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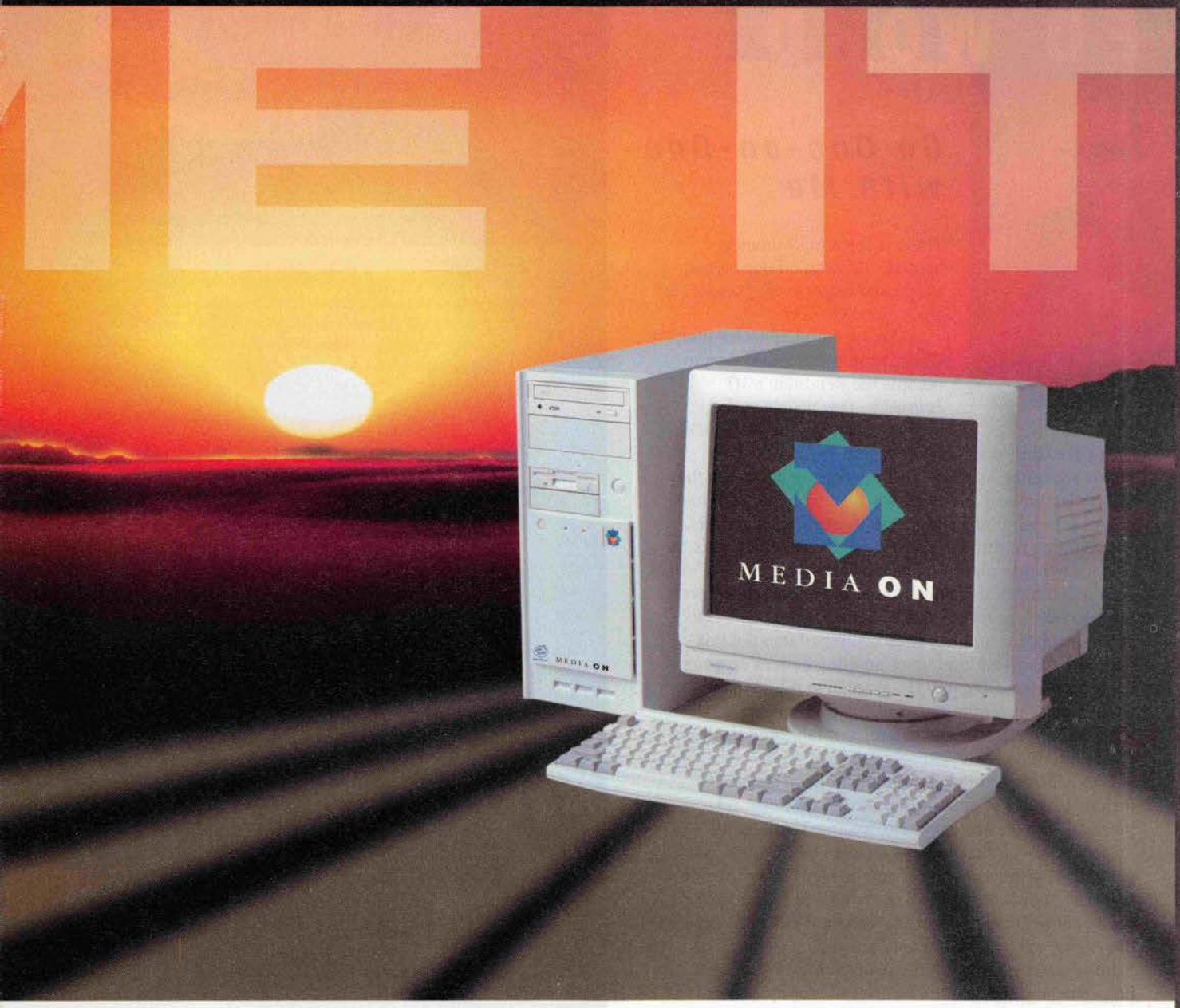

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ED WORD

Go One-on-One with Me

These is some busy times at bootHQ. Coming off our biggest PC-packed issues ever, changes are afoot. Good changes.

Our smmmokin' tech editor Chris Dunphy has bolted nest to become the Rendition's 3D evangelist. Few people in the industry really get the whole 3D thang like Chris does, and we're sure he'll shake it up. Hardware editor Andrew Sanchez steps up to take on the 3D accelerator beat and is already turning heads with his critical take on nVidia's texture compression techniques.

Coming in through the out door, this issue marks the first for our new managing editor Sarah Pirch (please send ammo and medical supplies to her attention, she knows not what she's in for). Actually, Sarah comes from *Unix Review* magazine and has already jumped into the mix with this month's round up of pointing devices on page 113. She's accelerating quickly, though, and *boot* readers should look forward to major pieces from her on electrotransmigration and sub-micron fab technologies in future issues.

Other new technologies on the horizon for *boot* include a couple of opportunities to get up close and personal with the *boot* crew. No, we aren't raffling off dream dates with that cuddly Canadian news editor. *boot*'s going live on Internet radio. Every week we'll record a new one-hour show filled with all the news and techniques you've come to expect from us. Also tune in for live on-air interviews with PC industry players and, of course, The Saint—Alex St. John—for the inside track on the latest happenings. Check out the bootNet site for more details as they become available, and look for custom client software on upcoming bootDiscs.

Need more direct contact with your friendly neighborhood editors? Tune into bootChat on the bootNet site (or via your favorite IRC client.) Chill with other *boot* readers and interrogate the *boot* editors when they drop in to unwind. This is your chance to get one-on-one advice straight from the bootLab and share tips with other PC fanatics. In the coming months we'll be scheduling chat sessions with some of the hottest names in PCs, so stay tuned.

Actually stay tuned to the whole *boot* experience, because it just keeps getting better.

Brad Dosland
Editor in Chief

***Riven**, page 114*

NEWS

14 bootWire ***News** that **matters**. Ripping new technologies such as DVD, AGP, and 3D acceleration are taking PC performance into the **stratosphere**. But **who's** making the high-octane software to feed these desktop **rockets**? We asked the industry and they **answered**. ALSO DVD has **missed out** on making a showing this last holiday shopping season and is showing early signs of becoming a breakthrough **unrealized**. We go to the **source** and get the skinny from the participant's at a Microsoft/SPA-sponsored conference to **save** the format.*

VOICES

23 The Saint ***Alex St. John** takes on the **challenge** and outlines his own operating system: **DirectOS**.*

27 Game Theory ***T. Liam McDonald** tells the **harrowing tale** of what happens when you make computer games your **life**.*

29 On the Line ***Shel Kimen** proclaims that **content** is king and that **consolidation** is the path to the **throne**.*

31 Fast Forward ***Tom Halfhill** hung with the **microprocessor** players at this year's MP Forum and comes back with the **roadmap for 1998**.*

126 Glitch ***Jon Phillips** pulls all the **nasty skeletons** from the overflowing closets of the **legendary bootLab**.*

DEPARTMENTS

5 Comm Port *Readers air out the **buzz** via e-mail, fax, and postcards from panda bears.*

12 bootDisc *Your guide to the **joys** of our shiny silver platter. A sampling of this month's bounty includes: New 3D-accelerator card bootMarks,* Zork Grand Inquisitor, Netstorm, FileMaker Pro 4.0, Virtua Fighter 2, *and patch-o-rama!*

18 Pure Lust ***Tech** toys for **digital** girls and boys.*

74 12-Step *You've got the **software** on this month's bootDisc, now follow this month's 12-Steps toward **benchmarking** your current (or future) **3D-accelerator** card.*

***DVD-Rom** Confusion, page 14*

CONTENT

Hercules **Stingray** 128/3D, page 101

P/REVIEWS

82 Previews *This month, we answer **all** your questions about the **hottest new 3D card** coming at you: **Voodoo 2**; ALSO **sneak peeks** at hot new games from the mouths of their **creators**.*

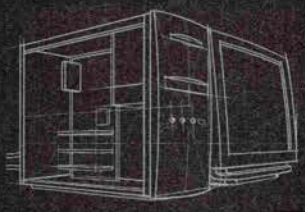
89 Reviews *A slew of **new 3D cards** are raining down on the bootLab recently and were benchmarking the **latest** from Diamond, Hercules, VideoLogic, Canopus, and UbiSoft in bucketloads.*

ALSO:
- *Compaq's **top-of-the-line** system is strong—but **stupid**.*
- *The new **workstation** from Intergraph made our heads **spin**.*
- **Netstorm** *and* **Ultima Online** *go head-to-head online.*

FEATURES

56 Pure Power Preview

*Here's the **scoop** on the hot hardware technologies that you'll be using **next year**. CPUs, 3D accelerators, hard drives, modems—all are getting **stronger**, **faster**... **better**. **Don't** buy a single part until you read our **recommended** upgrade paths.*



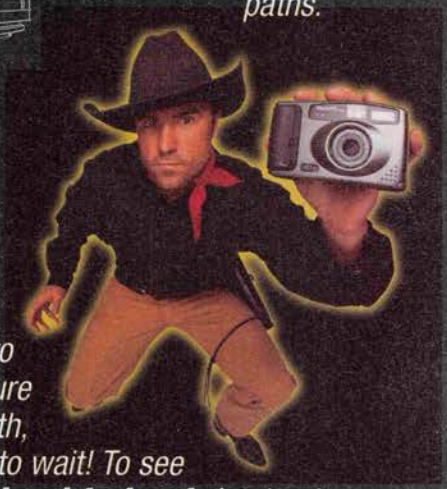
50 New Monitors

*Prices are **dropping**, so you'd be a damn fool **not** to buy a mongo monitor. The **magic numbers** are 19, 20, 21, and 24—*boot *reviews six CRTs that could change your life.*

68 Control Freaks

***Still** playing games with your **keyboard**? Egad, get a **proper** controller! From gamepads to joysticks to analog to USB, put the **power** at your fingertips with **seven** new controllers.*

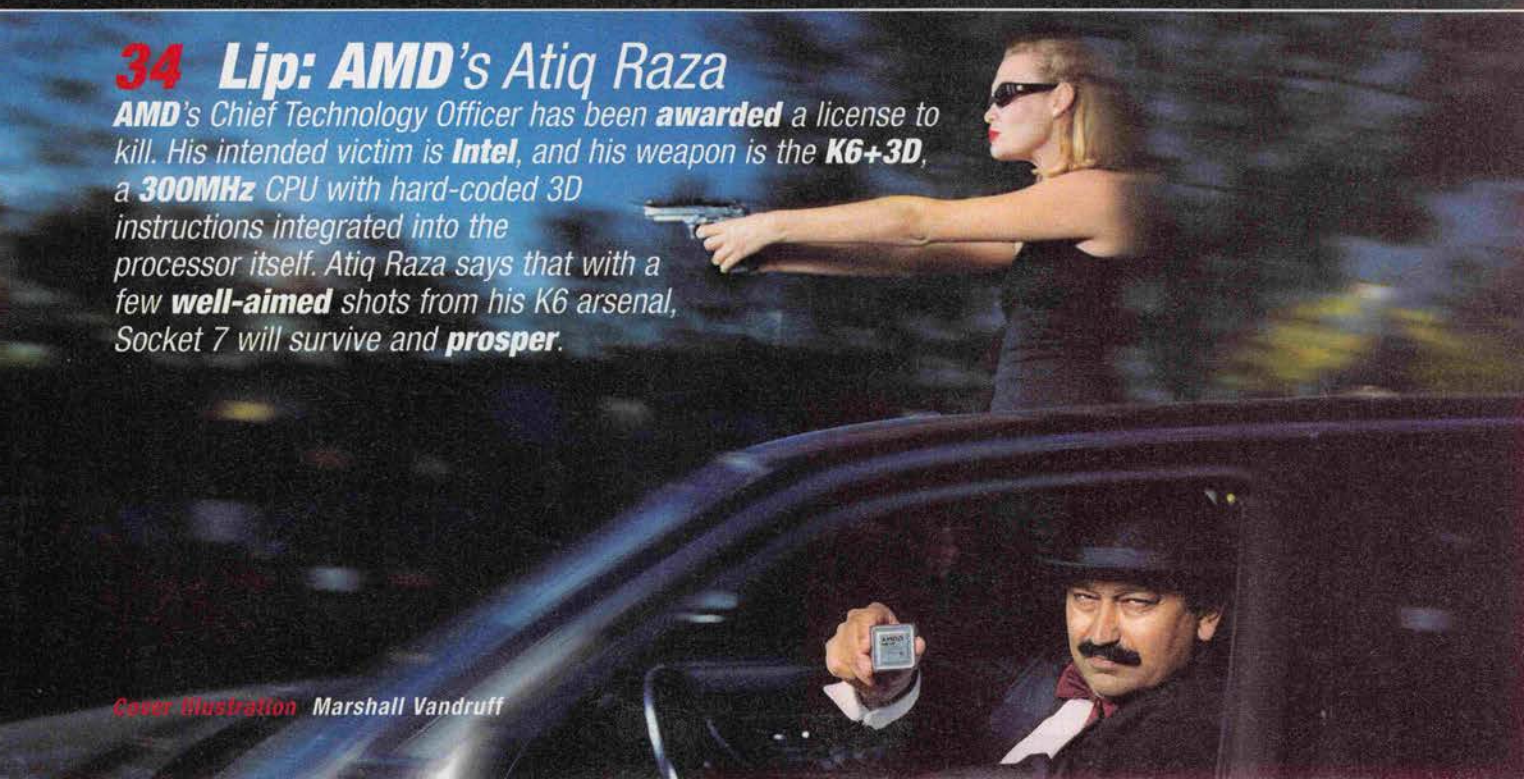
Digital Camera Shootout



*Late-breaking **new** products forced us to hold this **killer** feature story until next month, but you **don't** have to wait! To see the survivors of our **head-to-head** shoot out, check out the **complete** story **today** at: www.bootnet.com/youaskedforit/shootout.html.*

34 Lip: AMD's Atiq Raza

***AMD**'s Chief Technology Officer has been **awarded** a license to kill. His intended victim is **Intel**, and his weapon is the **K6+3D**, a **300MHz** CPU with hard-coded 3D instructions integrated into the processor itself. Atiq Raza says that with a few **well-aimed** shots from his K6 arsenal, Socket 7 will survive and **prosper**.*



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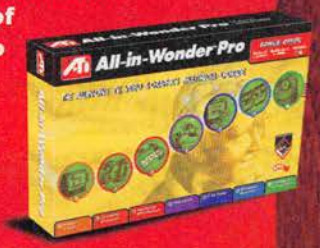

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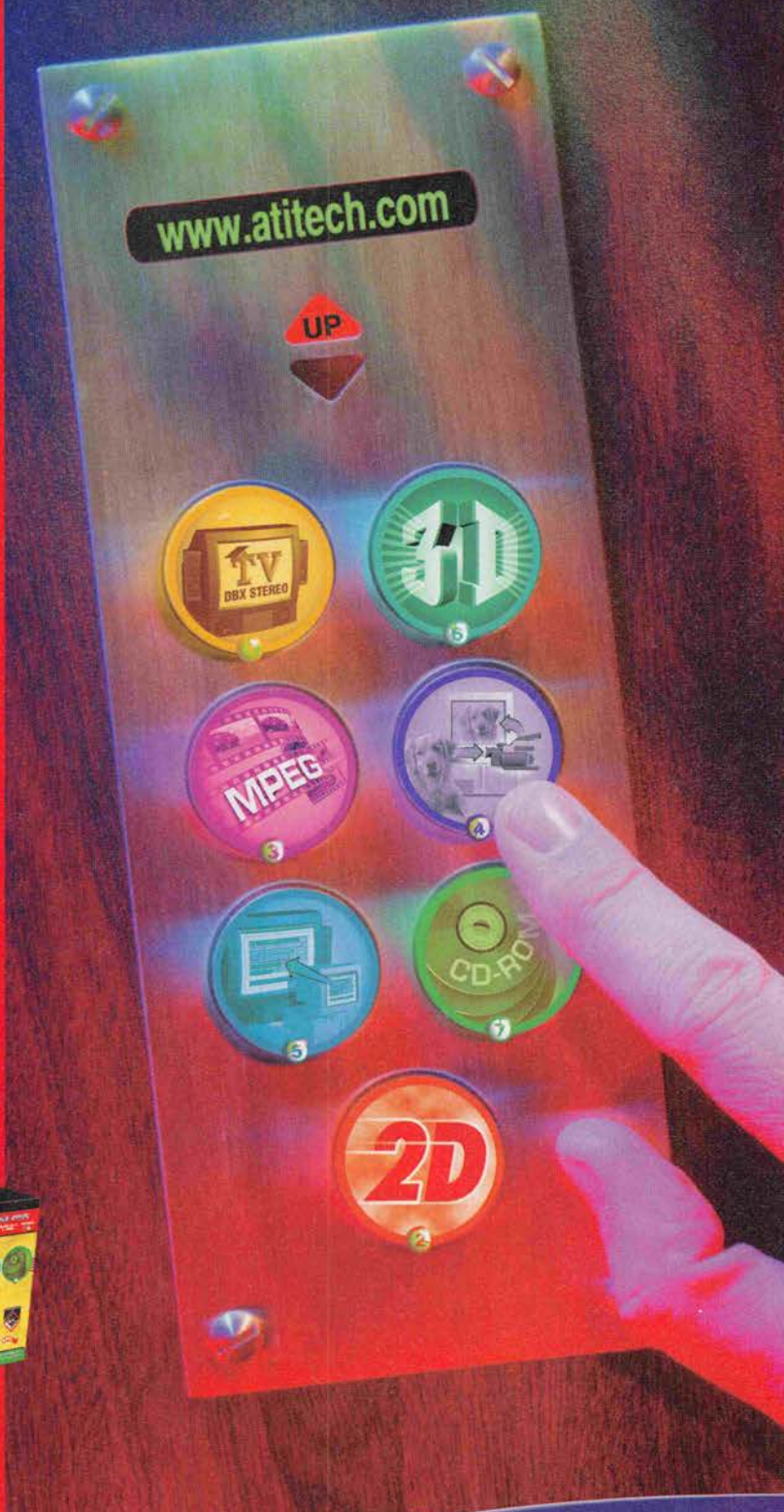

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COMM PORT

Sexy is as sexy does

For the life of me, I can't figure why you use the word "sexy" so often to describe computer components. A Corvette, maybe, but a motherboard? What's the story?

Mike Bell

Editor-in-chief Brad Dosland replies: *We use the term "sexy" to describe anything that invokes us with passionate desire, be it Corvettes or dual-CPU AGP on-board SCSI motherboards (or last month's cover model).*

Turn this mutha out

I own a computer company that makes custom computers. I love AT motherboards, but all the top motherboard companies are starting to sell ATX. Should I stick with my beloved AT motherboards or switch over to ATX?

Greg Varnum

I can't figure why you use the word ***"sexy"*** *so often to describe* ***computer*** *components.*

Hardware editor Andrew Sanchez replies: *I feel your pain, my fellow AT brother. Finding those sparkly new AGP-enhanced motherboards for the AT form-factor is getting harder every month. As ATX becomes more and more popular, your chances of having a particularly favorite mainboard grows bleaker and bleaker. If you're in the business of selling systems, you'd probably better switch over to ATX.*

When fps exceed refresh rates

I know an ass-kickin' card like the Monster 3D will increase 3D performance, but what if your monitor has a refresh rate lower than the video card's? Does your monitor slow your system because it can't draw the pictures fast enough? Or does the card supercede the monitor and force the picture up there faster? Also, what's the difference between frames per second and refresh rate?

Jeff Klopfenstein

Executive editor Jon Phillips replies: *Jeff, you've asked a question that could only come up in the age of Voodoo 2. Your monitor cannot display frame rates that exceed its maximum refresh rate at the resolution at which you're running. So, if your game wants to pump 92fps and your monitor is topping out at 75Hz, you'll simply run at a smooth, even 75fps—still buttah, eh? Yes, on a Voodoo 2 you can force excessive frame rates upon your poor little monitor if you turn off V-synch, but then you'll experience frame tearing, which is never a pretty sight. What's the diff between fps and refresh? Frames per second is the number of still images that flash on-screen every second. When they appear in rapid succession, you experience the illusion of realistic movement. 72mm movie film runs at 32fps. Because PC games have a much lower level-of-detail than Hollywood blockbusters, they need faster frame rates to sustain the illusion of realistic movement—lest you begin noticing all those blocky jaggies. Refresh rate is the number of times per second your CRT redraws your screen.*

Seeking validation

Using either *PageMill* and *FrontPage* (both reviewed in *boot* 13) is the worst thing an HTML neophyte can do and probably the best way to ruin a site. They don't foster learning of HTML, and therefore experimentation and understanding, and their crappy HTML never validates.

"Never validates—so what," you might say. But if you don't know anything about HTML (arguably one of the few reasons to use a WYSIWYG editor), a validator is your best friend. It'll catch dropped tags, let you know when your experimentation has gone awry, etc. Especially if someday you get gutsy and try some HTML by hand (which is only natural).

Starting out using those products forever dooms you to the mercy of the software designers. Whatever tags they feel are right and nothing more. And you'll be stuck on the upgrade path.

The only way to be reasonably assured of getting decent, backward-compatible pages is to write and validate according to HTML "standards." Even if your pages still break, you'll be secure in the knowledge that it's the browser's fault, and not your pages'.

William Rhodes
Eudora Web Team
Qualcomm

Burning sensation

When are the DVD Burners coming out? It'd be cool to burn my home videos onto DVD. Is this going to require an MPEG-2 decoder, and if so, how much will those cost? Is this all still in the fight to keep stuff from being pirated phase, deciding standards, etc.?

Dan Weak

Software editor Sean Downey replies: *Two standards have been announced for rewritable DVD media. DVD-RAM discs support a capacity of 2.6GB per side and DVD+RW promises 3GB. Neither format's media can be used in current DVD players or DVD-ROM drives, so the videos you burn to disc can be read only by the drive that created them. The first DVD-RAM drives should be hitting the shelves of your local electronics store in the next few months. The DVD-RAM spec doesn't require multi-read capabilities, while the DVD+RW makes it a fundamental component of its standard. DVD+RW media also doesn't require a caddy. Of course you'll have to wait until late next year for DVD+RW drives to ship in quantity. The upcoming third generation of DVD-ROM drives and players promise multiread compatibility, but we'll have to wait and see. Neither format claims to supplant the VCR as a comprehensive video recording and playback device.*

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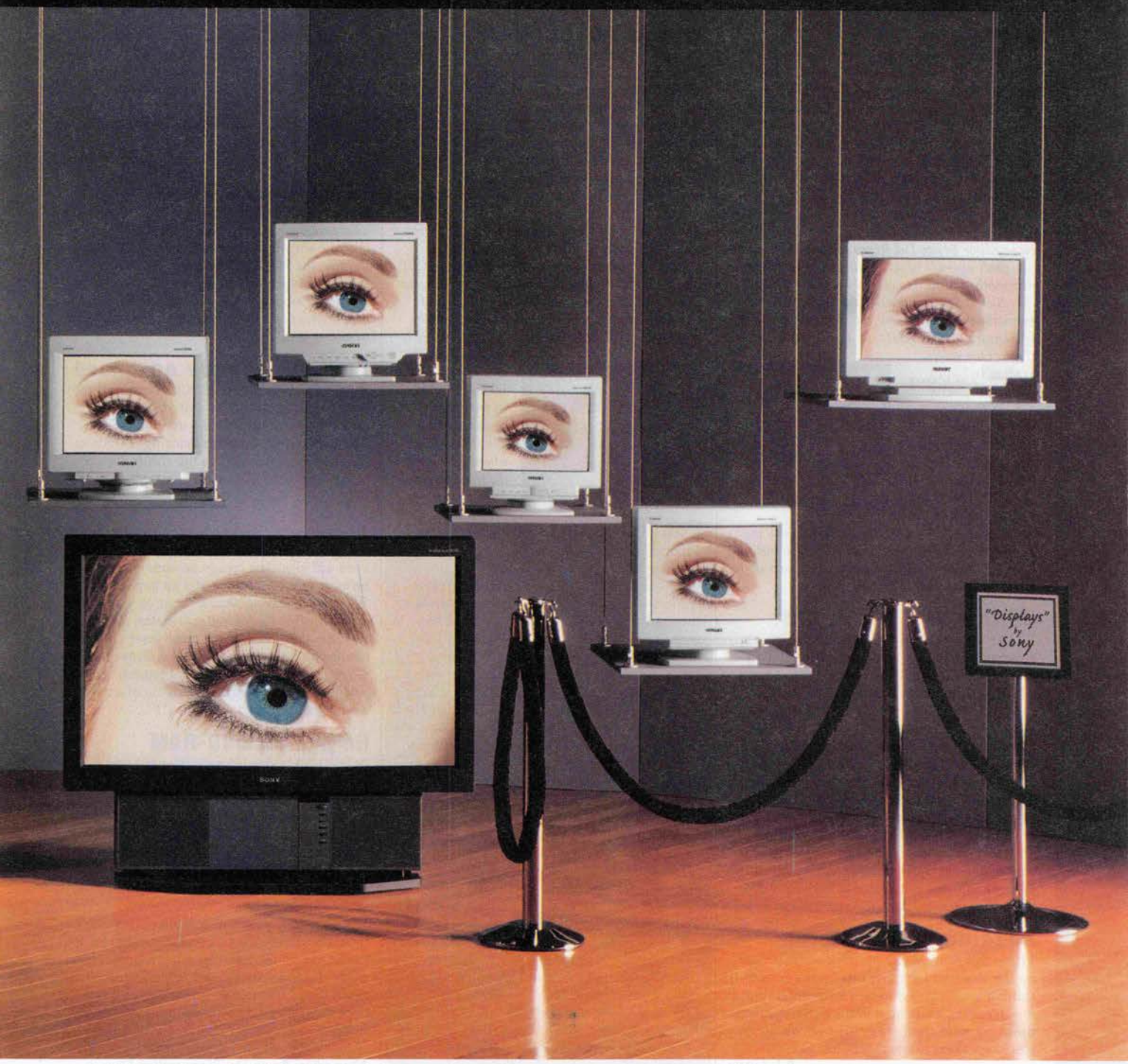

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COMM PORT

AGPless

I was just reading in the *boot* news section about AMD's two new chips: the K6+ and the K6+3D. I was surprised there was going to be AGP support. The news the day before was talking about AGP without resorting to Pentium II/440LX. How does all this work? I have a Pentium MMX chip now. Is it possible to go K6+3D and gain AGP without a new motherboard?

Alex

News editor Bryan Del Rizzo replies: *Sorry dude, you can't upgrade to AGP without purchasing a new motherboard. However, you're not limited to only Slot 1. You can purchase a Socket 7/AGP motherboard that'll allow you to pop in a variety of chips from IDT, AMD, or, dare we say it, Cyrix. One such product is Tyan's new Trinity ATX S1592S that'll support Intel's 233MHz Pentiums, AMD's 233MHz K6s, Cyrix's 6x86MX (M2), and ITD's 200MHz (and above) C6+ processors. In addition to the desirable AGP slot, the Trinity ATX also includes four PCI and three ISA slots, and supports up to 1024MB of on-board memory.*

SDRAM vs EDO... fight!

I'd like to upgrade to SDRAM, but since it's so expensive here, I could only afford a pair of 16MB SDRAMs. Will it be better to have a 32MB SDRAM than a 64MB EDO RAM?

Sanny Sarcia

Hardware editor Andrew Sanchez replies: *For games and cool apps such as* Photoshop, *faster SDRAM will eek out minute performance gains over its EDO counterpart. Also, if you decide to go with a newer motherboard, they'll most likely be running with DIMMs—buy a DIMM (or DIMMs) now and you can carry it over to your next motherboard without any hassles. Invest in 72-pin EDO, and you'll need to buy new RAM when you upgrade later.*

Hooking up the stereo

I have this Sony VAIO monitor with speakers on the sides, and another one on the bottom (I think it's a supposed to be a subwoofer, but if it is, it sucks). Compared to my stereo speakers, these are weak. Is there a way to hook up my stereo speakers to my computer?

B.J. Loyola

boot ***reader David Herald replies:*** *All these computer speakers sell for $75 to $300 and I'd like to offer my 50-cent solution: A cable with a standard headphone plug on one end and a set of RCA plugs at the other. Then plug your sound card into your stereo system, just like a tape deck or CD player. I personally have two 12-inch woofers, six 6-inchers, and four 3.5-inch tweeters, on four separate 55-inch towers, one in each corner of the room.*

What if your monitor has a ***refresh rate*** *lower than the video card's?*

Why is SCSI better?

I'm in the market for a new system and have yet to see articles in any magazine comparing an IDE-based system and a SCSI-based system. Granted, I see the benefits of expanding down the road when it comes to SCSI, but is the performance boost really worth the $1,500 extra? I do a lot of multitasking work but I would really like to see a head-to-head comparison.

Jason Moore

Disc editor Sean Cleveland replies: *SCSI takes the I/O pressure off the CPU and inherently supports multitasking environments better. SCSI has the ability to handle from 7 to 15 devices, can pump more information through its bus, and can execute up to 256 commands concurrently. Although SCSI's performance in Windows 95 is hardly distinguishable from UltraATA/DMA, its true power comes out in Windows NT where it is clearly the more powerful solution.*

Voodoo 2 to the MAX

I just read your stunning online preview of the new Voodoo 2. I'm a 3DStudio Max user—and gameplayer—and it'd be great if I could use a 3D accelerator card for both. Is there any chance 3Dfx, or anyone else, will write a driver supporting the Heidi API (for 3DStudio Max) or am I doomed to buy a more expensive card?

How well do 3Dfx cards (both Voodoo and Voodoo 2) stand against the full-blooded 3D accelerators based on processors like the Glint (3D labs), the 3Dpro/2mp (Mitsubishi), and the others in terms of visual quality, rendering speed, and usability?

Jan Strandh

Software editor Sean Downey replies: *Right now, the only way you'll get to monkey around in 3DStudio Max with a Voodoo card is with Quantum3D's Obsidian3DS bundle, which includes the Obsidian 50-4440 (with 4MB of frame-buffer memory and 8MB of texture memory), and the RealiStorm plug-in, which allows you to preview texture mapped models or render it to disk in real-time with advanced features like Z-buffering, perspective correction, sub-pixel positioning, trilinear filtering with per-pixel LOD MIP mapping, lighting, alpha blending, and more!*

Currently, we haven't heard whether Quantum3D plans to update the plug-in to work with Voodoo 2. With regards to comparing a Voodoo board with a full-blown OpenGL adapter, that's hard to say. Since only one plug-in allows you to use Voodoo with 3DStudio Max, it's almost impossible for direct comparisons between the two.

On the other hand, I'd do it for a Dodge Viper

I just got the *bootDisc* with *boot* 15 and seven out of 12 demos require a Voodoo card. How much did they pay you so we would run—not walk—to the computer retailer to buy one of these cards? Not in a million years would I go to Ford and ask to demo their car and they say, "Sure you can drive our car—oh, by the way, you have to buy the tires first."

James Whitley

Disc editor Sean Cleveland replies: *The 3Dfx demos on* bootDisc *15 took up 50MB. Seems like a lot except when compared to the 250MB of other demos on the disc along with the 18MB of utilities, the 54MB of Try Before You Buy software and the 235MB devoted to Linux.* boot *is a hardware magazine and will include accelerated versions of software to run on that hardware whenever available.*

Caution: sounds on-board

What would be better? A PCI sound card that stores sounds on the hard drive, or an ISA card that has sounds on-board? PCI seems like a good deal, but won't storing sounds on the hard drive slow down the computer even worse than an ISA card?

Oleg Kio

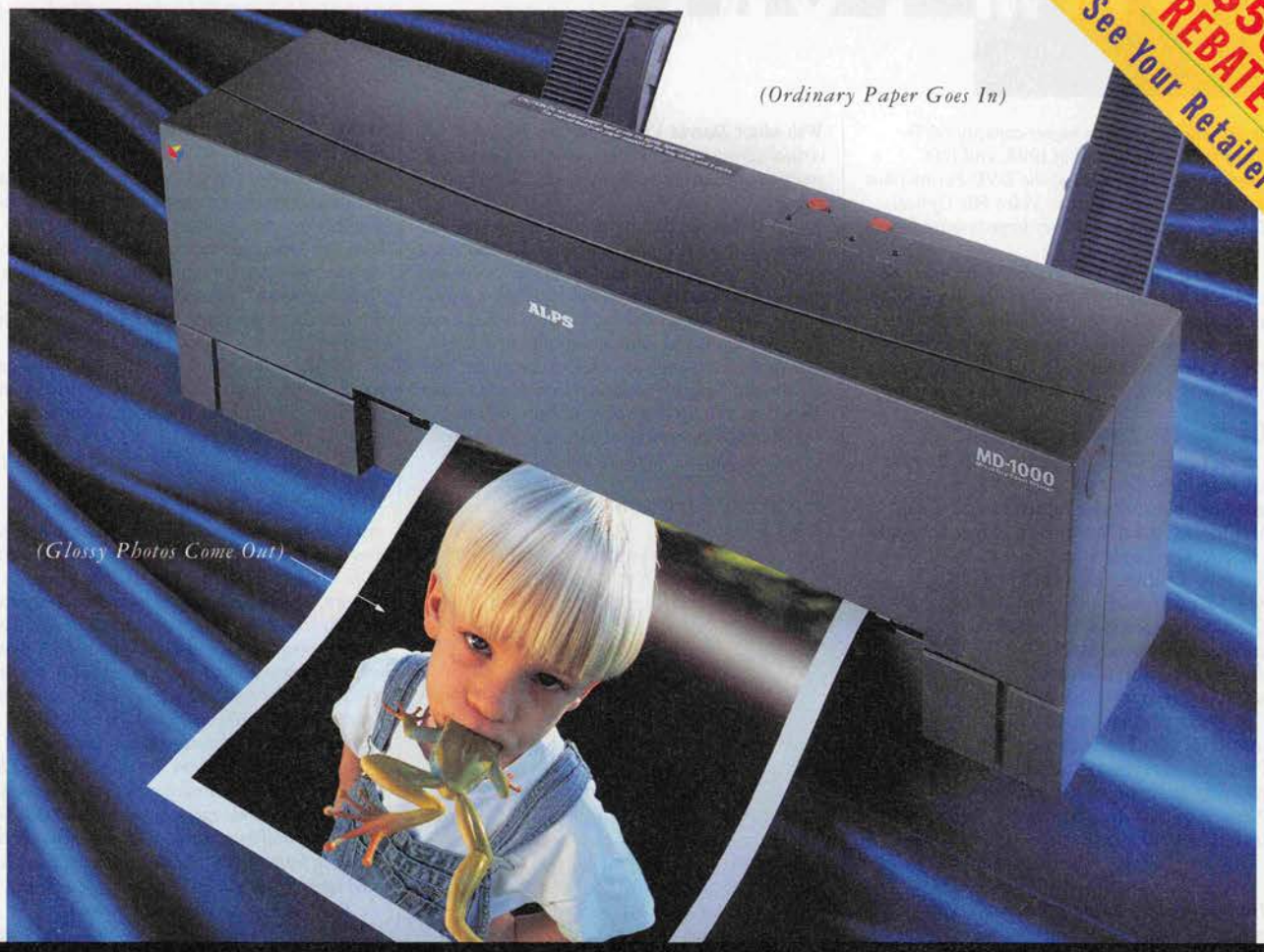
Hardware editor Andrew Sanchez replies: *Most PCI sound cards that store samples on the hard drive will allocate a certain amount of system memory to store these samples for applications. While it will take up physical space on your hard drive, they'll be loaded into your system RAM once your app starts. Throw in a much lower CPU utilization and the ability to have a dedicated MIPS DSP for hardware digital sound processing, and you'll be able to get more sounds out of a sound card without bogging down the CPU.*

No jigs for DVD-RAM

Is DVD-RAM dead? Last summer I was astounded with the progress made on the DVD-RAM standard; I remember saying to my wife (who could care less!) that this was not going to be another "3D Bungle" (I don't think she had a clue as to what I was talking about). I promptly added a DVD-RAM drive to my Christmas wish list, only to be let down by the very companies I had praised months earlier. What's a poor power user to do? I just don't understand how all of these companies can *not* learn from all the mistakes other products have made. I don't want to own another Beta VCR again, and I will not invest in a drive that does not conform to a single industry standard.

Glendell Roberson

News editor Bryan Del Rizzo replies: *Nope, it ain't dead, but it ain't exactly doing a jig either. The DVD-Forum recently ratified a 2.6GB format, but guess what? Many of its founding members (including such companies as Sony, HP, and Yamaha), instead pledged allegiance to an alternate 3GB format called DVD Phase-Change ReWritable (DVD+RW), which apparently includes extra provisions for CAV, deemed a natural extension to CD-RW. To make matters worse, the DVD-Forum itself is planning*



Ordinary Paper Goes In. Glossy Photos Come Out.

Only ALPS Gives You Glossy Prints On Ordinary Paper.

You're looking at one of the best color printers from start to finish. The ALPS MD-1000 Color Printer is the only color printer that can give you breathtaking glossy prints even on ordinary laser paper. The reason is simple.

The MD-1000 doesn't rely on liquid ink jet technology. Instead it uses ribbons coated with ALPS proprietary Micro Dry™ inks. Besides the usual cyan, magenta, yellow and black, you can also choose metallic or white inks . There's even the special Finish ribbon that gives photos this rich and glossy look.

Since the inks go on dry, they outshine and outlast anything you could ever get from an ink jet. In fact, output from the ALPS MD-1000 will look as good five years from now as it did the day it was printed.

Last but not least, the ALPS MD-1000 produces great results on ordinary laser paper, so it costs less to use. A lot less. (Just check out the price of fancy ink jet paper the next time you go shopping.)

For the dealer nearest you or for printed samples and more information, visit our Web site at www.alpsusa.com. Or call 1-800-720-ALPS (2577).

The new ALPS MD-1000 Color Printer. It's all you need to gloss up your act.

ALPS

Product Information Number 89

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on introducing an even higher-capacity DVD-RAM format by the end of 1998, and NEC (which is not a member of the DVD-Forum) has its own 5.2GB Multimedia Video File Optical Disk Technology, which they hope to introduce by 1998 as well.

Hitachi claims its DVD-RAM drive will be available in early 1998, but beware. There's no guarantee it will be compatible with any of the other standards should they come to fruition in 1998. Check out boot *15 for the in-depth bootWire report.*

Cyrix in the real world

I custom build PCs for local and mail order sales and use Cyrix CPUs in 90% of my systems, with not one return or complaint. In *boot* 11, you tested the three major manufacturers, and Cyrix only won one test. In *PC Today*, the Intel Pentium 233 MMX, AMD K6 233, and Cyrix 6x86MX 233 were tested, and the Cyrix blew away all others. Are all tests created equal? Have you tested the CPUs above on an equal machine? I currently run a P166+ in my system and can play any game on your *bootDisc*. Please explain why your tests results are different.

Jeff D. Irwin

The major players can't possibly touch the **speed** and **performance** of a properly configured custom system built by a smaller **local** company.

Hardware editor Andrew Sanchez replies: *With regards to benchmarks, all tests are not created equal. We do not rely solely on one synthetic benchmark to be the "all knowing" benchmark. Our "Pentium Killers" article was one of the few tests done on these Socket 7 CPUs that actually took place on the same motherboard, core-logic chipset, RAM, and system configuration, with the only variation being the CPU. Our tests represent a variety of real-world and synthetic benchmarks, from our own Symantec-bred bootMark, BAPco's SYSmark 32, to frame rates in* Quake, *real-world processing times under* Debabilizer Pro, Lightwave 3D, *and Microsoft C++ compiling. These aren't meaningless synthetic numbers. We're talking fps and rendering times. As seen from the results, the Cyrix CPU consistently placed last in real-world application scores. Do you run WinBench all day or do you use your system for real work and games? Our benchmarks prodded these CPUs in almost every way possible, from integer performance to floating point, and the Cyrix part simply didn't cut the mustard.*

Installed Linux... now what?

I installed the Linux OS included with *boot* 15 on a 120MHz Pentium, no problem.

Now I find myself with an operating system and no idea how to use it. Is there a book/manual on the basic operation of Linux?

Martin Hedgren

Web editor Daevid Vincent replies: *There's a virtual cornucopia of books available. I'm sure if you just pick up even a basic book, it'll get you going.*

Most commands have documentation on the system, simply type "man <command>", and you'll be greeted to more information on that command than you could ever want. There are some great magazines that are all about Linux as well, such as The Linux Journal, *and newsgroups and the web (www.linux.org) are another source for help.*

Finally, I suggest you join a local User's Group. They'll get you up to speed, and help you with anything and everything about arguably the best OS on the planet... welcome aboard.

Good things come in small packages

boot probably has the most constructive view of the computer industry I've seen in years, but I start to see red when you actively push only the big guns. I understand that you cannot possibly review every piece of hardware available, but the major players—Dell, Gateway, Sony, etc.—can't possibly touch the speed and performance of a properly configured custom system built by a smaller local company. The company I manage has nearly a 100% hit rate of wiping the floor of any system you've reviewed and with no great deviation of hardware specs. So give us small fries a chance to prove ourselves. I lay down the gaunlet: Name your specs. We'll ship you the machine, so you can see a *real* computer Kick Ass.

Andy Miller

Hardware editor Andrew Sanchez replies: *Send it on over—if it's worthy, we'll be more than happy to praise your system to the tech gurus out there in bootLand. Our shipping address is 150 North Hill Drive, Brisbane CA, 94005. Include a press kit outlining pricing, system configuration, and contact at your company, and we'll put any system under the knife.*

EB: phone home

I'm a manager for Electronics Boutique, and customers really appreciate the Kick Ass awards. Keep up the good work, it's so refreshing to read something other than a ZD clone mag.

Are you planning on releasing a version of the magazine without the *bootDisc*? I buy it every month and it'd be easier on me.

Joseph Marin

Editor-in-chief Brad Dosland replies: *Plans are underway to add a "naked" version (that's what our circ geniuses call the magazine without the* bootDisc*) starting with the February issue. The naked* boot *will sell for a scant $3.99.*

Don't make us summon hellspawn

You may have jumped the gun on your online Voodoo 2 report. I have to seriously question whether you folks actually had the board to test. I've heard rumors, and believe them to be true, that you got all your numbers from 3Dfx, and didn't actually perform the tests. If the numbers did come from 3Dfx, you failed miserably to report that little fact.

On the other hand, if you actually did get a hands-on test, then I apologize profusely, and ask that you not have the hellspawn eat my soul. That really itches.

Nathaniel Moore

Hardware editor Andrew Sanchez replies: *As stated in the online bootWire article, we (myself and editor in chief Brad Dosland) went down to 3Dfx's labs in San Jose. We watched Tony Tamasi, Product Manager of Graphics Hardware, type the timedemo demo1 command on* Quake's *console using a keyboard rigged to a 440LX motherboard that was mounted to a wooden board, and wrote down the resulting score. He then re-ran the benchmark at 800x600, and I recorded the results. The* QII *test score was taken at the start of a game, using the current iteration. He typed in the timerefresh benchmark at a point I requested. The resulting frame rate is what we reported. We were there, and we observed with our own eyes the resulting frame rates and performance. Heck, we even took digital photos of the reference board.*

Don't worry, we won't summon any hellspawn—I'm really low on manna and the weekend's coming up, when manna really comes into play.

Stoppin' at the Service Pack station

Re your response to the "Runnin' on NT" letter in *boot* 15's Comm Port: NT 4.0 does support DirectX 5.0 with Service Pack 3 and is automatically installed.

Greg Evans

Sounds like id spirit

How does id produce their SFX? How do they record them and with what software? I program in C and make SFX for games (currently using Cool Edit 96) and any answers would be greatly appreciated.

Jonathan Kensy

American McGee, music & audio director of id Software, replies: *When capturing sounds for our games I record with a Sony MD recorder and a pretty inexpensive Sony mic. Once I have source material, I run it through several processes to get the sound I want. For digital effects, I run it through a system called a Capybara (www.symbolicsound.com). When doing basic editing, I use* Cool Edit Pro *(www.syntrillium.com). If I can't create the sound I need from scratch, I turn to our sound effects library. This collection of 100+ CDs contains every imaginable sound. I try to avoid using these sounds raw though, so you won't end up hearing something from one of our games on next week's* X-Files.

Take Friday off.

This wheel helps you work so quickly you just might. With the Microsoft® IntelliMouse®, you can roll through everyday tasks with a touch of your finger. Use the rubber wheel to AutoScroll through documents and Web pages faster. Use Data Zoom to navigate through Web hot links or through the Windows® 95 operating system. Whether you're in Office 97 or any other IntelliMouse compatible program, you'll be surprised by how fast you can work. So while we can't guarantee you'll get Friday off, we can promise you a better way to work.

And now, the IntelliMouse wheel is available on an ergonomically-designed trackball.

Microsoft® IntelliMouse®

Microsoft® IntelliMouse® TrackBall

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Where do you want to go today?® www.microsoft.com/intellimouse

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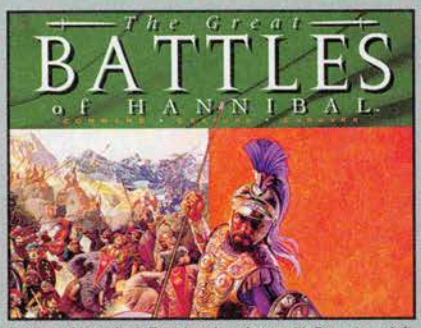
bootDISC

ON **THIS MONTH'S** DISC:

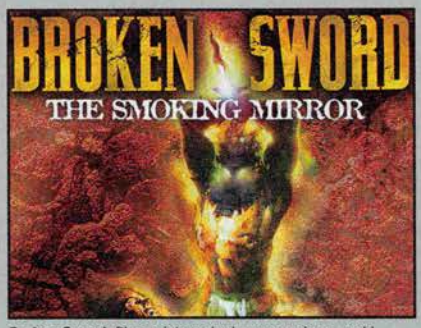
Benchmark your 3D card like a regular bootBoy!

3D bootMarks

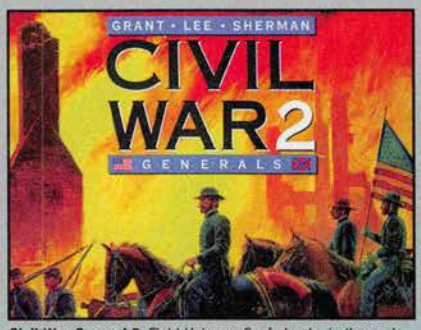
SOFTWARE DEMOS:



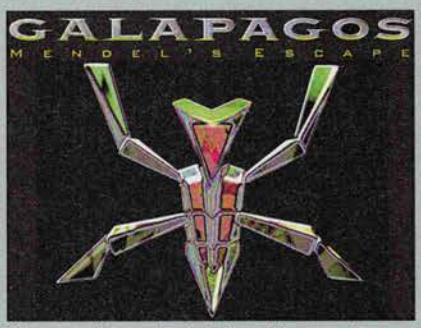
Battles of Hannibal: Two decades of war with Rome have left the Carthaginian Empire on the brink of ruin. To fight the greatest military power in the world, to stand against impossible odds, Carthage needs a cunning and fearless general. It needs Hannibal.



Broken Sword: Plunge into a shadowy conspiracy world where the schemes of a mad drug kingpin and the prophesied return of an ancient Mayan god clash in what could be the end for all mankind. Immersive 3D graphics and stylized animation combine to create a beautifully rendered environment.



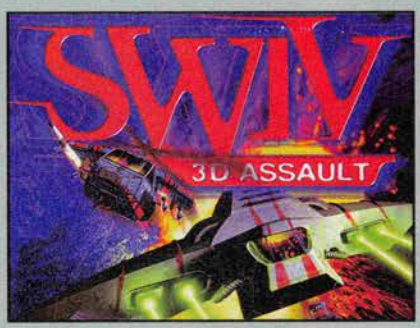
Civil War General 2: Fight Union or Confederate, in the eastern or western theater. New terrain types include walls, ruins, open water, coast, swamps, knolls, and pontoon bridges. It comes combat-ready with 40 legendary battles. Support for multiplayer head-to-head battles is also included.



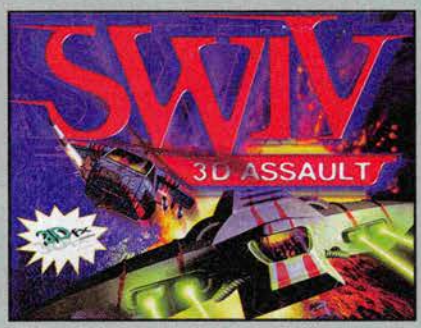
Galapagos: *Galapagos* is a fantastic and dangerous place where up and down have no meaning, where rivers of iridescent acid and high-energy laser mines are beautiful-but-deadly artifacts of some other time. You control Mendel, a synthetic organism with the ability to learn. Review on page 111.

Hexen II Demo 2: *Hexen II* is a worthy successor to the original, this time utilizing the full functionality of the *Quake* engine. This new demo allows you to play all four characters on three different levels. Three additional deathmatch levels are also included. Review on page 110 of *boot* 16.

iF-16: Take to the skies in the F-16, equipped with the latest technological upgrades, and fight your way through three future war zones: Korea, Cyprus, and Israel. Visuals include texture-mapped, gouraud-shaded 3D graphics. Review on page 96.



