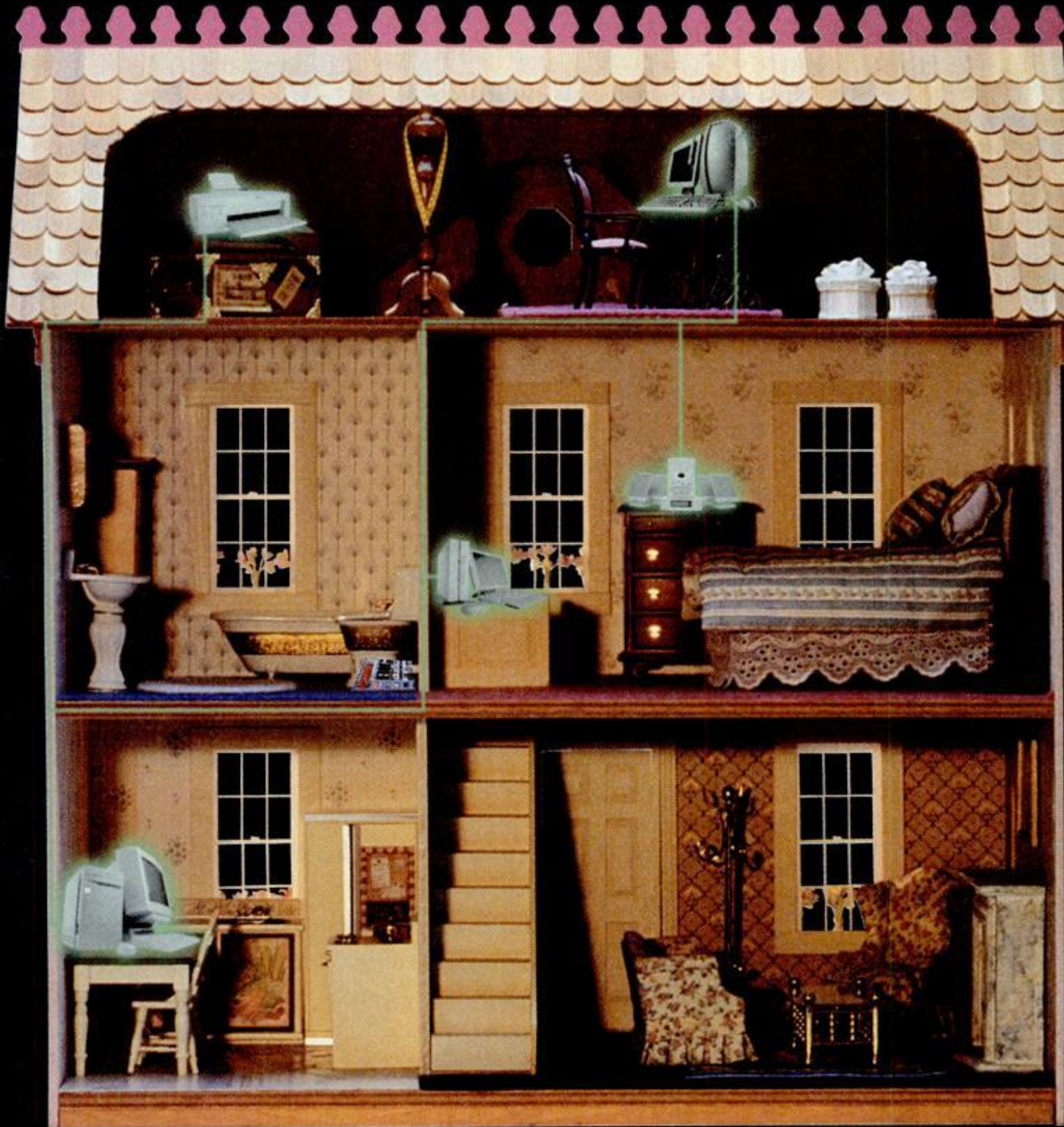
## X

**XML** eXtensible Markup Language. A meta-language for designing document markup languages. Markup languages describe the format of a document. An example of an XML-compliant markup language is Genealogical Markup Language (GedML), which defines a file format for family trees. HTML is another example of a markup language that, like XML, was derived from SGML, the king of markup languages.