SWIV 3-D: *SWIV 3D* (Special Weapons Interdiction Vehicle) lets you control six unique vehicles, including a helicopter gunship, a four-wheel-drive armored buggy, a Ski-Doo, and a Hovercraft in a shoot 'em-up action/arcade-style game.



SWIV 3-D 3Dfx: This is the *SWIV 3D* (Special Weapons Interdiction Vehicle) demo accelerated for the 3Dfx Voodoo and Voodoo Rush video cards. Support for MMX is included with both versions of the demo.

Virtua Fighter 2: *Virtua Fighter 2* now uses texture-mapped graphics, increased speed, and 500 new moves. Now you can punch, kick, and pile drive any challenger in the world over the Internet. Review on page 110.

bootDISC

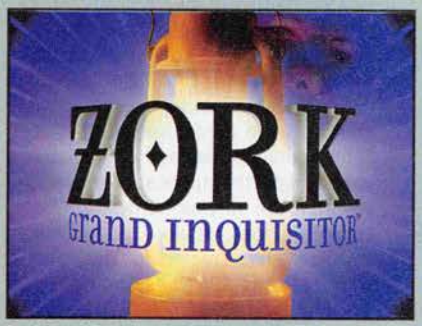
So you think your 3D accelerator is up to snuff? The Final Reality and X Direct3D benchmarks will push your accelerator to its limits—and beyond. Determine whether your board can do trilinear filtering, anti-aliasing, and all those other cool effects that will make your eyes goggle.

Dark Reign: In this real-time strategy game, you can control AI settings to determine each unit's behavior in combat. Place a unit on sentry duty, have it harass the enemy, or send it on a suicide mission. Determine whether it will retreat for repairs or fight to the death. Review on page 47 of *boot* 16.

FileMaker Pro 4.0 : *FileMaker Pro 4.0* allows you to manage information both on your desktop and on the web. Built-in HTTP support and CGI functionality mean that no additional CGI or web server software are required. Review on page 116.

Incubation: *Incubation* uses the *Extreme Assault 3D* graphics engine, allowing the action to be viewed from the eyes of the individual soldier, the other team members, the attacking aliens, or practically anywhere else via a user-controlled free-floating camera.

Netstorm: Command the skies as chief battle strategist, where floating islands wage war to gain the favor of the Furies of Wind, Rain, and Thunder. Strategic thinking replaces the all-out tank rush as the key to unit placement, not micro-management. Review on page 108.



Zork Grand Inquisitor: As an ageless, faceless, adventure person, you must return magic to the Zork realm. Activision's Z-Vision technology allows you to see a complete, 360-degree view of your surroundings from almost every point in the game. Review on page 114.

EVERY MONTH, **BOOT** DELIVERS **OVER 600MB** OF THE **HOTTEST** DEMOS AND **COOLEST** APPS

PATCHES, **PATCHES,** AND **MORE** STINKIN' PATCHES:

This month's disc contains patches to the following games:

GAME	PUBLISHER
AH-64D Longbow	Janes / Electronic Arts
AirWarrior II	Interactive Magic
ATF	Janes / Electronic Arts
Blood	GT Interactive
Carmageddon	Interplay
Chasm – The Rift	GT Interactive
Dark Reign	Activision
Diablo	Blizzard
Dungeon Keeper	Bullfrog / Electronic Arts
Ecstatica II	Psygnosis
Emperor of the Fading Suns	Segasoft
F-22 Lightning II	Nova Logic
Gettysburg	Firaxis / Electronic Arts
Great Battles of Alexander	Interactive Magic
Heroes of Might & Magic II	New World Computing / 3DO
Hexen II	Activision
Hind	Interactive Magic
iF-22	Interactive Magic
Interstate 76	Activision
Jetfighter III	Mission Studios / Interplay
Lords of the Realm II	Sierra Online
Outpost 2	Sierra Online
Privateer 2	Origin Systems / Electronic Arts
Quake	GT Interactive
Red Alert	Westwood / Virgin Interactive
Riven	Red Orb / Broderbund
Shadow Warrior	GT Interactive
Swiv 3D	Interplay
Total Annihilation	GT Interactive
Wages of War	3DO
Warcraft II	Blizzard
Wing Commander IV	Origin Systems / Electronic Arts
Wipeout 2097	Psygnosis
Xwing vs. Tie Fighter	Lucas Arts

NUGGETS

Creative Technologies To Buy Cambridge SoundWorks

In a stunning move, Creative Technologies has announced an agreement to buy Kick-Ass award-winning speaker wholesaler Cambridge SoundWorks for about $38 million. The power play signifies the purchase of an elite niche manufacturer by a large conglomerate, leading some to wonder whether Cambridge will continue under its own name, be assimilated into the Creative product line, or be 86ed to ease potential competition.

At press time in November, Creative, which currently owns about 25% of Cambridge SoundWorks' shares, planned to offer $10.68 for each share of Cambridge SoundWorks, with the tender offer expiring in early December, unless extended.

It is not known what will happen to the many Cambridge SoundWorks storefronts or what will happen to Cambridge's extensive line of home theater speaker systems.

Samsung's Alpha To Run at 700MHz

If you're running under NT and even Deschutes won't quench your thirst for speed, several new chips on the horizon just might do the trick.

Digital Semiconductors has announced plans to unveil its 667MHz Alpha processor, while Samsung has a 64-bit Alpha processor that should satisfy your MHz needs. At 700MHz, the new chip, based on technology licensed from Digital, sports 1.5 million transistors with a .25-micron production process.

And if that isn't good enough for you, IBM plans to push the envelope even further, with a stunning 1.1GHz 64-bit PowerPC integer processor using a .15-micron fab.

Production of the chips for servers and high-end workstations is expected to begin in late 1998.

Tillamook To Go Head-To-Head With Mobile Deschutes At 266MHz

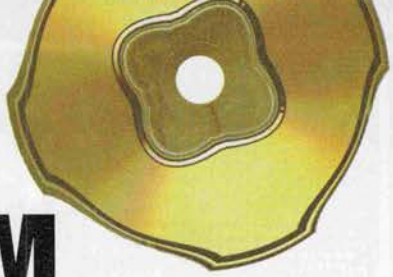
Intel has surprised everyone by announcing plans to produce a 266MHz, .25-micron Tillamook part for release early next year. Dell, NEC, and Digital have already announced notebooks based on the new chip, but with the P-II-powered mobile version of Deschutes (with clock speeds similar to the Tillamook part) launching only a few months after the high-speed Tillamook, many vendors are opting to wait on the sidelines until Mobile Deschutes becomes a reality.

Given that Intel is trying to get Slot 1/Pentium II into consumer systems by the end of 1998, it should be interesting to see whether it tries to release a 266MHz Socket 7/desktop part to match AMD's and Cyrix's 266–300MHz offerings.

Disney And Time Warner Spurn Navigator Users

Microsoft has signed exclusive deals with both Time Warner and Walt Disney. While such deals are common in the computer industry and could be dismissed as trivial, this latest

> 16



DVD-ROM Confusion

INCOMPATIBILITIES FINALLY ADDRESSED

Confusion surrounding the specs for DVD-ROM has chilled progress in getting titles to market in the new format—but help is on the way.

Early titles made Windows MCI calls that were incompatible with many combinations of PCs, disc drives, and decoders. As a result, most software developers balked at putting their wares onto DVD-ROM.

Since there is no application layer in the DVD-ROM spec, programmers had to guess at how to play various media. At a conference last August, developers "tested software on different [hardware], and well over 90% didn't work," said Jonathan Schwartz, an independent licenser who markets titles to OEMs. At that time, it was thought the only answer was to wait until April 1998 for Microsoft's DirectShow API to standardize media playback.

In late October, Intel, Microsoft, and the SPA sponsored another conference on DVD to address the situation, and announced a set of solutions. Intel's new "Recommended DVD-ROM Command Set for MCI," a subset of basic MCI calls, provides developers standardized commands comprising usable—although scaled-down—operability. It will allow developers to create software titles immediately, although they will not be able to take full advantage of the features of DVD-ROM.

Preliminary versions of this command subset had been available to developers, and many came to the conference with software using it. Representatives of OEMs and drive and codec manufacturers in the dozen or so testing suites at the conference reported good results. E4's Mike Schmitt tested titles with a Toshiba drive and two E4 cards, and said his tests were "very successful."

In contrast to the August tests, Schmitt said the second set of tests showed "definitely much more compatibility. Across the board, all titles are working soundly."

A more long-term solution came from Redmond. Microsoft's Kurt Hunter announced that MCI was the main reason for the incompatibility experienced by DVD-ROM titles and that MCI was being replaced by DirectShow. "MCI is legacy [and] we don't want to extend it any more than necessary," said Hunter. He followed by announcing a mid-December release of a beta-3 version of the API, promising "DirectShow would be available as part of the SDK."

While it was known that DirectShow would be built into Windows 98 and NT 5.0, the early release of the beta was met with relief. "DirectShow will provide the standard application programming interface for DVD features," said Hunter, "and will take full advantage of the features of DVD-ROM." He added that DirectShow should solve the current set of DVD-ROM incompatibility problems and allow programmers to write full-featured DVD titles. "The primary advantage of DirectShow is to isolate the application developers from the varying hardware. Of course, it does require that there are correct drivers created for the hardware that support DirectShow."

Although a 1997 DVD-ROM holiday season is as good as dead, the new developments bode well for its proliferation in 1998. *(For the full story on the 1997 DVD software vigil, read the* boot *16 feature story.)*

Make Room.

When we designed our new high capacity drive, common sense dictated it should also work with standard diskettes.

PC Computing

"Over 300 percent faster than the [competitor's] drive." 10/97

The fact that we make the best selling brand of standard diskette had nothing to do with it.

Okay, so maybe it had a little bit to do with it. But the big news here is that with our new SuperDisk™ Drive, you can access 120MB of storage, up to five times as fast as standard floppies. And here's the kicker, it still works with 1.44MB diskettes. Just plug it into your PC's parallel port. Or look for SuperDisk LS-120 drives built into new PCs. To make more room, call 1.800.888.1889, ext. 3001 or surf www.imation.com.

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Borne of 3M Innovation

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MICRO CENTER · MicroWAREHOUSE · Office DEPOT · OfficeMax · STAPLES · QUILL

NUGGETS

> 14

agreement is notable for one, little, interesting fact: Netscape users trying to enter Warner Brothers' Entertaindom are greeted with a message stating: "You must first download Microsoft Internet Explorer 4.0... Once IE4 is installed, you will be able to preview the following channels."

Disney says the ability to customize Microsoft's browser into what the company calls the D-browser and to implement Disney's Daily Blast (or D-mail, essentially a push channel) and D-phone (a multiuser chat system) were the compelling reasons to choose IE4 over Netscape Navigator 4.0.

As expected, Netscape users are upset.

Netscape claims it is still on good terms with both companies despite the situation, citing Disney's ABCNews.com and Time Warner's CNNfn as premier channels on Netcaster, although it does admit to being confused as to why any large company would exclude such a huge web base. To register your opinion, visit www.disney.com.

Sony And Fuji Team Up For The Floppy Of The Future

Sony and Fuji have announced plans for a successor to the floppy drive—dubbed the HiFD—that can store up to 200MB of data while retaining the ability to read and write to current 1.44MB 3.5-inch disks.

This new technology permits transfer rates of 3.6MB/sec, compared to the 1.4MB/sec from Iomega's 100MB Zip drive and the .6MB/sec transfer rate from O.R. Technology's 120MB LS-120 (Superdisk) drives.

With the similar LS-120 technology currently floundering, the HiFD's success will depend on how well Sony can convince system manufacturers to adopt the new technology. Sony plans to make the drives available through OEMs and the normal retail channel, but pricing information has not yet been released, nor has confirmation of a mobile version.

The HiFD will start spinning in early 1998.

Cyrix's Next-Gen Socket 7 Solutions Unveiled; Adds DVD To MediaGX

Not to be outdone by Intel or AMD, Cyrix has also announced its processor plans. While its 100MHz, AGP-enabled 6x86MX CPU is expected by the end of 1998, Cyrix announced the development of its next-generation CPU based on its 6x86MX design. The new core processor technology is currently known as "Cayenne" and will incorporate a 64K L1 cache, enhanced MMX technology (MMXFP), and a .25-micron fab.

And answering all the criticism of weak floating-point processing power, Cyrix promises the new chip will feature a dual-issue, fully pipelined, floating-point processor with a strong enough FPU to keep even id Software's John Carmack quiet.

Cyrix also announced the MXi, a high-performance x86 CPU integrating a 2D/3D video and DVD processor in one tidy package. Combining all the attributes of Cayenne, MXi promises greater than 4x AGP bandwidth, while giving you all the 3D features you'd ever want, including bilinear/trilinear filtering, alpha-blending, gouraud shading, mip-mapping, and

17 >

Picking the Fastest **Hardware Pony**

SOFTWARE DEVS GAMBLE ON **NEW TECHNOLOGY**

Nothing is more frustrating than splurging on a handsome new piece of hardware—be it a 3D accelerator, DVD-ROM drive, or blazing fast processor—only to find no software actually takes advantage of it. Early adopters know this. *boot* knows this. But it's a risk we take—even if means waiting in desperation for that one piece of software that will validate our purchase.

But if you think we have it bad, imagine what software developers have to go through. Bombarded by bombastic pitchmen from companies both big and small, developers have the unenviable task of evaluating, estimating, and calculating the importance of every new technology, API, and embedded instruction set this side of the Mississippi. And you wonder why their games ship late.

So with that in mind, what hardware are game developers getting most hopped up about for 1998? And what's getting the biggest dis?

To no one's surprise, 3D acceleration is the most credible contender. According to Acclaim's Shawn Rosen, the producer of upcoming games *Forsaken* and *Shadowman*, "3D acceleration has taken gaming further than anyone could have imagined, and it's opening up some huge doors for the PC market."

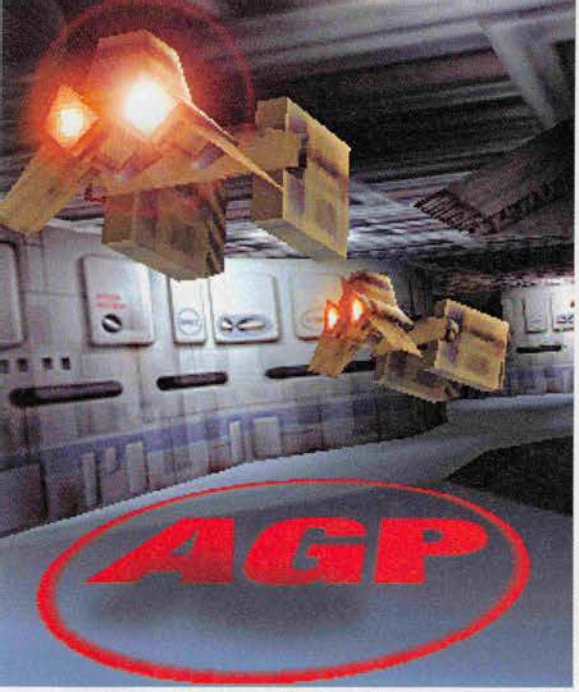
Said Dan Stanfill, Activision's Director of Technology: "During 1997, our titles were primarily designed for software rendering, although they scaled upward if 3D hardware was available. In 1998, that will reverse, so that our titles will be designed primarily for 3D hardware acceleration, but will still scale down for software-only systems."

AGP and the Pentium II's fast floating-point calculations are also getting votes of confidence from developers looking forward to utilizing main system memory to generate textures in software.

> "In **1998**, our titles will be designed **primarily** for **3D hardware acceleration,** but will still **scale down** for **software-only** systems."
>
> —*Dan Stanfill, Activision*

"AGP allows us to add much richer and more detailed texture maps to our games," said Dominic Mallinson, Psygnosis's Technical Director. "Plus, we'll exploit the Pentium II's increased processing power in combination with higher polygon rates to produce extra levels of detail in our 3D simulations."

"In *Terracide*, we're already using 6MB of textures *without* AGP," said Jonathon Newth, managing director of Simis (a wholly owned development studio of Eidos Interactive). "Once



it becomes more widely available, we plan on making good use of [AGP], especially for terrains." Both Simis and Activision have confirmed support for Voodoo 2, but only Activision plans native Glide drivers.

But what of Intel's other baby, MMX? Even with massive marketing muscle behind it, MMX was pretty much stillborn. It's been a year since its official launch date, and we're still hard-pressed to name more than a handful of games that actually make use of those extra instructions. To add insult to injury, most of the games touted as MMX "enhanced," "compatible," or "supported" are just plain crap. *Rebel Moon Rising* anyone?

However, with MMX-2 not slated for release until 1999, regular run-of-the-mill MMX is here to stay—at least for now. It's relatively easy to implement, and since it's supported by all new Intel, AMD, and Cyrix processors, MMX is a no-brainer for most developers, even if it only provides a minor performance increase. "The level of extra performance depends on the game," said Psygnosis's Mallinson, "but things like audio mixing, video playback, and 3D audio processing can be sped up significantly by giving more CPU time to the rest of the game code."

Not to be outdone, AMD is spending tons of cash to woo developers to its new K6+3D Socket 7 processor, which is slated for release in mid-1998. According to AMD's Atiq Raza (check out the Lip interview in this issue of *boot*, p. 34), the K6+3D contains extra 3D instructions powerful enough to replace your current 3D card (Raza promises *Quake* will run neck-and-neck with a 3Dfx card). Although we're taking a wait-and-see approach, AMD has, to its credit, convinced the folks at Digital Anvil—the company headed up by Mr. *Wing Commander* himself, Chris Roberts—to support the chip.

"AMD sought our advice for the development of its technology, which is an industry first," said Roberts. "Usually, the hardware industry establishes a technology and expects us to build around it."

Digital Anvil plans to incorporate AMD's 3D technology into all of its titles currently under development, but whether it's doing that because it believes in the chip, or because AMD made an equity investment in the company, remains to be seen.

And as for the dis, look no further than that DVD-ROM drive you probably *don't* have in your system. Thanks in part to a lack of defined specs, copyright issues, and competing standards in the rewritable arena, most game developers admit they're somewhat reserved when it comes to committing resources to DVD-ROM. Most companies, in fact, just plan to release rehashed versions of previous games, such as Activision's *Spycraft* and *Muppet Treasure Island.*

"Until the market matures a little more," said Activision's Stanfill, "don't expect to see the primary version of any games on DVD-ROM." Still, at least one company, Ubi Soft, is committed to the burgeoning platform, explaining that in its upcoming DVD game *Tonic Trouble* "the extra capacity permits a longer introduction and additional music tracks." Hoo boy.

But take heart—there really is one piece of hardware you'll need to survive the tech war. Or as Acclaim's Rosen says: "If you don't have an accelerator board, get one!"

> "**AMD** sought our **advice...** Usually, the hardware industry **establishes** a **technology** and **expects** us to build around it."
>
> —*Chris Roberts, Digital Anvil*

NUGGETS

> 16

Z-buffering. With a little help from National Semiconductor's Mediamatics, Cyrix also plans to incorporate DVD functionality into its next-gen MediaGX processor (which will also have an incorporated 6x86MX core). This DVDExpress technology will allow systems to integrate DVD playback either in a hybrid hardware/software solution or hardware only.

Incorporating DVDExpression technology will strengthen MediaGX's all-in-one CPU position, which currently incorporates a core-logic chipset, IEEE 1394 (Firewire), and more into the central processor unit. Cyrix also plans to add 3D to its next-generation 6x86MX processors. No word yet as to whether the 3D will trickle down to the MediaGX. Expect these bad boys in Q2 1998.

Merced Sneak Peek

At the Microprocessor Forum in San Jose, Intel gave the world a peek at Merced—its 64-bit CPU.

Intel promises it is on-track for 1999 production and divulged a few details regarding Merced's makeup and capability. The first member of Intel's new IA 64 architecture club will use a .18-micron process, possessing full IA-32 (current CISC programming) binary compatibility in hardware.

Merced's CPU process is neither CISC nor RISC. Instead, Intel has dubbed Merced's code-crunching process Explicitly Parallel Instruction Computing (EPIC), a process that attempts to clear bottlenecks caused by mispredicted branches in code, latency to memory, and most importantly, implicit parallelism of executed code. The compiler will exploit parallelisms in the source code and make it explicit down to machine-code level, faster-processing language. Curiously, Intel's announcements on IA-64 technology overshadowed Intel's forthcoming lines of IA-32 CPUs, mainly Deschutes, Katmai, and Willamette.

Suit Threatens To Delay 56Kbps Standard

Waiting patiently for that 56Kbps standard? Get comfortable, 'cause a new lawsuit threatens to postpone the standard indefinitely. Brent Townshend, an inventor from 3Com, has sued Rockwell Semiconductor for "trade secret misappropriation." In the suit, Townshend states that he developed a key factor found in Rockwell's K56flex spec, with patents pending in the U.S. Patent Office.

3Com, Rockwell's rival, recently signed a deal with Townshend stating that it could license his technology to other modem manufacturers. Rockwell and Lucent Technologies have said Townshend's claims are behind the International Telecommunication Union's failure to introduce a draft for the 56Kbps standard at its September meeting. Representatives of K56flex vendors stated that they weren't given enough time to look over the validity of Townshend's claims and that the suit should be dropped. Rockwell is also stating that Townshend's claims are without merit and, if the dispute continues, it would "vigorously defend" itself.

PURE LUST

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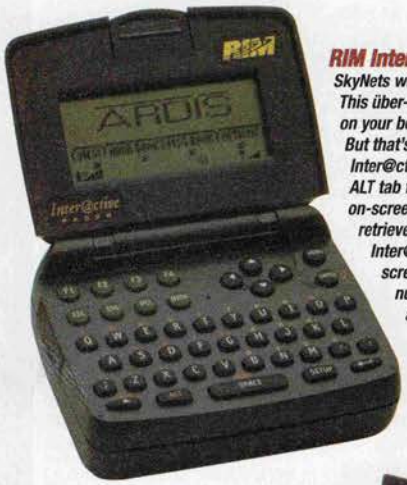
Final Fantasy VII *One of the most epic role-playing games of all time has finally made it to U.S. shores. Squaresoft's* Final Fantasy VII *breaks almost every PlayStation convention. Running about the gorgeously pre-rendered SGI landscapes will produce gasps of amazement. But it's only when you enter combat that* FFVII *takes you to task. Using its texture-mapped polygon engine,* FFVII*'s cinematic combat can best be described as awesome. The camera employs a plethora of angles to give combat a movie-like feel, complete with extreme close-ups, third-person views, and well-timed pauses. Spell-casting employs almost every visual trick the PlayStation offers. The sheer size of the world means you won't catch everything the first time around.* FFVII *will be available to PC owners with 3D acceleration sometime in 1998 . . . we hope. Sony/Squaresoft; 714.540.8822; www.square-soft.com*



RIM Inter@active Pager *Shame all your homies sporting SkyNets with the pager-to-end-all-pagers: RIM's Inter@ctive Pager. This über-pager is the size of a 30-foot tape measure and clips on your belt to receive phone numbers when you're on the road. But that's where the similarities end. Under the hood of the Inter@ctive is a full QWERTY keyboard, directional keys, an ALT tab for extended characters, and four F-keys for selecting on-screen menus. "But why do I need all these controls just to retrieve phone numbers?" the confused may ask. Because the Inter@ctive is more than a mere pager. The five-line LCD screen runs 34 characters wide and, in addition to alpha-numeric pages, receives and sends e-mail messages from a special Ardis account that covers nearly 11,000 U.S. cities. If you're out of range, the service holds your messages until a signal can be locked. With enough memory to store hundreds of messages, contact info, and stock replies, the $575 Inter@ctive also comes with a serial port and Windows app for downloading device configuration info. RIM; 519.888.7465; www.rim.net*

FlipCase *Ever since the FlipCase cameo'd in* boot *14 alongside TRG's 3MB SuperPilot upgrade in Pure Lust, everyone's been asking about this PalmPilot protector. And rightfully so. The wallet-grade leather case is our favorite. Just flip the protective cover up reporter's-notebook style and you're PDAing. A stiff cover protects your screen and prevents accidental power ups that drain precious battery life. Felt padding keeps the screen from getting scratched, and a stitched slot keeps an assortment of business cards handy. The FlipCase attaches to your PalmPilot via included velcro tabs and can be removed if needed. But you probably will never need to. Battery changes and memory upgrades can be performed without removing the case. Even hot syncs are possible with the case on! This must-have accessory for the PalmPilot sells for only $22.95, and a few dollars more buys you a belt-clip version. Synergy Solutions; 800.210.5293; www.synsolutions.com*

Ricochet Mobile Modem *In the tradition of smaller and faster, Metricom has announced two new models of its famous Ricochet wireless modems. The SE (pictured) is a chubby little box about half the size of its predecessor, with a battery life of 8 to 12 hours. An LCD display keeps you informed of connection quality and battery life remaining, so you can stay wired without fear of losing your connection. The thinner, lighter SX model is perfect for PDAs. Even cooler than the new, fully compatible, smaller mobile modems is the fact that Metricom plans on upping its infrastructure from the current 14.4Kbps to a screaming 128Kbps (depending on where you're logging in from) in Q1/99. Get all this mobile mania for only $350 (for the SE model pictured) to $380 (for the SX) plus a $30-a-month service fee. Metricom; 800.469.4737; www.ricochet.net*

Dayna Ethernet Hub Plus with 10/100 Bridge *Face it. Networks are primarily used for storing and retrieving dry data. They're convenient that way, yet if you're transferring at only 10Mbps, they're dog slow. Upgrading to Fast Ethernet (100Mb) will increase your bandwidth tenfold. And just imagine the time saved on large copies. Even though 10/100 network cards are cheap, you can't expect to upgrade everyone at once. Dayna makes it easy with its eight-port Fast Ethernet Hub Plus, which includes an additional auto-sensing 10/100Mbps port. This port lets you link your Fast Ethernet workgroup to any 10Mbps or 100Mbps hub or device. An additional port labeled "Out to Hub" makes it easy to include connections of stacked multiple hubs with a standard twisted-pair cable. If you run a small network or workgroup for CAD/CAM applications, heavy database management, imaging, or just transferring lots of large files, you should seriously consider Fast Ethernet and Dayna's Fast Ethernet Hub Plus. Oh yeah, and it's only $809. Dayna Communications; 801.269.7200; www.dayna.com*

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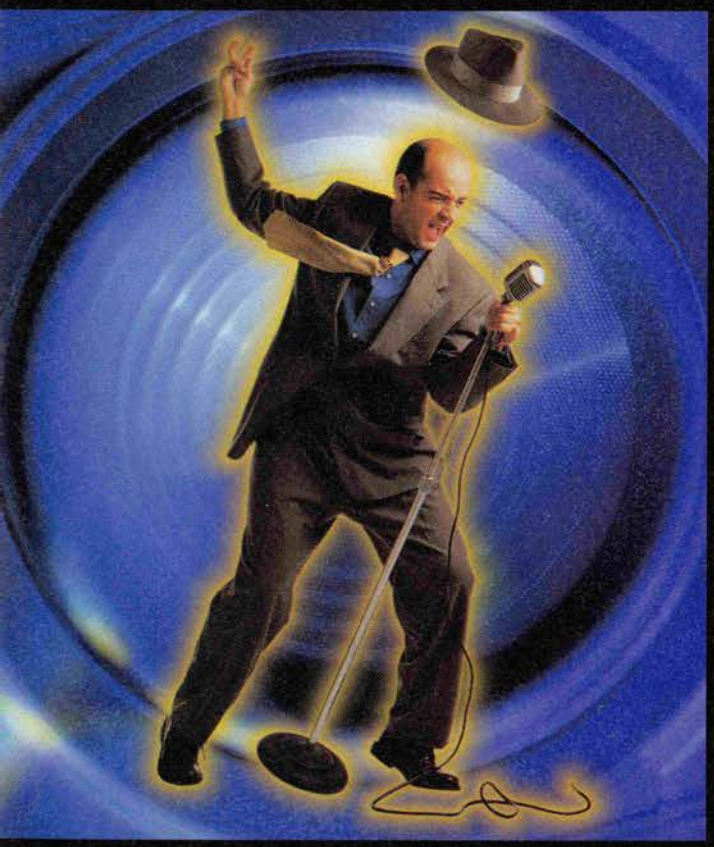

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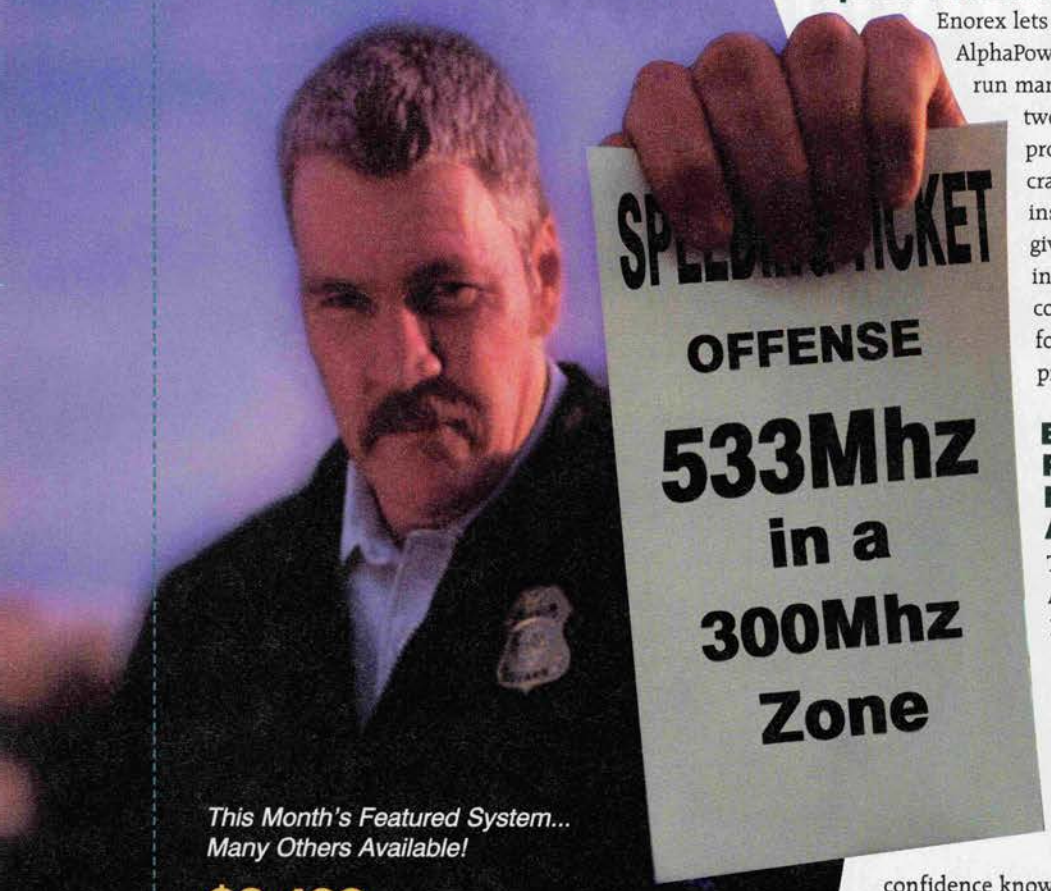

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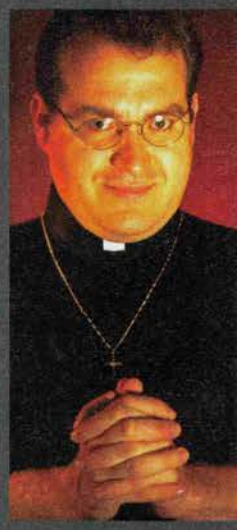

ALEX ST. JOHN From his position as Microsoft's game technology evangelist, Alex St. John was responsible for the controversial DirectX APIs that have either taken PC gaming to the next level or were horribly broken, depending on your point of view.

Readers often ask how I would build an operating system. It's an alluring fantasy for me. In the course of designing DirectX, we often joked about creating DirectOS—DOS for short.

The monolithic mass of code banged out by thousands of Microsoft monkeys over many years has created layer upon sedimentary layer of abstraction. Thousands of applications, all dependent on continuous backward compatibility at every level, freeze the whole mess in a state of perpetual stagnation. Oh, for the opportunity to give it all one good enema and start again fresh!

There can be no doubt that all the layers of OS detritus have significantly taxed Win95's performance, ease of use, stability, and functionality.

Anyone familiar with the PC takes the hierarchical file system for granted, but consider just how dangerous this paradigm is. Pull the plug on your PC and you can corrupt your hard drive.

Furthermore, your file system accumulates data debris like cholesterol in an artery. Applications permanently install crap all over your computer, and once they're done, you have no way of knowing what was shoved where, and whether it was important.

In fact, the OS itself accumulates crap. Stuff is added to your AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, and registry by countless applications and never goes away, even when no longer needed. Drivers gather in system directories. Temp files and caches pile up, and never have the courtesy to remove themselves completely. Sure, Windows "supports" many functions necessary to manage these resources, but it cannot enforce clean behavior, nor can it completely isolate older, less well-behaved applications. Doesn't NT deal with that? Sure by abstracting and isolating everything at the cost of a massive performance hit.

Hey, I think preemptive multitasking is as neat as the next OS junkie does, but ask yourself this: How often are you really running three or more apps concurrently and being productive? You're usually just leaving some open and doing nothing because they take so damn long to load.

But the cost of general-purpose preemptive multitasking is extraordinary. The world in which dozens of drivers, applets, and applications are set loose to vie for I/O, screen access, CPU, and memory resources, is the world in which a great big OS needs to tax a substantial portion of everything to prevent all hell from breaking loose. You need "bureaucracy APIs" to manage this chaos of applications trying to share resources and communicate with one another, all while allowing dynamic asynchronous driver, code module, and application upgrades, and maintaining backward compatibility. This thinking gets you technologies such as OLE and COM, which have about the same rationale for existing as the IRS.

Some 80% to 90% of the code in DirectX is devoted solely to pushing Windows out of the way so applications get direct access to the hardware. Much of DirectX's complexity—and D3D's performance loss—is dealing with preemptive multitasking, the Win16 lock, and coexisting with competing drivers.

Consider this: Your hard drive is typically 100 times slower than your RAM, yet Windows makes no distinction between the two. But to maintain any sort of frame rate, a game needs to know the memory it's working from is actually RAM. Windows 95/NT/98 will happily page out chunks of your game to the hard disk as it runs—without your game's knowledge. Because your game never knows when the OS will take away its RAM, it copes in one of three ways: requiring 4MB to 8MB more RAM than really needed; tricking the OS into not taking its RAM by spending CPU cycles touching critical pieces of memory periodically; or simply shuddering to a halt in the middle of a game, hoping you understand.

The same battle taking place for your hard drive, CD-ROM, RAM, and screen also occurs at the driver level for control of your I/O devices. Windows network drivers periodically kick in and stall the task scheduler, locking out all other applications for hundreds of milliseconds. And network and modem activity that theoretically should have very little impact on CPU consumption actually slows games down up to 20%.

And why does it take so long to boot? Is my 266MHz P-II calculating fluid dynamics in the background while I'm looking at that damn Windows logo? And why can't I just hit the power switch when I'm done?

Why do I have to fear that installing anything new on my computer will disrupt the delicate ecosystem of stability I spent weeks establishing?

Rocketing along at 200MHz, the system is held together by thumb tacks and scotch tape, losing tiles in the atmosphere as it heats up, until one tiny bit gets out of sync and the whole mess tears itself apart at incredible velocity and we're left to pick up the pieces. Is a 20% to 80% OS tax on all your computer's resources and never-ending stability headaches really the best solution?

Next month I'll balance the demands of general-purpose robustness, common sense, and idiot-proofing to arrive at an OS that eliminates the worst in PC computing while preserving and enhancing what I think is the best.

Rocketing along at **200MHz**, the **system** is held together by thumb **tacks** and **scotch** tape, until the whole **mess** tears itself **apart** at incredible **velocity** and we're **left** to pick up the **pieces**.

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A **Day** in My **Life**

GAMES ARE MY **LIFE**... FOR BETTER OR **WORSE**

The alarm buzzed in my ear like an angry bee. I shot it to pieces with a rail gun and jumped out of bed, slipping into my Plutonium armor and deciding whether to go with the Helm of Flight or the standard armored beret. I opted for the beret, figuring I'd pick up some jumping boots or a jet pack along the way.

Down in the kitchen, Lara sat silently at the table, inscrutable behind mirrored shades. Her muscles rippled as I entered the room, her fingers wrapping a little tighter around the automatic at her waist.

"Morning," I said as I downed some Moon Pies. (Raw! The way they taught me to in the Star Rangers!) I instantly felt more powerful.

She just sneered. I had never actually heard her speak, but then again, I didn't marry her for the scintillating conversation, if you know what I mean... and I think you do. Still, I wish her breasts moved once in a while. But what bothered me even more was the way she disappeared into any object she got too close to.

Fluffy entered the room, and Lara's gun was out of its holster. The cat was a puff of fur and flesh before it even had a chance to sniff its Tender Vittels.

With that she rocketed out of her seat, back-flipped across the room, leapt out the door, and disappeared. I never could figure that woman, so I decided to visit Girlfriend Terry. She was sitting on the couch, where she spent her days. At least she talked to me, though what she said was always pretty much the same.

"You sure know how to talk to a girl!"

"Mmm, I'm hot!"

"I won't remove my top unless you can come up with a better line than that!"

Titter titter.

Things like this make me relish my work all the more. I left Terry and made my way to the car. There was an old lady with a walker at the end of my driveway, as there was every day. What luck! A hundred points! I slammed the car into gear and backed over her at 60 mph. (A hundred extra points for style! Yowza!) I love the surprised look they get just before splatting against the windshield.

On the way to work, I nailed as many pedestrians as possible and rammed a cop car off the bridge. It was hard going, and the sonuvabitch dented my vehicle, but a few taps of that dashboard button had things right as rain.

At work I descended to the catacombs. The saber I'd ordered from Lightside Inc. wasn't in my mail slot, so I picked up a medieval halberd and chaingun and girded my loins for the day ahead. As usual, a barking two-headed hound of hell greeted me at the foot of the steps. I wasted him like I wasted the others, but they keep coming back every day. I have to do something about that.

As I went through the various rooms, I started feeling a little under the weather, since some ninja had ripped my still-beating heart from my chest, a stone golem had bitten my leg off, and my torso was shredded by hundreds of tiny nails. But I walked over to one of the little health packs and felt just swell again.

When I got to the locked door, I reached in my handy backpack and tried all the keys I had collected. No dice. I tried some mayonnaise I had found, a toenail clipper, an oriental rug, a terrier, a fire hydrant, and a '72 Dodge Dart, but the lock wouldn't budge. I slapped my head as the obvious occurred to me: I had to combine the pencil, the glow-in-the-dark plastic dashboard Jesus, some anchovies, and the blood of a virgin to get this particular lock open. I'm such a silly nit sometimes.

As always, there was a little antechamber on the other side of the door, and I had to struggle to remember the combination to open it. Now, let's see: you slide this tile down, this one up, this one over, then, no... wait. It's supposed to be a picture of a puppy, not a sausage. There! (I was glad the bosses had removed those damned chess problems. I never did solve them, and I got tired of having to go down to the basement over and over just to figure out the damned answer.)

Past this door was the part of the day I hate most: wandering around an endlessly twisting corridor. I felt like the boss had put this in just to waste my time, then he took away my map, making it even worse.

Finally, I made my way to the strip joint taking up one corner of the building. I sat for a drink, but a girl came down and started waving her goodies in my face. I had to blast her to pieces to make her stop. I hate when they do that.

By the time I'd finished off all the strippers, I was alone in the bar with nothing but the blood of my victims to keep me warm. I decided just to make myself invincible and get this sorry day over with as fast as possible. I bent to the bloody task of ridding the world of evil vermin and attractive women. Guts flew everywhere, the gore ankle deep as I waded through floor after floor, picking up new and better weapons that someone keeps dropping all over the place.

Finally, there it was, the thing I quested for, the thing to which all my power and all my thoughts were directed. Empires rise and fall to protect it, men give their souls to seek it.

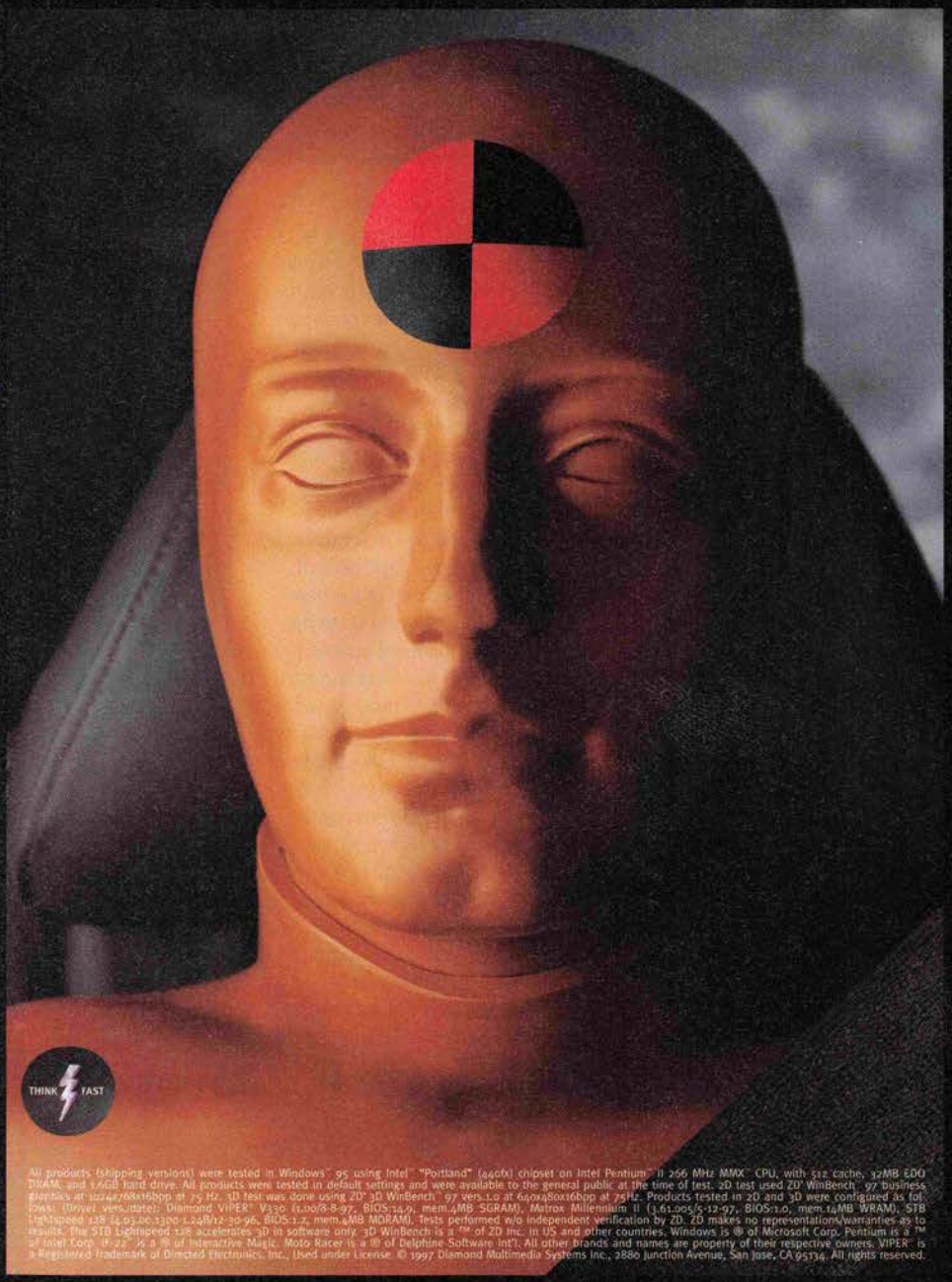
The Button.

Shiny, red, waiting to be pushed. I walked up, reached out to it, and—

DOS/4GW PROFESSIONAL ERROR (2001): exception OEb

T. LIAM MCDONALD is the all-knowing god of gaming. His mother still can't believe that he plays games for a living.

As usual, a barking **two-headed** hound of hell greeted me at the foot of the steps. I **wasted** him like I wasted the others, but they **keep** coming back every day. I have to do **something** about that.



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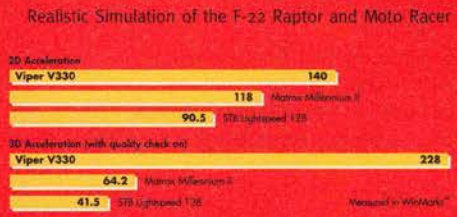

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Consolidation is King

ENGINEERS WILL BECOME **BLADERUNNERS** IN A BARROOM BRAWL WITH **MICKEY MOUSE**

Internet business is young business. We've already seen thousands of companies rise and fall, and we should expect thousands more to do the same—that is, until the Big Shake Out. Pay no attention to the little tremors that rumbled when Microsoft bought Vermeer (makers of *Front Page*) or when MetaTools bought Fractal Designs. These acquisitions register a mere 3.0 on the Richter Scale of Internet tectonic plate movement. And while Wall Street took a little more notice of the Microsoft-NBC collaboration, these iz still just small potatoes, relatively speaking.

Look at the life cycle of other media—telephone, radio, television, and print. A few companies make hardware (phones, radios, TVs, VCRs, and printing presses). A few companies make software (long distance services, remote controls, and paper). The rest is content, and *that* money is huge.

Today, the little fish has no chance of breaking into the cellular phone market and manufacturing those microwave machine guns we plug into our heads everyday. But that same fish could make a killing with a 900-number psychic chat line—proof that opportunity is on the content side of the equation. And I'd be willing to bet that competing with Disney for airtime is more feasible than competing with Kodak for film manufacturing and processing.

Consumers buy ideas and couldn't care less about how they're made.

This may seem foreign to *boot* readers, because they typically have inquiring minds that like to dream up ways to disassemble the phones in dodgy hotel rooms. You probably install your own RAM upgrades, jury rig more powerful fans for your overclocked CPU, and write chron jobs to beep when it's time to eat. I know, and I understand. But when it comes down to it, our voracious, consuming, cultural majority doesn't give a shit about the difference between *Internet Explorer* or *Netscape*, Microsoft or Sun, Java or whatever.

Last year, everyone and his brother, and aunt, and uncle too, sunk time and cash into Internet software ventures. Now? Now they all work for Microsoft, Netscape, IBM, or some gaming company. They make more money, *and* they have health insurance.

You might be assuming that I'm the type to bellow, "Hail Microsoft!" and advocate giving them the OS and most of the desktop software standards. After all, it will make them universal and cheap. And guess what? I *do* say that.

I really don't care who makes it. I just want it.

There's no room to confuse the masses with competing standards and voluminous manuals when we're desperately trying to make information accessible. Isn't that what the Internet is supposed to be—democratized information?

While we whine about just whose pocketbook's getting fat off the cash from all these goodies, millions of people are plain frustrated at scrambling to learn Mac, no, now it's Windows... *Quark*, no it's *PageMaker*... *Quake*, no *Mace*. And not just for specialized niche tasks, but for general use.

It's absurd.

And because it's absurd, the market won't stand for it. IBM won't stand for it. Hewlett-Packard won't stand for it. And the loudest voice in the choir, Microsoft, certainly won't stand for it as it champions the flag of ubiquity.

Recent developments clearly illustrate the end is near for all those desperate to finance a piece of the Internet pie.

Since the justice department finally put the squeeze on Microsoft (at a cost of a million dollars a day) to stop forcing vendors to include *Internet Explorer* on all their Windows-based systems, Microsoft must now pick a focus. Its days of OS-monopoly-turned-Internet-superstar-cum-content-provider are waning. But whichever arena the Redmond giant chooses to turn its ominous gaze upon, it *will* dominate. Most likely, Bill will cleverly disguise *Internet Explorer* as the operating system through a scheme of ActiveX controls and continue to be the software giant, but nothing more. All this content stuff is just a diversion to keep us from the true strategy. And there'll be little room for other software companies unless they have an established, highly focused agenda in a specialized field such as desktop publishing, sound editing, or gaming.

And Gateway's outrageously aggressive plan to ship 300MHz Pentium II boxes for $2,000 (monitor included) leaves little room for the smaller hardware companies to compete. They'll all evaporate, and soon we'll be picking from a few dozen manufacturers instead of the hundreds we currently enjoy—the same way Nikon, Canon, and Olympus are the only viable choices for an SLR these days.

What does this mean for today's web designers and engineers? Those in the design trade will continue to design and perhaps grow rich and powerful, and maybe come head-to-head as BladeRunners in a barroom brawl with Mickey Mouse.

Because, after all, content is king, and it's where the big bucks will eventually be.

Engineers will continue to work hard for the next five years on this Internet stuff, building software and slowly coming to terms with standards. Then comes the exciting part. We get to invent something new—cycle repeat. b

There's no room to **confuse** the **masses** with competing **standards** and voluminous **manuals** when we are desperately **trying** to make information **accessible**.

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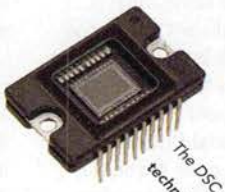

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Goodbye x86 Compatibility

FEAR, **UNCERTAINTY**, AND **DOUBT** AT THE **MICROPROCESSOR** FORUM

TOM HALFHILL is a senior editor at *Byte* magazine and the author of two computing books. He first became interested in computers during the disco era.