## Z

**z-buffer** In a 3D videocard, local video memory is often used to form a frame-buffer, which stores all sorts of data required by a 3D card in order to properly render a scene onto your monitor. With the advent of texture-mapped polygons interacting in a 3D world in realtime, the need to have a buffer with which to track positioning became a necessity. A z-buffer stores the z-axis value (front to back) of a pixel on-screen—this value is compared with incoming z-value data to determine whether the pixel will be drawn or not, and how overlapping pixels will be presented. How accurate a z-buffer is dependent on how the 3D accelerator handles z-buffer calculations, and how much memory is allocated to it. Higher color-depth rendering requires more z-buffer memory, as the amount of pixel information is made larger with more color usage. It speeds up 3D gaming by not rendering the parts of a scene that are obscured by other objects.

Coming Next Month...



# MAXIMUM PC

## home NETWORKING hook-up

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PRODUCED AND PRINTED IN THE UNITED STATES OF AMERICA.

Since, from the start, Microsoft refused to provide any support or budget for DirectX, it was clear that I would have to take marketing matters into my own hands. We code-named the DirectX development effort "The Manhattan Project" and printed T-shirts sporting glow-in-the-dark mushroom clouds that read: "Microsoft Manhattan Project... Shall we play a game?" Then I invited the game-industry press.

A few weeks later, articles about the technology featuring DirectX's radiation symbol logo peppered the press. The media especially liked the fact that Microsoft's management hated the name. Suddenly the Empire's flaks took an acute interest in managing the PR for DirectX.

Having discovered the effectiveness of holding controversial events to attract developers, press, sponsors, and Microsoft support, I initiated a series of events designed to make the most of my nonexistent marketing budget. Following Ground Zero, which attracted 1,500 game developers to the Great America theme park in San Jose, was Judgment Day, a Halloween event that turned an entire Microsoft parking garage into Hell. The Saint played the role of Satan, of course.

Again the event was very successful, attracting hundreds from the press and dozens of hardware and game companies, and costing Microsoft very little after sponsorships.

For spring CGDC, I planned the "Pax Romana" to launch

them grapes and fan them with palms. Senators received extra bags of coins that they could distribute to the guests as they saw fit. Guests could even buy their own slaves at auction.

Arranging all this at a bureaucracy such as Microsoft was, of course, an ongoing war. PR would scream that they couldn't get press to attend; I would ignore them and invite the media myself. Management would scream that there was no budget, and I would raise the money in sponsorships. The event group would protest that lions were impossible, silly string was dangerous, slaves were politically incorrect, and I would contract an outside event coordinator to do their jobs for them. The no-can-do types just needed a good distraction and an easy win to keep them busy while the rest of the event was planned. They got it.

About this time, the April 1996 issue of *Playboy* was brought to my attention. Centerfold Gillian Bonner, president of Black Dragon, was eager to promote her game, *Riana Rouge*. So she agreed to be our Cleopatra. A Microsoft exec (who was later fired

and became incredibly rich as a VP at Amazon.com) was to play Caesar. Microsoft management objected immediately, but I pointed out that she was the president of a game company and a sponsor entitled to participate like everyone else. Nevertheless, word "somehow" spread

on the Internet that a Playmate would be in attendance at the party, sparking immediate outrage among elements of the game-development community that assumed Microsoft had hired a bimbo to lure in the geeks.

Ah, there's nothing like a boycott to spur event registration.

## I Was a (Sacrificial) Pig

SOMETIMES DOING THE EMPIRE'S WORK REQUIRED A SACRIFICE

DirectX II. Battling Microsoft every inch of the way, I turned a San Jose stadium into ancient Rome. Of course, an Imperial-domination theme was too subtle for the press, it needed something more. Thus was born... BunnyGate.

The plan was to create a Roman circus inside the stadium. I had thousands of gold coins, togas, and laurels made. Guests could buy drinks and cans of silly string, gamble, or enter tournaments with their pouches of coins. If somebody entered a tournament and won, they got money and gifts from the sponsor. If they lost, centurions would march them off at spear point and confine them to the slave pit to be auctioned to the audience or fed to the lions.

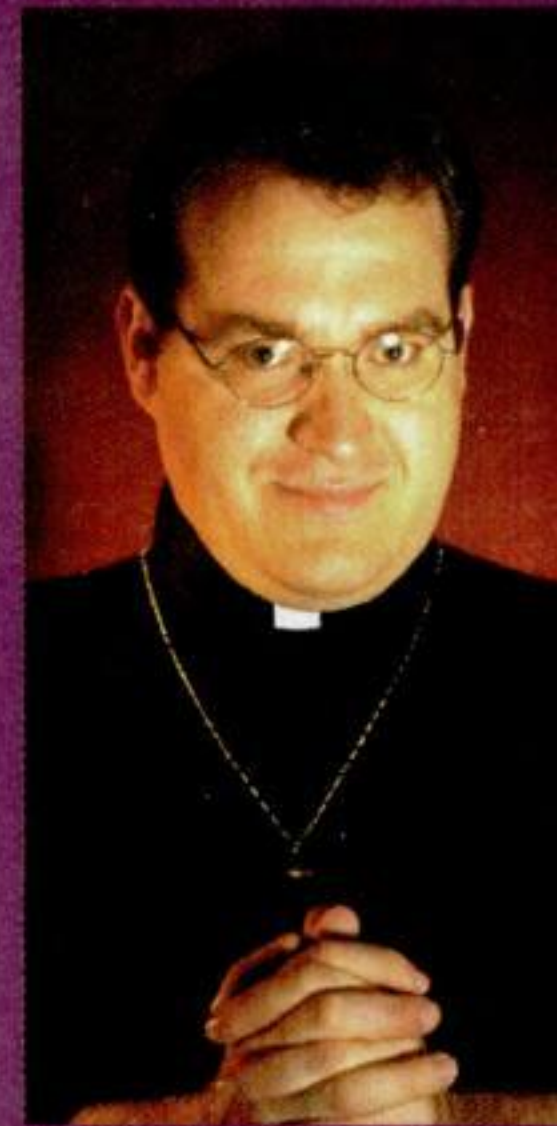
There were two live lions at the party, but only one actually escaped during the event.

In the center of the stadium, a Roman orgy convened. The slave girls were dressed in brightly colored robes, and the slave men (who were all local body builders) wore loin cloths and sandals. The party's sponsors, including Intel, ATI, IBM, and NEC, got to wear senators' robes, and had slaves hand-feed

**Word somehow spread on the Internet that Microsoft had hired a bimbo to lure in the geeks. Ah, there's nothing like a boycott to spur event registration.**

Microsoft's management demanded I remove Bonner. I obstinately refused, to the point of nearly being fired. Having been sufficiently distracted by the BunnyGate scandal, Microsoft allowed the rest of the event to go off as planned without further interference.

Capitulating on the day of the event, I had Gillian auction slaves to the audience. I was sold into slavery for 1,600 gold pieces, and they freed the slave girls that had been feeding me grapes and forced me to apologize to everyone for being a pig. ❀



**ALEX ST. JOHN** was the architect of DirectX while an evangelist at Microsoft. Since leaving the empire, he has remained a player, brokering many deals in the industry. Reach him at [saint@maximumpc.com](mailto:saint@maximumpc.com).