Not even *The X-Files* could contrive a plot this weird. In 1998, strange things will happen in the PC industry. And like a typical *X-Files* episode, the ending will be an unsettled cliffhanger that leaves a few loose ends until next season.

Just take a look at what happened in mid-October at the Microprocessor Forum, the annual Silicon Valley gabfest for chipheads:

Intel and Hewlett-Packard disclosed the first technical details of their new IA-64 microprocessor architecture. IA-64 is the 64-bit standard that will be implemented for the first time in Merced, which Intel now says will debut in the second half of 1999. At the MP Forum, Intel and HP outlined a highly advanced CPU that will carry parallel execution to new heights and have an enormous impact on future software.

Not to be outdone, Intel's x86-compatible rivals struck back with their own dramatic announcements. AMD divulged that its future K7 processor—also scheduled for release in 1999—will adopt the same I/O bus interface as Digital's Alpha 21264, one of the world's fastest RISC chips. Even more strange, the K7 will come in a cartridge virtually identical to Intel's Pentium II SEC cartridge and will fit into a slot virtually identical to Intel's proprietary Slot 1. But the similarity stops at *physical* compatibility: The K7 won't be *electrically* compatible with Slot 1.

AMD also revealed that it's adding a bunch of new instructions to its K6-series processors in 1998. The new instructions will greatly improve the K6's ability to crunch single-precision floating-point numbers. Why should you care? Because it'll give a real kick to 3D graphics. This is the same thing Intel is planning to do with MMX2 in a future Pentium II–series processor (Katmai), except AMD is doing it first.

Cyrix has something to say about it, too. The number-three x86 vendor plans to add some very similar instructions to its 6x86MX-series processors in the second half of 1998. A new CPU, code-named Cayenne, will have more than a dozen new instructions and will boost overall floating-point and MMX performance as well. Again, the main target is 3D graphics and multimedia. In 1999, a seventh-generation x86 chip, code-named Jalapeno, will add even more enhancements. Unfortunately, the new instructions in Cyrix's chips won't be compatible with the ones in AMD's chips. And *neither* will be compatible with Intel's MMX2. Trouble on the horizon....

Wait! It doesn't stop there. Centaur Technology, the newest vendor of x86-compatible processors, is also jumping into the fray. Like AMD and Cyrix, Centaur is rolling out a bunch of fast new instructions for single-precision floating-point math. *Quelle coincidence?* No, it's all because the PC game market is taking off like a rocket. Everybody wants faster 3D graphics, no matter what. Centaur's beefed-up instructions will appear in a new version of its IDT-C6 WinChip sometime in the first half of 1998. And need we mention that Centaur's extensions won't be compatible with those from AMD or Cyrix, nor with Intel's MMX2? What a bleeping mess.

Not enough for ya? There's more! All of Intel's rivals are scrambling for ways to keep their Socket 7 processors competitive with Intel's Slot 1 and future Slot 2 chips. In addition to the new 3D graphics instructions, they're pumping up clock speeds, adding pipelined FPUs, strengthening MMX performance, and in some cases integrating L2 caches right on their chips. Both AMD and Centaur plan to build a 256K L2 cache into their CPUs in 1998. That will eliminate the need for an external L2 cache and will lay down a wicked-fast bus interface between the cache and the CPU core. Never before have x86 processors integrated so much cache on chip.

Whew! There were so many x86-related thrills at this year's MP Forum that almost everything else got lost in the shuffle. We hardly noticed Sun's superspeed UltraSPARC III (600 MHz!), IBM's remarkable Power3 (eight parallel execution units!), and HP's record-setting PA-8500 (1.5MB of on-chip cache!). But those are low-volume RISC chips for high-end workstations and servers.

In 1998, the industry is focusing on x86-compatible PCs. Especially because the PC standard that has made so many companies so wealthy appears to be cracking at the foundations.

Consider the impact of the new 3D graphics extensions. Sure, we'd all like to have faster graphics. But at what cost? The fundamental PC compatibility that makes it possible to run virtually any DOS or Windows program on any PC clone is suddenly at risk.

Why? Because adding new instructions to a microprocessor is no small matter.

Each company says it has already **invested** too much **engineering effort** to **change** course at this point. When their **new** chips hit the market, there will be three **incompatible** sets of **3D** extensions.

CPUs are defined by their architecture, which includes the set of instructions they can execute, the internal registers they make visible to programmers, and the configuration of the I/O buses they use to communicate with other devices on the motherboard. If any one of those things significantly changes, it's not quite the same architecture anymore. Compatibility is threatened, and software starts to break.

That's why CPU architectures are usually tightly controlled by the company that first invented the architecture. In the case of the x86, that's Intel.

But not everyone is happy with Intel's control of the x86. Lately, software has been evolving so fast that the x86 is struggling to keep up. Remember that it's the most ancient CPU architecture in wide use today. The first chip in the series was the 8086, which Intel introduced in 1978, the year disco was king and Jimmy Carter was president. The x86 remained a 16-bit architecture until 1985, when Intel released the 32-bit 386. More than 12 years later, we're still feeling the aftershocks of that earthquake, with millions of PC users split between 16-bit Windows 3.1, 16/32-bit Windows 95, and 32-bit Windows NT, OS/2, and Unix. Twelve years!

MMX was the next major overhaul. Intel's goal was to bring the instruction set up-to-date with the demands of modern software. Multimedia didn't exist in the 1970s (except in aforementioned discos), so the x86 obviously wasn't designed to run it. This time, Intel was a little more conservative. Although MMX adds 57 new instructions and eight new registers to the x86, Intel took pains to make the transition smoother—but it had to compromise.

Intel admits that the best **x86** chips available in **1999** will run x86 software **faster** than **Merced** will.

One compromise is that MMX does absolutely nothing to speed up the basic math of 3D graphics: geometry transformation. This is the serious number crunching that happens every time a 3D object moves on your screen. It takes an enormous amount of arithmetic to recalculate the vertices of the polygons all 3D objects are made of. The coordinates of those vertices are single-precision (32-bit) floating-point values. MMX is worthless for the job because it can't handle floating point.

The special coprocessors on 3D graphics boards aren't much help, either. They're primarily designed to accelerate the later phases of 3D graphics, such as texture mapping, mip mapping, and bilinear/trilinear filtering. That's why Intel is planning to introduce MMX2 in Katmai, a chip that will probably appear in late 1998 or early 1999.

AMD, Cyrix, and Centaur don't want to wait. They see an opportunity to get the jump on Intel. Ideally, their new instructions would be compatible with MMX2. But Intel isn't sharing enough information to make that possible. So Intel's rivals are inventing their own rules.

Even if their new instructions can't be fully compatible with MMX2, the next best thing would be for AMD, Cyrix, and Centaur to join together so their instructions are at least compatible with each others'. But that's not happening either. Although AMD is now offering to share its AMD-3D extensions with anybody who wants them, it's way too late. Each company says it has already invested too much engineering effort to change course at this point. When their new chips hit the market, there will be three incompatible sets of 3D extensions.

That will rise to *four* when Intel releases Katmai and MMX2. And then it'll really get weird. To remain fully compatible with the x86 standard, Intel's competitors will almost certainly have to support MMX2. They'll have to add Intel's new instructions to their own. If any of the opcodes overlap—opcodes are the binary numbers that represent CPU instructions—AMD, Cyrix, and Centaur will probably have to change their opcodes, which could break any programs that use the old opcodes.

Yep, it's a first-class mess. It'll hit software developers the hardest. They have to write the code, and they are the poor souls who will probably get the angry phone calls and flame mail when users install a new game and watch it blow up like the Hindenburg.

Only one thing could hold all these fragments together: The 3D API sitting between the 3D hardware and the 3D software. By writing to the API, developers don't have to fool around with hardware-specific instructions and registers. Microsoft's Direct3D is an example of a 3D API; another is OpenGL.

Fortunately, Microsoft is supporting the new extensions from AMD, Cyrix, and Centaur in D3D. (Actually, the chip companies are writing most of the code for Microsoft.) If a program uses D3D with the proper 3D graphics driver, it should take advantage of the new instructions and run on anybody's chip without a hitch. But D3D isn't the only game in town. Several 3D APIs are in common use, and somebody will have to write drivers for all of them, or else your software won't even know the new instructions exist.

All this drama pales in comparison to the future transition to IA-64. Intel and HP didn't spill their guts about *everything* at the MP Forum, but their initial disclosures give a pretty good idea of what the next-generation CPU architecture will look like. And guess what: It'll look almost nothing like the x86.

IA-64 is a futuristic architecture that anticipates an age when CPUs will have hundreds of millions of transistors, instead of the few million they have today. It's an architecture designed for the 21st century, not the 1970s. When the 386 came out, it stretched the 16-bit architecture to 32 bits without changing the basics; IA-64, by contrast, starts with a virtually blank slate.

Sure, Intel promises that IA-64 will run existing x86 software. But Intel also cautions that you'll pay a performance penalty—native IA-64 software will run much faster. In fact, Intel admits that the best x86 chips available in 1999 will run x86 software *faster* than Merced will. The reason is that IA-64 radically changes the instruction format and the way the CPU processes those instructions. Backward compatibility is a priority, but not the top priority. IA-64 chips will be able to execute more native code in parallel because special compilers will arrange the instructions in the most efficient order before the CPU even sees them.

Don't lose too much sleep over IA-64, though. Intel is emphatic that IA-64 won't replace x86 for quite some time. Intel will continue to introduce new chips for both architectures for years to come. Indeed, Intel says Merced won't be a factor in the mainstream PC market because it'll be way too expensive for anything but high-end workstations and servers. We probably won't see affordable IA-64 chips for mainstream PCs until 2000 or 2001. By then, all the battles over 3D graphics extensions should be settled, and we'll be ready for the next episode.

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Product Information Number 306

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After holding its own in the third spot for years, ***AMD*** *surged ahead in the race for top CPU by stealing Cyrix's coveted second ranking with the* ***K6*** *"Pentium-killer." Now AMD has its eyes set on the leader of the pack and looks to school Intel with a secret weapon—the* ***K6+3D****. By integrating hard-coded 3D instructions into the processor itself and cranking the silicon up to* ***300MHz****, AMD looks to move into the enormous installed base of Socket 7 motherboards that* ***Intel*** *abandoned when it moved to Slot 1.*

*Leading this not-so-covert operation is Raza—****Atiq Raza****—AMD's Chief Technology Officer.*

the boot interview

boot ***How can you defend AMD's campaign touting the slower K6 as a "Pentium II killer"?***

Raza I don't think it's appropriate to call the K6 a Pentium II killer; but it is a very competitive alternative for mainstream machines. That's demonstrated by the fact that today we have more demand than we can satisfy.

boot ***Is AMD consigned to be the supplier of processors for low-end systems? When will top-tier manufacturers look to AMD for their top-of-the-line systems?***

Raza Well, in today's market it's hard to define just what "low-end" is, because you have a range of products with fairly compelling performance from top to bottom, available at a range of prices. You have high-performance PCs selling at $1,700; you have *very* high-performance PCs selling at $2,500. Is the $1,700 PC a low-end PC? By no means. A K6 PC with a 3Dfx card, 64MB of memory, 4MB of frame buffer, and a 6GB hard drive is *not* a low-end part. People are using the AMD microprocessor to give themselves more room for other system additions. Many of the systems using K6 actually have better sell-through than even the Intel Pentium- and Pentium II–based PCs, which is unbelievable.

But the fact of the matter is that larger companies like IBM decided to go with AMD because they got pressure from their retailers to have such systems on their shelves.

boot ***Retailers are asking for AMD systems?***

Raza Absolutely. The consumers buy them. There are two kinds of consumers coming in. One already has a PC, and the second is buying a PC for the first time. Every year, the consumer buying a PC for the first time is more financially constrained than last year's buyer. Why? Because if you could afford it last year, you bought it last year.

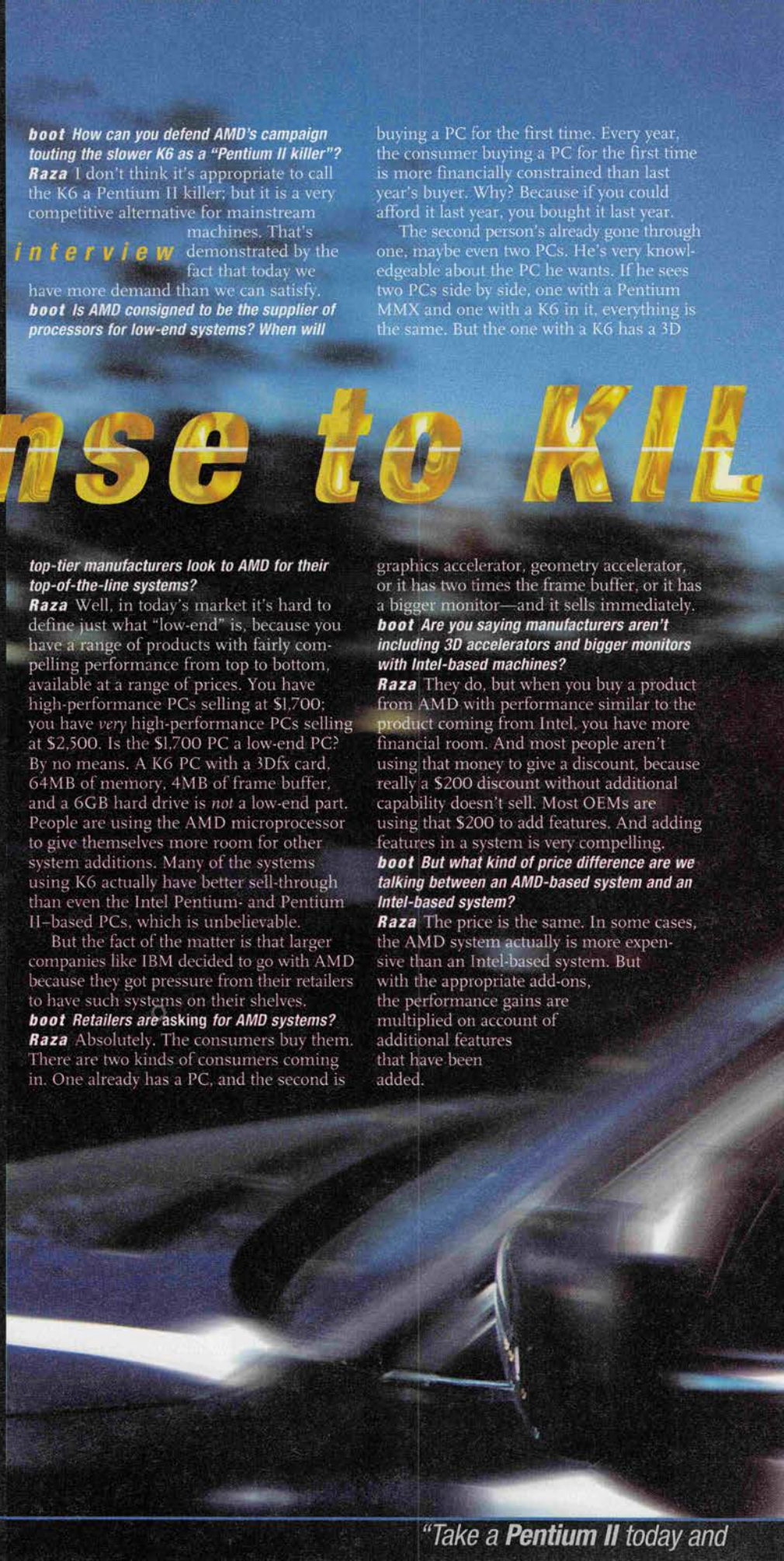
The second person's already gone through one, maybe even two PCs. He's very knowledgeable about the PC he wants. If he sees two PCs side by side, one with a Pentium MMX and one with a K6 in it, everything is the same. But the one with a K6 has a 3D graphics accelerator, geometry accelerator, or it has two times the frame buffer, or it has a bigger monitor—and it sells immediately.

boot ***Are you saying manufacturers aren't including 3D accelerators and bigger monitors with Intel-based machines?***

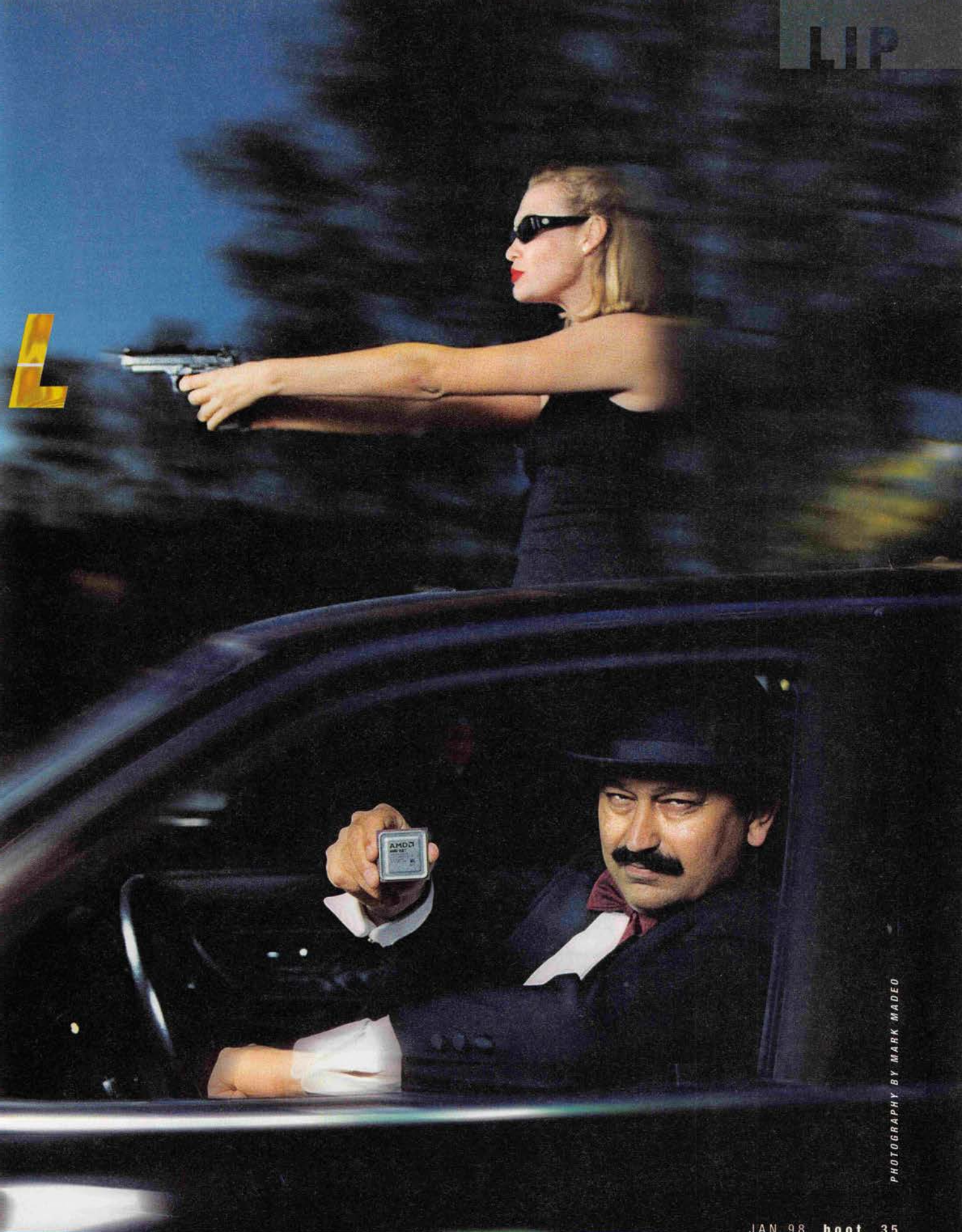
Raza They do, but when you buy a product from AMD with performance similar to the product coming from Intel, you have more financial room. And most people aren't using that money to give a discount, because really a $200 discount without additional capability doesn't sell. Most OEMs are using that $200 to add features. And adding features in a system is very compelling.

boot ***But what kind of price difference are we talking between an AMD-based system and an Intel-based system?***

Raza The price is the same. In some cases, the AMD system actually is more expensive than an Intel-based system. But with the appropriate add-ons, the performance gains are multiplied on account of additional features that have been added.



"Take a ***Pentium II*** *today and*



PHOTOGRAPHY BY MARK MADEO

*compare it with a **K6+3D**, you will see performance improve as much as **six times** with the **AMD** part."*

boot ***What about the "Intel Inside" campaign and Intel's new Pentium II commercials? How does that affect AMD's mindshare?***

Raza It's affected mindshare more in the commercial market than with consumers, contrary to what we initially expected. We've found that the consumers I just described are very value conscious and very knowledgeable, and the others are fundamentally not very well off. That causes people to buy the most compelling solution, even though they came because they saw an Intel ad. It's like, you see a Sony ad, but once you arrive you find an RCA television that's $300 cheaper and you can't tell the difference in the performance.

boot ***Do you think many consumers come into a store looking for an AMD machine?***

Raza No, they don't. They come in looking for the best PC they can get.

boot ***You're saying consumers really don't care if it's Intel inside? They don't care who makes the processor?***

Raza That's correct. Particularly because retail's now so dominant. The decision is on the spot. It's capricious. And because graphics are the most visible and the most impactful manifestation of performance, we are taking our product line and putting accelerated graphics inside the processor.

boot ***What do the K6+ and the K6+3D's added instructions do?***

Raza The instructions enable very wide multiplication. And it can occur either as a very wide instruction or as combinations of less wide instructions. Sometimes four of them at the same time, depending on whether they're 16-bit wide. Or two at the same time if they're 32-bit wide operations.

It's an extension of single instruction/multiple data, which is required to deal with things like picture composition from its elemental triangular building blocks, the creation of lighting effects, the creation of 3D effects and textures in a picture.

But quite frequently the composition of the picture is concurrent and interlaced with the physics effect. Because if it is any kind of reality simulation, there is physics behind it that allows that reality to be simulated. That physics runs in the processor. If the geometry was running outside the microprocessor, it'd have the overhead of leaving the processor and coming back in the processor as the physics and the creation of the picture were being simultaneously done.

At the same time, there's a video effect. The changing of that picture constantly, that video effect could be running in MMX. In today's approach, there's a lot of overhead in doing it, and in our approach that is eliminated.

boot ***And this is built into the processor. Does that mean people won't need a 3D accelerator?***

Raza Well, there are several kinds of 3D accelerators. Some accelerate geometry. Some accelerate rendering or set up. We still need the rendering and the set-up function because that is the process of the virtual dots in the frame buffer. That process is most appropriate as close to the frame buffer as possible, and that's where the accelerators are going to excel.

boot ***What kind of 3D performance can we really expect from the K6+3D?***

Raza Take a Pentium II today—which is a

Is overclocking a good or bad thing?

Raza Overclocking is bad. The CPU is designed to run reliably at a particular temperature. That ensures a customer's device will work. It drives me nuts when I read on the web that people are overclocking at 1, sometimes 2 bins. That shows how much margin we have in our products. K6 is one of the most over-binned of all processors. Oh, that drives me crazy!

*"We're trying to **fight** above our weight by leveraging **strategic** alliances to take advantage of the best*

What do you think of Intel's purchase of Digital's Alpha technology?

Raza It's a clear indication that Digital's claims actually had validity. A lot of people used to say was ridiculous and stupid. I'd love to be that stupid and get $1.5 billion for what Digital did!

I think Intel has to play their hand very carefully while the Federal Trade Commission is watching their unfair trade practices. Alpha is the only 64-bit competitor in the NT market to Merced. So Intel has to at least come across as not taking Alpha out. So they have to accomplish that in one form or another.

pretty damn good system—and compare it with a K6+3D, you will see performance improvement between 50% and as much as four to six times with the AMD part..

boot Six times? Strictly processor level?

Raza Strictly the processor level.

boot What about frame rates in Quake? What exactly will a stock K6+3D spit out?

Raza I do not have an exact number. My expectation is that it would perform as well as 3Dfx, potentially better.

boot So you expect the K6+3D to do 50fps?

Raza Or better.

boot Alright, we'll hold you to that. So can we expect games coming out in 1998 to support the K6+3D directly?

Raza Yes. We are being rather aggressive about making sure their graphics algorithms used in Immediate Mode are optimized.

boot Are you paying developers to support K6+3D?

Raza We have a variety of arrangements that I'd rather not go into. In some cases, it's financial; in other cases, it's marketing; some could be an investment.

Many of these companies are also responsible for defining our product. This product wasn't defined in a vacuum. The first time we defined it, we went to the game guys—they threw us out! So we started all over again and took all the things they said were wrong, incorporated them, then looked around again. It took about three rounds before they started saying, "We like this. We want this."

boot AMD is including 3D acceleration in the CPU, yet Intel is making the Auburn part standalone. Why the different strategy?

Raza The Intel Auburn part is not doing everything AMD is doing. Intel will do exactly what we're doing by the time MMX 2 comes along... at least that's my suspicion.

boot They're going to follow you with MMX 2?

Raza I wouldn't quite tell them that because they'll get all bent out of shape if I told them they'll follow our lead. But the lack of acceleration for the graphics was a flaw in MMX. And they will fix that flaw with MMX 2.

boot Will MMX 2 be as successful as MMX?

Raza Actually, it'll be more compelling than MMX because it will add real performance improvement to the games. Although MMX was not that successful, that was more because the Intel approach to the marketplace rubbed ISVs weirdly. Otherwise Intel would have been more of a success.

boot What progress is AMD making against the Pentium II?

Raza The Pentium II has that rather interesting Slot 1 solution. But it hasn't really been tested in the consumer market, and all the PC companies are on pins and needles worrying about what will happen to the return rate of their systems when they bring out consumer products with the Slot 1 solution. I bought one, brought it to the lab in my car, and it had flopped out of the slot. And I had been very careful.

boot That sounds a little far-fetched. Is this really a problem?

Raza Oh yes, that is not the first time I've heard of it. But right now, there's hardly any presence of the Slot 1 solution in the consumer world.

boot That's not true. Compaq, Micron, Gateway, and Dell are all doing Pentium II systems.

Raza They're just starting to bring Pentium II to consumer PCs. They're mostly in the commercial PCs, which is much more forgiving. Everybody is much more careful. The consumer takes his PC home in a car. They don't have trucks that deliver them very carefully to your back door from where it's wheeled to wherever it's going to be used. If you notice, there's about a 10% to 15% return rate, even of the best PCs.

boot For any number of reasons...

Raza None of them relating to the Slot 1. But Slot 1 has been notoriously unreliable. Intel has progressively made several improvements to it. They put in the two bars to hold the slot in place so it doesn't flop out. The early ones used to lean forward, so they put the heatsink on. It was still unstable and used to swing back and forth, so now they have a little rubber mat underneath the heatsink.

There's still risk associated with it, though. It's more expensive to install. It's much easier to drop a chip in a socket. A production line takes longer to run with Pentium II. So sales of the Pentium II are limited entirely by our ability to manufacture. We have not come close to reaching the sales limitations for *our* product.

boot Let's talk about that. The yields on the K6 have been notoriously low.

Raza Yes.

boot Why is that?

Raza First silicon was seen in late November 1996. By December 1996, production had started. This is one month. At Intel, the average start time is 12 months. This gave our fab no time for learning about how to manufacture the part. We've barely gone 11 months since first silicon, and during that time we've shipped progressively 10,000, 300,000, one million, and we're heading toward some 1.x million in the fourth quarter.

boot OK. But sales estimates were much higher?

Raza Revenue estimates were based on expectations to ship 1.3 million here and 2 million there.

boot And how many did you really ship?

Raza We shipped 1 million here, and we are looking at shipping a lot less than 2 million there. And that's been the penalty of not having the yield learning. As we learn all the issues, we are rapidly putting them in place.

boot You're saying Intel takes 12 months from first silicon to full production. Now you've had a full 12 months. What yields do you expect in 1998?

Raza Well, I cannot give you information that is not shared across the industry.

boot Sure you can! We've heard that one out of every four chips produced by AMD is actually workable. True?

Raza No, we're doing a whole lot better than that. Intel had first silicon on the Pentium II way, way ahead of AMD. And Intel's shipments actually started about the same time as AMD's. So they have approximately five times our capacity.

boot And they also have 14 fab plants.

Raza They have untold millions of people

John Carmack from id Software has previously stated that Quake is de-optimized for the K6. Any comments on that?

Raza Basically as it stands, the K6 processor has detriments in the floating point and in the MMX. We have a disadvantage over here. In order for us to rush MMX to market, we had a single-scalar MMX and a floating point that was not quite pipelined. We have to fix both of these—and not just fix them halfway, turning these disadvantages into an advantage.

technology. *But it's very difficult for me to believe that we can truly get ahead of* ***Intel.***"

"I wouldn't tell **Intel** that because they'd get all **bent** out of shape if I told

working on the product, they have a lot more time ahead of us and the number of products they have non-working compared to us is mind boggling. So the landfill, you probably have one or two of our chips for every 100 Pentium chips.

boot ***Ever fantasize about toppling Intel?***

Raza Absolutely. With K6, if we had infinite manufacturing and good yields, you would've seen some fun in this company.

boot ***When do you expect "fun" things to happen now?***

Raza Toward the second half of 1998, if we get our manufacturing act together. If we don't we'll just continue to putz along.

boot ***If you can't get it together, how long can you guys afford to "putz along"?***

Raza I don't want to think about that. That's too depressing. You can't always be planning on "What happens if the world falls apart?" I can't live like that. I basically think of everything that can go wrong in my domain or outside my domain and make sure we're doing what is necessary.

boot ***Aren't companies like AMD, Cyrix, and Centaur just going after Intel's scraps?***

Raza That's true at a million or two million chips. But AMD will be close to three million chips by the end the year. At ten million chips, it's a significantly big drop in the bucket, so AMD's goal for 1998 is ten to fifteen million chips.

boot ***Does Intel need competition?***

Raza The industry definitely needs competition because Intel is trying to subsume all parts of the system into Intel. That's not good for the industry, because when you look at Intel during the years when they haven't had competition, they've actually slowed down. And Pentium Pro is an example of them slowing down. If Intel had executed Pentium Pro as a mainstream processor, it would be tougher to compete with Intel. So competition makes Intel better.

boot ***Are you really trying to catch up to Intel's processor speeds?***

Raza Of course we are. I mean, there's no reason we shouldn't be there today. We used to be ahead of Intel, which is very difficult to do given Intel's enormous capital capabilities.

What's AMD doing in the mobile market?

Raza Well, AMD has a very good product in the quarter micron for mobiles. As soon as we have sufficient volume and yield for the mobile market, you'll see our presence. In fact, at Comdex you'll see some awesome demonstrations of mobile power. From '98 on, we could have better mobile products than Intel.

Two elements allow you to get ahead of Intel. One is the performance the design delivers. Second is how rapidly are you able to manufacture it and move it to the leading edge of the process to squeeze the most out of the process?

More and more emphasis is on how well you do the process. Intel has more dollars than us there. We're trying fight above our weight by leveraging strategic alliances to take advantage of the best technology. But it's very difficult for me to believe we can truly get ahead of Intel.

In the case of K7, we're trying like heck to get ahead of Intel. I'd be very happy if we're close to the best performance that Intel has in that time frame. If we do ever get ahead of Intel, it won't be easy, given the difference in investment and the difference in size, for us to sustain it for very long.

Nevertheless, we are not out of the space where products from us are very compelling. We have a 233MHz today, but admittedly Intel has a 300MHz and 266MHz. Still, Intel has hardly any 300MHz parts, and their top end is really 266MHz in volume. So, if we're just one or two bins below Intel, that's still very compelling.

Admittedly it is chasing Intel. But it is not chasing Intel by too far. And there is the possibility of capturing two bins and catching up with them.

boot ***So you're not resigned to the fact that AMD will always be a follower?***

Raza Our goal is to be creative and innovative. We are absolutely not resigned. All our plans are intended to understand where Intel is going and how to catch up and probably get ahead of them. But our constraints, in terms of size and capital and in terms of our learning, are real.

There's a lot we've learned in the last two years in engineering and designing well. And we've applied it, and done a great job with the K6. We also are learning how to manufacture better. And there's a lot that we can learn from what Intel has done.

boot ***Can you also learn from what they haven't done?***

Raza What they *haven't* done is be sensitive to the customer's need. And we learn a lot from that, too. That is our competitive advantage. And they do it rather blatantly. And that is something we absolutely must learn never to do.

boot ***Now, when you say something like that, what specifically are you referring to?***

Raza A variety of things. They treat PC OEMs as a channel. They rip out all the ability of a PC OEM to add real value. We work with PC OEMs and we'll even modify what we're going to do in order to give a PC OEM the ability to distinguish itself from another PC OEM, if he is big enough. That is the nature of business. Intel doesn't give their customers advanced information. They hold back if a customer decides to go with an alternative. They bully the retailers, which really rubs the retailers the wrong way.

boot ***But if there's such discord with Intel and their customers, why is it so difficult for AMD to get into the top PC OEMs?***

Raza It is not difficult at all to crack the top ten. IBM, Fujitsu, NEC. There's three of the top ten.

boot ***What about Gateway, Micro, Compaq, Dell?***

Raza Dell and Gateway are too dependent right now on the model of being pure Intel houses. They have too much invested in that model. The rest of the companies we definitely consider candidates for us to penetrate. However, we have to execute. We have to overcome our yield issues; we have to deliver products when we say we're going to deliver product. That's not Intel's problem. That's our problem, and we have to solve that for ourselves.

boot ***Do you think that's why the OEMs are reluctant to commit to AMD right now, because of the yield problems?***

Raza I don't think they're reluctant because of *that* reason. We are reluctant to overextend ourselves, and we won't knock on every door aggressively, to be very honest with you, unless we're sure we can do a good job of providing. We're taking on just as many top-tier customers as we can support satisfactorily.

boot ***If a Compaq came to you tomorrow and said "We want you to supply all our machines...," you'd have to say no?***

Raza Yes. We wouldn't be in a position to supply them.

boot ***Some accuse Intel of introducing new technologies, whether or not consumers even need them, just to make systems obsolete and they can sell more. Is that true?***

Raza MMX falls in that category.

boot ***Do you think MMX is over-hyped?***

Raza Oh, it's definitely over-hyped. There are very few microprocessors in the history of computers that don't have killer apps, and I don't know any for MMX.

I mean there are ones that show a little media performance. Some that show MPEG-1 improving. They're very fragmentary. It's a very hard-to-observe improvement. This was actually a case of pure marketing.

boot ***AMD obviously hasn't ignored MMX.***

Raza At that time, I was CEO of NextGen, and we didn't have access to MMX. We had developed our own multimedia unit in conjunction with Compaq. It was actually a much better architecture than MMX.

boot ***But you went through $90 million to develop the part?***

Raza No. We basically went through $90 million to develop *two* microprocessors. And $90 million is a drop in the bucket for any microprocessor development program. We had done two generations of microprocessors that we had brought to market against incredible odds.

At that time, our multimedia execution

"**Slot 2** is **dead**. That's just a variant of **Slot 1**, which in my opinion, is not worth going after.

*them they'll follow our lead. But the **lack** of **acceleration** for the graphics was a flaw in **MMX**."*

What do you think of Centaur's WinChip?

Raza Nice name. My personal belief is that it's more interesting for the mobile market. But then, why am I giving advice to Centaur?

unit was a better performing unit, even in the eyes of Microsoft. We had established the NextGen design team as the premier team in such innovation. But we felt at that time that we did not have the momentum or the clout to be able to come out with a different multimedia unit. And we ripped it out and replaced it with one that will be compatible with Intel's MMX.

boot ***Let's talk about your roadmap for 1998. What are the new chips' delivery dates?***

Raza Expect K6+3D in volume in the first half of the year. Expect a wider sampling in early second quarter, late first quarter of the year. You should also expect a new version of the K6+3D with on-chip Level 2 cache, which will be a one-chip alternative to the entire Intel module, allowing the bus to run extremely fast.

boot ***What will the bus speeds be?***

Raza 66MHz, 100MHz, possibly even 133MHz. Expect them by the end of the year. And a new microprocessor in the form of the K7 coming out with dramatic integer performance, dramatic floating-point performance, and 3D performance.

boot ***What will K7 be compared to?***

Raza I'd like to think the K7 is competitive with Willamette from Intel and will be superior in performance to the Katmai.

boot ***Is AMD trying to shrink the chip down?***

Raza Yes, we're moving to quarter micron, and we'll continue to move to a .18 micron in 1999. At that point we will also be bringing copper technology into our process.

boot ***What kind of performance and features are you hoping to get out of the K7?***

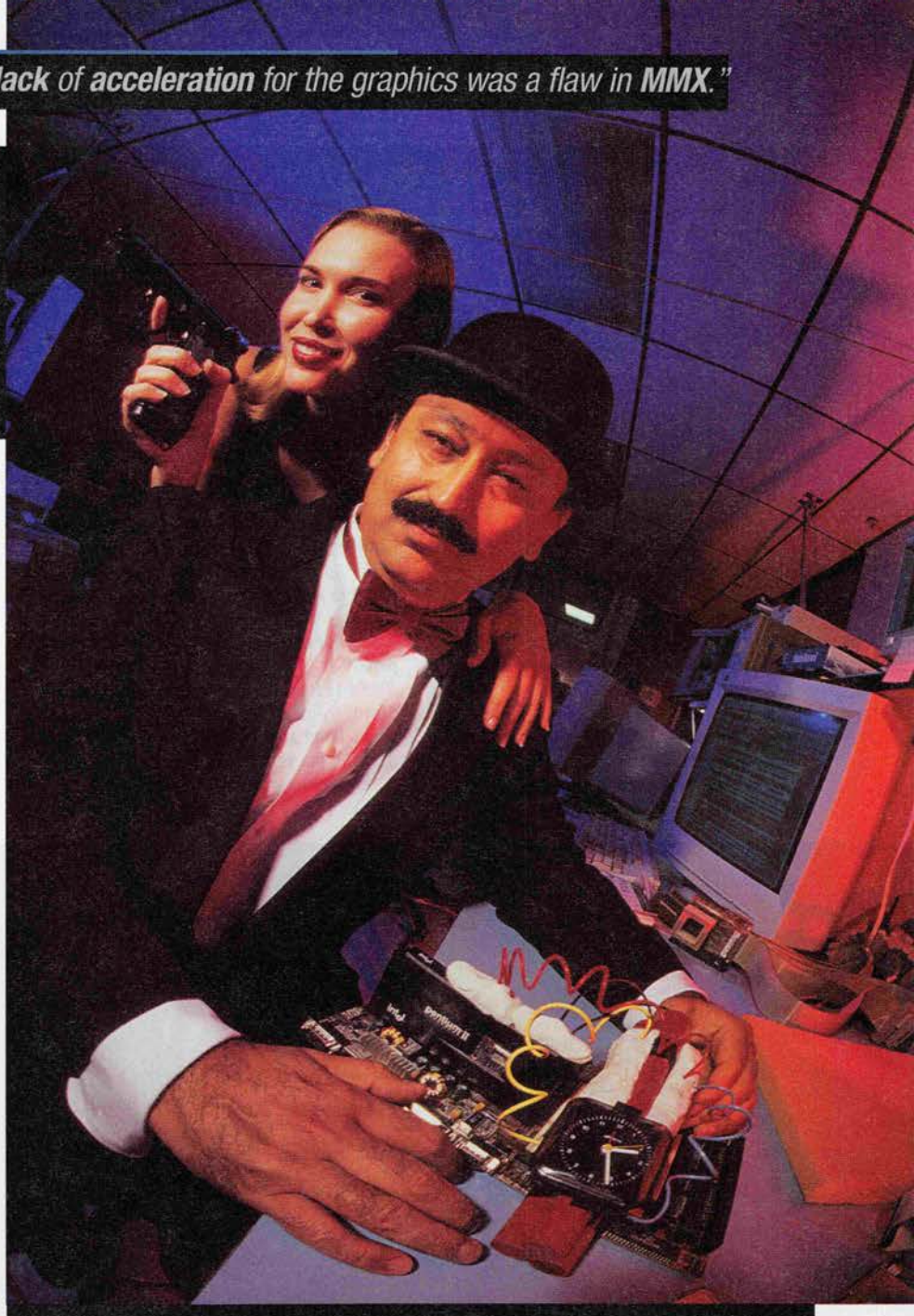
Raza K7 will be running upwards of 500MHz. It will have a very advanced micro-architecture completely different from the K6 architecture. It'll use a backside cache. It'll use a bus identical to the Alpha's. It will be installable in very low-cost machines. The plan of record we've described physically looks like Slot 1, except mechanically it's intended to be much more robust.

boot ***So, will the K7 be Slot 1–compatible?***

Raza No, it will be *physically* compatible to Slot 1, but the protocol and the signals will be different, intended to support a much higher performance than Slot 1.

boot ***How long do you think Socket 7 will last in terms of PC architecture?***

Raza As an external bus, up to 2000.



Is Cyrix a player anymore?

Raza Cyrix is a player, although they're not an active mainstream provider right now. But you cannot write off Cyrix. They've always been very innovative engineers. With their merger with National, their focusing on the sub-$800 PC-like appliances. We're keeping an eye on that market, but it hasn't evolved to where you can actually design products for it. But Cyrix, no—I wouldn't write off Cyrix.

I would write off Cyrix mostly for 1998.

boot ***Then what?***

Raza After that, it goes the way of the 486 bus—it disappears into the world of embedded controllers and set-top machines and table-top machines and routers and switches and intelligent controllers.

boot ***What will you think of Slot 1 then?***

Raza I don't much like it. I think it was intended to do one thing intelligently, which was multiple simultaneous transactions, with a backside cache on the processor. Of course that's no surprise to

*It doesn't give any **benefit** to the **user**."*

Is the MediaGX dead?

Raza MediaGX made tons of money for Compaq. It was Compaq's hottest-selling consumer machine. That was actually the first time I realized the consumer is looking for the best deal. He doesn't care what's in it. He buys when he sees a great deal, just like you buy everything else.

us. At NextGen we had backside cache on all our processors.

Moving forward, it will not satisfy the performance requirements of our processors— or even Intel's processors. So, in 1999, they'll have modifications to that bus from a protocol point of view.

***boot** But by the end of '98, Intel will be working on Slot 2, or even Slot 3.*

Raza Slot 2 is already dead. That's just a variant on Slot 1, which, in my opinion, is not worth going after.

***boot** Because it's Intel proprietary technology or because of the lack of benefits?*

Raza It doesn't give any benefit to the user. It was required by Intel's processor and that's Intel's approach. It has no value to anybody.

***boot** Do you think Intel will convince people they need Slot 1 instead of Socket 7?*

Raza I doubt it because that's a marketing campaign only appealing to a PC motherboard manufacturer. PC motherboard manufacturers are creatures of economic advantage, and if they see economic advantage in building systems with Slot 1, they will do so; if they see economic advantage in doing something different, they do that.

***boot** So you don't think then the consumer is going to walk into a computer store and say...*

Raza "I want Slot 1"? No!

***boot** But what happens to AMD if that happens?*

Raza If it turns out consumers demand Slot 1, then of course AMD is toast.

***boot** What about OEMs? Are they convinced Slot 1 is the way to go?*

Raza Actually the OEMs hate Slot 1.

Slot 1 forces wholesale changes to the way OEMs have been manufacturing and designing PCs since the 386. So they hate it. The only advantage is that it's coming in high-enough volume for them to do business, and it's a very good processor.

***boot** Is AMD content to simply compete with Intel's prices?*

Raza No. We'd much rather Intel lower their prices and we kept our prices high! [laughs]. Nevertheless, the reality of the marketplace is that with competition the prices come down.

***boot** Every time you announce a product, Intel lowers their price. Does it drive you nuts?*

Raza Absolutely! It drives us nuts! But we want to get into the microprocessor business. Competing with Intel as a small company, basically you have to be nuts in the first place. We are nuts, and yet that's why everything happens!

***boot** Can Intel drop their prices so far it will drive a stake through your heart?*

Raza No, I don't think so. We have to outdo Intel in the design, no matter what. So when we aim for a performance level, it's also aimed at a lower cost than Intel's part. Then, we ask our manufacturer to say "OK, now you make it as fast as you can."

*"**K7** will be running upwards of **500MHz**. It will look like **Slot 1**, except mechanically it's much more robust."*

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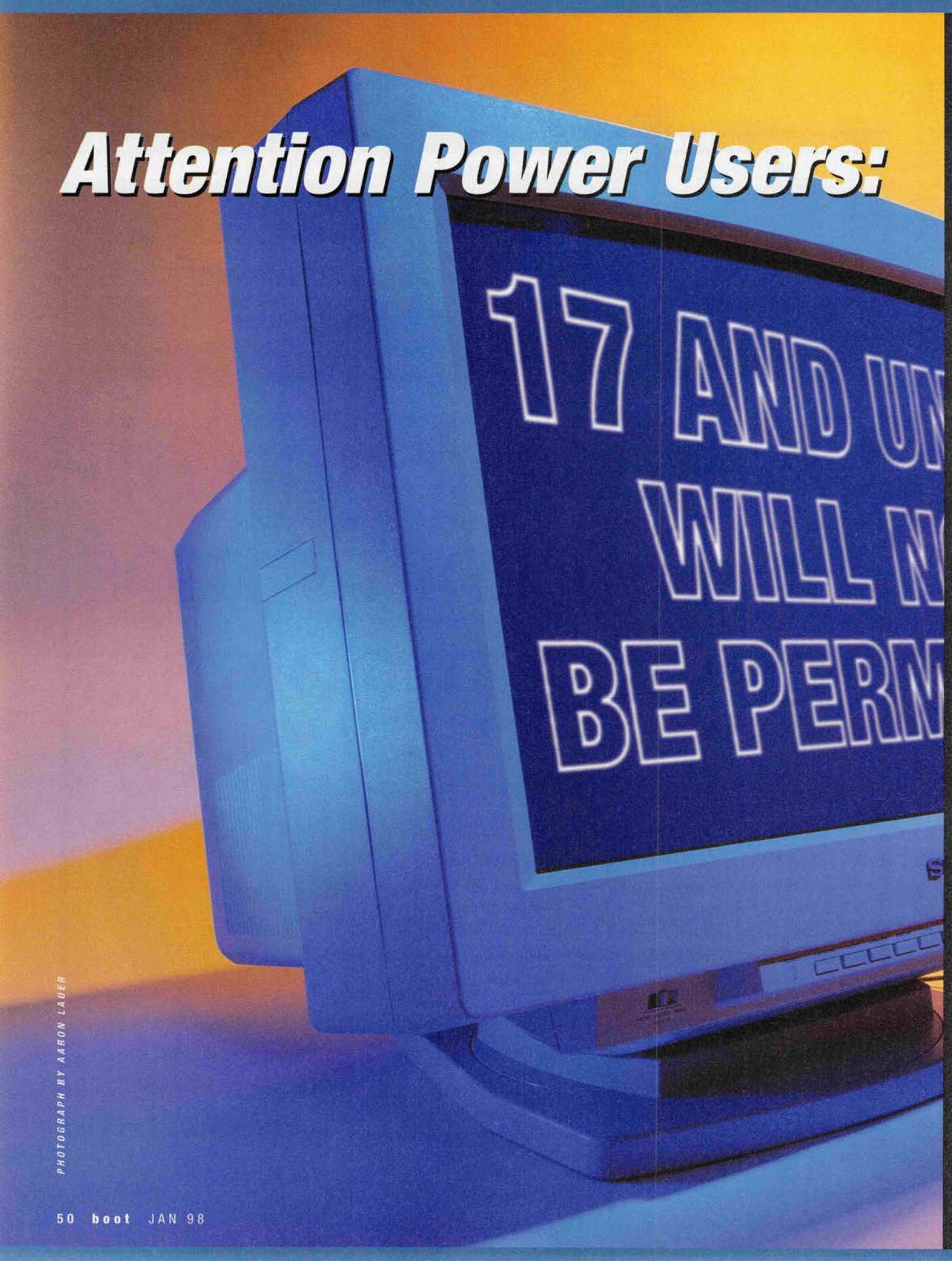
Attention Power Users:



PHOTOGRAPH BY AARON LAUER

The **cover charge** for entering the **big monitor** club is steadily **dropping**, so it's time to **choose** a lavish new display. The **magic numbers** are 19, 20, 21, and 24—**enough inches** to satisfy your most **decadent** desktop **desires**

The "industry" says monitors larger than 17 inches are for professional modelers and desktop publishers. Well, the "industry" has obviously never chunkified a shambler on a 21-inch behemoth—so screw the stuffed-shirts and up your Quake immersion quotient before you develop a nasty case of display envy. The entry fee into the 19-inch market has already fallen to the $850 range, and with 21-inch displays costing as little as $1,300 in 1997, we expect prices around $1,000 in 1998.

If you can't wait for next year's pricing wars, look no further than the six mongo monitors reviewed here. Some are designed for the home, while others definitely rumble in the workstation arena. We first tested the monitors with our own subjective peepers and then ran them through the rigors of DisplayMate's Video Obstacle Course, a flat-out brutal utility designed to uncover the most subtle flaws in any display. Each monitor was reviewed at its maximum resolution; results may vary under lower settings.

Remember: You'll swap CPUs and video cards from now until the new millenium, but chances are the next monitor you buy will outlast all your other components—so make sure you invest wisely for at least three years of steady use.