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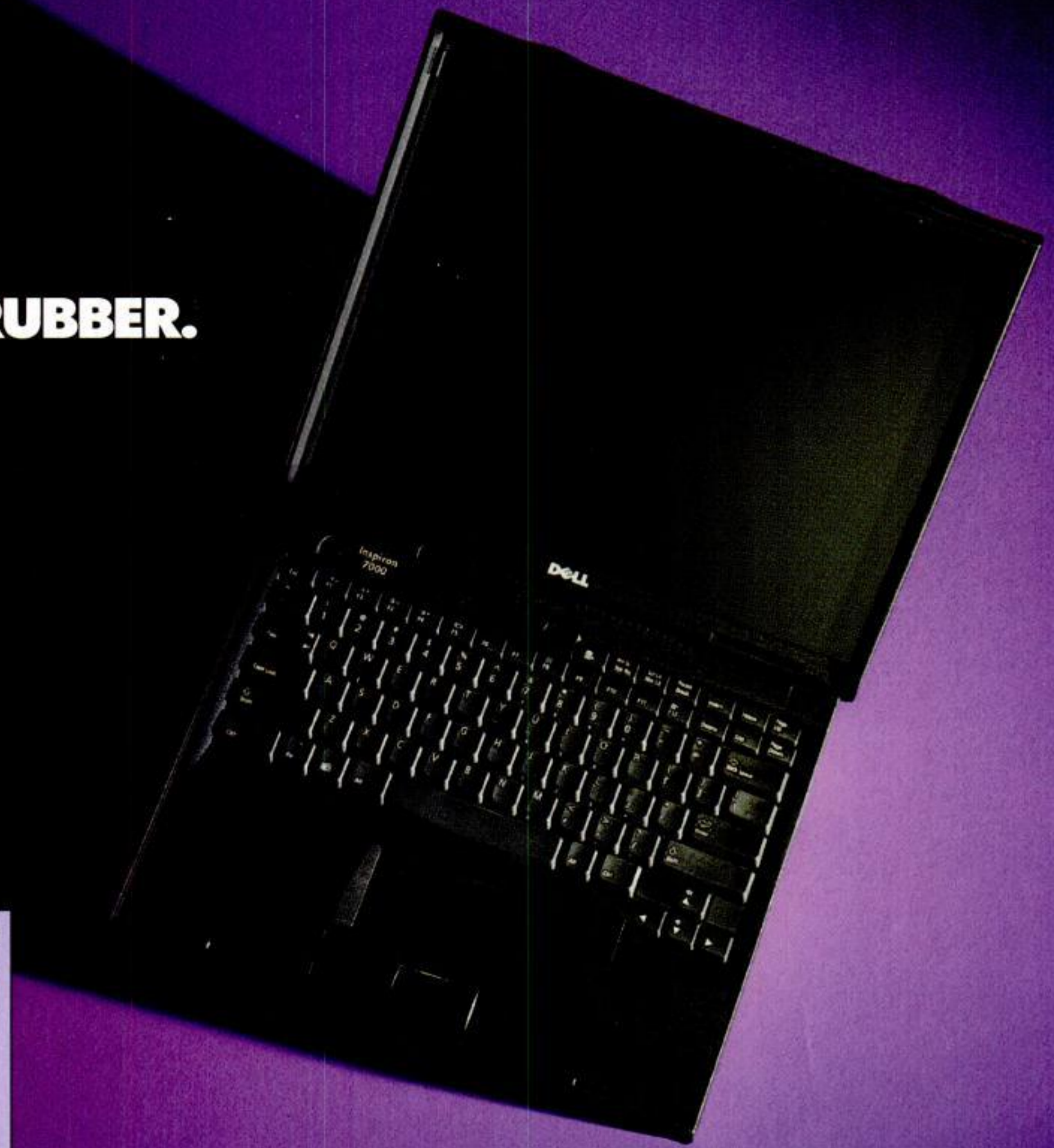


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