—Jon Phillips

Sony GDM-W900

Bigger is better—and it starts with one of the largest monitors you'll see this side of a CAD workstation. You can simply lose yourself in the vast panorama of Sony's freakish 24-inch GDM-W900. Make a visual sweep of the screen from one edge to the other, and you'll forget where you came from before you reach where you're going. Hell, the display is so wide, you'll actually need your peripheral vision to see enemies creep up on you in *Quake*. The overall effect is true immersion—and desktop publishers will finally have enough screen real estate to design 17x8.5-inch magazine spreads at full size without scrolling.

The GDM-W900 costs about $2,500 more than the average 21-inch display, but the extra inches make a significant difference, and the specs speak for themselves. We're talking a 76Hz refresh rate at the maximum resolution of 1920x1200 (whoah!), and a varying aperture-grille pitch of 0.25mm in the center of the display ramping up to 0.28mm on the edges. *DisplayMate*'s focus test revealed the peculiar qualities of the varying grille pitch: Fine pixel detail degraded as the pitch widened. Sony says it implemented the varying pitch to shorten the distance between the electron gun and the glass for a smaller desktop footprint. While 0.28mm is a standard spec for pro monitors, the focusing flaws are amplified when you compare the center of the screen to the edges.

Other than shabby color convergence (which was easily fixed via a complete and intuitive set of onscreen controls), *DisplayMate* provoked no other noteworthy sins. Color saturation consistency, which so often sucks on so many monitors, was perfect—amazing considering how much could go wrong on such a large expanse of real estate. But while the 90-lb. GDM-W900 is an aperture-grille monitor, it doesn't boast the superior brightness one would expect from this technology. It's simply difficult to light up a 22.5-inch diagonal viewing area with a cathode ray tube. Yes, the W900's brightness intensity was a big letdown. Finally, not many video cards support the awesome 1900x1200 resolution. Our Matrox Millenium II handled the job, but chances are most stock cards won't hang.

The GDM-W900 is a 20th century marvel, but doesn't really make sense for power fraggers until R&D beats the brightness bug and marketing lowers the price, which has already dropped twice over the course of a year for a total of $1,000 less.

Price $3,900
Company Sony
Phone 800.352.7669
URL www.sony.com

Optiquest V115

When a 21-inch monitor mosies in with a price tag below $1,300, you immediately begin looking for flaws—and an accompanying "salesman" in a leather trench coat who hangs out around the airport and "finds" great deals in the most unlikely places. But Optiquest, the consumer-level subsidiary of ViewSonic and the manufacturer of Dream Machine 97's 19-inch V95, is selling a bright, true display with no hidden compromises. The V115 simply owned *DisplayMate*'s Video Obstacle Course. We found only trivial problems with fuzziness in bright image detail, slight image expansion during bursts of intense brightness, and blue-red misconvergence on the lower right-hand side of the screen (unfortunately, the onscreen control set lacks convergence manipulation). The 63-lb. V115 performs beautifully out of the box without any fine-tuning, so where's the rub?

Well, it's not in the basic specs. You get a 20-inch diagonal viewing area, a 0.26mm dot pitch for the invar shadow mask CRT, and 75Hz@1600x1200 and 85Hz@1280x1024—refresh rates and resolutions you'll find in monitors costing $500 more. The display, however, ships with a noticeably bowed glass screen that could use better anti-glare treatment. Also, the on-screen controls are lumped together in a single, somewhat confusing control panel, and the monitor lacks BNC connectors. But what do you want for $1,300? If you can get over the screen curvature, the V115 is an excellent display.

Price *$1,279*
Company *Optiquest*
Phone *800.843.6784*
URL *www.optiquest.com*

ADI MicroScan 6P

Using the same 19-inch Hitachi CRT found in Optiquest's Kick-Ass V95, the ADI Microscan 6P is a beautiful, rich, inexpensive display, and ups the ante with a built-in microphone and five USB ports. You'd have to be insane to buy a 17-inch monitor with a value like this available. The 18-inch diagonal viewing area is only slightly beveled, boasts a 0.26mm dot pitch, and gives you 85Hz@1280x1024 and 75Hz@1600x1200. We especially dig the 6P's one-touch overscan feature that expands your viewing area to its maximum setting in perfect proportion.

The svelte 42-lb. monitor waltzed through the Video Obstacle Course like Cinderella on cloud nine. No pincushioning, no geometric distortion, and no image expansion during bursts of intense brightness. We also saw excellent bright image detail and focus, almost imperceptible moirés, and superb color convergence. In fact, the only blotch that keeps the 6P from the coveted 10 verdict is, well, a blotch: The bottom right-hand corner of the display is somewhat darker than the rest of the otherwise lush output. We degaussed the screen and moved the monitor around the bootLab to isolate it from potentially disruptive electrical fields, but the subtle darkness persisted. As long as you aren't doing CAD work or designing your swank Madison Avenue magazine on this beast, you need not worry about the inconsistency. boot really likes this monitor.

Price *$859*
Company *ADI*
Phone *800.228.0530*
URL *www.adiusa.com*

EIZO Flexscan FX-E8

Ho-ho, the price is a dilly all right, but the 21-inch FX-E8 commands top authority with its excellent performance and control set nonpareil. The 19.7-inch viewable invar shadow mask display boasts a 0.26mm dot pitch with settings of 87Hz@1600x1200 and a whopping 102Hz@1280x1024. Specs aside, the 70-lb. FX-E8's output is bright, luxuriant, and incredibly true. *DisplayMate* couldn't provoke any moiré patterns. Nada. None. Even more impressive, we saw the best color convergence and fine-detail focus of any monitor in this roundup. In fact, we now have a new visual benchmark for what fine focus should be. Simply brilliant. On the flipside, we found a pincushioning flaw (almost imperceptible and, yes, fixable) and slight image expansion during bursts of intense brightness. But chances are these dings will go unnoticed unless you're looking for them.

While many 21 inchers offer great performance (for much less money), we've never seen one so well-suited to the DTP professional. Screen curvature and glare are kept to a bare minimum. A BNC/D-sub toggle sits on the front panel, along with a control that automatically adjusts your display position and size when a new video signal is detected. Other on-screen controls include anti-moiré and convergence adjustments, and precise color temperature controls that let you designate independent cut-off and gain settings for the red, green, and blue channels. These are perfect for calibrating multiple FX-E8s in a single design shop or matching your display to specific printer output. Fraggers might scoff at these expensive niceties, but some pros need them desperately—and here they are with some of the prettiest pixels you'll ever see.

Price *$2,667*
Company *EIZO*
Phone *562.431.5011*
URL *www.eizo.com*

KDS VS-19

The VS19's screen is so bowed, you'd think it suffered from rickets as a child. The curvature is distracting and is enough to dissuade you from buying this otherwise worthy—and inexpensive—display. During *DisplayMate*'s geometric distortion test, it was difficult to determine whether the output was truly distorted or simply suffering from an illusion spurred by the curvature (imagine a flat wireframe of squares being wrapped around a sphere). We did our best to ignore the sphere illusion and eventually concluded the screen does slightly distort, making perfect squares appear somewhat squat (the problem can be addressed with on-screen controls).

This VS19 is actually a 20-inch monitor. KDS kept its model number in the teens because the monitor's price is "in the 19-inch price class." Semantics aside, you get an 18.8-inch diagonal viewing area (a range you'll never find in 19-inch monitors), a 0.28mm dot pitch, and a top refresh rate of 75Hz at a top res of 1600x1200. And by shaving off just one inch of viewable, the monitor costs about $600 less than KDS's VS21. The 57-lb. VS19 also boasts BNC connectors, a pro feature you don't usually find in this price class.

Besides the slight geometric distortion, *DisplayMate* revealed a mixed bag: great bright image detail, consistently good focus throughout the screen, and the teeny-tiniest of baby moirés. These pluses were tempered by bad image expansion during flashes of intense brightness and sloppy color convergence (ack! no convergence controls). But are these problems dealbreakers in light of the deep blacks, bright colors and friendly price? Nope, the only dealbreaker is the bulbous glass panel.

Price $849
Company KDS
Phone 714.379.5599
URL www.kdsusa.com

Philips 201B

VESA—that's the Video Electronics Standards Association, lest we forget—says your monitor's refresh rate shouldn't dip below 75Hz, because if it does, screen flicker will drive you more insane than a syphilitic merchant marine. So sing a salty sea shanty and plop yourself in front of the 201B for hours on end—because this bad boy does 1600x1200 at 93Hz! That's the best 1600x1200 refresh rate in this roundup.

The monitor weighs 77 lbs., comes with BNC connectors for individual red, green, and blue input, and boasts a dot pitch of 0.28mm. A bit thick, sure, but you'd never know it from *DisplayMate* testing. Fine pixel detail was fine, fine, fine, and focus was perfectly uniform throughout all portions of the display. Color intensity was also uniform from edge-to-edge, which is de rigueur when moving "mission-critical" JPEGs hither and yon. We've seen brighter monitors, but rest assured, the 201B will display your images of parrots and hot air balloons with vivid aplomb.

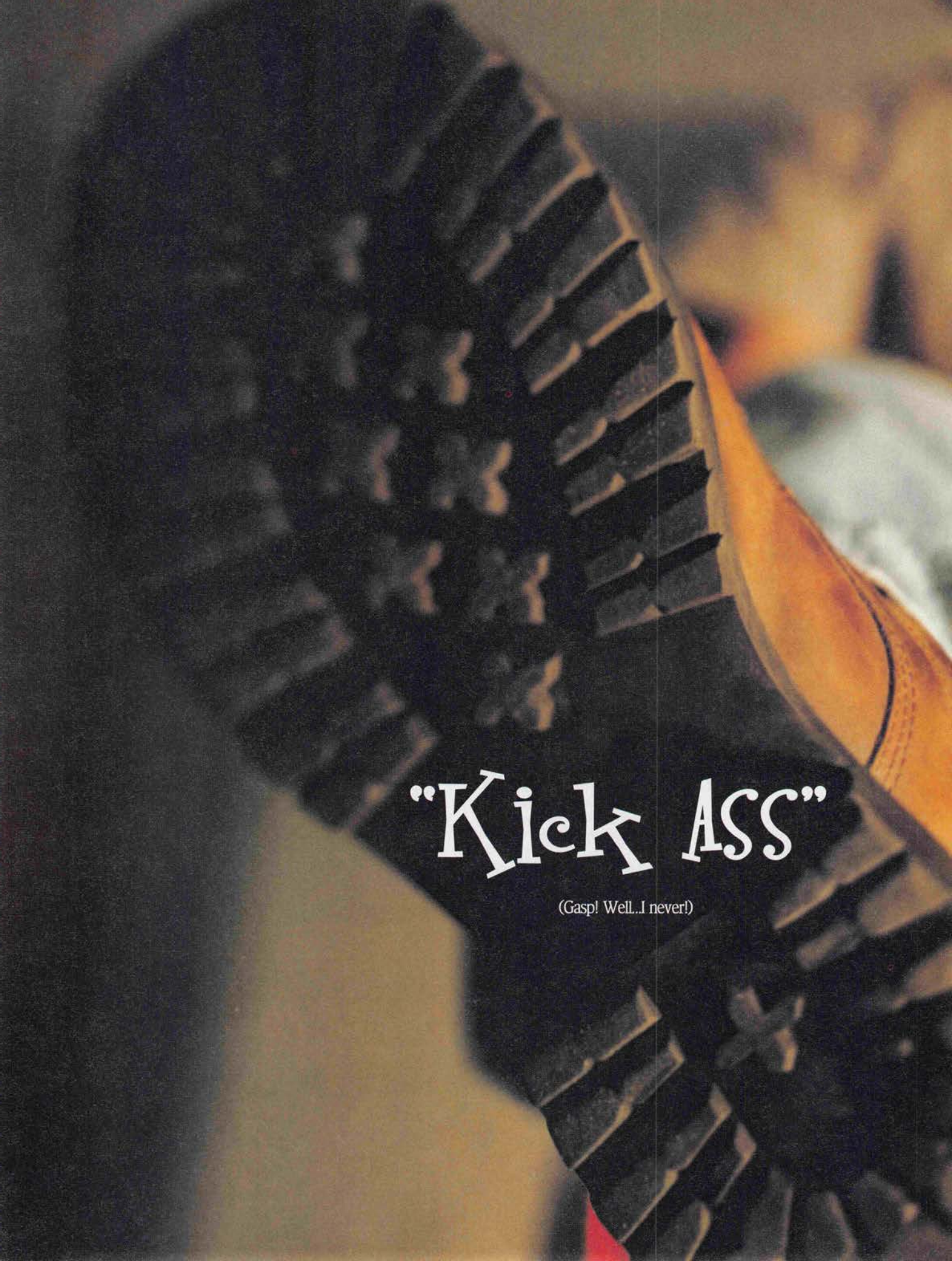
Still, the box wasn't perfect. *DisplayMate*'s merciless Video Obstacle Course grabbed the 201B by the throat and made it cough up some nasty moiré patterns, geometric distortion (slight vertical elongation at the top and bottom edges, to be precise), and color misregistration at the top of the screen. Worthy on-screen controls (which also report current res and refresh) addressed the moirés and geometric distortion, but alas, the 201B doesn't have convergence controls.

We've also seen less screen curvature and better anti-glare, but the 201B is definitely a contender. You get amazing refresh rates and solid performance in a lot of important categories. If you can handle the price, and the monitor syncs with your performance priorities, by all means pull the trigger.

Price $1,599
Company Philips
Phone 800.835.3506
URL www.philipsmonitors.com

Big Monitors at a Glance

Monitor	Viewable	Refresh@max Resolution	Dot/Grille Pitch	Dimensions (HxWxD inches)	Price
Sony GDM-W900	22.5 inches	76Hz@1920x1200	.25-0.28mm grille	20x23x22	$4,499
Optiquest V115	20 inches	75Hz@1600x1200	.26mm dot	19x20x20	$1,279
Philips 201B	19.6 inches	93Hz@1600x1200	.28mm dot	19x19x21	$1,599
KDS VS-19	18.8 inches	75Hz@1600x1200	.28mm dot	19x20x21	$849
ADI Microscan 6P	18 inches	75Hz@1600x1200	.26mm dot	19x19x18	$859
EIZO FlexScan FX-E8	19.7 inches	87Hz@1600x1200	.26mm dot	19x19x20	$2,667


"Kick Ass"
(Gasp! Well..I never!)

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STANDARD FEATURES
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USR Sportster 56K x2 data/fax modem*
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DVD-ROM,** DVD software
E4 Cool DVD PCI decoder card: 6 channel AC-3 to 2 channel out capability, SPDIF output (digital audio out)
AWE 64 ISA sound card
Cambridge MicroWorks-2 speaker satellite with subwoofer stereo system
Fusion 3D game pak: Mech Warrior 2: Mercenaries, AH-64D Longbow, U.S. Navy Fighters '97, Command & Conquer, Formula 1 D3D version
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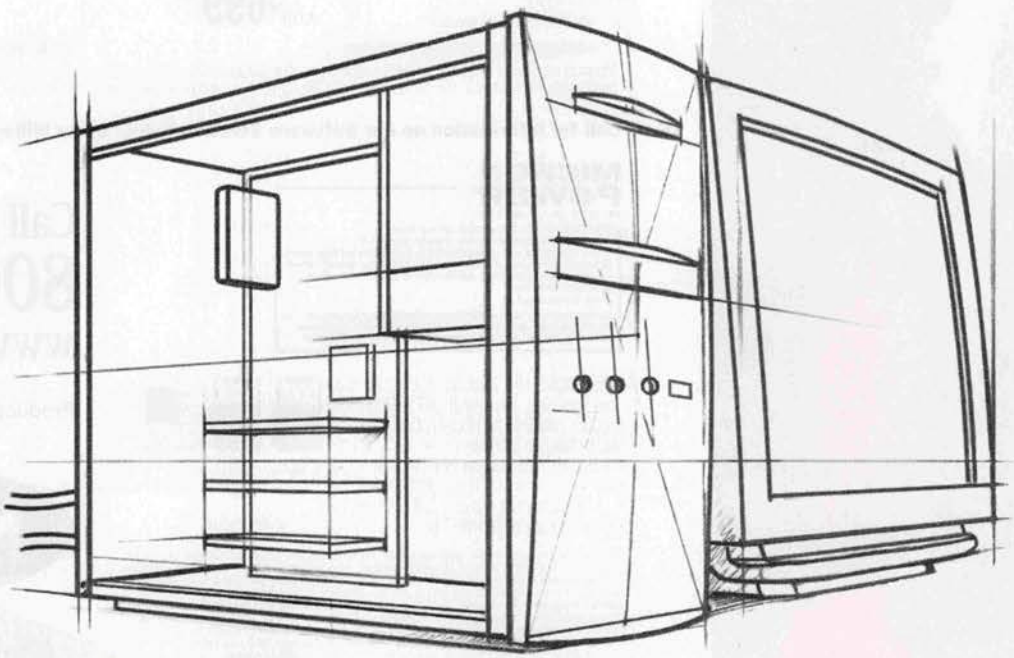


ILLUSTRATIONS BY MARSHALL VANDRUFF

It's an **awesome** time to be a **Pure PC Power** user. In 1997, the industry engineers and **propeller-heads** really delivered some **audacious** technologies, but 1998 hints to be even more **spectacular**. Get ready for nirvana, 'cause we've **infiltrated** the R&D labs, stolen the **blueprints** to next year's **power parts**, and printed them here so you'll have all the **intelligence** you'll need to **upgrade with authority** in the coming months. The following **reconnaissance** reports are for **power users** only—so step off unless you've got the **mettle** to build the most **incredible computer** possible.

CPUs and Core-Logic Chipsets

Pentium II is the name of Intel's game. From the entry-level 233MHz to the 333MHz Deschutes, Slot 1 will be the mainstay of the mighty Intel arsenal, with the faster Deschutes/Slot 2 processor poised to dominate high-end *Quake*Stations and rendering labs. As previewed in *boot* 14, page 76, Slot 2 Deschutes will come in with a 100MHz system bus, AGP, and larger L2 cache running at core processor speeds. While Intel is still working out final specs, you can bet that speeds in excess of 400MHz aren't that far out. While regular Socket 7 Pentiums and Socket 8 Pentium Pros will still be scuttling about, they'll be playing second fiddle to Slot 1 and 2 dominance.

"Intel will be pushing the **440LX** as its mainstay **AGPset**, but the **66MHz** system bus limitation won't be **solved** until the later half of **1998**.

But what if you're anti-Intel? AMD and Cyrix both have chips up their Socket 7 sleeves. AMD's forthcoming K6+ *(boot* 16, page 16) will include improved floating-point and MMX processing, larger L2 cache, and faster speeds from 266MHz to 300MHz. In fact, AMD is aiming for frame rates of up to 50fps for unaccelerated *Quake* at 640x480. Also expect a 100MHz system bus from AMD. The company's biggest ace-in-the-hole comes with the K6+3D, a CPU that will incorporate hardware 3D acceleration into the core processor, which is slated to eventually run as fast as 400MHz. The chip promises Direct3D support and improved floating-point performance. Look for AMD's Slot 1 K7 processor and all its hoity-toity madness no earlier than 1999.

But what of Cyrix, whose 6x86-MX processor was a flat-out failure due to substandard floating-point and a reluctance among OEMs to bite? Well, Cyrix also plans to do the 3D-incorporation thang with its next-gen CPU, code-named "Cayenne." Promising to fix the horribly broken floating-point processing and throw in 3D hardware acceleration, Cyrix also plans to improve MMX processing. Expect larger L2 caches and quite possibly integrated L2 cache to occur toward the latter half of 1998. Also watch for upstart Centaur Technologies to come correct with the MMX WinChip C6+ processor in 1998.

Of course, without the proper core-logic chipset, all these fancy-pants improvements won't mean squat. Intel will be pushing the 440LX as its mainstay AGPset, but the 66MHz system bus limitation won't be solved until the latter half of 1998 when (we hope) Intel will launch its 100MHz, dual-processor-ready 440BX AGPset alongside its Slot 2/Deschutes CPU. AMD, with the help of core-logic chipset vendors VIA and SiS, may actually beat Intel to the 100MHz punch with its own Socket 7 AGPset. Motherboard vendors are already sampling these parts, and if they can get stable product to shelves, they'll certainly put a dent in Intel's armor.

UPGRADING: Users who desperately want a faster system bus may opt for the earliest 100MHz Socket 7 solution: AMD's K6+ and K6+3D should be shipping around Q2 or Q3 1998, and will compete alongside Cyrix' Cayenne and Centaur's WinChip C6+ against a robust line of Pentium IIs. The Socket 7/AMD and Cyrix route will most likely get you locked in with a number of core-logic chipsets from AMD, VIA, SiS, Opti, and others. Stay tuned for more info on these upstart competitors.

System buses aside, what company besides Intel can guarantee 100% compatibility with all software? And can AMD and Cyrix really match Intel's floating-point prowess? We expect Slot 2 Deschutes to be the ultimate x86 processor for Pure PC Power users—but it's not arriving until late in 1998. If you can't wait a year, take advantage of steadily dropping prices and buy a cheap Slot 1 P-II right now. You'll be able to use your 440LX motherboard to upgrade to Slot 1 Deschutes, but, unfortunately, Slot 2 Deschutes requires the 440BX AGPset.

—Andrew Sanchez

Displays

The issue isn't so much power, but rather the *price* of power. You will *not* buy a 17-inch monitor in 1998. The new bottom-line is 19 inches, and prices are dropping fast enough to put even poor boys into this awesome size bracket, which provides 37% more square inches than 17-inch pretenders. During 1997, only one 19-inch CRT was available: an invar shadow mask display manufactured by Hitachi and found in a slew of monitors from the likes of Optiquest, ADI, and Philips. But Sony has just introduced its own 19-inch, an aperture-grille CRT that sells under the Sony name as the GDM-400PS and will probably someday appear in OEM products too.

All sources agree 19-inch street prices will quickly drop below the 1997 low of $850. Sean O'Brien, director of marketing for Sony display products, said he wouldn't be surprised if some of the current crop of 19-inchers hit $800 in Q1 1998. One OEM (which requested anonymity) said prices could go as low as $750 during the course of the year. Sony's GDM-400PS will begin shipping in January 1998 at a street price of $1,200. For the extra expenditure, you get Trinitron aperture-grille technology and all its attendant brightness, a "short-neck" electron-gun design that shaves two inches off the case depth, and a CRT design that is about 50% flatter than other jumbo class monitors, reducing geometric distortion and glare.

As 19-inchers claim the "low-end" consumer space, 21-inchers will become even cheaper than they are

today (dig the $1,279 Optiquest on page 52). TeleVideo Product Manager Nish Bains says 21-inch prices, which are currently hovering around $1,500, may drop up to 15% during 1998. Sony's O'Brien thinks a few brands will hit $1,200, while our anonymous manufacturer says prices may plummet to—hold on to your hats—$900. "For entry-level large-screen displays, you can take 1% off the price every month, and you won't be far off target," says O'Brien.

Prices aside, basic specs for 19s and 21s won't get much better. Manufacturers will continue to ship CRTs with dot pitches of 0.26mm (Sony's new 19s and 21s will have a variable grille pitch of 0.26-0.27mm). Resolutions won't get finer because anything sharper than 1600x1200 renders content too small. Refresh rates, however, will get better as manufacturers try to hit the sweet spot of 85Hz at 1600x1200.

Most monitor companies were hush-hush about their unique technology advancements, but it seems better focus is the mantra of 1998. EIZO displays will incorporate a 16-bit processor to correct screen distortion, while Sony's 19-incher and 21-inch GDM-500PS will include the Enhanced Elliptical Correction System, which refines the electron gun beam spot for better brightness, clarity, and focus in the corners. Sony's 21-incher will also employ Beam Landing Correction, which dynamically adjusts the red, green, and blue beams for better color uniformity across the entire screen.

Flat-panel pioneers will be happy to see lower prices, finer resolutions, higher refresh rates, and better brightness and color control—but tread carefully because this emerging display category is still fraught with image quality and off-axis viewing problems. Look for 14-inch viewable flat panels in the $2,000 to $3,000 range, and 15-inchers in the $2,500 to $3,500 range. We're really excited about a 15-inch ViewSonic that boasts 1024x768 for only $2,450.

UPGRADING: Buy your 19- and 21-inch monitors during Q2 and later to take advantage of inevitable price wars. Make sure you get an 85Hz refresh rate at resolutions no coarser than 1280x1024.

—Jon Phillips

Storage & I/O

CD-ROM isn't going anywhere. Although the format took a hit with the broken promises of 24x IDE, it still has plenty of fight left in it to stave off DVD-ROM. New 32x drives will run at advertised speeds to bring integrity back to the format. 1998 will also be the year of CD-R. New 4x-write and 12x-read drives will offer OEMs viable replacements for CD-ROM and removable storage drives.

DVD is already making its second grandiose entrance with second-gen drives. They spin legacy CD-ROM discs at 16x to 18x speeds, read gold one-off discs, and offer eight times the capacity of current CD-ROM drives. For DVD intelligence reports, read the *boot* 16 feature story on page 51, and the update in this issue on page 14.

The Ultra SCSI spec just got a shot of adrenaline called Low-Voltage Differential. This signal filtering technology reduces bus noise, improves data reliability, quadruples cable length to 12 meters, supports up to 16 devices, and doubles the overall bus throughput to a whopping 80MB/sec. Ultra2 LVD SCSI host adapters should become ubiquitous next year on high-end desktop systems. Expect to see product from Adaptec, Diamond, and ATTO in early January.

Ultra2 LVD also has a competitor, Fibre Channel Arbitrated Loop (FC-AL). This 1GB/sec (100MB/sec or 200MB/sec duplex) optical interface technology will make its presence known in 1998. Fibre Channel host adapters can connect up to 126 devices on an Arbitrated Loop. Workstations on a loop of FC-AL devices can communicate with storage devices using SCSI and other systems using TCP/IP, sharing a communication path as fast as most computer backplanes (IP and SCSI can both be mapped to one transport protocol). Distance limits range from 24 meters using electrical coax to a whopping 10 kilometers using Longwave Laster over fiber. Hard drive manufacturers will be bustin' loose with Ultra2 LVD SCSI and Fibre Channel by the time you read this. Capacities of 18GB will become the norm, at first dominating the high-end market and then penetrating consumer systems as the year progresses. UltraDMA IDE hard drives will dominate the low- to mid-range systems, offering bus speeds of up to 33MB/sec and backward compatibility with older

In 1998, Pentium IIs will clock in at 233MHz in entry-level Slot 1 CPUs, and theoretically run as fast as 450MHz in Slot 2 Deschutes CPUs—if bootPostulation sees fruition. This scaling model throws 233, 266, 300, 333, 350, 400, and 450MHz processors squarely into your upgrading plans. Slot 2 Deschutes will run a 100MHz system bus, with L2 cache—up to possibly 2MB worth—running at the same speed as the processor cores.

EIDE hard drives. Expect capacities to burst from 6GB to 16GB with RAID solutions hitting in a big way. IDE is definitely guaranteed a future even in the Pure PC Power market.

UPGRADING: *boot* saw Plextor's UltraPlex 32x CD-ROM drive in action, and it rocked. If other manufacturers are up to spec, 32x drives will be a good investment in 1998. Don't shy away from a full system that uses a second-gen DVD-ROM drive, but don't buy an add-in DVD-ROM kit until more software emerges. And don't buy into DVD-RAM or DVD+RW until the war is over—you may inadvertently end up with junk. The SCSI future sits on a solid foundation with Ultra2 LVD, which should be all-good through the year 2000. Please research Fibre Channel before investing—it does not make sense for everyone.

—Sean Cleveland

Notebooks

Integrating fast processors and spewing gobs of video performance, notebooks can now go toe-to-toe with desktops. With the advent of Intel's 200MHz and 233MHz Tillamook, manufacturers have practically abandoned the once-stately mobile Pentium 166MHz with MMX. And speeds are only getting faster: A 266MHz Tillamook should be available by the time you read this, and a mobile version of Deschutes is expected during the second half of 1998.

Looking for a different flavor? AMD says a mobile version of the K6 will appear sometime in early 1998.

Although Voodoo 2 won't be appearing in notebooks anytime soon, 3D acceleration is indeed poised to pounce. Leading the contenders is S3's ViRGE MXi, a 2D/3D chip offering 2MB of integrated DRAM, support for dual monitors, and a TV encoder equipped with Macrovision copy protection. Trident's high-end Cyber9397 incorporates a TrueVideo processor that provides horizontal and vertical interpolation as well as edge recovery scaling, and includes a hardware triangle setup engine to enhance 3D games. If we had to pick a winner, though, we'd place our bet on ATI's 3D Rage LT Pro, featuring a 2x AGP interface, up to 4MB of onboard SDRAM or SGRAM, and TV-out support. Better yet, the LT Pro supports LCD resolutions up to 1600x1200.

Aurally frustrated? ESS Technologies' Maestro-2 is a 64-voice mobile PCI audio accelerator. It supports 3D spatial enhancement, AC-3, and WaveCache technology, allowing you to store MIDI samples in your main system memory. Cirrus Logic's CrystalClear CS9236B is a 32-voice, AC97-compliant, single-chip wavetable synthesizer that can be combined with the CS4237B and CS4238B, providing SRS or QSOUND 3D technology (if the application supports it). New to the mobile audio amphitheater is NeoMagic's MagicWave 3D, an audio codec that provides a 32-voice software wavetable, with a signal-to-noise ratio of 20Hz to 15KHz and THD of less than 0.2%.

As for displays, size *does* matter. Says Gary Elsasser, Toshiba's vice president of worldwide product planning, "The majority of mainstream notebooks next year will include a 12.1-inch display, although many will include the 13.3-inch, thanks in part to some hefty price cuts." However, don't expect to see many 14.1-inch displays. Elsasser says that since the 14.1-inch screens contain more glass, notebooks end up weighing more than most consumers want to lug around and require custom cases (the 12.1-inch and 13.3-inch screens are interchangeable). We expect new polycarbonate displays to arrive in 1998. They'll use a mixture of plastic and glass to strengthen the screen while lowering overall cost.

UPGRADING: For those of you with unlimited budgets, check out Panasonic's CF-63, incorporating a Tillamook processor, DVD-ROM, MPEG-2 hardware, and four speakers. Sharp has a series of notebooks—the W-100s—that include an 11.2-inch display with a widescreen format measuring 9.7x5.7 inches. And don't forget: Thin is in. The OmniBook, co-developed by Hewlett-Packard and Mitsubishi, features a Tillamook processor in a case that weighs only 3.1 lbs. and is only three-quarters of an inch thick! But it'll cost you close to $6,000.

If these big boys don't get you hot and bothered, check out the latest crop of mini-notebooks, all running Windows 95. Toshiba's tiny $1,999 Libretto 50CT (reviewed in *boot* 13) will undergo a facelift, incorporating Intel's newly minted 120MHz mobile MMX Pentium and a bigger hard drive. Joining it is NEC's $2,000 MobioNX—but it's currently available only in Japan. Two other entrants: Mitsubishi's 2.4-lb. AMiTY CN with a 7.5-inch DFP display, and Hitachi's 2.7-lb. VisionBook Traveler with an 8.4-inch display. Both incorporate a Pentium 133MHz MMX processor.

—Bryan Del Rizzo

boot saw Plextor's UltraPlex **32x CD-ROM** drive in action, and it **rocked**. If other manufacturers are up to spec, 32x drives will be a **good investment** in 1998.

3D Accelerators

Mario, move your low-res, texture-mapped, anti-aliased ass out of the way, 'cause the PC is pushing trilinear-filtered, alpha-blended, texture-mapped polygons that'll make your wee little plumber's hat spin. The magic starts with 3Dfx, which has captured the hearts of all

the bootLads. From what we've seen with our own eyes, the monstrous 3D-only Voodoo 2 portends to be the best chipset of 1998 (see preview, page 86). The company's 2D/3D AGP Banshee part also promises stellar, console-busting performance. Do other chipset vendors even have a chance? Yes, they do—and the list of accelerators vying for the 3D crown is lengthy.

nVidia's ultra-fast Riva 128 has caught the attention of many system manufacturers, as has ATI's 3D Rage Pro chipset. Rendition's V2000 is now shipping in Diamond's Stealth II S220 and Hercules' Thriller 3D to an eager crowd, while 3Dlabs's Permedia 2 is making appearances on almost every manufacturer's entry-level OpenGL offering (see next month's issue for a Permedia 2 showdown). Even NEC/Videologic's less-than-stellar PowerVR architecture will make a second comeback with PMX1 (aka Highlander). And surely Sega's use of the PMX1 architecture in its next-generation console machine should help raise PowerVR mindshare.

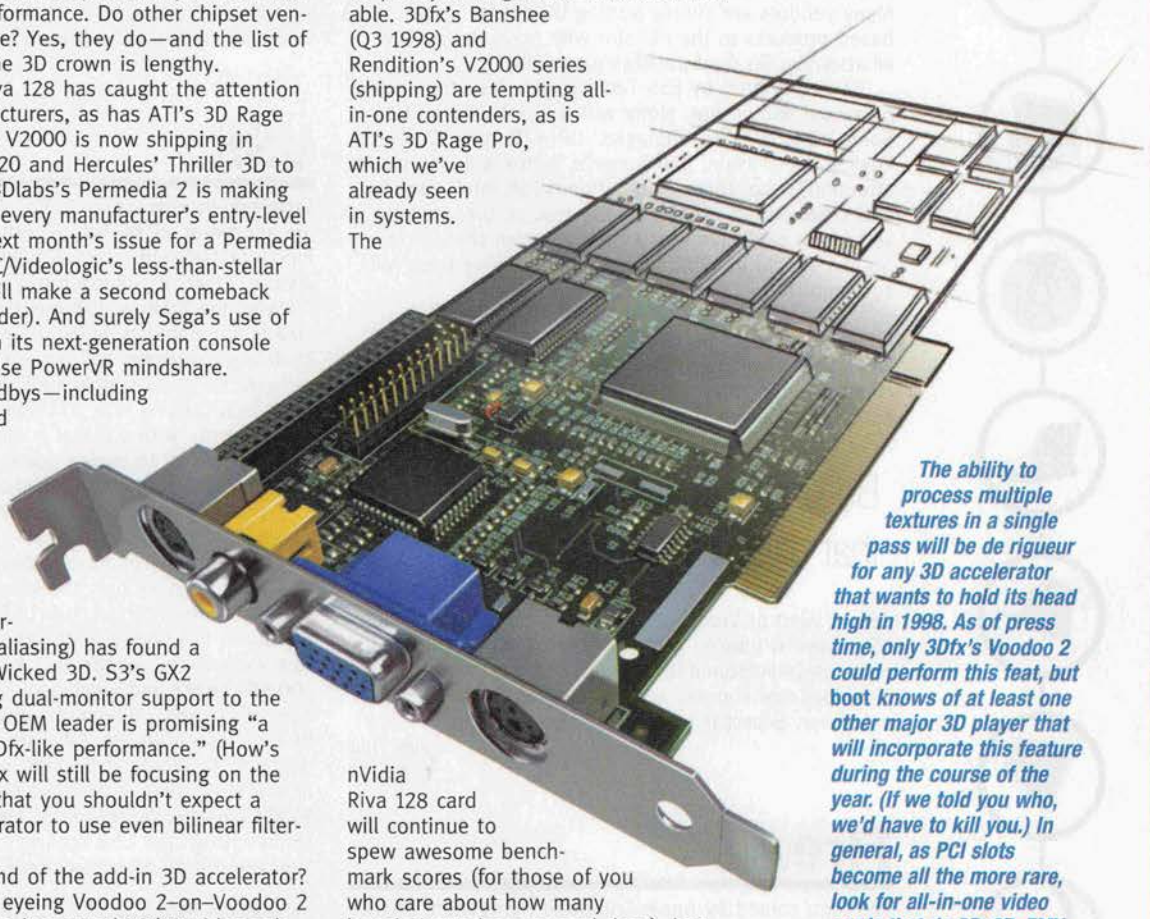
While some old standbys—including Tseng Labs, TriTech, and RSSI—have yet to announce new products, others have risen to the challenge. Oak Technologies' 2D/3D WARP 5 processor (capable of trilinear filtering and full-screen anti-aliasing) has found a home with Metabyte's Wicked 3D. S3's GX2 processor plans to bring dual-monitor support to the table, and the one-time OEM leader is promising "a new architecture with 3Dfx-like performance." (How's that for cojones?) Matrox will still be focusing on the 2D arena and has said that you shouldn't expect a Matrox-native 3D accelerator to use even bilinear filtering until next year.

Will 1998 spell the end of the add-in 3D accelerator? No—especially if you're eyeing Voodoo 2–on–Voodoo 2 love action. However, the integrated 2D/3D video subsystem will gain power as 1998 rolls forward, and there'll be choices galore once the dust settles.

And what about AGP? While the majority of manufacturers agree AGP is a good thing, some vendors plan to skip the texture-storage-in-system-memory madness and use AGP as a fat I/O port capable of massive 66MHz data-transfer rates. This means pumping triangle data and vertex information up and down the AGP port, and nothing more. Still, others will indeed use that AGP bus for moving mounds of high-res textures from system memory straight to the 3D processor, so it'll be interesting to see which idea proves more appealing to software developers.

UPGRADING: High on the power user's list will be that mandatory Voodoo 2. We said mandatory—so if you're scared of bad mojo, don't come running to us, crying about unaccelerated *Quake II*. Whether you go with a dual PCI configuration or a single AGP card depends on how much you're willing to spend and which vendor you shack up with. Creative Labs, Diamond, and Jazz have announced PCI Voodoo 2 add-in boards, but you'll have to wait until March of 1998 to see this Voodoo 2 doo-doo.

Can't hang with add-in boards? Don't bug. There will be plenty of single-card solutions available. 3Dfx's Banshee (Q3 1998) and Rendition's V2000 series (shipping) are tempting all-in-one contenders, as is ATI's 3D Rage Pro, which we've already seen in systems. The nVidia Riva 128 card will continue to spew awesome benchmark scores (for those of you who care about how many bungholioMarks your card does), but visual fidelity remains something the Riva 128 may never truly attain. And as far as everyone else claiming muy grande fill rates and trilinear filtering galore? We'll believe it when we see it.

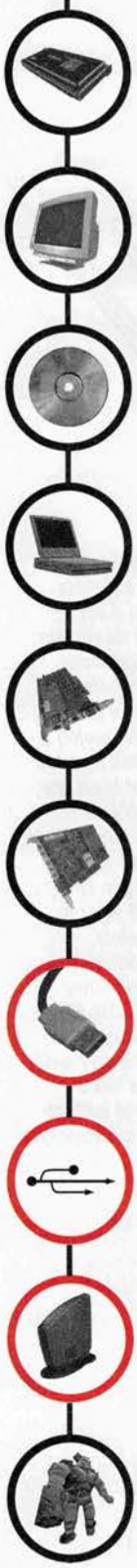


The ability to process multiple textures in a single pass will be de rigueur for any 3D accelerator that wants to hold its head high in 1998. As of press time, only 3Dfx's Voodoo 2 could perform this feat, but boot *knows of at least one other major 3D player that will incorporate this feature during the course of the year. (If we told you who, we'd have to kill you.) In general, as PCI slots become all the more rare, look for all-in-one video cards that do 2D, 3D, FMV playback, and composite/S-video-out extremely well. And expect even more boards to come in with an affordable 8MB of memory.*

—*Andrew Sanchez*

Sound Cards

SoundBlaster compatibility is dead—and in 1998 you'll see PCI-based audio accelerators assume command. More and more games will rely on DirectSound and DirectSound3D as the API du jour, and you can bet that 3D positional audio will also become the norm. If you're still sticking with that resource-hoggin' SoundBlaster, expect your frame rates to drop like a rock when those multiple sound channels come a-callin'. Doubt us? If you own an ISA-based sound card, try playing *Jedi Knight* with 32 audio channels. Getting a bit choppy? With a dedicated DSP riding the PCI bus,



the sound card takes care of mixing and processing, taking the load off your CPU.

In the mass migration to PCI, make sure you're getting an actual accelerator on that new sound card. Many vendors are simply porting their existing ISA-based products to the PCI slot with no on-board DSP whatsoever. So read packaging carefully.

Cards powered by ESS Technology's Maestro-1 signal processor will be hot, along with cards based on S3's Sonic Vibes. Oak Technologies' OPI-610 Audia3D, Cirrus Logic's SonicFusion, and Aureal's Vortex will also vie for attention. Other technologies from VLSI, Intel, Yamaha, and Q-Sound are running about, too, so prepare yourself for an explosive year in audio, which should blow up like 3D did in 1997. Shoot, even Creative Labs will succumb to a PCI part.

UPGRADING: You'll be ready for the PCI/DSP excursion when you're willing to give up "100% SoundBlaster-compatibility." Many cards are entering the DSP-enhanced PCI sound card market, and we've already caught wind of Videologic's amazing Sonic Storm. This ESS Maestro-1-based card will sell for under $100 and offer full DirectSound3D support, DLS 1.0 support for downloadable sounds, and an integrated 500MIPS processor. Expect it by the time you read this.

—Tim Tully

Be on the **lookout** for **modems** that offer **112Kbps** via POTS.

Firewire

The term coined by Apple Computer burns more brightly in the imagination than any tech term since SCSI. And despite legalities forcing non-Apple folks to refer to it by its proper name—"IEEE 1394"—it's already renowned as Firewire. We're talking superfast I/O, bringing high-end video production to regular consumers.

Compatible devices can burn data across IEEE 1394 at speeds starting at 400Mb/sec, and Intel moles swear the chipmaker will heat it up to 3.2Gb/sec in the not-too-distant future. The hot-dockability of 1394 devices mean you can flagrantly plug-and-play, and then unplug again while everything's up and running, with no crashing or burning.

Though DV editing is the 1394 application of the present, the white-hot data pipe is intended to speed up connections between the PC and the world of consumer electronics. Firewire devices for high-bandwidth, content-rich applications such as DVD-ROM, digital video decks, hard disks, digital still cameras, video conferencing cameras, and even printers and scanners are all coming. Interestingly, 1394 is already a hit in Japan, where a good half of all the camcorders come with a 1394 port for downloading video to digital VHS players.

UPGRADING: If you're hot for building a digital video editing system, fire away today with a Firewire camera and a workstation equipped with Firewire ports (more and more add-in video capture cards come equipped with Firewire ports, too). Otherwise, unless you're going to Japan soon, there's little to upgrade to—this year.

—Tim Tully

USB

Extremely inexpensive to build, Universal Serial Bus ports are appearing on all PCs, as well as on more and more monitors designed to act as hubs to which USB peripherals can attach. As opposed to the ultra-high-bandwidth Firewire, the 12Mbps USB was designed to support more standard peripherals, such as keyboards, mice, game controllers, scanners and printers. It does, however, have enough oomph to supply audio loudspeakers—such as the Altech Lansing ADA 305 SurroundCube Speaker System—with a digital audio stream that the speakers convert to analog audio. Taking the digital-to-analog converters out of the noisy PC environment provides potentially cleaner sound and obviates the need for a sound card.

USB devices have appeared slowly in retail, partially because only the latest OEM version of Windows, OSR 2.1, has USB drivers. (Windows 98, of course, will have the drivers—when it finally ships.) One workaround for this is exemplified by Kodak's DVC-300 still-image and video-conferencing camera. This $199 USB goody, like many others, ships not only with its own device drivers, but with an OSR 2.1 "USB supplement" to Windows 95 that includes USB drivers. Intel's $199 Create and Share Camera Pack and the $130 Connectix QuickCam VC also provide USB video conferencing, and USB scanners are available from Logitech, Umax, Microtech, Leaf, HP, and Plustech.

UPGRADING: The name of the USB game is "no add-in cards" and their attendant IRQsomeness. Do nothing until you have a new system with a USB-friendly OS and the USB ports built in. But once you do have this system, go for broke with USB goodies.

—Tim Tully

Net Access

Most home consumers—even power users—will top out at 56.6Kbps during 1998, using either 3COM's x2 spec or the K56flex spec co-developed by Rockwell and Lucent. Unfortunately, due to disagreements over patent licensing, the International Telecommunications Union will not be able to propose a unified 56.6Kbps standard for another few months, meaning final ratification will be delayed and modems using the official ITU spec won't appear until 1999. But be on the lookout for modems that offer 112Kbps via plain old telephone service. Boca Research's DynamicDuo modem and Diamond's Shotgun modem use tandem 56.6Kbps chipsets to give you this ISDN-like bandwidth. Unfortunately, these novel boxes

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The **1998** Blueprint

Don't buy any system in 1998 that lacks these high-end parts. Sure, you can play around with options in each component category, but ask us first about technology that doesn't appear here.

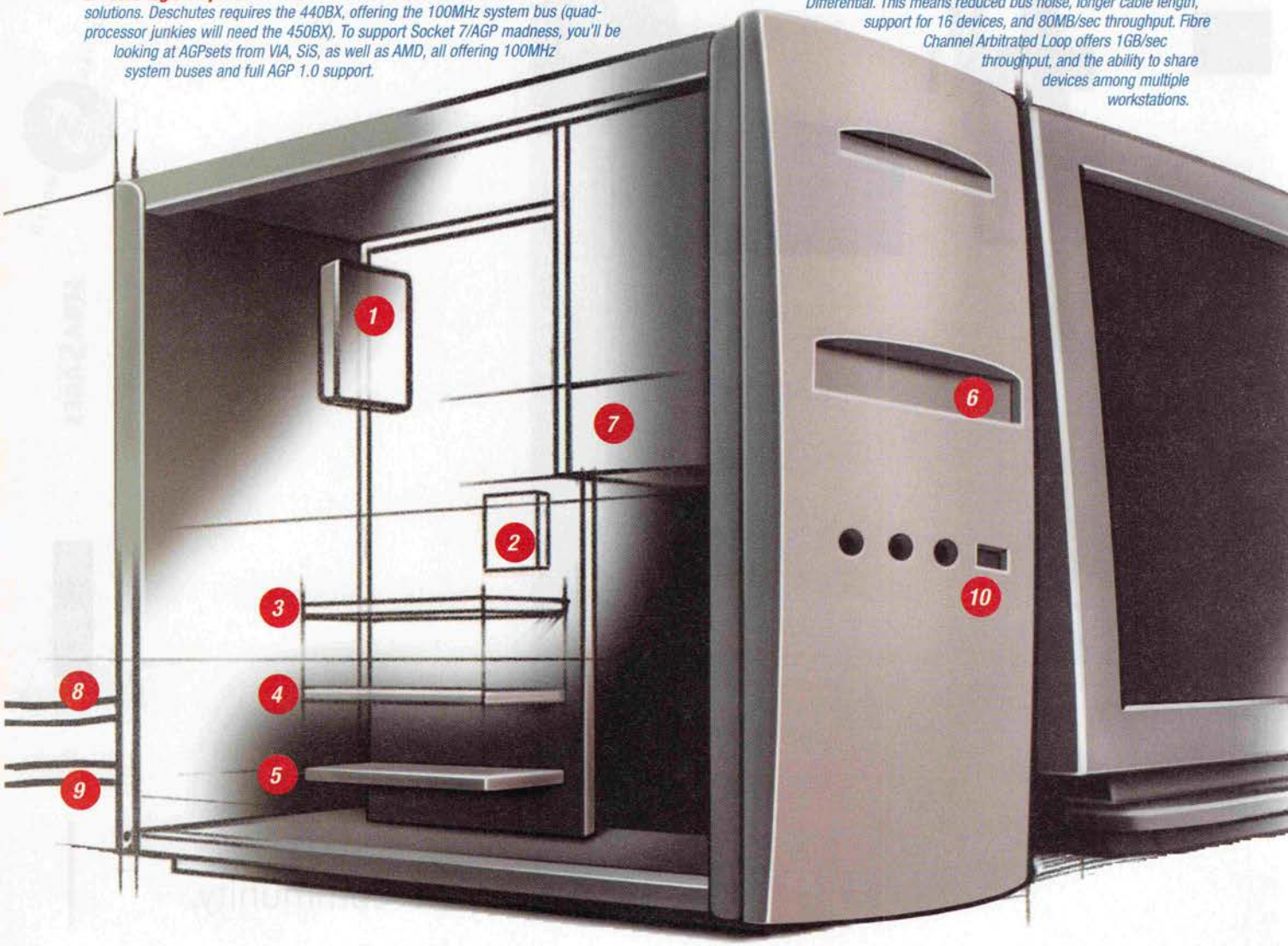
1 CPUs: *We expect Intel's 333MHz Slot 1 Deschutes to appear sometime in Q1, while mega-fast Slot 2 processors won't hit until the end of next year. Look for major rumblings from AMD—its K6+3D processor running at 400MHz is getting incredibly strong support from software developers and motherboard manufacturers. Look for it on store shelves in Q4.*

2 Core-logic Chipsets: *Intel's 440LX will still be the mainstream AGPset for Slot 1 solutions. Deschutes requires the 440BX, offering the 100MHz system bus (quad-processor junkies will need the 450BX). To support Socket 7/AGP madness, you'll be looking at AGPsets from VIA, SiS, as well as AMD, all offering 100MHz system buses and full AGP 1.0 support.*

3 3D acceleration: *Voodoo 2 is of course the sure bet, but look for yet-to-be-announced accelerators from nVidia, PowerVR, ATI, and Rendition. These mysterious chipsets promise to match Voodoo 2's 3D prowess in every way, and also give you high-res 2D with fast RAMDACs.*

4 Sound: *Next year's sound card will ride the PCI bus with a dedicated DSP. Promising chipsets include ESS's Maestro-1, S3's Sonic Vibes, Aureal's Vortex, and Oak's Audia3D—all offering support for DirectSound3D and A3D.*

5 I/O: *You should already be seeing Ultra2 SCSI host adapters with Low-Voltage Differential. This means reduced bus noise, longer cable length, support for 16 devices, and 80MB/sec throughput. Fibre Channel Arbitrated Loop offers 1GB/sec throughput, and the ability to share devices among multiple workstations.*



6 Storage: *Make sure your CD-ROM runs at 32x, and don't shy away from CD-R—drive prices are dropping, media costs are at an all-time low, and read speeds have reached 12x. Go with second-gen DVD-ROM if you find it in a complete system.*

7 Hard Drives: *Capacities will hit 18GB, while drive throughputs should reach the 15MB/sec mark. Smaller platter sizes and improved spindle motors will improve latency and seek times.*

8 Firewire: *You'll need the 400Mb/sec throughput for your digital video projects, but other IEEE 1394 applications are another year away.*

9 Net Access: *Cable modems will stride past DSL schemes in the broadband arena, but chances are you'll be using either an x2 or K56flex modem for 56.6Kbps access—it will be late 1998 before a unified K56flex spec is ratified. Got two phone lines? Then go for 112Kbps with a dual-chip modem.*

10 USB: *More peripherals are on the way, including cameras, scanners, and game controllers. Look for ports on the fronts of cases and on monitors, too.*

11 Displays: *Low-end 19- and 21-inch monitors will drop down to $800 and $1,200, respectively. Refresh rates and focus will improve, but you won't see finer dot pitches or resolutions. Cheaper flat-panels will be a boon for dual-monitor support in Win98.*

require two phone lines and possibly even two ISP accounts. Expect Shotgun modems sometime during Q1 1998. The DynamicDuos might even be shipping by the time you read this.

Broadband Digital Subscriber Line variants (which are only available via phone companies because they require compatible equipment in the telcos' switching rooms) will pick up steam next year, but will still be limited to select markets and cost you fat bank. Pacific Bell's FastTrack DSL service will offer downstream speeds of up to 1.5Mbps for an installation fee of $125 and monthly fees of $80 to $250. FastTrack customers will also have to purchase a DSL modem for anywhere between $440 and $660. Other notable phone companies in the DSL hunt include US West, Southwestern Bell, Bell South, and Bell Atlantic. DSL solutions are emerging slowly because phone companies despise both change and anything that cuts into their very profitable T-1 services, which sell for an average of $1,500 monthly. Nonetheless, an unflappable Rockwell has proposed a 1Mbps "consumer" DSL standard and says CDSL modems and services will be rolling out in the second half of 1998.

Broadband cable modems (1.5Mbps to 3Mbps downstream) currently serve about 50,000 subscribers connected to services such as @Home, Road Runner, and MediaOne. Subscriber numbers could jump into the millions, however, with the advent of a congealing cable modem deployment model backed by Intel, Cisco, and @Home. The new model would ditch internal Ethernet cards and instead employ USB or Firewire to connect external cable modems to PCs. This means a much quicker (and cheaper) installation process that can be done by subscribers themselves rather than cable company technicians making house calls. Currently, an estimated 6.5 million homes can access cable modem service.

Finally, data packets will also speed up on the backbone end as Qwest Communications continues to build its awesome transcontinental network. The all-fiber network is being erected from scratch as an IP conduit—this as opposed to a voice network upgraded piece-meal to high-speed Internet duties. The 16,000 miles of fiber should be done by 1999. The bidirectional SONET ring network will initially operate at OC-12 (622Mbps) but will eventually run at OC-192 (10Gbps). Qwest says that when its project is complete, it will serve 125 cities and own 77% of all U.S. backbone action—so chances are indeed good that your packets will ride this amazing IP bullet train.

UPGRADING: Don't buy any 56.6Kbps modem that doesn't give you an unconditional upgrade to the final ITU spec (and make sure your ISP supports your particular modem spec, be it x2 or K56flex). Since DSL solutions cost so much and are so scarce, we recommend that you keep a careful watch of the "availability" updates on the cable modem service web sites and jump on the high-bandwidth wagon when the circus comes to your town. @Home, Road Runner, and MediaOne currently charge around $100 for installation and $40 to $50 for monthly service. You'll also have to buy or rent the cable modem, and possibly even a network card.

—Jon Phillips

Gaming Engines

The hot 3D engines we've been drooling for should be old hat by the time you read this. Mixed colored lighting and layered transparencies will not be the gee-whiz of tomorrow, but the ho-hum of yesterday. So what will be in the next generation of gaming engines?

Forget about software acceleration, for starters. All 3D games will be hardware-only. Everyone from Andy Hollis at Origin to John Carmack at id is going pure hardware. Voodoo 2 will have penetrated the marketplace by late 1998, bringing with it a 192-bit memory architecture and 2.2GB/sec in memory bandwidth. That's 50 billion operations per second, 3 million triangles per second, and 90 million dual-textured, bilinear-filtered, mip-mapped, Z-buffered, alpha-blended pixels per second. Multiple boards can be daisy-chained, with both boards automatically using Scanline Interleave (SLI) mode. This means the first board draws the even scanlines of a frame, while the second draws the odd, doubling the performance speed.

As for the game engines that take advantage of all this power, *Prey* will finally be here (maybe), while *Unreal* will have had its initial shake-out and begun spawning new games based on its world builder. Distance rendering will be much better, with *Redline* showing some impressive strides in this area. Continuous levels, built using portals, will be the norm, freeing level designers for more interesting, fluid worlds. Expect to see outdoor environments, better environmental effects such as snow and rain, and wider vistas. *Dark Project* aims to raise the bar for environmental interactions with collapsing levels and burning tapestries. Completely destructible levels should be common coin. And forget about the keys—just blow a hole in the wall.

The *Unreal* editor could be the strongest shaping influence for 3D games into 1999. By allowing the creation of total conversions with a greater level of ease and flexibility than ever before, it could spawn the legion of amateur games that has so far eluded *Quake*. Meanwhile, id is keeping its programming monster John Carmack in the basement and throwing him raw meat while he works on something called "Trinity." This is the next-gen id engine and will also probably power gaming nightmares into 1999. On the board are "true" fogging effects, with fog and smoke moving and being stirred by movement.

UPGRADING: Beat the Christmas '98 rush. Upgrade now. *The Quake II* engine hints at wonders to come.

—T. Liam McDonald

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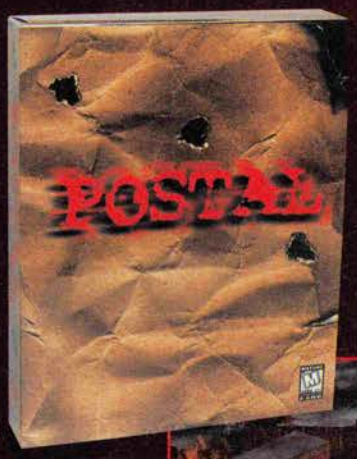

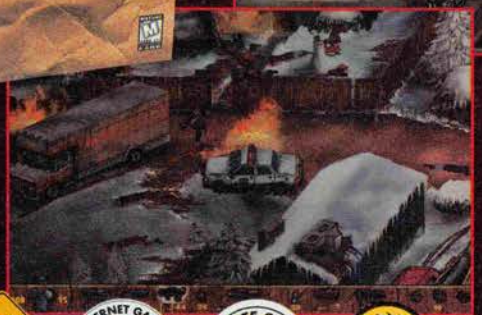

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*Let's **face** it. Even if you're a **die-hard keyboard fragger**, not all games are suited for those 101 **assorted** half-inch **keys**. From **sports sims** to **flight sims** to sims that defy classification, PC games are a mixed breed—a **mongrel** of hot audio, **hotter graphics**, and even **hotter action**.*

*So how do you channel all that **adrenaline** into the PC? With your hands, of course. And to do that, you're gonna need something to **grab onto**. From **gamepads** to **joysticks**, from **analog** to **USB**, controllers are the only tools you'll need to gain the **upper hand** in your never-ending **quest** to beat the **machine**, or better yet, beat your **best friend**.*

—Bryan Del Rizzo

CH Racing System

A real lemon

Once you finally get the CH Racing System set up, you'll wonder why you even bothered.

CH Products calls the CH Racing System a "high-performance" PC system. A steering wheel and a pair of pedals (housed as a separate unit) are dutifully included, as is a desktop clamping mechanism. There's even a special edition (read: cheap OEM version) of Electronic Arts' *Need For Speed* thrown into the box for good measure. While we won't quibble on the definition of "system," we do take exception to the words "high performance."

High performance our ass.

The wheel—constructed primarily of hardened plastic—isn't adorned with any rubber grips, and it feels... just like hardened plastic. Still, with a 160-degree range of motion, its turning radius is surprisingly sweet and tight and worked well in such games as *Need For Speed II* and *Grand Prix II*. However, the wheel is practically devoid of tension and has an extremely limp return to center (and a rather annoying center detent). The clamping system, which uses a sort of wedge design, isn't as effective as the one found on Thrustmaster's Nascar Pro Racing Wheel, but still managed to secure itself safely to the weird curvatures of our desks. Unfortunately, with a somewhat limited clearance, size does matter. If your tabletop is any thicker than one and a half inches, you'll be holding the wheel in your lap.

For shifting chores, the wheel is adorned with four buttons—two on the front and two on the back. Automites may find this arrangement acceptable, but we bet manualites will find the lack of a gearshift offensive. And just in case you were contemplating purchasing the wheel sans pedals, keep in mind you'll have to work the gas and brakes with your thumbs—a cumbersome process.

The pedals are an abomination. They're positioned way too close together, and if you're a real flatfoot, you'll run the risk of pushing both at once. There's no weighted base, and because the pedals are placed so closely, you don't have enough room to hold down the unit with your other foot. As such, the entire unit just ends up fishtailing across the floor.

The installation procedure is poorly documented, and since there are no specialized Win95 drivers, you'll have to contend with myriad buttons, switches, and more buttons just to calibrate the damn thing. It took us about five attempts to get the wheel to stop drifting all over the road like a drunken driver.

According to Volkswagen, on the road of life, there are drivers and there are passengers. If this axiom holds true for the PC, we'd rather take our chances with Sandra Bullock and that bus from hell.

***Price** $119*
(wheel w/o pedals is $69)
***Company** CH Products*
***Phone** 760.598.2518*
***URL** www.chproducts.com*

Thrustmaster NASCAR Pro Racing Wheel

Taking the ole checkered flag

When it comes to racing controllers, we usually follow a few rules of thumb: The system has to include a wheel that feels good, pedals that perform good, and a clamping system that secures good. Luckily for us, the Nascar Pro Racing Wheel scores a hat trick.

The wheel is a beaut', not merely from an aesthetic point of view, but also from a performance perspective. Even with pitiful driving skills, the Nascar Pro performs like a champ. Control is slick, extremely fluid, and even better, the wheel's been designed with a hefty, graduated resistance. This ain't no namby-pamby controller—to drive this muscle car, you're gonna need real muscles, boy.

The wheel incorporates a 270-degree turning radius (the actual dead-zone will vary from game to game), and it'll take you a few practice tracks to become master of your domain. But thanks to the natural-rubber compound coating the wheel, your hands will get one hell of a comfortable workout. A plastic gearshift with a full-metal shaft is positioned just to the right of the wheel, with two buttons in the middle of wheel assigned normal game commands, such as change-of-view or "hey-girl-wanna-check-out-my-new-wheels." If you don't like using the shifter to change gears, you can reassign its functions to other game commands as well.

The pedals rock. Although the entire unit is laughably lightweight, the pedals offer good resistance. Plus, their dimensions are somewhat realistic, with the brake pedal substantially bigger than the gas. And like the CH Racing Wheel, you can hook up the pedals separately (on different axes) or combined (on one).

The base unit is made of ABS plastic (Acrylonitrile Butadiene Styrene), and the clamping system, with unique arms and immense adjustability, is first in its class. Plus, the Nascar Pro Racing Wheel includes dedicated Win95 drivers, so installation and set up is a real snap.

If you really dig racing sims, you'll dig the Nascar Pro Racing Wheel. About the only thing missing are the cup holders.

***Price** $129*
***Publisher** Thrustmaster*
***Phone** 503.615.3200*
***URL** www.thrustmaster.com*

The Nascar Pro Racing Wheel is the epitome of everything a good PC racing system should be.

Thrustmaster Rage 3D

A really rad pad

This is one comfy controller. And although you can't see 'em, two additional buttons are located on the underside of the Rage 3D.

When we completed our first roundup of gamepads more than a year ago, only two of the contenders scored a bootVerdict of more than 5—Gravis's GamePad Pro (which scored an 8) and Thrustmaster's Phazer Pad (which scored a 7). Since then, the Phazer Pad has been permanently phased-out and has been replaced with the new Rage 3D.

It's been worth the wait.

The Rage 3D is an astonishing accomplishment, one that manages to integrate the coolest features from both a traditional gamepad and arcade controller into a single, devilishly programmable, digital controller.

At its core (and under Win95), the Rage 3D is a basic two-axis controller with ten buttons. The Rage 3D will function in a DOS window—albeit with limited functionality (thanks to that ol' gameport)—but not pure DOS. All the buttons are programmable for up to ten keystrokes each, but you can't define separate commands for a button press and button release. Regardless, the Win95 interface is a treat—not only is it remarkably easy to set up and use, it's also seamlessly integrated into Win95's joystick control panel. You can even print out the control sets, which is a must for complex fighting games. But the interface acts only as a front-end—you'll have to launch your games via more traditional methods.

The Rage 3D incorporates two modes of play: 2D and 3D. Break open the black plastic shell, and you'll discover a small ring positioned directly underneath the directional pad that's surrounded by small rubber spring posts. When the pad is in 2D mode, that ring is locked into place by the posts; in 3D mode the spring posts swing freely. The end result? In 2D mode, the Rage 3D functions as a normal gamepad, with control in eight directions. In 3D mode, however, the D-pad produces a full-range of unrestricted motion. Although the 3D mode has a slight learning curve, stick with it—you'll quickly gain the upper hand against your opponents in such games as *MotoRacer*, *NHL 98*, and *Manx TT*, where this 3D modus operandi can come in very handy. You can even switch between the two modes in the middle of a game.

Very cool.

For multiplayer mayhem, the Rage 3D includes an adapter allowing you to hook up four controllers at once. And if you place the Rage 3D on a flat surface, you'll discover the specially designed pontoons secure the pad in place, turning the Rage 3D into a pseudo desktop arcade controller.

The Rage 3D is a winner.

Price $50
Company Thrustmaster
Phone 503.615.3200
URL www.thrustmaster.com

boot verdict 9

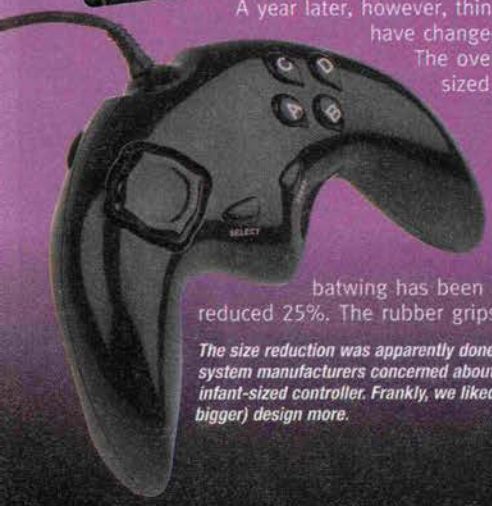
Alps PC Gamepad

It's USB, baby!

The military-themed programming interface is excellent and is integrated seamlessly with Win95's joystick control panel.

When Alps introduced a prototype of its USB gamepad in late 1996, we were excited for two reasons: It was the first USB controller we'd ever seen, and the oversized bat-winged design simply raged.

A year later, however, things have changed. The oversized batwing has been reduced 25%. The rubber grips under the extended pontoons are gone. And the speckled red and blue color schemes have been swapped for a simple, shiny, stealth black. Luckily, though, performance is still killer.



The size reduction was apparently done at the request of system manufacturers concerned about bundling a non-infant-sized controller. Frankly, we liked the original (and bigger) design more.

We were of a split mind with the smaller design, but it's still comfortable to hold, and all the buttons are positioned well within fingers' reach. However, thanks to the shortened pontoons and lack of rubber grips, we experienced some cramping in the palm while holding the pad tightly during a bone-crunching period in *NHL 98*. Overall, however, the buttons and D-pad have an excellent feel to them, and the pad is both quick and precise in execution.

Like most top controllers, the pad is completely programmable. The programming interface—dubbed the Gaming Munitions Manager—is intuitive, although we're undecided about the military motif. Regardless, the interface is one of the best we've seen. Our only complaint: You can only assign three keystrokes to the buttons, and you have to install the game on your hard drive before making a new control set.

Unfortunately, because the pad is USB, you won't be able to purchase it at retail (dang!) until Microsoft releases Windows 98 in late 1998. Several Japanese and European manufacturers (including NEC and Toshiba) have pledged to bundle the pad with their new systems overseas, and its our fervent hope their U.S. counterparts decide to do the same.

Price TBD
Company Alps Interactive
Phone 800.950.2577
URL www.interactive.alps.com

boot verdict 9

Microsoft SideWinder Precision Pro

Doesn't force the issue

The SideWinder Precision Pro is essentially the same stick as the SideWinder Force Feedback Pro (reviewed in *boot* 15), minus all the cool accouterments. If you balked at shelling out a whopping 150 greenbacks for the force-feedback version, you'll be pleased the SideWinder Precision Pro is priced considerably cheaper—half the price to be exact.

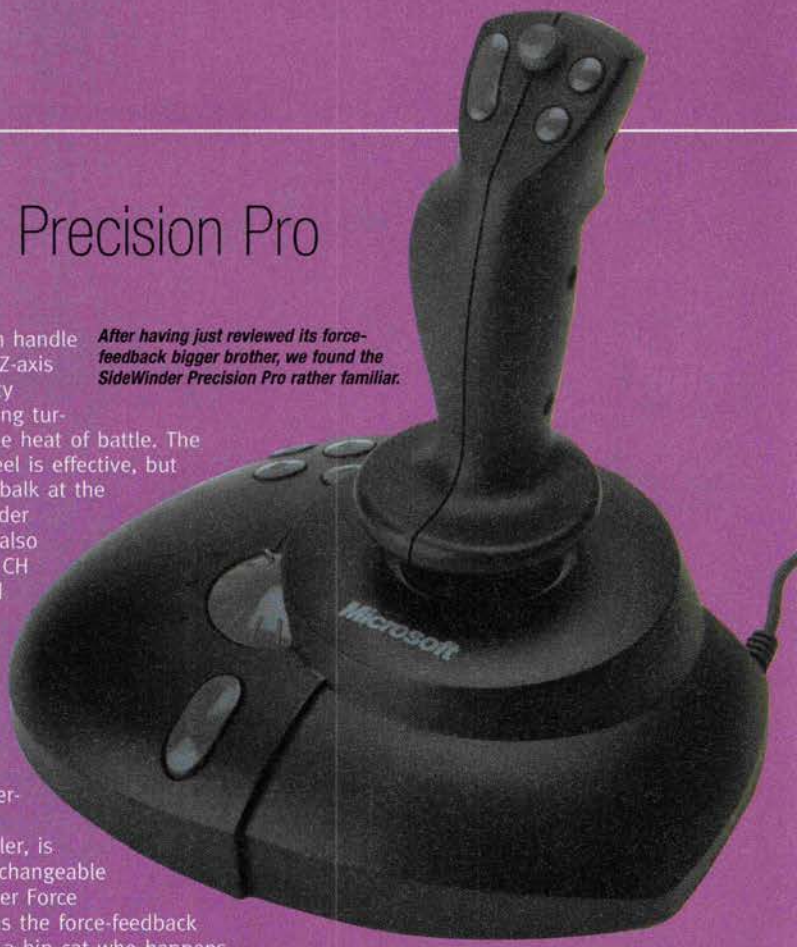
So what do you get for your 70 bucks? You get plenty.

Like all the new breeds of digital game controllers, the SideWinder Precision Pro utilizes an optical system that provides precise game control, reducing joystick drift in the process. Remember folks: No potentiometers means better control. The handle has been ergonomically designed, and—get this—is equally suitable for either right-handed or (gasp!) left-handed control. The ten fire buttons (including the trigger and an eight-way hatswitch) are placed in easy-to-reach positions and have resounding tactility.

It's not much too look at, but it gets the job done nicely.

Just like the original SideWinder Pro joystick (released almost two years ago), the handle also swivels. And as long as your gameport can handle it, that additional Z-axis can come in mighty handy for controlling turrets and yaw in the heat of battle. The rotary throttle wheel is effective, but flight purists may balk at the idea. The SideWinder Precision Pro can also emulate the older CH Flightstick Pro and Thrustmaster joysticks, but only in a DOS box. If you're still running pure DOS games, this stick is useless.

The Win95 interface, dubbed the Game Device Profiler, is identical and interchangeable with the SideWinder Force Feedback Pro (sans the force-feedback stuff), so if you're a hip cat who happens to own both devices, a single software install will do ya. We like the interface—it takes only seconds to create new control sets—but we're not keen on having to use a shift button (located just beneath the rotary throttle) to toggle between the two tiers of button assignments. Two niggling complaints: You can't print the control sets, and you can't launch the game automatically from the GDP.



After having just reviewed its force-feedback bigger brother, we found the SideWinder Precision Pro rather familiar.

If those fandangled force-feedback sticks are giving your hand and wrist a workout, this may be the stick for you.

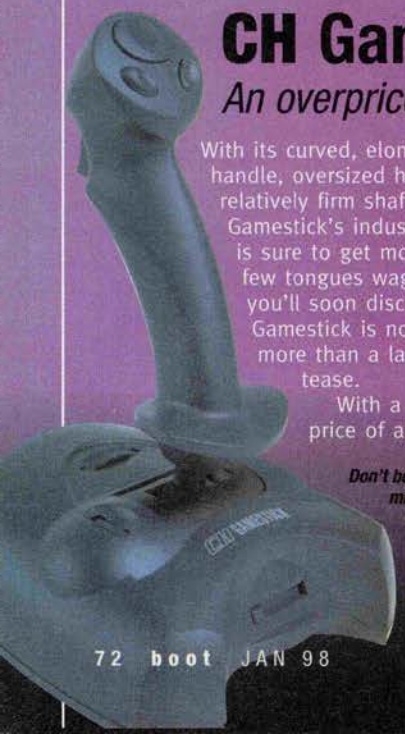
***Price** $70*
***Company** Microsoft*
***Phone** 800.426.9400*
***URL** www.microsoft.com*

CH Gamestick

An overpriced underperformer

With its curved, elongated handle, oversized head, and relatively firm shaft, the Gamestick's industrial design is sure to get more than a few tongues wagging. But you'll soon discover the Gamestick is nothing more than a lascivious tease.

With a street price of almost $40, you'll be better off with a stick with a few more defining features—such as programmability, digital control, and additional buttons. Not that the Gamestick is a complete dog. Performance is actually quite good, with fluid motion and good tactile button response. And even though the design feels comfortable in either hand (lefties will be pleased), you'll find it extremely difficult to reach the uppermost button if the handle is pushed all the way forward on the Y-axis. But with that elongated handle and an extremely lightweight base, the laws of physics dictate the Gamestick will end up lifting off your desktop. Luckily, you won't have any problem holding it down on your desktop with one hand while working the sliding throttle control on the front with the other.



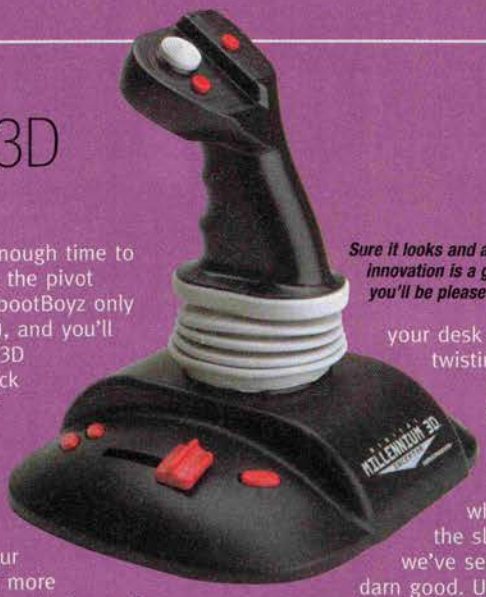
Don't be fooled by the misleading advertising. The Gamestick is not programmable.

If the Gamestick was priced around $20, we might've recommended it for the low-end, entry-level gaming crowd. But with its profound lack of features and severely inflated price, you'd be wise to check out CH Products' slightly more expensive, but much better, Flightstick Pro instead.

***Price** $40*
***Company** CH Products*
***Phone** 760.598.2518*
***URL** www.chproducts.com*

Thrustmaster Millenium 3D

A riveting, pivoting experience



Sure it looks and acts kinda strange, but innovation is a good thing? Give it a try, you'll be pleased you did.

Based on a rotational hand controller used on board the Space Shuttle, the Millennium 3D is clearly one of the quirkiest PC joystick we've gripped in a long time. But quirky as it is, it's also one of the coolest and most original.

In some regards, the Millennium 3D is just like other conventional joysticks. It provides movement across three axes—X, Y, and Z (the latter comes in handy during games such as *Flight Simulator 98* and *MechWarrior 2*). It's replete with buttons, including a four-way hat-switch, five fire buttons, a single-stage trigger, and a sliding throttle control. It's digital, and it's also programmable. So what's the big diff?

The Millennium 3D features left and right roll on all three axes, but instead of moving the handle up or down (affecting a traditional gimbal/potentiometer system), the Millennium's grip pivots around the center of your hand. For example, if you pull back when using a traditional joystick, the entire handle moves back as one unit. Execute the same move on the Millennium, however, and the bottom of the handle pivots forward, causing the top of the handle to move back (toward you). This isn't a complex controller, but the pivoting motion may perturb seasoned flight jockeys who'll classify the feel as "unnatural."

In addition to the usual programming interface, the Millennium 3D has a test and activation program, which means you'll never have to set foot in the joystick control panel again.

Bah. Give yourself enough time to grow accustomed to the pivot motion (it took the bootBoyz only a couple of minutes), and you'll find the Millennium 3D absolutely rocks! Stick trick: Playing with it directly in front of you makes for a wrist-wracking experience. Instead, place the Millennium off to your right or left for a far more comfortable (and enjoyable) experience. It'll take a while to become comfortable with the stick's stiffness, as well.

Gamers with fists of death will find the Millennium's oversized handle provides a perfect grip. Others not so well endowed may find it a tad uncomfortable. Personally, we didn't encounter any discomfort at all. The rear of the handle is contoured to hold your fingers in place, and even with a super-tight grip, all the buttons—including the ones on the base—are well within reach. The sliding throttle provides smooth operation, though we would've preferred a much more rigid hat. Also, with a total weight of 3.5 lbs., you don't have to worry about the Millennium slipping and sliding across your desk while you're twisting your wrist.

A Win95 programming interface dubbed ThrustMapper is included, and while it's not quite the slickest interface we've seen, it's still pretty darn good. Unfortunately, programmability is somewhat limited. You can assign only one keystroke or DirectInput control to each button—say goodbye to those long-winded cheat codes—and you can't launch the game executable directly. The hat-switch and throttle are off-limits, but you can print out the control sets. Less than a dozen sets were included with the shipping unit, and a quick visit to Thrustmaster's web site unfortunately provided no further resources. We hope Thrustmaster will have remedied this by the time this issue of *boot* hits the newsstands.

The Millennium 3D is one solid controller contender.

Price $70
Publisher Thrustmaster
Phone 503.615.3200
URL www.thrustmaster.com

CONSOLE'ATION PRIZE

If you're a real gamer, you already own a PC and at least one console machine—preferably a PlayStation. After all, how else can you brag about the PC's superior graphics and gameplay without having first dissected both versions of, say, Tomb Raider*? And don't you take great pleasure (like we do) in tormenting your console-loving friends by continually mentioning the names of games that aren't available for their console, but are available for your PC?*

But a strange phenomenon has recently hit the PC and console camps. On the console side of things, analog joysticks have suddenly become the controller du jour; for the PC, digital gamepads and joysticks are multiplying faster than rabbits.

So what gives? Has the PC fallen by the wayside in terms of controller technology? Nope, never happened, never will. When analog joysticks first appeared on the PC (in the late 70s to early 80s), an onslaught of flight simulators and combat sims quickly appeared, taking advantage of their full range of motion on the X- and Y-axes. In the early 90s, the first PC digital gamepad was introduced, but back then, digital meant the buttons were either "on" or "off." Pretty simple stuff.

Consoles, meanwhile, including the original NES and Genesis systems, used the same digital technology. As such, realistic flight sims were merely a pipe dream for the console crowd.

But not anymore. In the last year or so, we've witnessed a spate of new analog joysticks (and other forms of game hardware) cropping up for the console markets that bring with them new levels of control for those set-top boxes. After years of being humbled by the PC, console fanatics are only now finally tasting what PC gamers have dined on for years—terrific flight sims with terrific control to match.

But nowadays, the PC is even studlier, and digital technology in particular, is a whole new can of worms. Gone is the rudimentary "on-or-off" limitation. In its place are gamepads and joysticks with faster communication pipelines, full programmability, force-feedback, and multiple degrees of freedom. And USB. So even with the recent strides by its console cousins, the PC is, and will always be, a few steps ahead. So there.

12-STEP

DEALING WITH YOUR **PC OBSESSION** DAY TO DAY BY BREAKING IT DOWN INTO 12 **EASY** STEPS

Benchmarking Your 3D Accelerator

TRY IT ON THE DISC

So you're standing there at the local computer mart, staring wide-eyed at the video card section. You've exorcised that evil S3 ViRGE decelerator from your system and now stand ready for some real visual stimulation.

There's a new breed of 3D accelerators awaiting your tender caress. We know you're smart enough to recognize trash, but with everyone claiming ten zillion mega-pixels-per-second and quad-linear filtering, how do you figure out which 3D accelerator will bring you closer to polygon ecstasy?

Simple—fire up these two new benchmarks and you'll poke those pesky polys and tickle those texels fantastic.

Grab this month's bootDisc and prepare to step into our shoes as a red-blooded 3D-accelerator reviewer.

—Andrew Sanchez

1 Locked And Loaded

Make sure the video card being benchmarked uses the absolute latest drivers and firmware. This means everything, from BIOS to display drivers. The best place to go is the manufacturer's web site; the latest drivers should be in the support section.

While it's best to get the latest drivers from your board's manufacturers, sometimes the 3D accelerator chipset makers come out with reference drivers that work with all boards based on their chipsets. If you want to see performance differences among manufacturers, feel free to install different drivers for your video card, as many of them are interchangeable. We must warn you that mixing video drivers is not recommended for everyday use, as your registry will become bloated and bad things may happen.

Here are some manufacturers' URLs if you've forgotten where to get them.

ATI:	**www.atitech.com**
Matrox:	**www.matrox.com**
Canopus:	**www.canopuscorp.com**
Diamond Multimedia:	**www.diamondmm.com**
3Dfx:	**www.3dfx.com**
Rendition:	**www.rendition.com**
Intergraph:	**www.intergraph.com**
Hercules:	**www.hercules.com**
Jazz Multimedia:	**www.jazzmm.com**
VideoLogic:	**www.videologic.com**
PowerVR:	**www.powervr.com**
S3:	**www.s3.com**
Number Nine:	**www.nine.com**

2 Knowing Your Friends

We'll look at two benchmarks. The first is a test based on Egosoftware's *X*, a forthcoming space exploration and action sim that demonstrates how fast your system can push polygons under Direct3D. *Final Reality*, a test by VNU European Labs and Remedy Entertainment, will give you all sorts of data about your 3D accelerator, including fill rates, polygons-per-second, and frame rates on various 640x480 D3D 5.0 scenes.

All your 3D accelerator functions will be tested and put on display, from alpha-blending, filtering quality, fogging, and more. So, if your card claims mondo feature support, it had better be ready to walk the walk, and talk the talk.

3 Packing In The Ammo

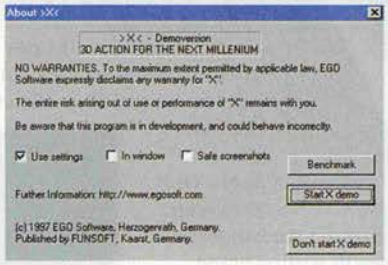
Installing these benchmarks is as simple as popping in this month's bootDisc and following the directions. *Final Reality* requires DirectX 5.0. If your system is already DX5 ready, skip this part. If it isn't, we've provided it for you with this month's bootDisc.

4 Et Tu, Resolution?

With *Final Reality*, the tests are all conducted at 640x480/16-bit. With *X*, however, you can monkey around with resolutions until the benchmark tells you it can't initialize the setting you ask for. So feel free to test all resolutions. With an 8MB board, you can get into some super-sharp modes, but don't expect frame-rate miracles. To see the type of performance gains and hits you should expect with D3D applications, set your display to 512x384, 640x400, 640x480, and 800x600. If any weird "in-between" modes are available, test them too because if *X* senses them, your D3D games should too. Who knows, you just may find that running at a resolution slightly lower than the standard 640x480 may get your favorite game smooth like buttah.

5 X Marks The Spot

Ready to rumble? Good—'cause once we're in, there's no turning back. Run *X* and you'll get the following screen.

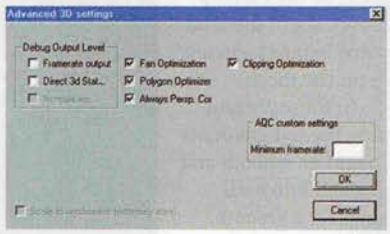


Before you gather your benchmark score, you should familiarize yourself with *X*. So, click on the Start X Demo button to see what interstellar scenes *X* will give you. If you notice your output is skanky looking and horribly choppy, *X* may be trying to use software emulation. If this happens, press Fll and change the benchmark parameters (see the next paragraph for more information on setting up *X*).

If you want to skip to the next scene, press the space bar. To jump back a scene, press the "b" key. To stop the test, press the ESC key and you'll return to Windows. Now, restart *X*, click on the Benchmark button, and the test will begin. The benchmark may try to run in D3D software-emulation mode, so you'll need to check and make sure *X* is using hardware acceleration. Press and hold down the Fll key until you see the following menu.

Click on OK and you'll get this option screen. Options to check before you continue:

- Make sure your DirectDraw device is set to the accelerator you want to benchmark. If you have more than one 3D accelerator (e.g., an ATI 3D Rage Pro and a 3Dfx Voodoo), it will show up in a list if you click on the DirectDraw Display.
- Under Direct3D Device, ensure it's set to Direct3D HAL (Microsoft Direct3D Hardware)—anything else will be software emulation and will run like crap.
- Under Global 3D Settings, we use the configuration shown here. If your board doesn't allow adjustment to a particular setting, it will be grayed out as shown here with the Z-buffer and gouraud shading option. If transparency isn't choosable, you don't have it. You have four options here, listed from worst-case scenario to best: no transparency, stippled, alpha, and Dest blending. Whenever possible, go with Dest blending. Some cards may not support this mode. If yours doesn't, go with the next best option available to you.
- Under full-screen resolution, we test at 640x480/16-bit and 800x600/16-bit. Make sure you're set to full screen on the bottom.
- Under the texture formats, *X* usually determines what's best for your 3D accelerator via its drivers and sets this for you automatically. But if you get gross visual anomalies, you may need to adjust these to fit. More on this later.



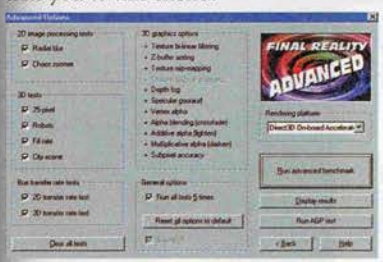
Now, press the Advanced button and you'll get this option screen.

Set your benchmark exactly the way you see here and click OK. Click OK again to start your official run.

6 Entering The Final Reality

To gain entry to *Final Reality*, launch the application. If your system has MMX and AGP on-board, the splash screen will tell you it detects them. After accepting the agreement, you'll be greeted by the following screen.

If you want to get a feel for what the benchmark is all about before doing the serious testing, click on the Run Benchmark button and prepare to be dazzled. Once you've gotten over the initial euphoria, it's time to roll up your sleeves and get started. Click on the Advanced Options button and it'll take you to this menu.



From here, you can see what features your board's current driver supports. Ensure all your settings match what you see here. Like with *X*, make sure the Rendering Platform is set to the video card driver you want to test. You'll want to run the benchmarks five times; check that box. Once you're ready, click on Run Advanced Benchmarks and away you'll go.

As *X* and *Final Reality* run through their paces, observe the following effects and see how your card compares with what we've seen so far.

7 What To Watch For: Filtering

Bilinear filtering is a feature rarely perfected. Some vendors don't care about filtering at all, while others give a half-assed attempt at interpolated pixels. Only the very best cards can give you smooth textures worth writing home about. Here are three examples of filtering qualities, each with explanations on what to look for.

Here, take a close look at the ground textures and the mech. Are they filtered smoothly?

High quality texture-mapping from 3Dfx. Note the lack of visual artifacts and the smooth transition from one color to the next.

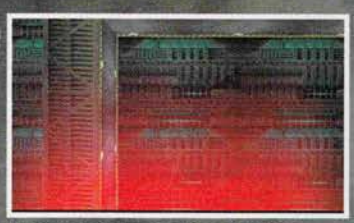
Tsk tsk, nVidia—mip-map compression is showing here loud and clear as dotted visual artifacts. When viewed from far away, it looks as if you're watching your scene through a sieve.

This is just straight-up wrong—no filtering and blocky edges, with no smooth transition. Ugh!

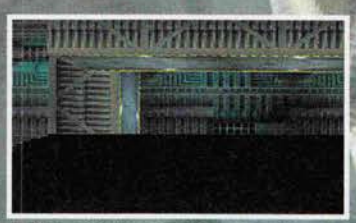
8 What To Watch For: Transparency/Alpha Blending

Blending semi-transparent edges around textures for special effects is another area deserving close scrutiny. If your card isn't up to snuff, the texture map will appear with a solid-colored box clearly visible around it. Or worse, the texture will completely disappear and be replaced by a solid-colored box. The best place to look for alpha problems is in the engine glows throughout *X* and the semi-transparent cloud cover surrounding the planet toward the end of the benchmark. Also, in *Final Reality*'s Robot benchmark, watch the spotlights as the camera moves about the landscape before focusing in on the mech.

In these *X* examples, the red gradients should be smooth and blended into each other for a smooth color transition.



Notice the lack of edges and how smooth the transition is between the red glow and the background textures.



In this pitiful excuse, there's no blending whatsoever. It's a solid block of blackness that's just bunk.

In this Final Reality *scene, two layers of moving clouds should be visible.*

In Final Reality*'s City, pay close attention to the flying ship's exhaust. There should be no black edges. Note the spotlights strewn throughout this scene and the semi-transparent dome to the right.*

Here's an example of missing transparencies—this screenshot's from an nVidia Riva 128 accelerator. Note the lack of a semi-transparent dome.

A great test of your 3D accelerator's transparent capabilities can be found in Lucas Arts'* Jedi Knight. *Try this out: start a new game and make your way to the bar where the bartender keeps telling you "Get out of here, you always cause trouble." Look into the two big windows facing opposite the bar.

If your card supports transparencies, you should see the massive light spires of Nar Shaddaa in the distance. You should also notice just a hint of texture on the windows. If it can't see those buildings, then your card's bunk, G.

9 What To Watch For: Perspective Correction

If your card isn't talking perspective correction, your texture maps will warp and angled lines will become distorted and broken. Take a look at these scenes from *X* to get an idea of what to look for.

This is what you should have—straight lines and textures scaling accordingly.

Ack! This perspective correction is broken. Notice the distorted textures and wiggly lines—very bad.

10 What To Watch For: Specular Highlights and Lighting

Lighting polygons is a feature most cards do without a hitch. Something to watch for is whether your card does lighting "per-pixel" or "per-polygon."

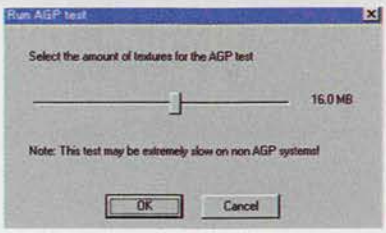
Per-pixel is the best way to go, yielding a smooth gradation of colored lighting from the light itself to the object. Under "per-polygon," cards light the larger triangle, rather than the tiny pixel, resulting in solid lighting with no smooth gradation from lighting to object. With specular highlights, you have to watch the edges of objects to see what kind of lighting you get.

Here's an example of good specular highlighting—notice the smooth transition on the highlighted corner of the asteroid.

In this example, you're not even getting specular highlights—bah!

11 The AGP Connection

As an added bonus, Final Reality has an integrated AGP benchmark that's simple to run. Under the Advanced Options screen, choose Run AGP Test. You'll get the following screen, which lets you adjust how many megs of textures you want to slam your video card with.



Adjust accordingly and fire it up. You should see an animated spiral and a textured background.

After the benchmark is finished, you'll get a result measured in images-per-second.

12 What Does It All Mean?

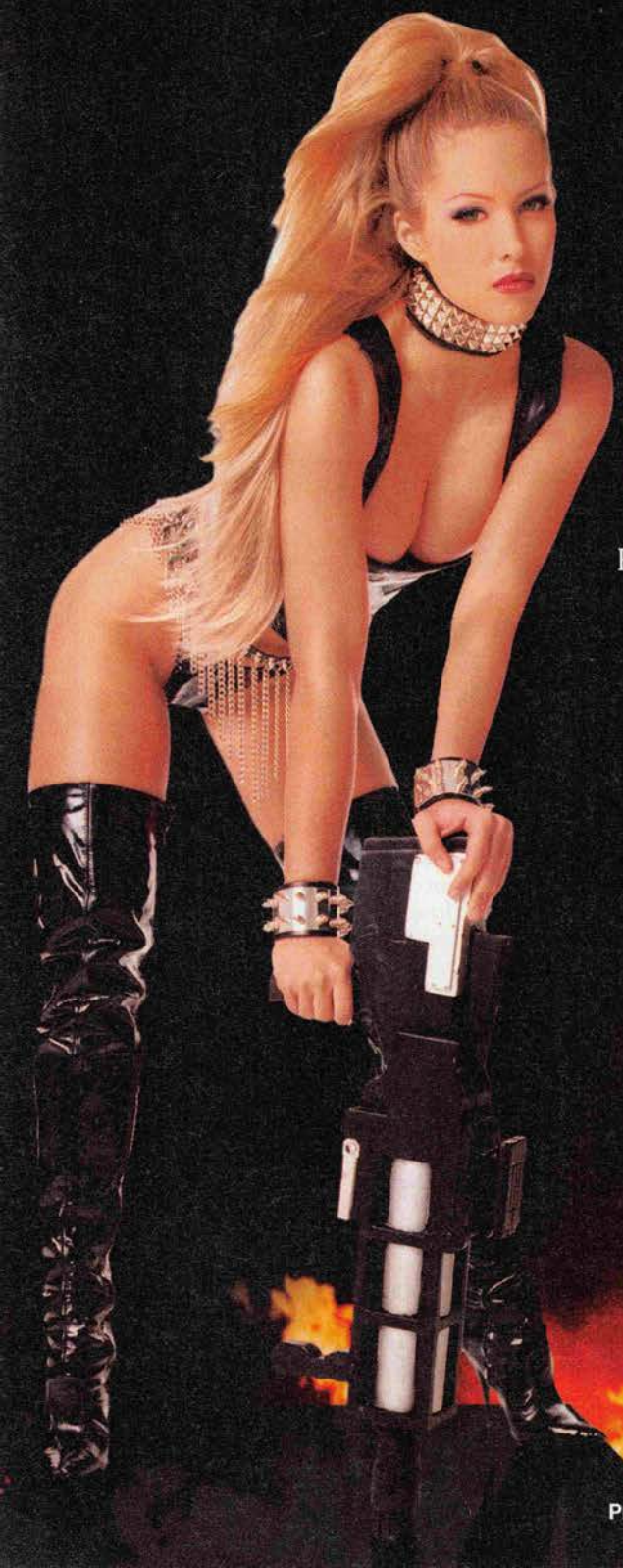
When both benchmarks finish running their course, here's how you interpret the results. With *X*, it's a straightforward average frames-per-second—the higher, the better. 30fps is good, while 45fps+ is excellent. If your system can hit the magic 60fps, then you have one helluva D3D dynamo.

Under the scrutiny of *Final Reality*, take a look at the 3D performance applet when you click View Results. With all scores, the higher the result, the badder your 3D accelerator is.

To see how many polygons your accelerator can push, take a peek at the *FR* Polygon results. This result is reported in thousands-of-triangles-per-second (i.e., 40Kpoly/sec). To see how fast your fill rate is, take a look at the *FR* 25-Pixel result. This score is measured in mega-pixels-per-second (i.e., 50Mpixels/sec). The other scores shown here are in images-per-second, a k a frames-per-second. So, a score of 50.2limages/sec is really 50.2lfps.

Think your card's up to snuff?

PLAY ME...



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Daevid Vincent
webgoth

Sean Downey
software editor

Shorting Jumpers Not Good Enough

As a VAR who specializes in custom PCs, I would like to respond to an anonymous letter in your October Clinic. Your reader asked if his generic motherboard that claims P55C compatibility with only two voltage jumpers (3.3v and 3.5v) supports MMX chips. From experience, I say tread carefully! Recently, a customer upgraded from an IBM Pl50+ CPU (single voltage) to an IBM 6x86l P200+ CPU (dual voltage). Making the same assumption as you, I believed that shorting the jumper designating the CPU as a P55C series chip would drop the core voltage to the correct level. We were quite wrong in that assumption, and due to serious instability, had to upgrade his motherboard with clearly defined core voltage jumpers. In any case, to avoid possible headaches, your reader would be well advised to upgrade his motherboard with his CPU.

Dan Thompson, HD Technologies

GLQuake Problems Galore

I have a Pl66 with a Matrox Millenium to handle my 2D/3D shtuff, and a Monster 3D for 3D acceleration. *GLQuake* is running way slower than I think it should be. I have the latest version of Glide, the latest drivers from Diamond, and the latest version of *GLQuake*. I do have the OPENGL32.DLL in my Quake directory, so I don't think that could be the problem. However, when I first installed *GLQuake* on my machine, I put the OPENGL32.DLL in my Windows directory as well, overwriting the one that was already there. Was that a mistake?

I'm also running a program called TWEAKIT that improves performance on 3Dfx boards. I'm only getting around 20fps when playing single-player, and I get around 13fps(!) when playing on the net. The *Tomb Raider* demo and *Mechwarrior 2*, which came with the Monster 3D, run fine. Please help. *GLQuake* was the main reason I got this card.

Finally, I can't change the resolution of the game in *GLQuake*. The text is at l024x768, like my desktop, but the game itself is still at a measly 640x480, and I can't change it, neither in the game nor by typing -width and -height.

DaMauleR

Hardware editor Andrew Sanchez replies: *Answer one: Overwriting OPENGL32.DLL was a mistake. The OPENGL32.DLL driver for 3Dfx is an ICD, meaning it only supports certain functions of OpenGL. If you put it into the Windows subdirectory, weird things may happen. Get a copy of OPENGL32.DLL from a friend's Windows subdirectory (provided he's not running a full OpenGL-compliant card), and install it in your Windows subdirectory. Or you can reinstall Windows—or beg Microsoft for the original driver.*

Answer two: While the Voodoo does a lot of the polygon acceleration, your CPU speed will still play a factor in how fast your Voodoo performs. Your CPU is still in charge of feeding all the vectors and triangle data down to the 3D accelerator. So, the faster the processor, the greater the speed. Slowness during multiplayer mayhem is to be expected—with multiple objects on screen and tons of special effects, it will bog down. Some people prefer using the Rendition board with multiplayer because it's able to sustain smooth frame rates with lots of objects on screen (thanks to its RISC engine and triangle set-up engine). But apart from anti-aliasing, Verite doesn't give you all the cool visual effects the Voodoo/GL port provides, nor does it scale as well when you go with a higher-speed processor. Beta GL drivers for Verite have just been released—we're taking a wait-and-see approach to the new performance.

Answer Three: Regarding the 640x480 limitation of GLQuake, *you don't have enough video memory on your Voodoo to do 800x600/16-bit. While some games will allow a 3Dfx Voodoo board to do 800x600 accelerated, it'll be without a Z-buffer and will suffer performance hits. If you went with an 8MB Voodoo Rush board, you could go 800x600—but it will be slower than if you went 640x480.*

Does Linux Run On Fumes?

I want to start playing around with Linux, but as I'm unfamiliar with UNIX, I don't want to jeopardize my new home-built Pl66 MMX. Would it run on an old 486DX250 with 8MB RAM and a 540MB hard drive?

Tucker

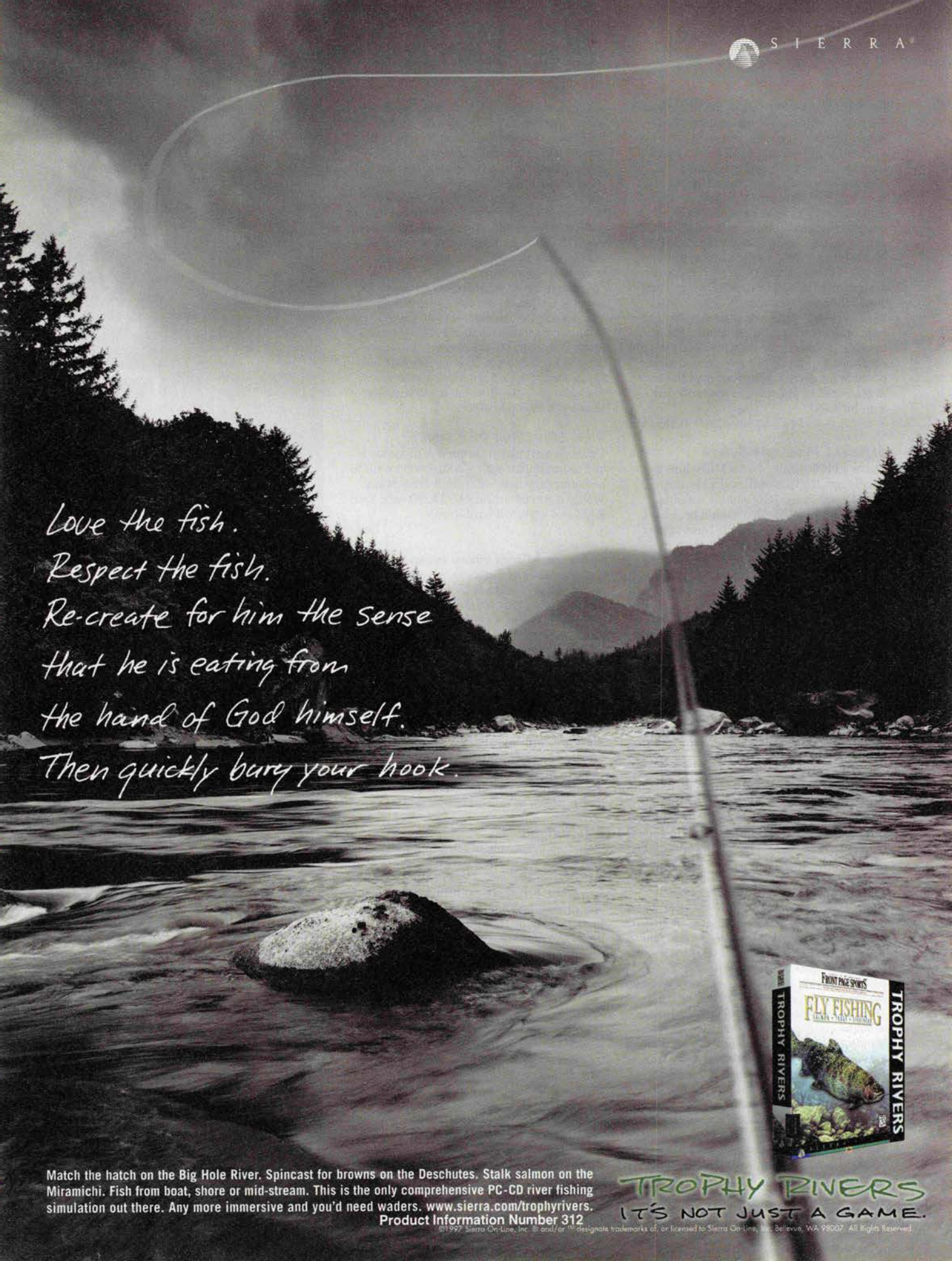
Online editor Daevid Vincent replies: *Linux is a true 32-bit OS and would run very well on a 486 system. Actually, because Linux doesn't fully support the Plug-n-Pray peripherals as easily as some other OSes do, you're often better off with an older system until the kernel drivers for the peripherals become more robust. The kernel can be compiled and optimized for each type of CPU up to P-Pro. Eight megs of memory is a bit slim for X Window, though it will work, albeit slowly, thanks to virtual swap. I have run a full-service, 24-hour server for the past three years on a 486DX266 with 32MB RAM connected to a T3 line with nary a problem. I suggest you join a local Linux Users Group. There's usually one in every city, and they're a great resource for setting up some of the trickier aspects of such a powerful system.*

Waste Removal

How does one go about removing unused drivers from Win95? (I have OSRl.) After installing several driver updates and DirectX 2, 3, and 5, I have several listings for my display drivers; only one is for DX5, which I use. I would imagine the situation is similar for my sound card and CD-ROM drive. How do I find these unused drivers, and how do I remove them from my system—or would it be best if I just left them?

Mcheu

Disc editor Sean Cleveland replies: *If everything is working properly, just leave them. It's worth the extra couple of megabytes, because if you start stripping drivers out of your Registry—which is what it would entail—and blow it somewhere, you could create some larger headaches. But if you must remove them, use a third-party software package such as Helix* Nuts & Bolts *or Symantec* Norton Utilities *to check your Registry for unused entries and drivers.*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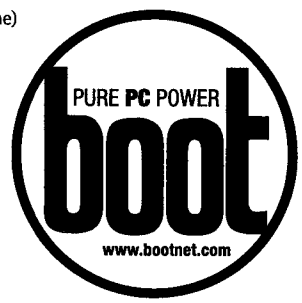
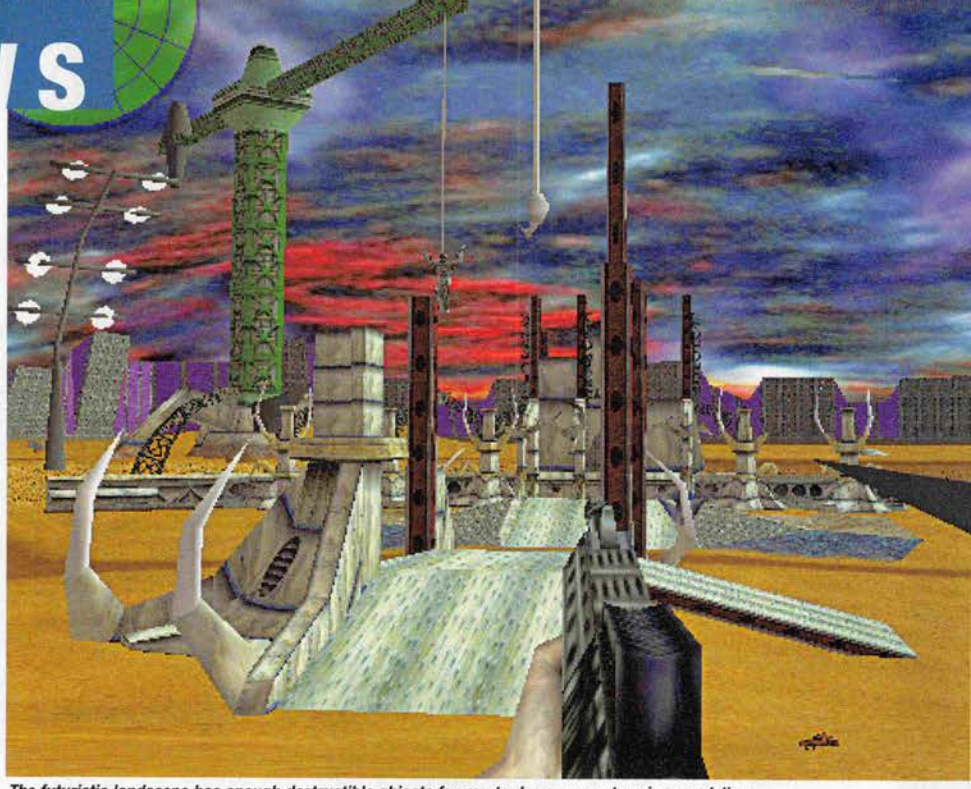


Redline

Four–on-the-floor with a gun on the door

If you don't recognize the classic hit Battle Wheels, *you're not alone. This excellent* Car Wars*–inspired vehicular-combat game existed solely on the Atari Lynx as its one kick-ass game. Beyond Games plans to refamiliarize you with a sequel that'll bring* Battle Wheels *multiplayer mayhem to the PC. The all-new, 3D-accelerated engine combines the fast-paced action of a first-person shooter with the advanced collision detection of a driving game. Beyond Games' vice president,* ***Clark Stacey****, filled us in on the game that will teach* Quake *a thing or two about distance rendering.*



The futuristic landscape has enough destructible objects for you to do your own terrain remodeling.

Redline's combination of first-person and behind-the-wheel action brings a unique experience to the multiplayer arena.

boot What sort of gameplay will* Redline *feature?

Stacey Intense, heavily armed combat in and out of vehicles. Players outfit their vehicles with a variety of twisted weapons and engage each other in visually stunning arenas to advance in media ranking. They fight until their cars can't continue, then bail out and continue to fight on foot. As the player advances, he joins one of the Outsider gangs and performs missions to advance the gang's objectives. These missions take place outside the arenas in the remnants of past cities and feature extensive vocal scripting and interaction with other members of your gang. As the player's stature in his gang increases, he is entrusted with more and more information concerning their enmities and alliances, as well as their ties to the Insiders. The story is integral to the gameplay of *Redline,* but it is first and foremost an organ-grinding action game with killer weapons and vehicle physics.

boot What kind of polygon counts can we expect from the new 3D engine in development for* Redline*?

Stacey *Redline* is the first game based on Beyond Games' Daedalus engine, an accelerator-only engine developed by our president and lead programmer, Kris Johnson. The engine's upper limits aren't precisely known yet. We have levels in the game that approach 18,000 polygons, and even with optimizations remaining to be implemented we're getting good frame rates.

boot What kind of frame rates can we expect?

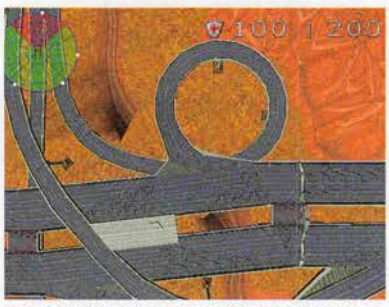
Stacey We are shooting for 30fps. And while lower-end machines might not hit that, they won't be far from it. We've done a lot to optimize the rendering loop, and things like level of detail and sector clipping make a big difference.

boot How have you managed to push the line of sight out so far?

Stacey A lot of it comes down to strategic level design; designing things to be spectacular but still allowing for level of detail and the like on major structures. We don't clip things out in front of the player, only what he can't see—so we don't have geometry materializing out of the ether.

Our sight distance creates other problems, though. A big hurdle early on was perspective. In any other 3D game, you're never very far from a wall or some other enclosure, so designers don't have to worry about the renderer's vanishing point. This would cause things to scale away from the player much too quickly, and it was the first problem that really brought it home to us that we were breaking new ground. Nobody had been faced with that problem on this scale before.

Carjacking is the preferred method to hook up a new ride and take the load off your aching feet.



Redline *features huge levels with enough asphalt to make L.A. jealous.*

boot How detailed is the level design in* Redline*?

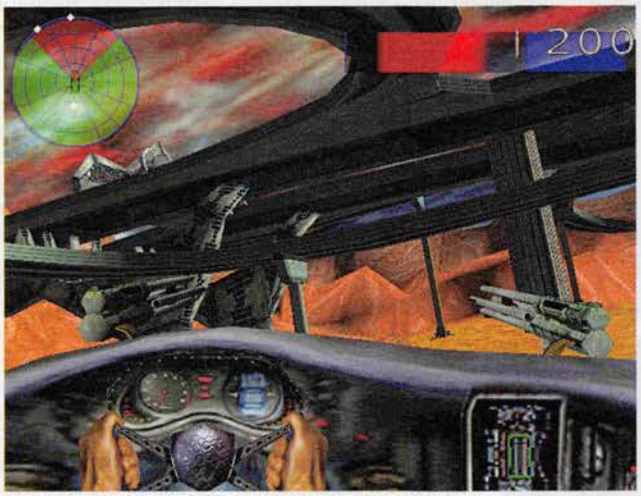
Stacey Some levels are insanely detailed. Our objective is to be *the* definitive car combat game, and our level design is guided by this principle. We therefore have mission arenas that are open terrain—though I should stress it's beautifully detailed terrain. The scripting built into the Daedalus engine allows designers to do almost anything with geometry, so most any structure can be made destructible. We are putting in a lot of these effects: collapsing walls, destructible guardrails, lots of cool property-damage effects. I'm excited to see what gamers come up with once our editor is released, though.

From the beginning, Kris's focus has been to put gameplay design into

the hands of designers. Effects like these would normally have to be created by a programmer working with the suggestions of a designer, monopolizing the time of both people. Once the functionality is in the scripting, the programmer can move on. Ultimately, this means more power in the hands of gamers to extend the life of the game.

***boot** How do you plan to handle the physics of a first-person shooter and the high-speed collision detection of a driving game?*

Stacey The physics of a first-person shooter are a breeze. There really aren't that many surprises a realistic model of human movement can throw at you, and typically they only follow the ground with one point. Our biggest challenges come with trying to incorporate a physics and collision model that doesn't limit our level design. It would be easy to just build all our levels as simple geometry with no tricky ramps, angles, or topography, but we want something that we—and players on the net who'll build their own levels—can throw almost *anything* at and have it play well. This means realistic and adjustable shocks, camera dampening and tuning in the cockpit, and the ability to follow complex terrain with a good acceleration model.



The awesome visuals in **Redline** *are a 3D accelerator–only treat.*

***boot** What sort of special effects can we look forward to from the Daedalus engine?*

Stacey Awesome weapon and explosion effects, beautiful colored lighting and shadowing, dynamic lighting, exquisite environmental detail, and realistic destructible geometry.

***boot** Is* **Redline** *a 3D accelerator-only title?*

Stacey Absolutely. This is the future of PC gaming.

***boot** Do you have plans for* **Redline** *to support specific 3D card API's, or provide 3D accelerator support through Direct3D?*

Stacey We'll do both. We're working closely with PowerVR, 3Dfx, nVidia, ATI, and others to squeeze as much performance as possible out of their cards' APIs with the shipping version of *Redline*, so we hope most owners of next-generation 3D hardware won't have to hunt for specific *Redline* patches for their cards.

***boot** Which card shows off* **Redline** *the best?*

Stacey We've gotten excellent performance out of the four I just mentioned, with the edge currently going to the AGP cards. Since our texture handler will take advantage of AGP's fast access to system RAM, we're particularly excited about these cards.

***boot** Will the Daedalus engine take advantage of AGP?*

Stacey It comes down to five words: System RAM equals texture RAM. This is exciting, because it means we can detect AGP and use more detailed textures in those systems.

***boot** What's the* **Redline** *multiplayer experience like?*

Stacey *Redline* multiplayer is a blast—tracking someone across a huge area on radar, brutal car combat, people fleeing burning cars on foot to take up elevated sniping positions, people working in tandem. An organized *Redline* gang working together will be a beautiful sight, because there are so many tactical options with different classes of cars, plus combatants on foot with nasty things like EMP generators to carjack opponents.

product info

Available *April 1998*
Price *TBA*
Developer *Beyond Games*
Publisher *Accolade*
URL *www.3dfx.com*

HARDWARE ON THE HORIZON AND SOFTWARE SOON TO SHIP

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Messiah 85
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The boot Tracking Sheet

TITLE	DEVELOPER	DATE
GF-1000 DVD-RAM	***Hitachi***	***Jan-98***
Dominion Storm	*Ion Storm/Eidos*	*Jan-98*
Rebellion	*Lucas Arts*	*Jan-98*
Deathtrap Dungeon	*Eidos*	*Jan-98*
Forsaken	*Acclaim*	*Feb-98*
Formula 1 Championship Edition	*Psygnosis*	*Feb-98*
Star Trek: First Contact	*Microprose*	*Feb-98*
F22 Air Dominance Fighter	*DID/Ocean Int'l*	*Feb-98*
Extreme Tactics	*Media Station*	*Feb-98*
Monster 3D 2	***Diamond Multimedia***	***Mar-98***
Renegade 3D	***Jazz Multimedia***	***Mar-98***
3D Blaster Voodoo 2	***Creative Labs***	***Mar-98***
AMD K6 266MHz	***AMD***	***Mar-98***
Intel Pentium II 333MHz/ Slot 1	***Intel***	***Mar-98***
Apollo VP3 PCIset 100MHz/AGP	***VIA Technologies***	***Mar-98***
Unreal	*Digital Extreme/ GT Interactive*	*Mar-98*
SiN	*Ritual/Activision*	*Mar-98*
Dark Vengeance	*Reality Bytes*	*Mar-98*
Daikatana	*Ion Storm/Eidos*	*Mar-98*
Interstate 76 Nitro Pack	*Activision*	*Mar-98*
Adrenix	*Digital Dialect/PIE*	*Mar-98*
Outwars	*Microsoft*	*Mar-98*
AMD K6 300MHz	***AMD***	***Apr-98***
AMD AMD-640 100MHz/ AGP PCIset	***AMD***	***Apr-98***
Half-Life	*Sierra On-Line*	*Apr-98*
Battlezone	*Activision*	*Apr-98*
Falcon 4.0	*Microprose*	*Apr-98*
Red Line Racer	*Criterion/Ubisoft*	*Apr-98*
Trespasser	*DreamWorks*	*Apr-98*
Baseball 3D	*Microsoft*	*Apr-98*
SoftImage v4.0 (sumatra)	*SoftImage/Microsoft*	*Apr-98*
Anarchy	*Microsoft*	*Apr-98*
F22 Total Air War	*DID/Ocean Int'l*	*Apr-98*
Ultim@te Race Pro	*Kalisto/Microprose*	*Apr-98*
Redline	*Beyond Games/Accolade*	*Apr-98*
Deschutes/Slot 2	***Intel***	***Q3/98***
Mobile Deschutes	***Intel***	***Q3/98***
K6+3D 400MHz	***AMD***	***Q4/98***
Grand Prix Legends	*Papyrus/Sierra On-Line*	*Q2/98*
Kings Quest: Mask of Eternity	*Sierra*	*Q2/98*
MechCommander	*Microprose*	*Q2/98*
Riot	*Microsoft*	*Q2/98*
10th Planet	*Bethesda*	*Q3/98*
Messiah	*Shiny/Interplay*	*Q3/98*
Windows 98/Memphis	*Microsoft*	*Q3/98*
Duke Nukem Forever	*3D Realms*	*Q3/98*
Star Trek: Klingon Honor Guard	*Microprose*	*Q3/98*
Windows NT 5.0	*Microsoft*	*Q3/98*
Prey	*3D Realms*	*Q4/98*
Starship Troopers	*Microprose*	*Q4/98*

These dates are subject to change
****Bold indicates hardware***

Red Line Racer

Accelerating into the red

Fast processors, high-res displays, and 3D accelerators allow a PC to deliver the resolutions and frame rates previously found only in arcades. We caught up with ***Fiona Sperry****, producer for* Red Line Racer*, and asked why the next PC peripheral will be a coin slot.*

Red Line Racer ***automatically scales its graphical features to your hardware.***

boot How intense will the* Red Line Racer *experience be?

Sperry The whole idea was to create a true arcade experience in the home, and we've gone for visual realism and as much physical realism as made sense.

boot Will there be drastic differences in the way each bike handles?

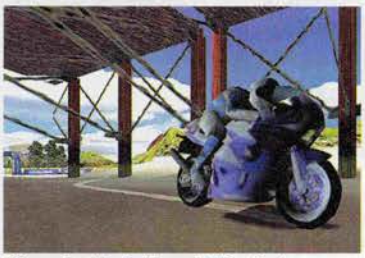
Sperry The physics models' realism allows just about every imaginable parameter to be tuned. Bikes have different engine sizes, wheel sizes, gear ratios, torque curves, breaking speeds, turning angles, grips, to name but a few. Thus, each bike feels realistic and has its own characteristics.

boot What frame rate can we expect?

Sperry Three factors affect performance: accelerator fill rate (big effect), accelerator triangle set up speed (medium effect), processor speed (big effect).

A good accelerator—such as a 3Dfx card—and a reasonably fast machine—such as a 166—should give about 30fps and greater. A 233MHz Pentium II and a fast accelerator such as the AGP Riva 128 pull about 60fps with really rich textures. This also depends on what graphic details are on.

Visor-cam view puts you head first above high-speed flesh-eating asphalt.



***3D acceleration is the only thing that can deliver the true engine-thundering, between-your-legs feel of* Red Line Racer.**

***boot Tell us about the engine that drives* RLR.**

Sperry We use our proprietary 3D graphics engine internally known as Dive. The engine allows truly general worlds—you're not confined to buildings or tracks, etc. Many of the techniques come from the experience Criterion picked up from the ground-breaking RenderWare 3D libraries. Dive is the game's logical extension of RenderWare.

The big wins in 3D-engine design come from understanding where the bottlenecks are and removing them—be that through clever algorithms, pre-processing, or a hand-optimized assembler. *RLR* has the Dive engine and also uses a form of general PVS (possible visible set), allowing the game to draw only polygons that can be seen. Level of detail technology is used to vary the polygon density of objects in the game depending on their projected screen size.

boot Will* Red Line Racer *require a 3D accelerator?

Sperry Yes.

boot What does AGP let you do that you can't do already on a 3Dfx card?

Sperry Far larger and richer texture maps and procedural texture maps. On an AGP system, the game provides higher detail levels when you drive up close to objects.

With AGP, you can hold textures in system memory, letting us modify them quickly in real-time via the processor and giving far larger and therefore more-detailed texture maps.

On the beach levels you have real-time sea undulating away; grit thrown up; sparks in tunnels; tire trails; skid marks; smoke from the engine; projected shadows; waterfalls; animated objects; environmental effects; night driving; lighting effects; light cones; realistic lens flare; and more.

boot How many polygons can Dive push? What resolution and color depth will it run in?

Sperry There isn't a defined framework to compare one engine to another. We can push 250,000polys/sec on a P166 using Glide. Depending on the situation, we'll push more or less (for example, if the polygons are large we'll push much less).

We use 32-bit phototextures with very high polygon counts. The bike and rider alone consist of about 3,000 polygons. AGP allows us to have much larger texture maps than previously possible. Typically, texture maps were 512x512/32-bit. *RLR* automatically scales the texture detail depending on the machine's configuration. On an AGP system, there can be over 12MB of textures.

The engine can run in any resolution and depth. In *RLR* it has been set up to work at 640x480/16-bit.

boot What kind of real-time lighting effects will* RLR *feature?

Sperry *RLR* has real-time dynamic lighting, world environmental lighting, real-time projected shadows, and light cones. The dynamic lighting is used for lights on the bikes and can be seen in tunnels or on levels set late in the evening. The world is also lit environmentally with soft shadows created by trees and rocks and the like. All the bikes project shadows in real time.

boot Are you just using Direct3D or are there plans for direct card support?

Sperry Currently we have a native 3Dfx version. D3D is our main delivery platform.

The game is designed such that new APIs can be slotted underneath the game engine, so it's a fairly painless task to switch to proprietary rendering solutions.

boot What other technologies are you planning on using?

Sperry The game supports force-feedback joysticks, digital joysticks, and 3D sound. The force feedback really makes you feel like you're there, feeling the road. The engine reacts to the forces of the road, giving a feeling of how the engine is performing, and sends shocks when the guy tumbles off the bike. 3D sound lets you sense where the other players are; you can hear them approaching from behind. It also creates some great Doppler effects as bikes fly past the camera.

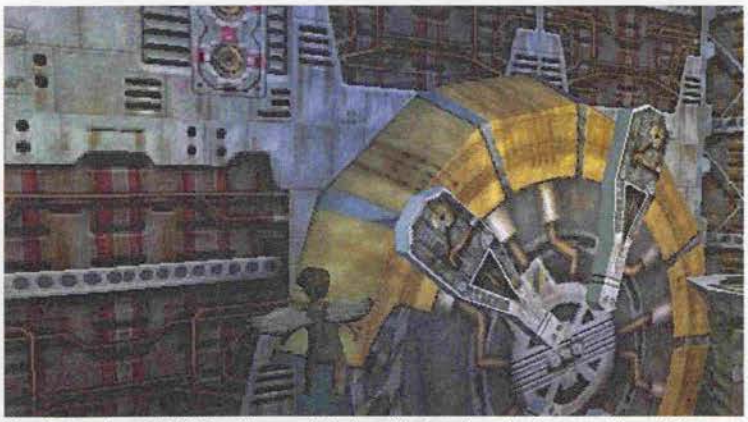
product info

Available ***April 1998***
Price ***TBA***
Developer ***Criterion Studios***
Publisher ***Ubi Soft Entertainment***
Phone ***800.482.4763***
URL ***www.ubisoft.com***

Messiah

Patent Pending

Messiah puts you in the role of Bob, a chubby little cherub who just happens to be the prophesized savior of the world. Development on the game's engine has resulted in several technology patents, which could potentially change the way all 3D rendered games are developed. We talked to ***Dave Perry****, president of Shiny, to find out whether* Messiah *is indeed the chosen one.*



Messiah's volumetric lighting allows real shadow effects, such as the heavy machinery below dampening the light across most of Bob's body.

boot What's the backstory to* Messiah*?
Perry God's sent you, in the form of an angel, to rescue the world from Satan. The only thing is, you're basically a baby, which makes for interesting gameplay.

boot What sort of gameplay does* Messiah *feature?
Perry Because you're so weak, you have to use others to do your work for you, which you do by possessing their bodies and running amok! Any abilities and weapons they have, you have, so it makes sense to go for the biggest guy you can find if you know you're about to walk into World War III. You're not confined to one character, as you would be in *Tomb Raider*.

boot How's the game engine differ?
Perry Other game engines load in a completely new model, depending on how far away the camera is from the character.

Messiah's control mechanism is very similar to Joust's flap and glide model.

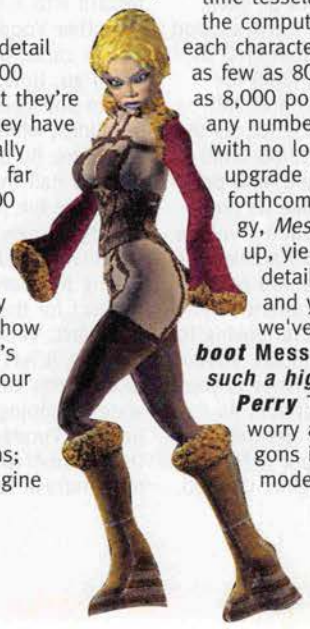
They might have, say, three detail levels, varying from 100 to 600 polygons. The problem is that they're limited. If you're up close, they have too few polygons to look really convincing, and if you're too far away, they're still drawing 100 polygons for a character that may be only two or three pixels tall. Extremely inefficient. Messiah constantly checks the processor to see how many polys it can use, and it's always using the maximum your PC can handle.

We should get away from describing polygon maximums; there really isn't one. The engine is capable of displaying 10 to 1,000 (or more) polygons per pixel on the screen. There is no limit to the number of polys. The only limitation is the processor speed. On an SGI Onyx, our characters would probably average 100,000 polygons. Maybe we should stress that the engine is drawing the optimum polys to display a shape. This allows characters to keep their rounded and fleshy appearance.

boot How does the engine achieve a truly scalable level of detail in real time? What exactly is tessellation and deformation, and how is it used in* Messiah*?
Perry Real-time deformation creates in-game characters with all the physical characteristics of real human beings. Each model has a real bone structure, with muscles holding them together and a textured skin stretched over the outside. Characters' clothes crease and pull tight as they move, the chest rising and falling as they breathe.

Tessellation has been the Holy Grail of 3D for five long years. Real-time tessellation allows the computer to scale each character model from as few as 80 to as many as 8,000 polygons and any number in between, on-the-fly, with no loss of speed. As players upgrade to AGP, Pentium II, and the forthcoming Highlander 3D technology, *Messiah* will automatically scale up, yielding ever-more-complex detail. Load *Messiah* on a P300 and you'll see polygons that we've never seen!

Each of* Messiah*'s ultra-realistic models feature real bone structures, muscles, and textured skin tightly stretched over their surfaces.



boot* Messiah*'s characters have such a high level of detail. How?
Perry The artists don't have to worry about the number of polygons in a character, they simply model them as detailed as they can. The engine then processes the final model (with as many as 300,000 polygons) and reduces the character to his "shapes." These "shapes" are later used to generate the character. Our artists are some of the best in the business, and we allow them to fully use their talents with this technology.

boot What techniques are you using to get more realistic movement?
Perry We're using a blend of motion capture and hand animation. The skeletal-animation system reduces the amount of memory used and allows us to use as much animation as we want. Motions can also be blended to seamlessly lead into another, no matter how extreme. That means no waiting to complete an animation, and no pops.

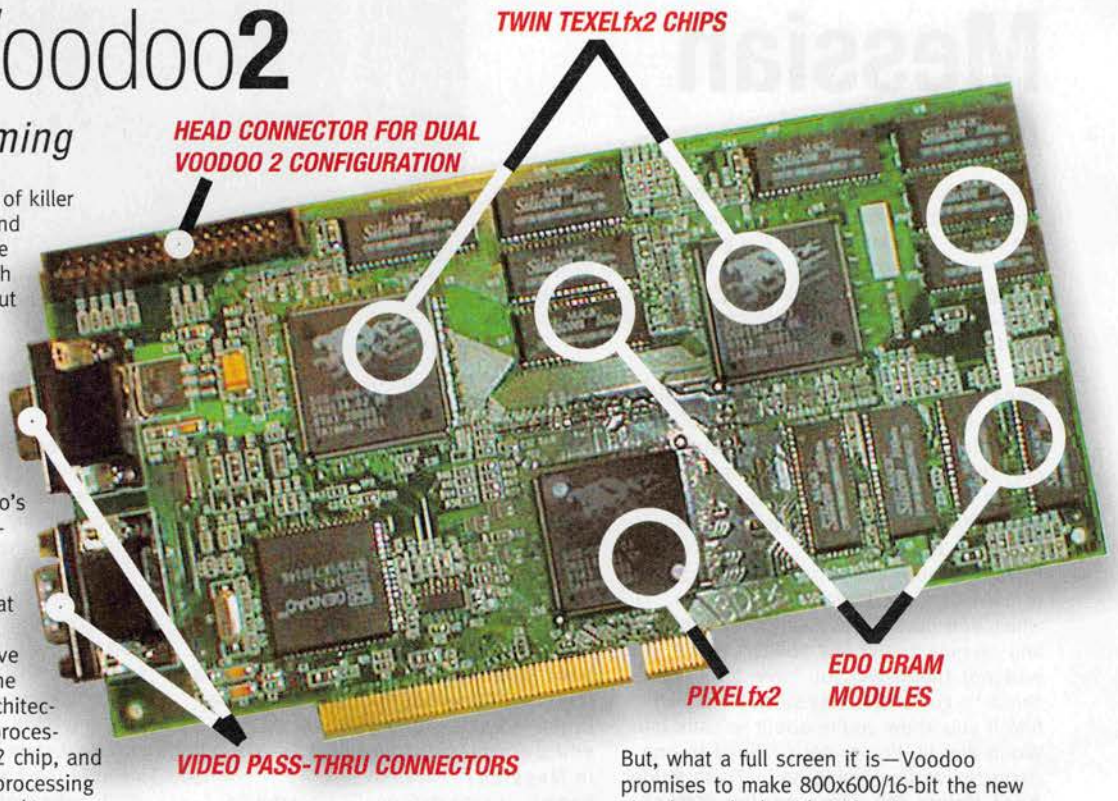
boot Are there new special effects and lighting that we can look forward to in* Messiah*?
Perry We have all the colored light everybody else is shouting about. Over and above them, we have volumetric lights that allow real solid shadows to be cast by any light. This means when a character walks in front of a box that blocks the light from the waist down, only his lower half will be in shadow. We also have moving shadow-casting lights and real shadows cast by the characters. There are also some environment-distortion effects that I won't describe. They have to be seen to be believed!

product info

Available ***September 1998***
Price ***TBA***
Developer ***Shiny***
Publisher ***Interplay***
Phone ***800.468.3752***
URL ***www.shiny.com***

3Dfx Voodoo2

The Second Coming



Isn't it ironic? A combination of killer arcade-caliber performance and hot native titles has users the world over equating 3Dfx with 3D acceleration on the PC. But now, a flock of manufacturers, including nVidia and Rendition, are claiming the 3D throne back from the unrivaled king, chanting the litanies of awesome benchmark results and massive OEM support. Hey, guess who's just around the corner threatening their short-lived reign?

Voodoo 2—3Dfx's next-generation 3D accelerator that promises to rock your world.

Supporting Direct3D, native Glide, and *Quake*/OpenGL, the Voodoo 2's split-memory architecture revolves around three processors—a single 64-bit pixelfx2 chip, and dual 64-bit texelfx2 texture processing units (TPUs), which allow simultaneous application of two textures to a triangle in a single pass. So, in a single cycle, complex effects such as trilinear filtering, lighting effects (such as *GLQuake*'s two-pass alpha lighting, which requires simultaneous use of Z-buffer and alpha-blending), spotlights, and detail texturing can be accomplished with zero performance hits. These dual TPUs effectively double your texture fill rate and performance, while the entire package will operate anywhere from the 80MHz- to 100MHz-clock region. Also, a full triangle set-up engine is finally integrated in hardware.

The 192-bit (64x3) architecture and 2.2GB/sec memory bandwidth claims 50 billion operations per second, while the full hardware triangle set-up engine features triangle culling (automatic removal of polygons smaller than one pixel). Voodoo 2 promises 3 million triangles per second, and 90 million dual-textured, bilinear filtered, per-pixel mip-mapped, alpha-blended, Z-buffered pixels per second. Yikes!

All those cool 3D buzzwords are supported, including per-pixel/per-vertex atmospheric fogging, sub-pixel/sub-texel correction, and polygon-edge anti-aliasing. But whether Voodoo 2 will take a performance hit with anti-aliasing remains to be seen.

Voodoo 2 will support anywhere from 6MB of EDO DRAM (2MB for frame buffer and 2MB per texelfx2 TPU), all the way up to 12MB (4MB for frame and 4MB per TPU). Just like its predecessor, Voodoo 2 will be an add-in 3D accelerator, with a pass-thru cable from your current video card. If you're looking for a 2D/3D solution, Voodoo Rush or Banshee is your only 3Dfx option. As such, you'll get full-screen output only, just like the original Voodoo.

But, what a full screen it is—Voodoo promises to make 800x600/16-bit the new visual standard, with 60fps the norm.

With current software titles, expect frame rates to go through the roof. In fact, 3Dfx claims it has *GLQuake* running in excess of 110fps! Why all this "over-engineering"? Simple: Voodoo 2 opens a new 3D world, where characters are no longer bound to 250 to 500 polygons. With Voodoo 2, developers can now push worlds well into 30,000 polygons-per-frame and still maintain high frame rates.

Wondering why we dropped hints over the past five-odd months about keeping your PCI slots free? Here's the reason: dual Voodoo 2 cards. Install the second daughtercard into a free PCI slot and hook it to the other Voodoo 2 card via an internal ribbon cable, and a-parallel processin' you'll go. How? Scanline interleave mode, where one Voodoo 2 card renders even scanlines, while the other renders odd scanlines. By making each board take up only half the load, you can squeeze out twice the power. Doubling up Voodoo is nothing new to 3Dfx—Quantum 3D's Obsidian line did. But now 3Dfx is introducing this concept in a consumer-level product for the first time.

In fact, Voodoo 2 runs so fast, 3Dfx is claiming it has yet to reach a maximum fill rate for this card because of current hardware technology limitations. What's bottlenecking Voodoo 2? How about your monitor's refresh rate? If your monitor's maximum refresh rate is 90Hz at 640x480, then

Benchmark Results

A big word of warning—the following results were taken on first-generation silicon (only three weeks old) with the current version of GLQuake *and* Q2Test. *None of these applications was optimized in any way for Voodoo 2.*

System configuration

CPU	Intel Pentium II 266MHz
Motherboard	Intel 440FX ATX motherboard
RAM	64MB EDO-DRAM
OS	Windows NT 4.0

Quake

GLQuake 640x480/16-bit (timedemo demo1 no_sync)	94.8fps
GLQuake 800x600/16-bit (timedemo demo1 no_sync)	70.9fps
Q2Test 640x480/16-bit (timerefresh at start of level)	72.0fps

id's* Quake II *will be the first to take advantage of the Voodoo 2's multi-texturing capabilities out of the box. Expect others using* Quake II *technology to follow suit.

3Dfx Voodoo 2 Configurations

What Voodoo Will You Do?

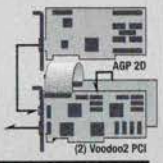
Probably the number-one question asked about Voodoo 2 revolves around what configurations you'll be able to concoct. If you don't see it here, it won't exist, at least until someone decides to make an AGP bridge chip—Intel, are you listening?

1. Current AGP 2D with Dual Voodoo 2 PCI

Total expansion slots required: 3

1 AGP

2 PCI

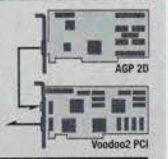


2. Current AGP 2D with single Voodoo 2 PCI

Total expansion slots required: 2

1 AGP

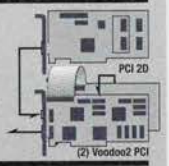
1 PCI



3. Current PCI 2D with Dual Voodoo 2 PCI

Total expansion slots required: 3

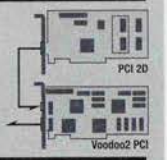
3 PCI



4. Current PCI 2D with single Voodoo 2 PCI

Total expansion slots required: 2

2 PCI

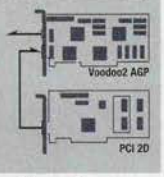


5. Current PCI 2D with single Voodoo 2 AGP

Total expansion slots required: 2

1 AGP

1 PCI



the maximum frame rate you'll get is 90fps—no matter how many Voodoo 2s you slap in there! Other bottlenecks include the 66MHz system-bus speed limit, and others. 3Dfx hopes Intel's next-generation Slot 2 Deschutes coupled with a 100MHz 440BX AGPset will alleviate that.

Diamond Multimedia, Creative Labs, and Jazz Multimedia have announced plans for Voodoo 2 boards, while others will surely follow suit. 3Dfx says about six vendors will hawk Voodoo 2 parts, so you can draw your own conclusions on who they'll be. But don't expect any final retail products until well into the first quarter of 1998 (March if you're lucky).

So where will the original Voodoo and Voodoo Rush stand in the grand scheme of things? You'll still see Voodoo/Voodoo Rush boards well into 1998, but by the time Voodoo 2 makes its appearance, you can consider the original Voodoo to be 3Dfx's entry-level hardware.

Since our world-exclusive, first-hand look at Voodoo 2 the day the product was announced, we've been bombarded with questions galore about it. Rather than answer each one individually, we've compiled them into a few common questions.

The Voodoo 2 Q&A

Q: If Voodoo 2 becomes an AGP part, what level will it be?

A: When someone makes a Voodoo 2 AGP part, it will be a 1x/DMA mode part with no sidebands. Voodoo 2 will strictly make use of the faster bus for transfer of triangles and data movement, but it will not use system memory for straight-to-3D processor movement of textures.

Q: Since the Voodoo 2 can run with two boards, does that mean when technology surpasses a single Voodoo 2, adding another Voodoo 2 board will enable it to keep up with the big boys?

A: Yes. It will take developers a while until they've maxed out a single Voodoo 2 board, considering the power it promises to pack. While 3Dfx has said it is working with key developers on making Voodoo 2–enhanced titles, none have officially been announced.

But, looking at past relationships, you can bet id's forthcoming next-gen gaming engine (code-named "Trinity") and 3Drealm's *Prey* will take advantage of its power, as these two gaming technologies represent the future of 3D.

Q: If someone were to come out with a Voodoo 2 AGP part, would you be able to install a second PCI Voodoo 2 daughtercard and feel the parallel-processing power?

A: No. Voodoo 2 requires that both cards be on the same bus to work properly. When the main Voodoo 2 board polls the PCI buses and senses the second card, it goes into scanline interleave mode. So, unless some wise lad or lass designs an AGP bridge chip that will allow more than one AGP port, we're all up poop creek without a paddle.

Q: What is the maximum resolution Voodoo 2 will support?

A: With a single card solution and 8MB of total memory (2MB per texture processor and 4MB frame buffer), expect to get 800x600/16-bit with full Z-buffer. If you want to go higher (1024x768) with all the fixings, then you'll need to get either the AGP part or a second PCI board.

Q: Will the Voodoo 2 support Linux?

A: At this time, that's not part of 3Dfx's plan. While Linux has never been "officially supported," as the old saying goes, "Where's there's a will, there's a way."

Q: Is the Voodoo 2 architecture the same or similar to Quantum 3D's Obsidian line of 3D accelerators?

A: Voodoo 2 is similar to Obsidian in that they share a common lineage—the Voodoo architecture. Indeed, Quantum 3D's balls-nasty hardware is aimed squarely at coin-op/arcade machines, as seen in Atari's *S.F. Rush* and *Mace: The Dark Age*. And, the Obsidian 50-4440 card shared the same single pixelfx/dual texelfx chip set up. But, current Obsidian products are centered on the year-and-a-half-old Voodoo architecture.

Q: It sounds like the scanline interleave trick with the two cards would be ideal for LCD shutter glasses. Any chance 3Dfx will support stereo?

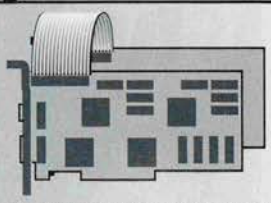
A: It's really up to LCD shutter glasses developers. Stereographics and H3D are working on implementing Glide support, and if some OEM card maker wants to include LCD glasses output on its Voodoo 2 board, it's welcome to. Again, it's a wait-and-see situation.

Q: How much will Voodoo 2 cost upon release?

A: While everyone involved in Voodoo 2 is still working out the logistics of final pricing, 3Dfx did state that you should expect final video card prices to be around the same as early Voodoo boards when they were first released. Initially, those boards were priced at $400, but they finally hit the streets at $300. Expect the same. The second board option pricing has not been made official yet, but don't be surprised if a dual–Voodoo 2 set up winds up costing upwards to $600.

—Andrew Sanchez

Ménage-à-Deux Avec Voodoo 2



While scanline interleave technology isn't new for 3Dfx (Quantum 3D's been doin' it with Voodoo), Voodoo 2 marks the first time they've entered the consumer market with a dual board scenario.

When the second daughtercard is installed on the PCI bus and connected to the original board via an internal ribbon cable, the board goes into scanline interleave mode, where one board renders odd lines, while the other renders the even lines on-screen.

Remember, you can't mix AGP Voodoo 2 with PCI Voodoo 2—the boards need to be on the same bus in order to communicate.

product info

Available March 1998
Price $300 per board (estimated)
Company 3Dfx
URL www.3dfx.com

THE FIRST REAL-TIME 3D ADVENTURE
BLADE RUNNER FOR THE PC

The most talked about sci-fi movie of all time has come to the PC. And your PC will never be the same again. Armed with your investigative skills and the tools of a 21st century BLADE RUNNER ™, you'll be immersed in a futuristic world that revolutionizes computer gaming, and tests your ability to survive in one of the richest and most atmospheric games ever created for the PC. Are you ready?

TEEN T AGES 13+ CONTENT RATED BY ESRB

Westwood STUDIOS

www.bladerunner.net

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Product Information Number 341

bootLab **Policy**

boot *isn't like any other computer magazine, and neither is our product-**evaluation** process. We don't test equipment in the cold, sterile environment of a warehouse-size lab, and we don't write our reviews based on the **test scores** that labcoat-wearing technicians scribble on clipboards.*

*Our review **scores** are based on a combination of objective **benchmark** testing, real-world performance, and our subjective evaluation of features, performance, and the many less tangible **characteristics** that go into a product. All of our evaluations are based on **hands-on** use of the product.*

New Benchmarks:

Final Reality and X

This month, we're adding two new tests to our 3D benchmarking bag of tricks. X is an upcoming Direct3D space combat and trading game from EgoSoft. The demo runs through a scripted series of scenes, and reports an average frame rate. Final Reality, a comprehensive 2D/3D benchmark developed by VNU European Labs, is based around a game engine from Remedy Entertainment's upcoming Max Payne. It tests several flythrough scenes, as well as some abstract performance tests. We expect it to become an industry standard in 3D performance testing. Look for both new tests to come bundled on the bootDisc beginning next month.

REAL-WORLD BENCHMARKING
The new meter has the precise scores for each category benchmarked. Plus, the color bars to the right give you a quick idea of how well the system performed in that category.

It's simple: The farther right the bar reaches, the better the system scored. Green means the system performed on par or beyond what we expect of a current system. If you see nothing but red, the system performed below expectations.

PLUSES AND MINUSES
Here's where we list the best and worst a system has to offer.

CONTACTS
Look here for price, and the company's phone number and URL if you want more information.

BOOT VERDICT
The one that really matters. This score reflects how we feel about a system, taking into account the benchmark results, quality of parts, usability, overall performance, and our intense, under-the-hood scrutiny.

Only the **best** earn enough respect to be worthy of our **editors'-choice** award.

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

Cirque Power Cat pg 113

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Compaq Presario 4850

Powerful... and stupid

Packing both a 300MHz Pentium II processor and an AGP video subsystem, the Presario 4850 is a macho beast. But peer inside the swarthy black interior, and you discover the Presario 4850 has a lot in common with those steroid-swallowing, bulked-up boys from the WWF: too much brawn and not enough brains.

Leading the list of things we don't like—nay despise—is the integrated AGP video solution. We dig the ATI Rage Pro chipset, and we'll gladly consume the 4MB of integrated SGRAM. But there's a hitch: The whole shebang is soldered onto the motherboard. Thanks to that completely asinine design decision, there's no way in hell you can upgrade to a better AGP card. The ATI Rage Pro is excellent, but how long before you're hankering to replace it with something even better? Our guess—maybe three months tops.

The second-generation DVD-ROM drive is nice, even if it is only coupled with the Zoran/CompCore software MPEG-2 decoder. Video quality was good, but compared with hardware MPEG-2 decoding, the 4850's playback was less clean, exhibiting minor shearing and jagged edges. Still, the DVD drive spun discs with zest, climaxing at a very respectable 2171K/sec transfer rate. While the inclusion of DVD is all well and good, something's still missing in the 4850—TV-out ports. How this glaring omission ever made it past the product-planning stage blows our mind.

The annoyances keep coming. Thanks to the atrocious LPX form-factor motherboard (which shouldn't be claiming squatter's rights in a tower case in the first place) and the oversized heatsink, you'll have a tough time jamming a full-sized card into any of the free slots.

The 6.5GB hard drive consumed only 16% of the clock cycles to spit out an impressive 3.09MB/sec. transfer rate, but the drive is encased in its own metal tomb, making upgrade or removal a very painful and unnecessarily arduous process. Worse yet, the hard drive is positioned right next to the power supply, which, as we all know, is the PC component voted most likely to fail.

Also onboard is a lowly ESS1887 FM-synth chip. FM on notebooks is bad enough, but on a high-end desktop? I don't think so.

The one thing we can't complain about is performance—it's all muscle. The bootMark and MDK PerfTest scores of 144.7 and 142, respectively, easily bested Dell's Dimension XPS D300 (reviewed in *boot* 16), but in all other benchmarks, the Presario 4850 came up just a tad short. The 24.5fps in *Quake* should pacify even the heartiest of gamers, but only until that crop of new *Quake*-based games starts showing up. Without OpenGL drivers, you'll be playing those games unaccelerated.

Despite all the Presario 4850's brawn, it still lacks the brains; its excellent performance is marred by a multitude of inane design flaws that ultimately reduce its overall appeal. Looks aren't everything—it's what's on the inside that really counts. And in this case, what's inside hurts.

—Bryan Del Rizzo

under the hood

THE BRAINS	
CPU	Intel Pentium II 300MHz
L2 Cache	512K pipeline-burst
RAM	32MB SynchDRAM (256MB max)
Motherboard	Intel 440LPX
THE BRAWN	
Video	AGP ATI Rage Pro (with 4MB SGRAM)
Hard Drive	Various 6.5GB EIDE
DVD-ROM	Hitachi 2x
Expansion Bus	Two PCI, three ISA, one shared
Fax/Modem	56Kbps K56flex-compatible
I/O Ports	Two USB, one parallel, two serial, one game/MIDI, RCA video-in and audio-in, one monitor, stereo-out, microphone-in
THE BEAUTY	
Display	1725 S 17-inch screen size with built in JBL speakers
Sound	ESS1887 FM-synth only
Speakers	JBL Pro stereo speakers (on monitor)
Other	Volume control on monitor

THE BUNDLE Videophone | MS Money | MS Works MS Encarta 97 | MS Creative Writer | MS Bookshelf Sega Virtua-On | Formula 1 | Sim City 2000 | Colordesk & iPhoto Express | Warren Miller Ski World & Warner Music Videos (both DVD) | online services

EXPANSION MAP

PCI	Free
PCI	Free
PCI	Shared/Free
ISA	56.6Kbps modem
ISA	Free
ISA	Free

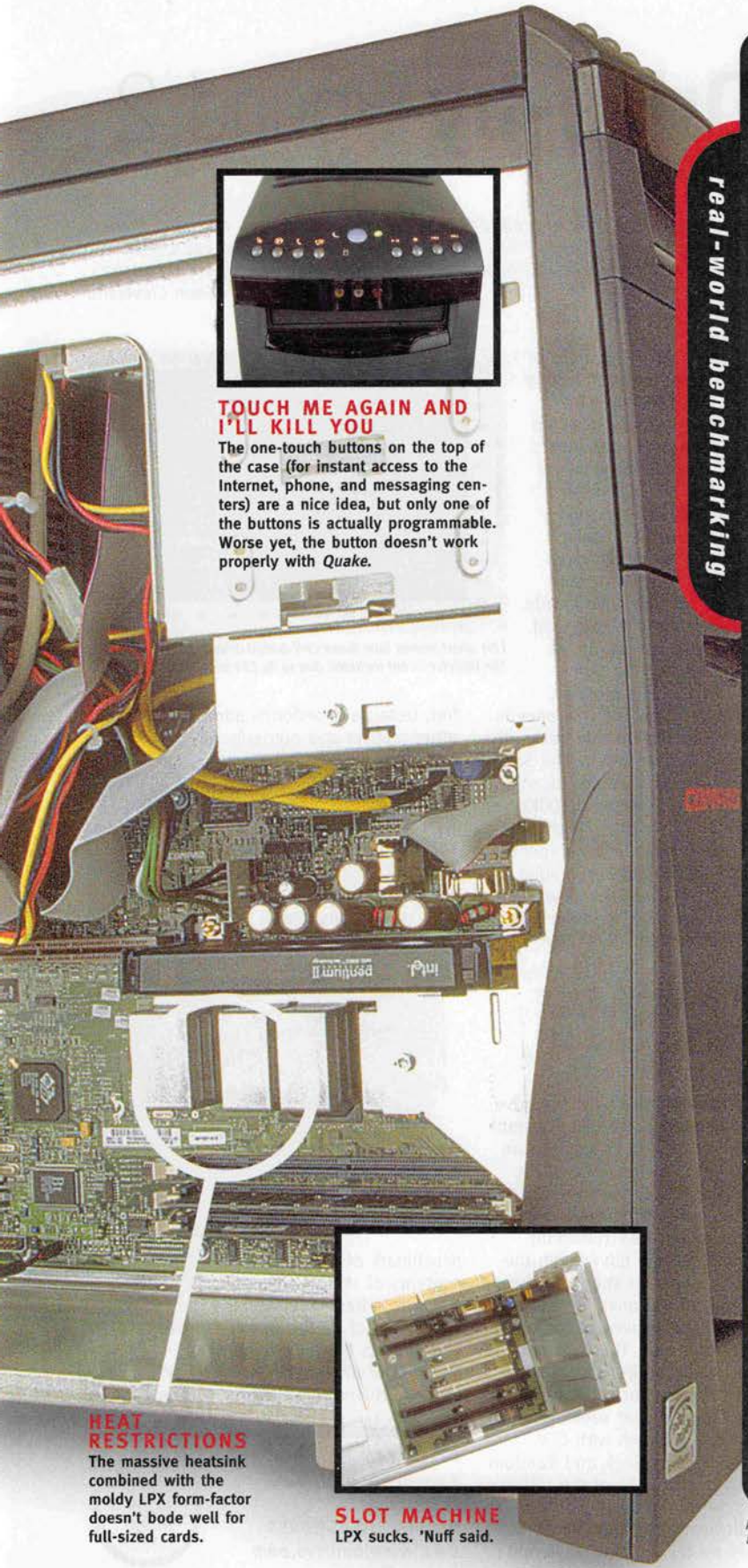
boot down 1:00 :04

THE WINTER OF OUR DISCONTENT
Check it out: The 6.5GB hard drive is hanging loose behind that metal case. To remove the hard drive, you have to remove the screws, the case, and then the drive. Talk about a pain in the ass.

POP'N'FRESH
This thick cable (presumably for MPEG-2 decoding) travels throughout the entire case and through the top. Weird.

RAGE AGAINST THE OPPRESSION
Sitting like a fish out of water is the 2x AGP-version of ATI's Rage Pro with 4MB of integrated SGRAM. We like the chip. We just don't like being held hostage and forced to give up on expansion.

DOOR TO NOWHERE
Putting the video inputs on the front is a smart idea. Hiding them behind a plastic door is a dumb idea, especially since the door has to remain open when you have cables trailing out the front. Notice the button on the door? It's needed so you can actually access the CD-eject button on the DVD drive.



TOUCH ME AGAIN AND I'LL KILL YOU

The one-touch buttons on the top of the case (for instant access to the Internet, phone, and messaging centers) are a nice idea, but only one of the buttons is actually programmable. Worse yet, the button doesn't work properly with *Quake*.

HEAT RESTRICTIONS

The massive heatsink combined with the moldy LPX form-factor doesn't bode well for full-sized cards.

SLOT MACHINE

LPX sucks. 'Nuff said.

real-world benchmarking

	Compaq Presario 4850
CPU/MOTHERBOARD *bootMark*	144.7
WIN95 APPS *SYSmark32*	271
DIRECT3D *Terramark*	composite 673
HARD DRIVE *Adaptec ThreadMark v1.0*	MB/sec 3.09
CD-ROM *CD Tach/Pro v1.65*	K/sec 2171 +
WIN95 VIDEO *VidTach v1.52*	% played 59.8
DOS GAMING *Quake v1.06*	fps 24.6 +
DIRECTX GAMING *MDK PerfTest v1.4*	142 +
MMX PROCESSING *DeBabelizer Pro*	secs 207 +
CPU/DISK *Microsoft Visual C++ compile*	secs 137

You'll appreciate the overall performance and the majority of features, but can you really dig a system that doesn't let you upgrade the AGP video solution? We can't dig it.

⊕	⊖
Pentium II 300MHz with enormous heatsink	AGP soldered on motherboard
Shining performance	LPX motherboard
AGP 2x courtesy of ATI Rage Pro	Hard drive mounted in awkward place
DVD-ROM drive with above-average MPEG-2 software decoding	No TV-out ports
Easy-access buttons on case	No game controllers
Front audio inputs	Cheesy FM-synth
Large hard drive	No TV-out for DVD
Good gaming and software bundle	Cheap keyboard

Price *$2,499, (monitor $699)*
Company *Compaq*
Phone *800.345.1518*
URL *www.compaq.com*

boot verdict 7

A complete breakdown of benchmark results is available on the *bootNet*. Point your browser to www.bootnet.com

24x CD-ROM Drive-by Round 2

Still learning to drive

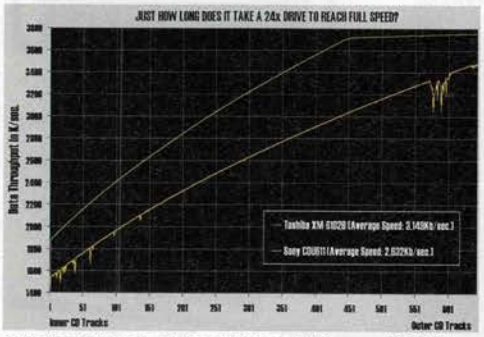
We recently tore into a slew of bunk 24x CD-ROM drives (boot 14), revealing them for what they were—hype. These drives aren't bad and will give you better performance than 16x drives—just don't expect the 24x speeds they promise.
—Sean Cleveland

The Sony CDU611 contains a 256K buffer and supports both PIO Mode 4 and DMA Mode 2.

Sony CDU611 IDE (ATAPI) CD-ROM Drive

Sony found a way to deliver a true 24x performer with some innovative proprietary technology. Unfortunately, the drive still fell short of expectations.

Sony's new patent-pending spindle motor reduces noise and vibration by migrating ball bearings to help counteract unbalanced discs. As we mentioned in the previous roundup, this was the main problem with these drives—they couldn't handle perfectly round and weighted discs, and due to their CAV architecture, they performed poorly when forced to lower speeds to compensate. Regardless of this new technology, the Sony CDU611 failed to reach the 3,600Kb/sec necessary to usurp the title from its unworthy opponents. The chart depicts several areas where the drive had trouble tracking the disc. But where other drives would completely lose it, the Sony drive seems to recover quite nicely, most likely due to its spindle-motor technology. While the Toshiba drive clearly outperforms it in a straight, raw read, further testing of the Toshiba drive showed seek problems. The Sony doesn't seem to have this problem. The CD Tach scores show the true speeds of the inside, center, and outside tracks; the outer track is the one to watch. The Sony CDU611, with its 2,721Kb/sec speed, still falls well short of the expected 3,600Kb/sec that would make it a 24x drive. With almost identical center and outside track speed, the Sony should be marketed as a solid 18x CD-ROM drive. If that were the case, it would be a Kick Ass drive. If you're buying a new system that contains this drive, don't fret, because it performs admirably in every other respect and outperforms any other drive in its class.



This chart shows how these CAV-based drives read CD-ROMs The USDrive is not included due to its CLV architecture.

Price *Available only through OEM distributors*
Company *Sony*
Phone *800.352.7669*
URL *www.sony.com/storagebysony*

On The Field of Battle

	Sony CDU611	USDrive 24DT	Toshiba XM-6102B
CDTach Read Tests			
16k Outside Tracks (Kb/sec)	2,721	1,227	1,867
16k Center Tracks (Kb/sec)	2,698	2,775	2,202
16k Inside Tracks (Kb/sec)	1,558	1,626	1,921
CD Tach SEEK TESTS			
Full Stroke (ms)	146	210	135
Random Access (ms)	84	105	88
CD Tach CPU Utilization Tests			
2x (300 Kb/sec)	2%	2%	4%
4x (600 Kb/sec)	4%	4%	8%
6x (900 Kb/sec)	6%	6%	12%
8x (1200 Kb/sec)	8%	25%	16%
12x (1800 Kb/sec)	14%	Failed	22%
20x (3000 Kb/sec)	Failed	Failed	Failed
CD Tach DRIVE RATING			
CD Tach Drive Rating	14.2	13.0	13.3
Copy Wing Commander IV Disc 1 Files to Hard Drive			
Time to copy in Min:Sec	4:53	6:02	5:39
CDTCAV Results			
Average Speed (Kb/sec)	2,632	N/A	3,149

USDrive 24DT IDE (ATAPI) CD-ROM Drive

The USDrive is the only 24x drive in both roundups to use Constant Linear Velocity (CLV) architecture exclusively. CLV drives vary the speed the disc is spinning at so the data rate of the drive is constant, whereas CAV (Constant Angular Velocity) drives spin the disc at a constant speed so the data rate of the drive increases as the pickup moves to the outer edge of the disc. The constant motor speed of CAV drives eliminates the need for settling the optical pickup after seeking data, which is a problem with CLV drives. The Full Seek and Random Access benchmarks of the USDrive illustrate this perfectly. They were the slowest of all the 24x CD-ROM drives we tested. Our real-world benchmark of copying the contents of *Wing Commander IV* disc 1 to a hard drive yielded the worst time of all the drives as well. The 24DT is the least expensive, and one of the worst, 24x CD-ROM drives we've seen.

The USDrive 24DT contains a 128K buffer and supports both PIO Mode 4 and DMA Mode 1.

Price *$95*
Company *USDrive Technology*
Phone *510.657.0388*
URL *www.usdrive.com*

Diamond **Stealth II** S220

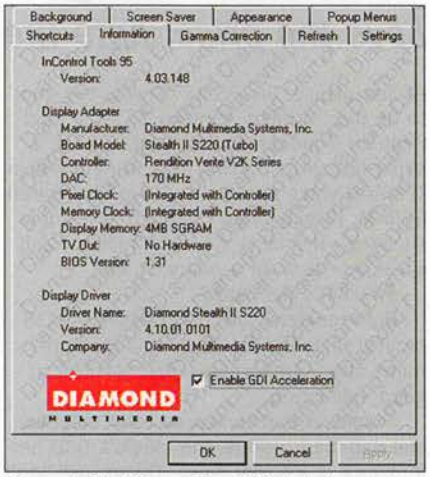
A new 3D world order

Purging the bunk-ass ViRGE architecture that plagued the Stealth series for many moons, Diamond has just raised the Direct3D performance bar to a level other cards can only dream of achieving.

Based on Rendition's 64-bit Verite V2100 TruMedia Accelerator (part of the V2000 line), the Stealth II S220 comes with 4MB of non-upgradable SGRAM with a 170MHz RAMDAC. Like the V1000 of old, the V2100 combines an embedded RISC engine with a dedicated, fixed-function accelerator (with integrated triangle set up) to prevent polygon-drawing processes from bogging down the host CPU. Other cards may claim faster frame rates, but the V2100 maintains consistently fast frame rates. All your favorite D3D features are supported, including trilinear filtering and anti-aliasing.

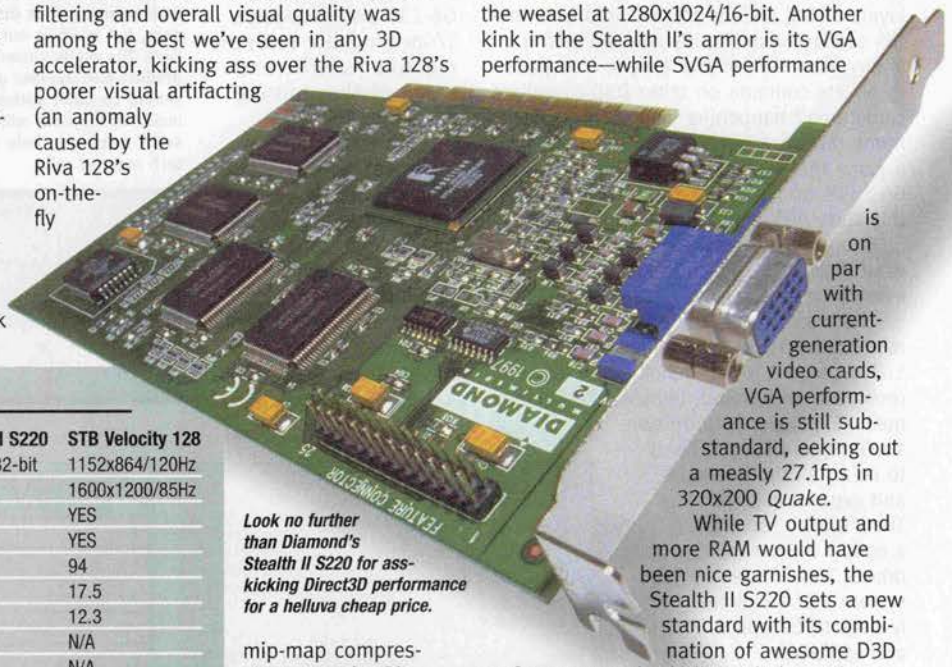
APIs accelerated include Rendition's native Speed3D (DOS) and RRedline (Win95), as well as D3D apps (windowed and full-screen). The board claims OpenGL-compliance, but drivers are still forthcoming. Other features include a hardware video scalar for full-screen MPEG-1 playback and VESA 2.0 compliance.

Under the intensity of our new 3D benchmarks, the Stealth II S220 proved a screamin' D3D demon. *X*'s 800x600 interstellar combat arena posted a cool 39.5fps—almost as fast as Hercules' Stingray 128/3D 8MB Voodoo Rush board (reviewed on page 100–101). Drop down to 640x480, and the Stealth II S220 screams past 3Dfx at 51.7fps—faster than ATI's 3D Rage Pro–powered Xpert@Play (32.53fps) and Ubi Soft's 3Dfx-powered Gamer 3D (47.7fps). But how does it compare with nVidia's Riva 128? The Stealth II's bilinear filtering and overall visual quality was among the best we've seen in any 3D accelerator, kicking ass over the Riva 128's poorer visual artifacting (an anomaly caused by the Riva 128's on-the-fly mip-map compression—see the Riva 128 roundup in *boot* 16 for the full 411).



Diamond's latest incarnation of InControl shows up here on this Verite V2100-powered video card.

Shortcomings? The Stealth II's low fill rate (16.34Mpixels/sec compared with the Riva 128's killer 61.2Mpixels/sec) hurts, as does the full-screen MPEG-1 playback, which consistently shears video at 800x600/16-bit color depth and chokes on the weasel at 1280x1024/16-bit. Another kink in the Stealth II's armor is its VGA performance—while SVGA performance is on par with current-generation video cards, VGA performance is still substandard, eeking out a measly 27.1fps in 320x200 *Quake*.



Look no further than Diamond's Stealth II S220 for ass-kicking Direct3D performance for a helluva cheap price.

While TV output and more RAM would have been nice garnishes, the Stealth II S220 sets a new standard with its combination of awesome D3D performance and a ludicrously low price.

—Andrew Sanchez

Dare to Compare

	Diamond Stealth II S220	STB Velocity 128
Max 24-bit resolution/refresh	1024x768/75Hz * 32-bit	1152x864/120Hz
Max 16-bit resolution/refresh	1280x1024/75Hz	1600x1200/85Hz
VESA 2.0 Support	YES	YES
Virtual Desktop Support	NO	YES
MDK PerfTest v1.4	92	94
Quake (640x480)	14.0	17.5
Quake (800x600)	11.1	12.3
Quake II Test (640x480 software)	15.71	N/A
X (640x480)	51.76	N/A
X (800x600)	39.58	39.21
Final Reality Overall	2.34 R-Marks	2.48 R-Marks
FR 2D	2.09 R-Marks	2.07 R-Marks
FR Bus Speed	2.26 R-Marks	1.39 R-Marks
FR 3D	2.51 R-Marksec	3.01 R-Marks
FR Polygons	75.76 Kpolys/sec	74.22 Kpolys/sec
FR Fill	16.34Mpixels/sec	61.23Mpixels/sec
FR Robots	23.27fps	25.94fps
FR City	21.14fps	27.90fps

Test Methodology

System	Micron Millennia Mxe
CPU	Intel Pentium 200MHz MMX
O/S	Windows 95 OSR2
RAM	32MB EDO DRAM

THE STATS: BIOS: 1.31r | Win95 Driver: 4.03.148 ***THE BUNDLE:*** Forsaken self-running demo | Moto Racer | Half-Life AVI | SODA Off-Road Racing | Terracide | WipeOut XL

Price *$119*
Company *Diamond Multimedia*
Phone *800.468.5846*
URL *www.diamondmm.com*

Gateway G6-233

Love the price, hate the card

At first glance, the G6-233 seems too good to be true. It has a genuine 233MHz Intel Pentium II processor, 32MB of SDRAM, a super-fast 24x CD-ROM, and an nVidia Riva 128 AGP video card with 4MB of integrated SGRAM. If that weren't enough, the whole shebang—including a 17-inch monitor and speakers—lists for a paltry $1,999.

So what's the catch?

Unfortunately, the STB nVidia Riva 128 proves once and for all that souped-up frame rates don't necessarily make for a good video card.

Thanks in part to screwy color palettes and mip-map trickery, the nVidia's D3D performance is a soggy mess. Things just don't look right. In *Final Reality*, textures are mysteriously missing from the sky, and multiple layers of fog are compressed into one. In *X*, the screen looks like it's covered with a grainy filter. And in *Jedi Knight*, transparency effects common on other D3D-compliant cards aren't happening (see sidebar). Sure, frame rates are fast, but who wants to play a game that looks like crap? Thanks to the G6-233's terrific case design, removal of this sorry AGP card takes mere seconds.

Enough negativity. Let's explore what kicks ass—which is just about everything else.

The interior, sporting an ATX form-factor motherboard with support for 384MB(!) of SDRAM, was a joy to behold, with lots of room and uncluttered, unobstructed components. Expansion is a breeze: You'll need a second hand to count all the free slots and expansion bays. There's even room for a couple more hard drives. This is one system that absolutely begs to be opened and explored.

As for performance, the G6-233 is a PC freak's dream, clocking in with terrific results across the board. The bootMarks speak for themselves, and with the notable exception of our tough VidTach test, all the benchmarks were well into the green (in some cases right off the charts). And, although the nVidia card was super-fast, remember that numbers alone don't tell the whole tale.

The 24x CD-ROM drive and 2.0GB hard drive performed with gusto, kicking out transfer rates of 2,059K/sec and 3.42MB/sec, respectively. We would've preferred a bigger hard drive (2.0GB doesn't quite cut it these days), but this is understandable considering the G6-233's highly ambitious price.

Other G6-233 treats include a robust Ensoniq PCI sound card (with a CPU utilization of only 9%) and a U.S. Robotics 56.6Kbps x2-compliant internal modem (the only card occupying an ISA slot). And lest we forget, the G6-233 also includes a 17-inch monitor (with the requisite features) and a pair of Altec Lansing speakers. Phew!

With Intel dropping processor prices faster than a Kennedy drops trou, now is the perfect time to pick up a new PC. Kudos to Gateway for putting together a terrific system at a terrific price. Let's hope other manufacturers follow suit.

—Bryan Del Rizzo

under the hood

THE BRAINS	
CPU	Intel Pentium II 233MHz
L2 Cache	512K pipeline-burst
RAM	32MB SynchDRAM (384MB max)
Motherboard	Intel 440ATX
THE BRAWN	
Video	AGP STB nVidia Riva 128 (with 4MB SGRAM)
Hard Drive	Western Digital 2.0GB UATA
CD-ROM	Toshiba 24x
Expansion Bus	One ISA, three PCI, one shared, one AGP
Fax/Modem	US Robotics TelePath x2-compatible 56.6Kbps modem
I/O Ports	Two serial, one parallel, two USB, two PS/2, one monitor
THE BEAUTY	
Display	Gateway EV700 17-inch; .28mm dot pitch, shadow mask tube
Sound	Ensoniq PCI FM/wavetable
Speakers	Altec Lansing ACS41

EXPANSION MAP

AGP	Video
PCI	Free
PCI	Free
PCI	Shared/Free
PCI	Sound card
PCI	Shared
ISA	Shared
ISA	Modem

THE BUNDLE Microsoft Word 97 | Microsoft Works 4.5 Microsoft Money 98 | Microsoft Encarta 98 Encyclopedia Microsoft Entertainment Pack–The Puzzle Collection Greetings Workshop | Online Services

boot	down
1:10	:06

INSERT FINGER AND PULL
The entire front panel pops off easily enough, but when you try to snap it back in place, you may be distressed to find the wide gap existing along the side and bottom. Don't worry about it—the side panel sports a curvature that closes the gap up nice and tight.

I'LL TAKE DOOR NUMBER ONE, MONTY!
Open up the front door and you'll discover three empty expansion bays. At first glance, we thought the product serial number was emblazoned on the inside of the door, but much to our chagrin, it isn't. The digits shown are a product part number only. Gateway should consider stickering the inside of the door with the system serial number to help expedite tech support calls.

LOTS OF ROOM TO GROW
The inside of the case is cavernous. There are plenty of free expansion bays, including an extra 3.5-inch baby. There's even enough space to house a couple of extra hard drives. The only potential problem? If a manufacturer stupidly introduces a full length AGP part, the hard drives won't fit. Better pray that doesn't happen.

AWWW... LOOK AT ALL THE CUTE BUTTONS!

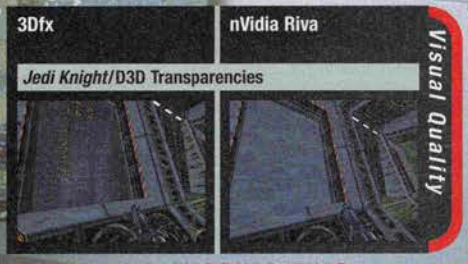
The very comfortable keyboard even includes a bevy of buttons to control the CD-ROM, volume level, and sleep mode. Strangely, a couple of the buttons are pre-programmed for TV and radio controls, even though a tuner card isn't installed. Oops!

CENTRAL AIR INCLUDED

You'll never have to worry about that Pentium II overheating: The large plastic shell helps direct the airflow to the elongated mounted heatsink on the processor.

BEHIND RIBBON CABLE NUMBER ONE...

Yeah, we know you can't see it, but the G6-233 can handle up to three 128MB SIMMs for a total of 384MB. Way cool!



SOMETHING MISSING THIS WAY COMES

In a side-by-side comparison to a 3Dfx card, the STB nVidia Riva 128 sucks when it comes to handling transparent effects. Nowhere is this more apparent than in *Jedi Knight* (level one, mission one). On any 3Dfx card you can observe the cityscape through the wall. On the nVidia you can only observe the wall. How exciting. The Riva 128 may be D3D compliant, and it may cough up excellent frame rates, but this blows chunks.

real-world benchmarking

Gateway G6-233

CPU/MOTHERBOARD *bootMark*	112.5	
WIN95 APPS *SYSmark32*	202	
DIRECT3D *Terramark*	composite 1145	+
HARD DRIVE *Adaptec ThreadMark v1.0*	MB/sec 3.42	
CD-ROM *CD Tach/Pro v1.65*	K/sec 2059	+
WIN95 VIDEO *VidTach v1.52*	% played 31.7	
DOS GAMING *Quake v1.06*	fps 24.4	+
DIRECTX GAMING *MDK PerfTest v1.4*	110	
MMX PROCESSING *DeBabelizer Pro*	secs 261	+
CPU/DISK *Microsoft Visual C++ compile*	secs 171	

With a price tag of only $1,999, the G6-233 is a buyer's dream. However, we'd swap out that STB/nVidia card in a heartbeat—call us crazy, but we like our games with full textures and proper transparencies.

+	−
233MHz Pentium II processor	Screwy STB/nVidia Riva 128 video card
Above-average performance	Only a 2GB hard drive
AGP slot solution	No TV-out ports
Cool keyboard	No DVD
Sporty CD-ROM drive	No game controllers
PCI sound card	DirectX 5.0 not pre-installed
Price includes 17-inch monitor and speakers!	

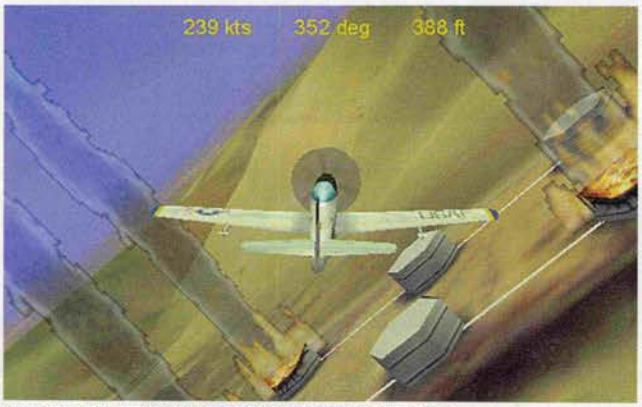
Price $1,999
Company Gateway 2000
Phone 800.846.2000
URL www.gateway2000.com

boot verdict **8**

A complete breakdown of benchmark results is available on the *bootNet*. Point your browser to www.bootnet.com

Sabre Ace

A combat sim with Seoul



The prop-driven F-51 does serious damage to an oil refinery.

Sabre Ace is the best seat-of-the-pants air-combat sim since *Chuck Yeager's Air Combat.*

With 53 missions over Korea, there's plenty of variety. You fly a handful of prop and jet aircraft in addition to the F-86 Sabre, in either U.S. or communist careers.

The AI will give even expert pilots a workout. Particularly impressive is the computer pilot's penchant for using the entire sky, often dragging you from 30,000 feet right down to the deck.

Although only 640x400, the D3D-accelerated image looks crisp and frame rates stay well over 20fps at all times on a 3Dfx-equipped P166, with only the occasional hiccup when textures or sounds load.

Sabre Ace's terrain is well drawn, with textures detailed and believable, even at fairly low altitudes. Occasional low mountains and 3D embellishments such as bridges and airport buildings add spice to low-level combat.

With about 1,300 polygons on the screen, landscapes exhibit dramatic relief and some draw-in on the horizon. Aircraft, at about 300 polygons each, are spectacular. Force feedback is equally well crafted, from the rumble of wheels on tarmac to the buffeting of flaps-down flight.

The only limitations stopping *Sabre Ace* from jetting into the stratosphere are the fixed views (rather than a true virtual cockpit) and the lack of HUD to keep you from auguring in while tracking a bogey. Otherwise, *Sabre Ace* is as sharp a simulation as you'll find in this year's crowded digital skies.

—Frank Lenk

Aircraft look magnificent, with wings that glint in the sunlight, shadows that move as you do a barrel roll, and bomber crews that actually bail out.

CHECKLIST

Sabre Ace
Version: 1.0

Maximum Resolution/Color
640x400/16-bit
Win95 Native
3D Acceleration
Direct3D
DirectX
DirectDraw DirectSound
DirectPlay DirectInput
Multiplayer
LAN Modem
Direct/serial TCP/IP
Specialty Controllers
Force feedback Throttle
Rudder

Price ***$50***
Developer ***Eagle Interactive***
Publisher ***Virgin Interactive Entertainment***
Phone ***800.843.3661***
URL ***www.vie.com***

boot verdict 8

iF-16

The wrong stuff

TRY IT ON THE DISC

In a sky full of futuristic fighter sims, has the workhorse F-16 become a hangar queen? The developer of *Apache* and *Hind* hopes to revive the Falcon's fading fortunes, showing the detail and visual impact of its previous helicopter simulations, while presenting a believable model of the fixed-wing F-16. However, one omission becomes apparent right away: 3D acceleration.

Not to worry; the graphics still look terrific. Terrain is painted with a variegated palette of textures and is strongly contoured. Ground detail is abundant, and aircraft exteriors are stunning.

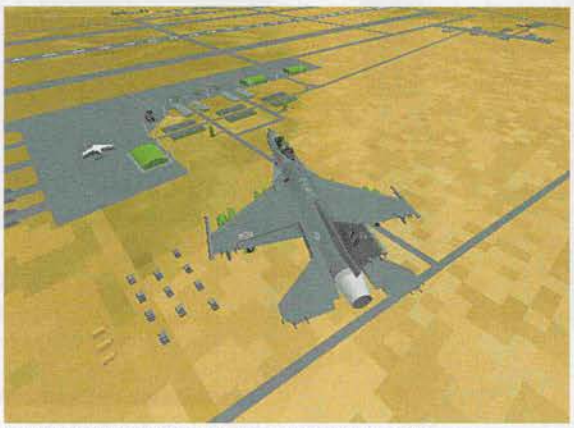
iF-16's software rendering is sluggish alongside the recent crop of 3D-accelerated sims. Frame rates hovered around 15fps on a P200 system. However, turning off cloud textures produced a more reasonable 18fps, and less-detailed terrain modes brought frame rates well into the double digits. D3D is badly needed to lift *iF-16* up to more eye-pleasing frame rates with all visual delights left intact.

Viewing options include a true virtual cockpit and target-lock mode. The latter includes a HUD heading and attitude indicators that track wherever you look.

Beyond frame rates, our one gripe with *iF-16* is the lack of joystick support. The software seems to bypass the Win95 controller API, supporting only a handful of specific joysticks. The venerable CH FlightStick Pro was on the list, but wouldn't calibrate properly. The SideWinder 3D Pro worked better, but couldn't register "up" on the hat switch.

A 3D-accelerator patch is in the works. If Digital Integration can fix the unserviceable joystick technology at the same time, *iF-16* could emerge with flying colors.

—Frank Lenk


Aircraft detail includes full weaponry and even the pilot.

CHECKLIST

iF-16
Version: 1.0

Maximum Resolution/Color
640x480/16-bit
MS-DOS Executable
Win95 Native
DirectX
DirectDraw
Multiplayer
LAN Modem Direct/serial
Specialty Controllers
Throttle Rudder

Price ***$50***
Developer ***Digital Integration***
Publisher ***Interactive Magic***
Phone ***919.461.0722***
URL ***www.imagicgames.com***

boot verdict 6

VideoLogic **Apocalypse** 5D

Showing signs of age

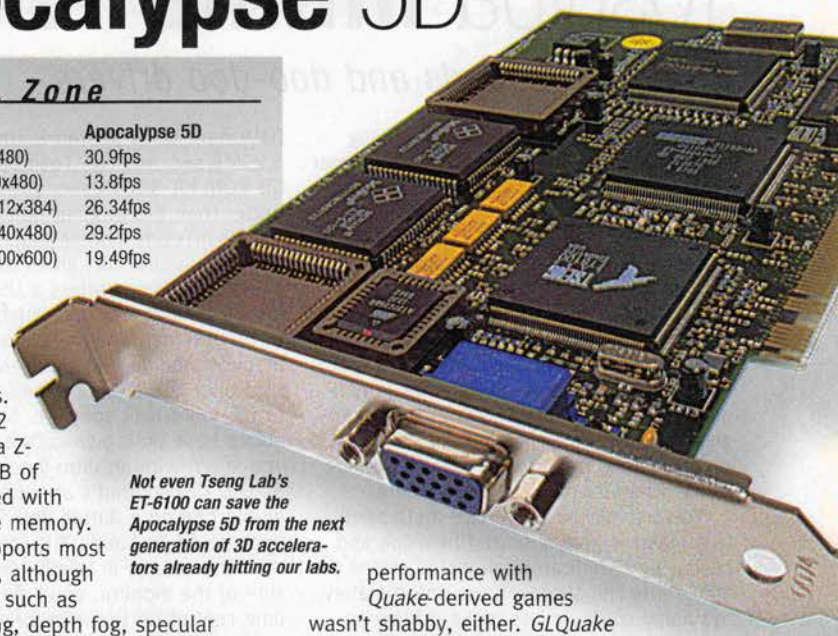
We gave you an early look at the PCX2-powered Apocalypse 5D back in *boot* 10. At the time, only Hercules' Stingray 128/3D could go up against this all-in-one powerhouse. This newest Apocalypse 5D packs Tseng Lab's newest 2D chipset (the older version had the ET-6000) and the latest drivers for speedier Windows 95/GL gaming. But, is it enough to keep the wrinkles away?

The Specs

Max 24-bit resolution/refresh	800x600/100Hz
Max 16-bit resolution/refresh	1158x864/80Hz
VESA 2.0 Support	YES
Virtual Desktop Support	YES
MDK PerfTest v1.4	94
Quake (640x480)	16.0fps
Quake (800x600)	11.1fps
Quake II Test (640x480 software)	16.34fps
X (640x480)	30.35fps
X (800x600)	26.56fps
Final Reality	
Overall	1.80 R-Marks
FR 2D	2.08 R-Marks
FR Bus Speed	1.61 R-Marks
FR 3D	1.71 R-Marks
FR Polygons	59.77Kpoly/sec
FR Fill	21.45Mpixels/sec
FR Robots	18.59fps
FR City	18.21fps
Test Methodology	
System	Micron Millennia Mxe
CPU	Intel Pentium 200MHz MMX
O/S	Windows 95 OSR2
RAM	32MB EDO DRAM

The GL Zone

Benchmark	Apocalypse 5D
GLQuake (640x480)	30.9fps
GLHexen 2 (640x480)	13.8fps
Quake II Test (512x384)	26.34fps
Quake II Test (640x480)	29.2fps
Quake II Test (800x600)	19.49fps

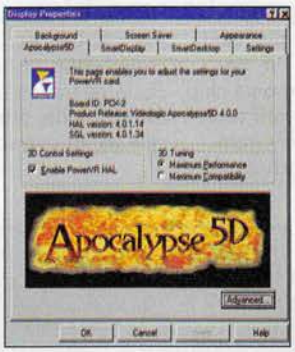


Not even Tseng Lab's ET-6100 can save the Apocalypse 5D from the next generation of 3D accelerators already hitting our labs.

The PCX2's "infinite planes" approach to displaying texture-mapped polygons makes it the odd-man out in the hotly contested 3D market. Despite claims of massive software support, the only game demonstrating the PCX2's power to render real-time shadows and spotlights was Kalisto's *Ultim@te Race*—a game getting a 3Dfx/Glide makeover and looking just as hot. Can the Apocalypse 5D survive?

Tseng Lab's 128-bit ET6100 takes up three-quarters of the PCI card's circuit board. Armed with 2MB of multibank DRAM (upgradable to 4MB) and an integrated 175MHz DAC, the ET6100 is coupled with the PowerVR PCX2 3D accelerator for texel-pushing duties. Since the PCX2 doesn't need a Z-buffer, the 4MB of SDRAM coupled with it is all texture memory. The board supports most D3D functions, although many features such as trilinear filtering, depth fog, specular gouraud, and various forms of alpha blending, still aren't enabled (some can be enabled via the control panel).

The benchmarks tell a divided tale. On the one hand, Direct3D performance is unacceptable. While the *Final Reality* fill rate on the PCX2 is higher than Rendition's V2100, the PCX2 bogged down on almost every other benchmark. *X*'s 800x600 floated in at 26.5fps—not bad, but 3Dfx and Rendition are pushing 40fps+ on the same test. 640x480 *X* came in at 30fps—a far cry from the Stealth II's awesome 51.7fps.



Add all those D3D apps that refuse to cooperate to this list. From here, you can add feature attributes to applications, so your transparencies may have a fighting chance for normality. Why can't the drivers just handle this automatically?!

Transparencies are handled neatly, but thanks to the stunted alpha-blending edges show up as black instead of clear. You can add an offending app to the Apocalypse 5D control panel and adjust settings to get the visuals right, but that list is gonna get big real fast—why can't the drivers just take care of business on their own?

On the other hand, VESA 2.0–compliant DOS gaming coughed up above-average scores, while MPEG-1 performance held up well even in full-screen 16-bit color. GL performance with *Quake*-derived games wasn't shabby, either. *GLQuake* punched in at 30.9fps, while the *Quake II* test spewed out 29.2fps at 640x480. Unfortunately, the drivers shipping within the *QII* test commit horrible lighting errors, resulting in a flickering per-polygon light-sourcing that resembles a Friday-night discotheque. This should be fixed by the time you read this review.

Despite the improved drivers and newer 2D chipset, the Apocalypse 5D is looking dated, especially with the new batch of 3D accelerators from nVidia and Rendition kicking ass and taking names. Yes, this board has GL mini drivers for *Quake*—but so will practically everyone else. And, considering the weak D3D performance, the lack of strong, native PowerSGL software titles only adds another wrinkle on this aging accelerator's sagging features.

—Andrew Sanchez

THE STATS: BIOS: 1.31 | Win95 Drivers: Apocalypse 5D v4.0.1, GraphixStar 4.3.4 **THE BUNDLE:** Mechwarrior II | Wipeout XL | Ultim@te Race | Terracide

Price $229 (6MB)
Company VideoLogic
Phone 800.578.5644
URL www.videologic.com

Toshiba **Infinia** 7260

A tale of doodads and doo-doo drivers

This funky-looking black box will answer your phone, connect to the Internet at the touch of a button, and balance your checkbook. OK, it's just a computer, but we're talking lots of bells and whistles here, folks. From the integrated speakers and glorified program launcher mounted to the front of the monitor, to the svelte case all done up in midnight gray, the Infinia 7260 has more gadgets than a Buzz Lightyear action figure. Unfortunately, the Infinia achieves nothing stellar when it comes to performance.

You'd think the 266MHz P-II strapped to a massive gold-anodized heatsink and cooled by a dedicated fan would rocket the Infinia into the stratosphere. Unfortunately, too many compromises make it blow an O-ring on take off. Start with substandard video performance offered by the 3D Rage Pro PCI card. Sure, ATI's 3D Rage Pro is a Kick-Ass chipset, but the drivers provided by Toshiba are laughably inept. The onboard Yamaha OPL-3A soundcard-on-a-chip is one small step up from soft-synth wavetable, yet still one giant leap away from hardware wavetable solutions such as the Roland SCC-1.

On the plus side, there's ample room for expansion, with two free PCI, a shared PCI/ISA, and two free ISA shared slots. The four DIMM slots on the Intel PD440FX motherboard arrive with two slots filled by 64MB of EDO DRAM. Two 3.5-inch drive bays and room for two more 5.25-inch drives in the front allow plenty of room when it's time to add a Zip or CD-R drive.

The system ships with Win95 OSR2, but bus-mastering wasn't enabled on either the hard drive or the CD-ROM drive. Bus-mastering lowers CPU utilization and, in the Infinia's case, results in higher throughput from both devices. With bus-mastering enabled, the Maxtor Diamond Max Ultra DMA hard drive posted a ThreadMark of 5.29MB/sec, and the Toshiba 24x ATAPI CD-ROM hit 3,164K/sec, both markedly better than the original benchmarks.

The InTouch module mounted on the Infinia's monitor has given us a new understanding of how useless a USB device can be. Pushing one button launches you on to the Internet, another plays a CD. The InTouch module also doubles as a CD/DVD controller and provides the same functions to the voice-mail software. Since all the above have their own software equivalent, you're left with an ultra-fancy hunk-o-plastic LCD display that's about as useful as a nipple ring on a Barbie doll. The volume knob could be handy if it controlled more than the volume in Win95. On the left-hand side of the monitor, you'll find the real volume control for the monitor's speakers, as well as microphone and headphone jacks.

Setting up the voice-mail system on the Infinia is painless thanks to the provided Syncro Connect software and the DSVD capabilities of the Win Modem. Voice mail is in operation even when the system is in sleep mode, providing the system a second life as an oversized answering machine.

—Sean Downey

under the hood

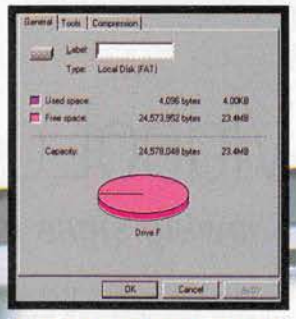
THE BRAINS	
CPU	Intel Pentium II 266MHz
L2 Cache	512K internal SBRAM
RAM	64MB EDO DRAM DIMM (256MB max)
Motherboard	Intel PD440FX ATX board
THE BRAWN	
Video	ATI Rage Pro with 4MB SGRAM
Hard Drive	Maxtor Diamond Max 86480D6 6.4GB Ultra DMA
CD-ROM	Toshiba M-6102B 24x ATAPI
Expansion Bus	Three PCI, one ISA/PCI shared, two ISA
Fax/Modem	Lucent Technologies DSVD K56flex Win Modem LT
I/O Ports	Two serial, one parallel, two USB, one MIDI/gaming port
THE BEAUTY	
Case	Two front-accessible 5.25-inch bays, one internal 5.25-inch bay , three internal 3.5-inch bays
Display	17-inch (16.23 viewable) with external microphone and audio in/out
Sound	Yamaha OPL-3A YMF 715 on motherboard
Speakers	2x4.5-inch full-range satellites and subwoofer integrated into monitor
Other	InTouch Module

EXPANSION MAP

PCI	Video Card
PCI	Free
PCI	Free
PCI	Shared/ISA
ISA	Shared/Modem
ISA	Free
ISA	Free

THE BUNDLE AT&T WorldNet | Family Album Creator | Get Ready for School Charlie Brown | Investor Insight | Jonny Quest | Mayo Clinic Family Health | Encarta 97 | MS Money | MS Works | Netscape Navigator PE | Quicken SE | Syncro Connect Home | Video Phone | MechWarrior 2 | Mediamatics Arcade Pak | MS Golf | Shanghai | SimCity 2000

boot down 1:08 :05



A MORE INTELLIGENT PARTITION SCHEME

Toshiba's partition scheme on the Infinia's 6.4GB hard drive is somewhat ill thought out. Although we don't have a problem with FAT and its limited 2GB partition size, the decision to create three 2GB partitions on the hard drive leaves 23.4MB left over that invariably wastes a drive letter. A more intelligent partition scheme would use this space more efficiently.

LOCK AND LOAD

The excellent case design features easy access to the Infinia's interior. Clips and rails make adding and removing drives from the front panel a snap.

The Monitor

Equipped with a laser and retractable wing jets

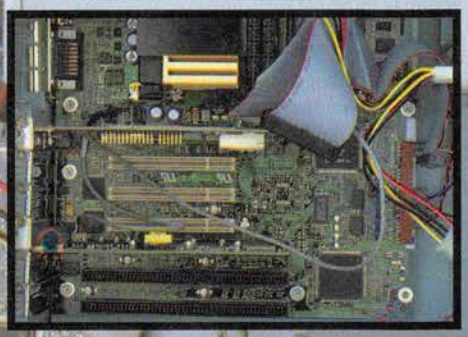
The optional 17-inch multimedia monitor pulls a maximum resolution of 1280x1024 and 0.28mm dot pitch. Two 2x4.5-inch speakers are mounted in the columns on each side of the screen and are isolated from the picture tube by rubber shock absorbers. The 5W sub-woofer pumps its sonic vibrations from the base of the unit. The sound system is decent, but don't throw away your Cambridge SoundWorks just yet.

ACCESSORIZE WITH COLOR-CODING EASE

The ATX I/O connector features all the ports we've come to know and love, including two USB connections, as well as audio in/out and microphone jacks. Bright color-coding helps make doubly sure that you don't jack into the wrong port.

OPEN FOR SILICON INJECTIONS

The Infinia offers lots of open space for future add on cards. Of course, the first thing anyone who buys this system should do is move that ISA card out of the shared slot in order to free up another PCI slot.



real-world benchmarking

Toshiba Infinia 7260

CPU/MOTHERBOARD	*bootMark*	129
WIN95 APPS	*SYSmark32*	225
DIRECT3D	*Terramark*	composite: failed
HARD DRIVE	*Adaptec ThreadMark v1.0*	MB/sec 4.25
CD-ROM	*CD Tach/Pro v1.65*	K/sec 2740 +
WIN95 VIDEO	*VidTach v1.52*	% played 60
DOS GAMING	*Quake v1.06*	fps 20.8 +
DIRECTX GAMING	*MDK PerfTest v1.4*	122 +
MMX PROCESSING	*DeBabelizer Pro*	secs 231 +
CPU/DISK	*Microsoft Visual C++ compile*	secs 105

+

- Pentium II 266MHz
- Innovative monitor design
- Solid hard drive performance
- Easy access to case interior

−

- Faulty video drivers
- Lame-ass InTouch Module
- Weak audio performance

Price $1,999
optional monitor $699
Company Toshiba
Phone 800.334.3445
URL www.toshiba.com/tais/csd/products/

boot verdict **7**

A complete breakdown of benchmark results is available on the *bootNet*. Point your browser to www.bootnet.com

ATI Rage Pro

Master of None

With the pre-installed drivers, the 3D Rage Pro PCI card was unable to run our Terramark benchmark or any Direct3D game we loaded. Upgrading to new drivers provided by ATI enabled us to run through all the Terramarks, only to spew out an error message instead of a final result. With the new drivers, VidTach bombed out, although it worked properly with the pre-installed drivers. Installing DirectX 5.0 allowed us to run Jedi Knight but with a psychadelic color palette. It really is sad to see a card that's capable of so much crippled by incomplete drivers.

Voodoo Is As Voodoo Does

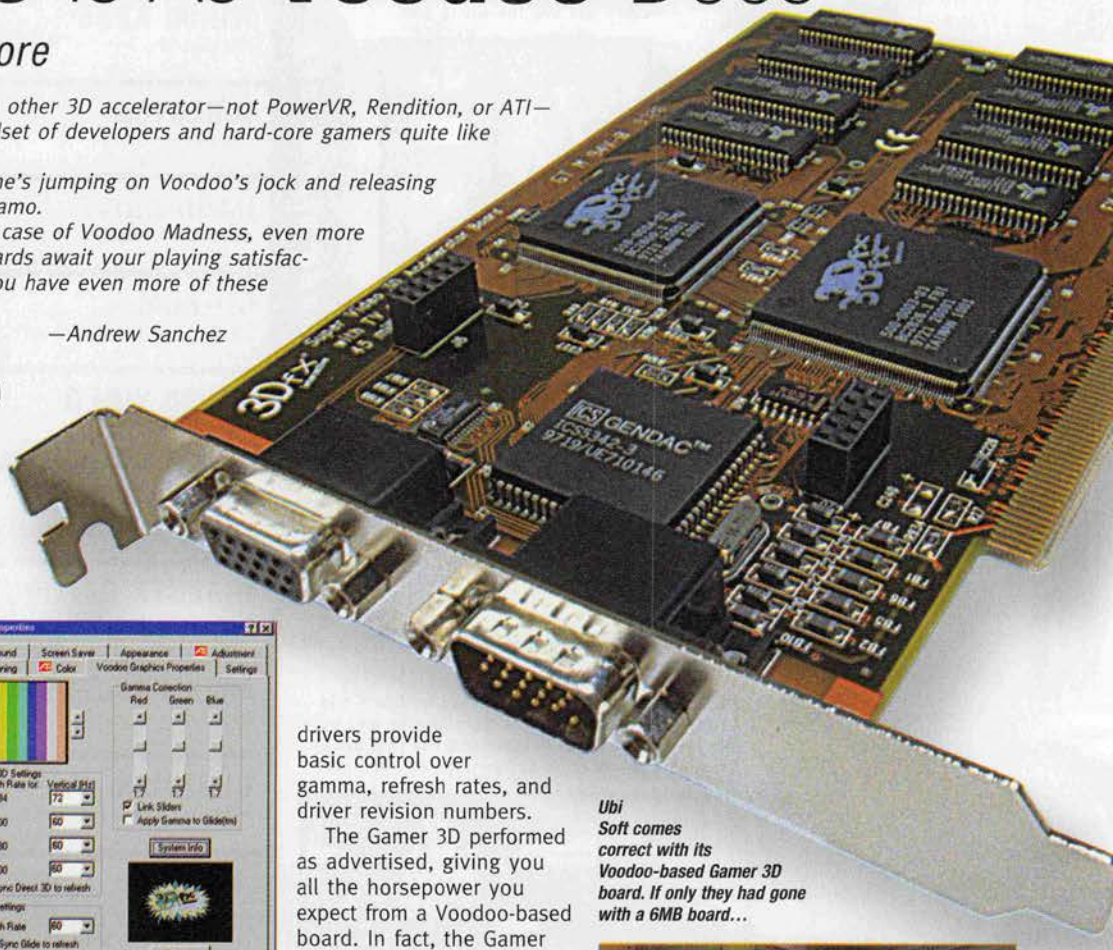
Gliding In For More

3Dfx is hot—damned hot. No other 3D accelerator—not PowerVR, Rendition, or ATI—was able to capture the mindset of developers and hard-core gamers quite like Voodoo.

So it's no surprise everyone's jumping on Voodoo's jock and releasing their own version of this dynamo.

Following up last month's case of Voodoo Madness, even more 3Dfx Voodoo/Voodoo Rush cards await your playing satisfaction. So, buckle up, 'cause you have even more of these bad boys to choose from.

—Andrew Sanchez



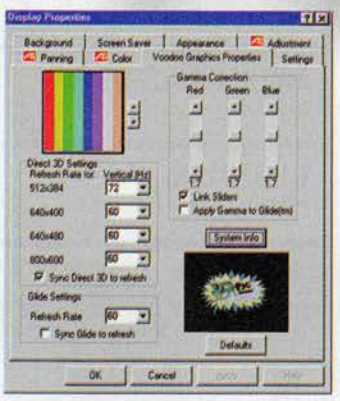
Ubi Soft comes correct with its Voodoo-based Gamer 3D board. If only they had gone with a 6MB board...

Ubi Soft **Gamer** 3D

The Guillemot/Ubi Soft marriage produces yet another hardware offspring—the Gamer 3D.

This Voodoo-armed add-in board comes with 4MB of 40-nanosecond EDO DRAM (2MB for frame buffer and 2MB of texture memory), the board itself following standard Voodoo design. All your favorite API flavors are supported—Glide, Direct3D, and OpenGL. After trying a TV output daughterboard with earlier revs, Guillemot decided against it because the results weren't up to snuff.

Installation proved uneventful, and the drivers provide basic control over gamma, refresh rates, and driver revision numbers.



It may not be as flashy as Diamond's applet, but these controls get the job done.

The Gamer 3D performed as advertised, giving you all the horsepower you expect from a Voodoo-based board. In fact, the Gamer 3D edged out Canopus' Pure 3D (reviewed in *boot* 16) in almost every benchmark. From *GLQuake*'s 28.6fps, to *Final Reality*'s blazing polygon throughput, to the 47.7fps in our 640x480 *X*/Direct3D test, the Gamer 3D shined. Visual quality remained razor-sharp throughout.

While the lack of TV output or extra RAM may sour those ready for the next level of Voodoo, the Gamer 3D is a solidly performing card for those who haven't yet taken the 3Dfx plunge.

With Quake II being unleashed around the holiday season, if you're not armed with a 3Dfx Voodoo or Voodoo Rush-based board, then you're NOT PLAYING QUAKE II!!!

The GL Zone

Benchmark	Ubi Soft Gamer 3D	Hercules Stingray 128/3D 8MB
GLQuake (640x480)	28.60fps	22.00fps
GLHexen 2 (640x480)	20.80fps	15.60fps
Quake II Test (512x384)	42.79fps	27.75fps
Quake II Test (640x480)	29.20fps	23.50fps
Quake II Test (800x600)	N/A	15.29fps

Test Methodology

System	Micron Millennia Mxe
CPU	Intel Pentium 200MHz MMX
O/S	Windows 95 OSR2
RAM	32MB EDO DRAM
2D card	ATI Xpert@Play (with 8MB)

With GLQuake v0.95, we used our own bootmark.dem file, while GLHexen 2 used the demo2.dem file. Both at full screen, no menus.

The Quake II Test (v3.00 October 1997) currently does not have a timedemo benchmark, so we resorted to the timerefresh command. The test was run at the start of a new game, after the green flash disappears, with the screen size set to maximum.

THE STATS: BIOS: N/A | Win95 drivers: v3.0 **THE BUNDLE:** Pod (3Dfx) | SubCulture (3Dfx)

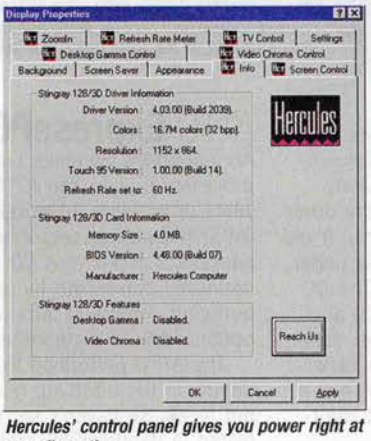
Price $199
Company Guillemot/Ubi Soft
Phone 800.824.7638
URL www.guillemot.com

Hercules **Stingray 128/3D** 8MB

The last time we looked at it, Hercules' 6MB version of this card produced some of the most impressive D3D performance ever to hit the bootLabs and walked away with a 9 out of 10. But that was six months ago, and the world's now seen the light of AGP and nVidia's rubber-burning Riva 128 accelerator.

All the while, the first-gen Stingray 128/3D with Voodoo Rush architecture has come under attack from fanatics complaining of sluggish *GLQuake* performance (up to 5fps slower). The lack of upgradable BIOS only exacerbated the situation.

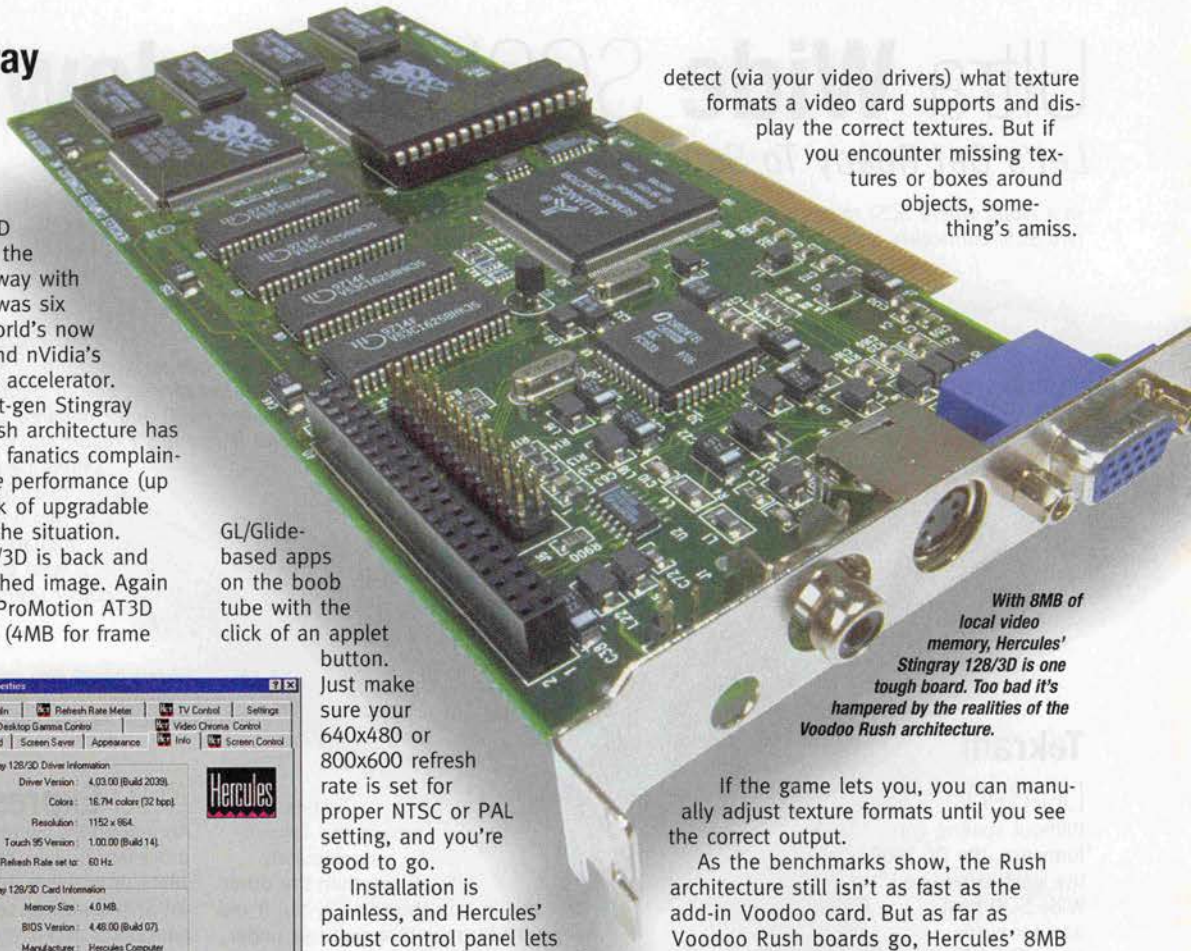
But the Stingray 128/3D is back and ready to clean its tarnished image. Again centering on Alliance's ProMotion AT3D and 8MB of EDO DRAM (4MB for frame buffer and 4MB for textures), the Stingray 128/3D adds flash BIOS (for VESA 2.0 compliance and eternal upgradability) to the mix. The Voodoo Rush daughterboard configuration's been ditched, while the addition of S-Video and composite TV outputs tosses your GL/Glide-based apps on the boob tube with the click of an applet button. Just make sure your 640x480 or 800x600 refresh rate is set for proper NTSC or PAL setting, and you're good to go.



Hercules' control panel gives you power right at your fingertips.

Installation is painless, and Hercules' robust control panel lets you set all your video card options.

But how does this puppy perform? Not too badly when compared with the other two Voodoo Rush boards we've seen (reviewed in *boot* 16). Thanks to some optimized drivers, the Stingray 128/3D completed the *Final Reality*/Direct3D benchmark without a hitch, with results rivaling the best Voodoo Rush boards, while on *X* it turned in faster frame rates than either the Adrenaline Rush or Intense Voodoo Rush boards. And TV output is acceptable. The only quirk involved adjusting texture formats for proper visual appearance. Once fixed, visual quality remained on par with the high standards set by previous 3Dfx cards. Under normal circumstances, most D3D games automatically detect (via your video drivers) what texture formats a video card supports and display the correct textures. But if you encounter missing textures or boxes around objects, something's amiss.



With 8MB of local video memory, Hercules' Stingray 128/3D is one tough board. Too bad it's hampered by the realities of the Voodoo Rush architecture.

If the game lets you, you can manually adjust texture formats until you see the correct output.

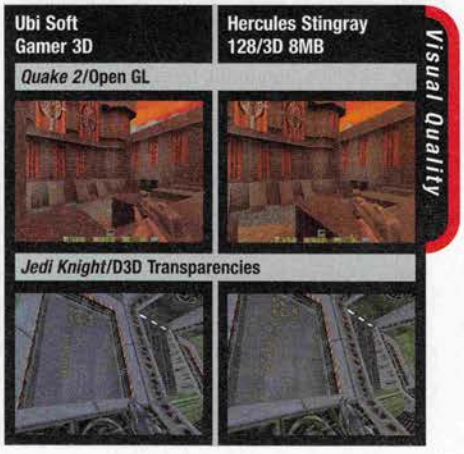
As the benchmarks show, the Rush architecture still isn't as fast as the add-in Voodoo card. But as far as Voodoo Rush boards go, Hercules' 8MB Stingray 128/3D is the best Rush-based board currently out.

THE STATS: BIOS: v4.30.00-B07 (8.08.97) | Win95 drivers: 4.03.00 (build 2039) **THE BUNDLE:** None

Price $249
Company Hercules
Phone 800.532.0600
URL www.hercules.com

Dare to Compare

	Ubi Soft Gamer 3D	Hercules Stingray 128/3D 8MB
Max 24-bit resolution/refresh	N/A	1280x1024/60Hz
Max 16-bit resolution/refresh	N/A	1600x1200/60Hz
VESA 2.0 Support	N/A	Yes
Virtual Desktop Support	N/A	No
MDK PerfTest v1.4	N/A	94
Quake (640x480)	N/A	15.9fps
Quake (800x600)	N/A	7.2fps
Quake II Test (640x480 software)	N/A	16.10fps
X (640x480)	47.7fps	44.6fps
X (800x600)	43.7fps	40.1fps
Final Reality Overall	N/A	2.35 R-Marks
FR 2D	N/A	2.07 R-Marks
FR Bus Speed	N/A	1.46 R-Marks
FR 3D	2.80 R-Marks	2.74 R-Marks
FR Polygons	77.25Kpolys/sec	73.02Kpoly/sec
FR Fill	28.40Mpixels/sec	27.97Mpixels/sec
FR Robots	18.05fps	26.17fps
FR City	32.89fps	26.77fps



Ultra **Wide** SCSI **Showdown**

Let's Get Ready To Scuzzyyy!

In a world where SCSI reigns supreme, only the fastest survive. Enter Atto and Tekram, two SCSI controllers armed to take on SCSI peripherals—but in drastically different ways. One offers integrated technologies that enhance performance and heavy loads, while the other provides an inexpensive entrance into the land that is Ultra Wide SCSI (albeit without the bells and whistles). Both are full 32-bit Ultra Wide host adapters that support bus speeds of up to 40MB/sec. We tested them with Seagate's Cheetah Ultra Wide hard drive (also reviewed here) and compared them to Adaptec's 2940UW and Diamond's Fireport 40. When the smoke cleared, we found two controllers that suit two different camps with dramatically different needs and a hard drive that should keep power users giggling for days.

–Sean Cleveland

Tekram's DC390F Ultra Wide SCSI host adapter is a good, inexpensive card for those wanting Ultra Wide performance without all the pomp and circumstance.

Tekram DC-390F

Without sparing performance, the DC-390F is the least expensive Ultra Wide SCSI host adapter we've seen. The DC-390F uses the typical Symbios Logic 53C875 processor and comes with nothing else but the drivers necessary to run the card. It may be inexpensive, but it is certainly not cheap. Supporting up to 15 devices, offering full 32-bit PCI DMA bus master compliance, and harboring a completely jumperless design, this plug-and-play board is easy to use. It offers automatic termination, as well.

Testing proved the Tekram to be approximately 12% slower than the other cards in this showdown—but it did keep up with multithreaded use under Adaptec's brutal Threadmark test. The DC-390F (along with ATTO's ExpressPCI) also had the worst CPU utilization scores, meaning less processing power for other tasks.

Nonetheless, if you're looking to buy a high-end Ultra Wide hard drive but can't afford an equivalent controller, the Tekram DC-390F is an excellent introductory card to this high-performance world.

Price ***$145***
Developer ***Tekram***
Phone ***800.556.6218***
URL ***www.tekram.com***

ATTO **ExpressPCI** with ADS

An embedded Symbios Logic 53C875 RISC processor powers the ATTO ExpressPCI, while proprietary Advanced Data Steaming (ADS) technology sets it apart from the pack. ADS accelerates I/O performance and optimizes bandwidth by using full-block buffering, improved data interleave, and optimized SCSI-3 algorithms.

The ATTO performed like a speed demon in the bootLab, reaching throughput levels we haven't seen with any card tested in Windows 95, including Adaptec's 2940UW. The Adaptec controller, however, outshined the ATTO in NT, the operating system that ATTO offers its cool tools to. These tools include a utility for adjusting the card settings, including the PCI burst rate and bus reset delay, both of which would most likely boost NT performance (we tested the card with the default settings). You also get a disk benchmarking utility for testing different parameters or striped disks (Windows NT Server supports disk striping, RAID level 0; disk mirroring, RAID level 1; and disk striping with parity, RAID level 5).

Other features include automatic

The Numbers Speak for Themselves

System Used: Micro X MXP-5000 with Intel 200MMX, 32MB SDRAM on a Tyan 1572 Titan Turbo ATX

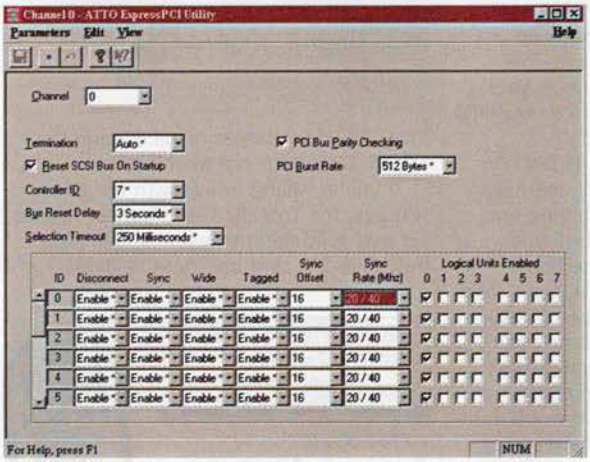
	Seagate Cheetah ST34501W Ultra Wide SCSI Hard Drive			
	ATTO ExpressPCI	*Tekram DC-390F*	*Adaptec AHA 2940UW*	*Diamond Fireport 40*
Adaptec Threadmark	**Win95 / NT**	**Win95 / NT**	**Win95 / NT**	**Win95 / NT**
Data Transfer Rate (MB/sec)	**7.89** / 9.42	6.65 / 9.74	6.97 / **10.38**	5.88 / 9.96
Average CPU Utilization	39% / 24%	40% / 25%	25% / 25%	**22%** / **24%**
BootMark Physical Benchmark				
Drive Throughput (MB/sec)	**9.1**	7.8	8.7	8.7

Bold indicates best score in test

ATTO's ExpressPCI Ultra Wide SCSI host adapter offers more than the general gamut of options. Proprietary Advanced Data Streaming (ADS) technology is geared toward RAID-level bus use.

termination, support for up to 15 devices, plug and play, and a flash ROM BIOS for firmware updates. The ATTO is fully ASPI compliant, and an optional RAID solution kit (combining a disk utility and RAID level 0 software for true bus-filling power) is available. If you're considering a RAID solution or building a server, the ATTO is the perfect solution.

Price $395
Developer ATTO
Phone 716.691.1999
URL www.attotech.com



ATTO's ExpressPCI Utility gives you the power to adjust those card settings that are not generally available. Yes, this card is targeted at high-end workstations and servers.

Seagate **Cheetah** ST34501W **Ultra Wide** SCSI **Hard Drive**

This baby seethes testosterone. The fastest drive ever to arrive in the bootLab, the Cheetah made the Kessle Run in 9.1 MB/sec. And with an astonishing disc rotation spec of 10,000 RPMs, it's the first drive to break the 7,200 RPM barrier.

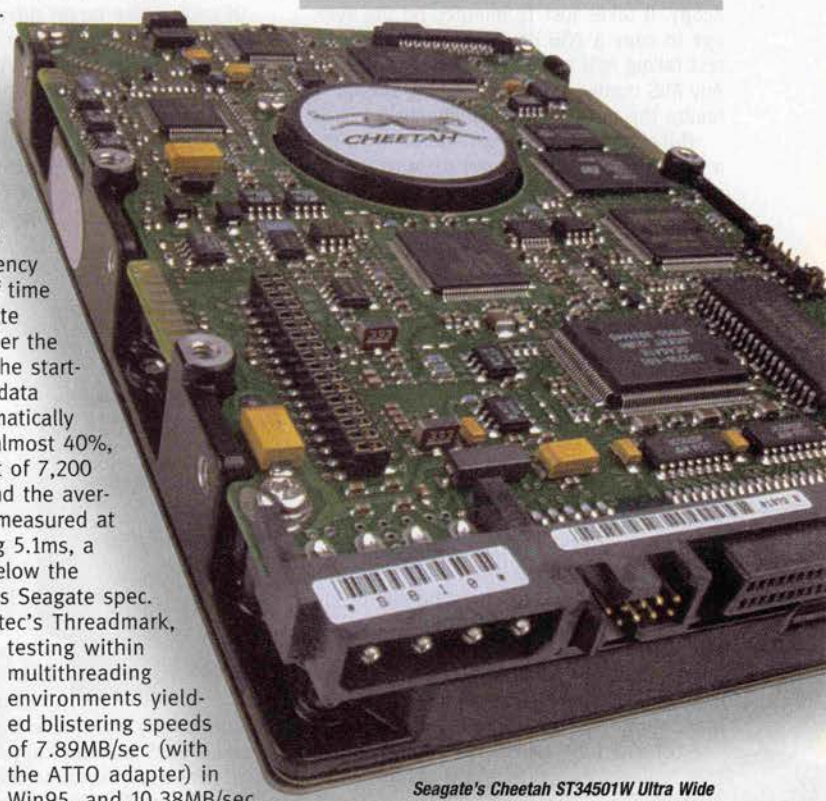
The Cheetah comes in two flavors: a four-platter 4.55GB model and an eight-platter, 1.6-inch high 9.1GB model. Both are available with a choice of Ultra Wide connectivity (16-bit, Ultra SCSI, or Fibre Channel-Arbitrated Loop) or Narrow connectivity (8-bit). Of course, the FC-AL version raises the bus speed to 100MB/sec.

We tested the 4GB Cheetah with 512K cache. To begin with, latency (the amount of time it takes to rotate the platter under the drive head at the starting point of a data stream) is dramatically decreased by almost 40%, well under that of 7,200 RPM drives. And the average seek was measured at an eye-popping 5.1ms, a number well below the promised 7.5ms Seagate spec.

Using Adaptec's Threadmark, testing within multithreading environments yielded blistering speeds of 7.89MB/sec (with the ATTO adapter) in Win95, and 10.38MB/sec in WinNT. Be aware that increased motor power within the hard drive assembly increases the heat generated by this drive, and it's quite a significant increase. This baby runs hot. We suggest directly mounting the drive on the metal of your case (if possible) to create a conductive path. Proper airflow throughout the case is also important and requires the addition of a separate fan.

Although the price is a bit high, for pure balls-out performance, this is the drive to get. You'll notice the difference.

Price $775 4GB, $1,120 9GB
Developer Seagate
Phone 800.732.4283
URL www.seagate.com



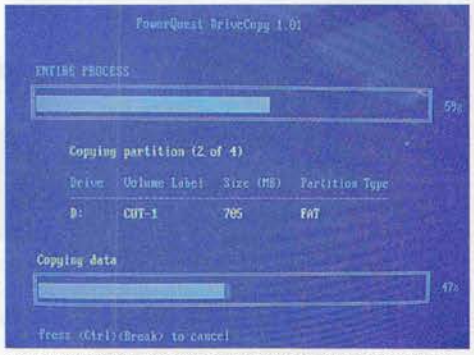
Seagate's Cheetah ST34501W Ultra Wide SCSI Hard Drive comes equipped with a standard cache of 512K that can be upgraded to 2MB for just $100 extra.

Why Buy Ultra SCSI?

Why buy into a Ultra SCSI host adapter that offers 20MB/sec and 40MB/sec bus speeds when Ultra hard drives transfer at only one-quarter of that? Well, buying into Ultra SCSI gives you advantages over Fast (narrow) SCSI adapters because of their architecture. Ultra SCSI offers faster cycle times for data transfer made possible by the higher speeds of new semiconductor technologies in SCSI chipsets. And the arbitration of SCSI commands improves speed by resolving competing demands from multiple processes. The speeds of Ultra Fast and Ultra (fast) Wide hard drives are continually increasing, as can be attested by Seagate's new Cheetah drive, which can be found only in an Ultra SCSI version.

DriveCopy

Leave those woes behind



It only took half an hour to copy all four partitions of one 4GB hard drive to another hard drive—clearly faster than setting up a new drive from scratch.

boot KICK ASS! PRODUCT

The days of backing up, fdisking, partitioning, formatting, and reinstalling are over: hard drive upgrades are now a snap. Powerquest's *DriveCopy* fits on a floppy and copies the contents of one hard drive to another. This marks the end of reinstalling Windows to run the application used to create the backup simply to restore that backup—a damn silly idea to begin with—and of truncated long filenames caused by the likes of DOS's Copy and Xcopy. It takes just 15 minutes on the average to copy a 2GB drive, with our longest test taking half an hour for a 6GB drive. Any MIS monkey worth his beans should realize the potential of a utility such as this.

DriveCopy changes your source drive to a slave drive and the target drive to the master, making it easy to disconnect the old drive and boot from the new one. A command-line parameter for power users copies in reverse direction (/CRD). Also included is Partinfo, a utility that lists all drives and their partitions under clear labels that are used throughout *DriveCopy*'s straightforward interface. *DriveCopy* supports any number or combination of FAT, HPFS, FAT32, and NTFS partitions, and dynamically increases the partition sizes copied over to the newer drive up to the file system's maximum size. We abused this little app in the bootLab, and it never failed.

Of course, the target drive must be the same size as or smaller than the source drive, for obvious reasons. Also, some limitations are outside *DriveCopy*'s range, such as the 2.1GB partition limit of FAT16 and the 504MB BIOS limitation of older BIOSs. Owners of older machines and newer hard drives using software such as Maxtor's Disc Manager can still use *DriveCopy*, but they need to install the hard drive software on the target drive first. With hard drive prices down and the new 20GB drives on the way, this is one utility you can't be without.

—Sean Cleveland

Price $30
Developer/Publisher Powerquest
Phone 801.437.8900
URL www.powerquest.com

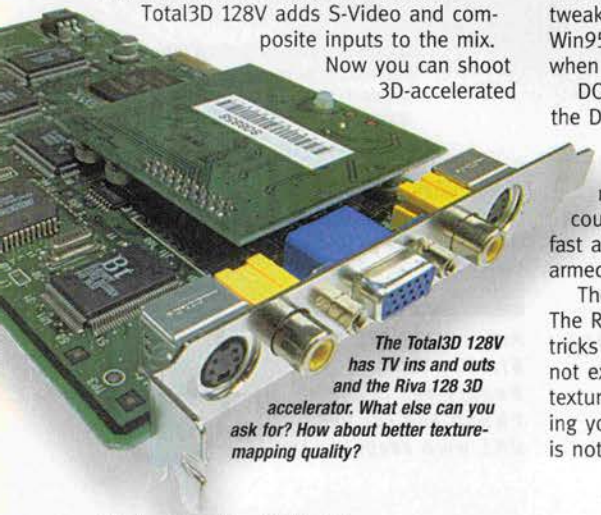
boot verdict 9

Canopus Total3D 128V

Fast as fast can

Last year, the Canopus/Rendition synergy yielded the Total3D—the best Verite V1000 card. This year, Canopus skipped Rendition's V2000 series and got together with nVidia's Riva 128 processor. The Total3D 128V is the resulting bundle of joy.

The Total3D 128V, like other Riva 128–based boards, includes 4MB of non-upgradable 100MHz SGRAM and a 230MHz RAMDAC. But unlike the offerings from Diamond and STB (see *boot* 16), the Total3D 128V adds S-Video and composite inputs to the mix. Now you can shoot 3D-accelerated games to your boob tube. Chuck your Snappy and capture single-frame and full-motion video. You can have both monitor and TV hooked up simultaneously for double trouble. The tweaked BIOS automatically bumps your Win95 desktop resolution down to 640x480 when only the TV's hooked up.



The Total3D 128V has TV ins and outs and the Riva 128 3D accelerator. What else can you ask for? How about better texture-mapping quality?

DOS/VESA 2.0 performance is fast. On the D3D tip, this board is neck and neck with other Riva cards, spitting out fast fill rates and smooth frame rates. With 640x480 *X*, the board coughs up a cool 40fps—fast, but not as fast as the 51fps of the Rendition V2100–armed Stealth II S220 reviewed on page 93.

The big difference is in visual quality. The Riva 128 pulls mip-map compression tricks to boost frame rates, and words cannot express the grittiness of the resulting texture quality—it looks as if you're viewing your D3D world through a sieve! This is not a Canopus-specific fault—this is a Riva 128–wide problem embedded in the silicon. Drivers cannot fix this either.

If you're willing to live with the gritty textures, the Total3D 128V's robust feature set and solid performance make this the best Riva 128 card out there to date.

–Andrew Sanchez

The Specs

Max 24-bit resolution/refresh	1152x864
Max 16-bit resolution/refresh	1600x1200
VESA 2.0 support	YES * VESA 3.0
Virtual Desktop	No
MDK PerfTest	90
Quake 640x480	17.5fps
Quake 800x600	12.3fps
Final Reality Overall	2.51
FR 2D	2.08
FR Bus Speed	1.56
FR 3D	3.01
FR Polygons	78.42 Kpolys/sec
FR Fill	63.12Mpixels/sec
FR Robots	24.99fps
FR City	27.93fps

THE STATS: BIOS: Rev: 1.51B | Win95 driver rev: 1.01.11 | WinNT driver rev: N/A

Price $229
Company Canopus
Phone 888.868.2533
URL www.total3d.com

boot verdict 8

Jammin' **DVD** II

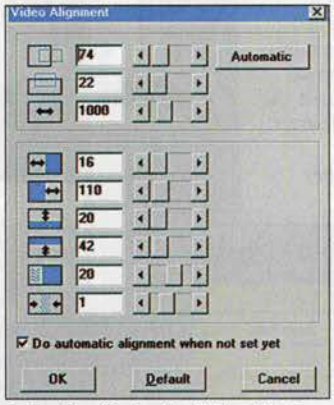
I Wanna Jahm It Wit You

The DVD-ROM—is it a highway to gigabytes or a dead-end storage medium? Jazz Multimedia hopes it's the former, 'cause the Jammin' DVD II kit contains everything you'll need to take DVD out for a spin. Brace yourself for a bumpy ride.

The Jammin' DVD II is made up of three parts: a Toshiba SD-M1002 first-generation DVD-ROM drive (of EIDE nature), an MPEG-2 decoder card, and an IR remote. Bundled DVD titles include two sampler discs containing movie previews and music videos. C-Cube's single-chip ZiVA-DS 1.1 and Auravision's VxP524 digital/analog mixer power the pint-sized MPEG-2 decoder card. Armed with 20Mb of DRAM, the card interfaces via a pass-thru cable with your video card.

You'll be workin' that remote from your favorite sitting position with Jazz Multimedia's Jammin DVD II.

The board is cleanly laid out, while the I/O interface consists of the VGA output, a bulky multi-cable connector (which houses the video-card input, S-Video, S/PDIF and Composite output, and mini-jack for the IR receiver), and a 1/8-inch stereo speaker output.

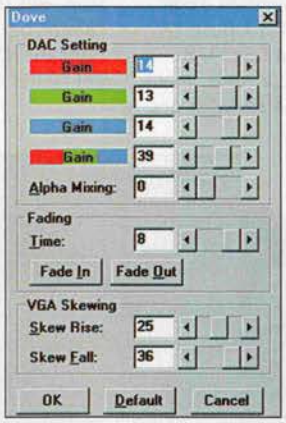


Automatic adjustment is flighty at best.

The tiny IR receiver and button-laden remote control require line-of-sight, but once wired, the hand-held controller works like a charm. Nothing flexes maximum pimpness like controlling all your DVD functions—including volume and screen size—from 10+ feet away. Installation went without a hitch, with the decoder card taking up a lone IRQ and memory range.

Firing up our usual litany of DVD discs revealed a strong visual package—the decoder card scaled effectively up to a crispy 1280x1024/16-bit without dropping any frames. Even at this high resolution, the display exhibited no shearing effects, while rounded edges and diagonal lines remained clean. Output to TV, whether by S-Video or composite, was also very clean, while the S/PDIF connector can be linked to an external AC-3 decoder for even greater aural delights.

While the main controls for viewing DVD titles are simple and easy to work, the Auravision adjustment applet is not. While you can adjust color saturation, overlay positioning, and much more, with all the various buttons to choose from, manual adjustment is tedious—the fact that the options aren't explained anywhere in the manual makes it worse.



Confused? So are we!

The biggest blow against the Jammin' DVD II is the use of a first-generation/1x DVD-ROM drive, which refuses to read gold CD-Rs. Hitachi is already shipping 2x drives armed with CD-R reading capabilities, so it's a shame this kit is hampered by this discrepancy. Jazz is aware of this and promises to work it into this bundle once the newer 2x drives are widely available.

This one's a tough call. The kit's strong software-configuration utilities and Rico-suavé remote control are very compelling, as is overall performance. But the sluggish 1x drive has gotta go, and Jazz needs to make that control panel more user-friendly if it wants to convince hard-core CD-ROM users to make that leap of faith.

—Andrew Sanchez

Toshiba SD-M1002 DVD-ROM drive

Average Seek Time (CD)	1201K/sec
Average Random Access Speed	111ms
CPU Utilization	36% at 8x
Comparable CD-ROM speed	8.8x
Drive type	CLV

Price *$379*
Company *Jazz Multimedia*
Phone *408.727.8900*
URL *www.jazzmm.com*

Intergraph **TDZ 2000**

Purple reign

boot KICK ASS! PRODUCT

Some companies are content selling you mediocre machines that don't push the envelope—Intergraph isn't. A case in point is the TDZ 2000, a leviathan of an NT workstation that brims with power.

First off, dig that funky, rich-purple tower case—so smooth, so round, so fully packed! The drive bays hide behind a panel that slides up and into the chassis—no more dangling doors. Getting inside the workstation is a simple two-sliding-panel operation—no tools required. Once you're in, prepare for intense processing power. Behind the massive 500-watt power supply lurk twin Pentium IIs, heatsinked and running at 300MHz. Don't worry about cooling, 'cause the chill factor comes in the form of a huge fan mounted into the back end of the chassis. If you thought dual P-IIs weren't enough, take a peek at the extended ATX motherboard. Packing the 440LX AGPset, this has to be the mother of all boards, with no less than five PCI and one shared ISA/PCI slot, in addition to an AGP slot. Integration galore garnishes this motherboard, with its on-board Symbios Logic Ultra Wide SCSI controller, 10/100Base-TX Ethernet adapter, and Crystal CS4237B audio chip—all standard. Meanwhile, memory is handled via four DIMM sockets; one is currently filled with a 128MB module.

Two PCI slots are taken up by Intergraph's own RealiZm II VX25-GT OpenGL accelerator card (see sidebar for specs), leaving the other expansion slots free and up for grabs. For hard drive duties, Intergraph chose Seagate's ST3450W 4.3GB SCSI drive. The other two internal hard drive bays are free. Sony's CDU611 24x-max EIDE CD-ROM drive and a lone 3.5-inch floppy drive round out the storage duties, and two 5.25-inch bays are ready for any removable-storage needs that arise. Intergraph offers Zip and Jaz drives as options—this system didn't come with one. And if this isn't enough, the modular TowerMate expansion base attaches to this machine's base and allows an external docking platform that houses a RAID subsystem, additional adapter slots, or other expansion devices.

For your viewing pleasure, InterGraph includes the InterView 28hd96 monitor. This imposing 28-inch beast comes with the 16:9 HDTV aspect ratio, so you can set vast viewing pastures up to 2042x1152.

With this much power, you should expect intense benchmark results. OpenGL performance is the best we've ever seen for any NT workstation. The Viewperf CDRS-03 score of 65fps burns workstations from Digital and Sun, and even SGI's 1x195 Octane (a $54,000 machine). Almost everything here broke through our benchmarks, from the awesome Seagate SCSI drive to the spin-happy CD-ROM drive. Rendering times under *3DS Max* and *Lightwave 3D* also rocked.

If anything brings this baby down, it has to be the cheesy multimedia keyboard and the Crystal CS4237B audio controller.

This purple beauty is not cheap—total system cost rolls in at a bank-busting $27,480. Nor can the monitor be called small—it'll bend a weak desk into submission. But the raw, unbridled horsepower cannot be denied. For those who want the ultimate NT rendering machine, it doesn't get better than this.

—Andrew Sanchez

Yeah, But Does It Do Quake?

You remember those early, hi-resolution screenshots of Quake II *floating around the net? They were taken with this machine and its accompanying video hardware. The hardware may be extreme, but how many video cards can claim the ability to* Quake *along at 24-bit color depths with trilinear filtering engaged…at 30fps+?! Pumping shotgun shells and tearing into Rottweilers on the accompanying monitor makes it even more unreal.*

Here are some benchmark results, for those of you who frag as hard as you render. Why did we play Quake *on this beast? Cause we can.*

640x480/24-bit	33.4fps
800x600/24-bit	25.2fps
1024x768/24-bit	15.5fps

under the hood

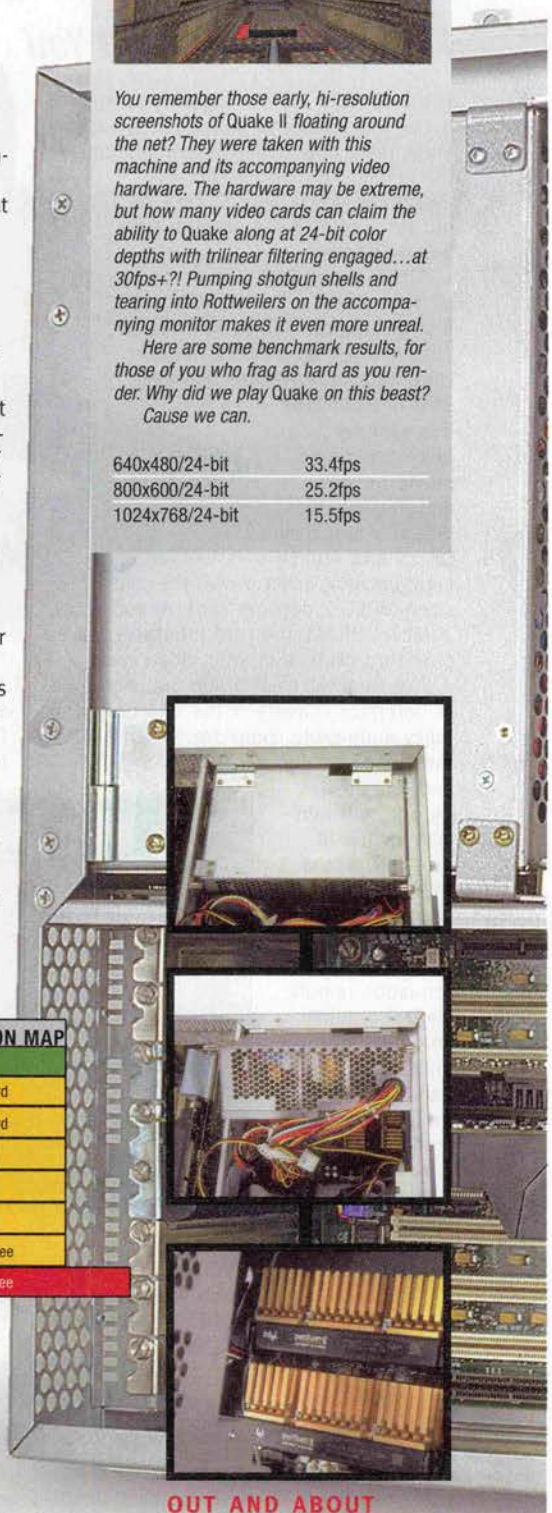
THE BRAINS	
CPU	Dual Intel Pentium II 300MHz
L2 Cache	512K internal SBRAM
RAM	128MB DIMM (512MB max)
Motherboard	Intergraph TDZ 2000 ATX (440LX AGPset)
THE BRAWN	
Video	Intergraph Realizm II VX25-GT (with 16MB texture memory)
Hard Drive	Seagate ST3450W 4.3GB SCSI
CD-ROM	Sony CDU611 24x max EIDE
Expansion Bus	One AGP, five PCI, one ISA/PCI shared
Fax/Modem	None
LAN	10/100Base-TX Ethernet (integrated on motherboard)
I/O Ports	Two serial, one parallel, two USB, one 10/100Base-T Ethernet, one 72-pin SCSI
THE BEAUTY	
Display	InterView 28hd96 28-inch monitor (2048x1152 @ 80Hz, 16:9 aspect ratio, .32mm dot pitch, shadow-mask)
Sound	Crystal CS4237B integrated on motherboard
Speakers	Integrated speakers on keyboard
Other	Microsoft Intellimouse, multimedia keyboard

THE BUNDLE Windows NT 4.0

boot	down
1:44	:21

EXPANSION MAP

AGP	Free
PCI	Video Card
PCI	Video Card
PCI	Free
PCI	Free
PCI	Free
PCI	Shared/free
ISA	Shared/free



OUT AND ABOUT
The massive 500-watt power supply hides the twin 300MHz P-IIs from prying eyes—a simple thumbscrew twist and a pull on two locks gets this power supply out of the way for CPU and memory access.

UP, UP, AND AWAY

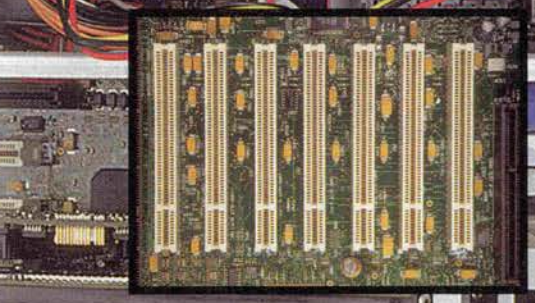
It looks cool closed, but a simple slide and push gets this door out of the way, exposing all your drives to the glaring public.

THE GANG'S ALL HERE

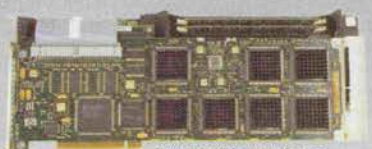
The ATX I/O connector has everything you'd ever want—twin USB, serial and parallel, and audio jacks. Off to the side, the external SCSI connector is ready for some serious pluggin'.

MMM...PCI SLOTS...

Jackie Amico, you're out of business. There's only one ISA slot, and it's shared. Everything else comes up PCI or AGP—woo-hoo!!!



The RealiZm II VX25-GT



Intergraph's own home-grown 3D accelerator comes ready to rock your OpenGL world. With gobs of memory at your disposal (up to 32MB of frame-buffer memory and 64MB of texture memory), you'll be swimming in 32-bit true-color heaven for all your applications. OpenGL, Kinetix's Heidi, and RenderGL apps can all feel the RealiZm love.

NOTE: *Benchmark results were taken at a resolution of 1280x720.*

real-world benchmarking

Intergraph TDZ 2000	
WIN 4.0 APPS *SYSM for Windows NT 4.0*	285
OPENGL PERF *CDRS-03 Mean score*	65.89 fps
OPEN GL PERF *DRV-04 Mean Score*	8.48 fps
HARD DRIVE *Adaptec ThreadMark v1.0*	9.85 MB/sec
CD-ROM *CD Tach/Pro v1.65*	2582.6 K/sec
LIGHTWAVE 3D *Raytrace.lws*	829 secs
3D STUDIO MAX *kyx_rays.max*	122 secs
MMX PERF *DeBabelizer Pro*	208 secs
CPU/DISK *Microsoft Visual C++ compile*	69 secs

The Intergraph TDZ 2000 is one big, bad mamma jamma filled with enough OpenGL power to make 3D rendering that much more pleasurable.

+

- Dual P-II 300MHz
- RealiZm II OpenGL 3D accelerator
- Killer motherboard design
- Loads of free slots
- One ISA slot
- Incredible OpenGL performance
- Fast hard drive
- Expandable via docking station for more PCI slots and drive bays
- Integrated SCSI
- Massive monitor

−

- Substandard sound solution
- Cheesy keyboard

Price *$17,485 as configured minus monitor; InterView 28hd96 monitor $9,995*
Company *Intergraph*
Phone *800.763.0242*
URL *www.intergraph.com*

boot verdict 9

A complete breakdown of benchmark results is available on the *bootNet*. Point your browser to www.bootnet.com

Netstorm

Islands in the storm

Activision's new real-time strategy game takes you to the fantastic world of Nimbus, where beautiful islands float across the sky. Here you erect island-spanning bridges, temples, workshops, altars, and wondrous machines of mass destruction. Winning the battle means sacrificing your enemy's priest to appease the Furies and gaining knowledge and power as you struggle to become the most powerful ruler in all of Nimbus.

This* Netstorm *island has girded its loins for a frontal assault.

Use the bridges to go next door and borrow a cup of sugar. Or just kick their ass and take it!

Netstorm was built from the ground up for Internet play. The game hosts up to eight players with no lag, even with a 9600 baud modem. A dedicated server matches you with players of your own skill level. Twenty-two single-player missions ready you for Internet play. Although the graphics are only 8-bit at 640x480, they're beautiful to look at, and the details on the sprite-based buildings and weapons are as stunning as the music and sound effects. When a loud clap of thunder signals the start of a battle, your subwoofer shakes the walls and rattles the windows.

Winning at *Netstorm* relies more on strategic thinking than on amassing troops and slaughtering everything in sight. The underdog always has a fighting chance. One inferior but well-placed weapon can take down your opponent's whole defense. In multiplayer mode, forging alliances creates a little four-on-four action. This makes for one frantic game—you don't know where the enemy's coming from.

Netstorm lets you customize your technology path as you play, so each player's path is unique, since it's based on acquired technologies and battles won. Each player receives a "reliability rating" that shows how often they've quit games early and a running tally of how many games each player has played. Spend a little time checking on other players, and you can pull together a very good match and have a terrific time.

—Paula Reaume

CHECKLIST

Netstorm
Version: Final Version

Maximum Resolution/Color
640x480/8-bit

Win95 Native

DirectX
DirectDraw DirectSound

Multiplayer
LAN TCP/IP

***Price* $50**
***Developer* Titanic Entertainment**
***Publisher* Activision**
***Phone* 800.477.3650**
***URL* www.activision.com**

The Eye in the Sky

We talked to Titanic's president, ***Ken Demarest****, whose genre-forging footsteps have trod the soil of* Wing Commander *and the* Ultima *series, to find out just what makes a great Internet game.*

Is there a "magic formula" you've implemented to maintain the game's exceptional stability?
Well, to be honest, we hacked and hacked away at the problem. We special-cased things, we designed special systems. Our goal for the player was "no waiting!" Literally every major system in the game had to be written differently from a single-player game to adapt to long lags. Damage is estimated until the server gives an authoritative "you're dead" signal. Units walk where they think they should until they hear otherwise. Streaks of energy mask delays in unit creation. Horrible, painful code was written to allow on-the-fly game reconnections. It isn't pretty code, but we sure know the issues inside and out!

How many servers have been set up for *Netstorm*, and how many players can be logged on at one time?
We're going to stick with the "home server" at Activision until our initial sales are settled and we have enough players to justify starting more servers. A single server can handle between 1,000 and 10,000 players, depending on its configuration.

What's been done to compensate for lag problems?
Warping, which is just an effect of lag, is inevitable in Internet games. Netstorm *had the luxury (and the challenge) of knowing this from the very start and of being designed "around" the problem. For example, the behavior of your non-mobile units is pre-determined, and we don't have many moving creatures. The ones we do have tend to operate autonomously.*

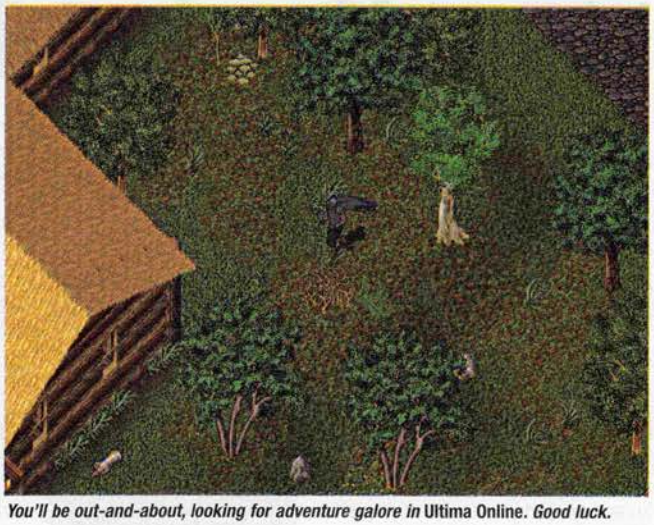
Also, a single game can have only eight players. On the flip side, we move all our traffic through the players' 14.4 and 28.8 modems, while games such as Ultima Online *use huge T1 pipes. Abrupt logouts are possible in* Netstorm*, but if it happens, the players' service providers will be at fault. And since we show the Reliability Rating, you can just avoid playing with low-reliability people if logouts bother you.*

I should also say that Ultima Online *uses the classic Role Playing Game model—a model designed completely for single-player gaming. Even worse is the Internet, with two- to twenty-second lags. Too much of their gameplay was predetermined by expectations about existing RPGs.*

Every time an Ultima *player sees a warp, he should thank God for it. The only other alternative is to wait for the complete exchange of information from the server—meaning you get to take one step every two seconds rather than eight steps, which might end up, rarely, warping you back due to some interference.*

Ultima Online

Too big for its britches



You'll be out-and-about, looking for adventure galore in Ultima Online. *Good luck.*

CHECKLIST

Title Ultima Online
Version: 1.0

Maximum Resolution/Color
640x480/16-bit

Win95 Native

DirectX
DirectDraw DirectSound
DirectPlay

Multiplayer
TCP/IP

Live vicariously through an avatar in *Ultima Online*, Origin's much ballyhooed multiplayer Internet adventure. This ongoing alternate reality seethes with everything a hungry role-playing fanatic could ever fantasize about—too bad the dream is shattered by technical difficulties galore.

UO's 640x480/16-bit color isometric terrain generator sports the cleanest graphics to date for any *Ultima*. Combining the tiled-based graphics from *Ultima 8* with texture-mapped polygons for elevations (rolling hills and jagged mountain peaks), *UO*'s engine renders vast cityscapes and dungeons without busting a sweat. Everything else in *UO* is presented in sprite form—some as large as 106x142 for the dragons. Pre-rendered in *3D Studio* and *Lightwave*, over a thousand frames of animation per character bring each sprite to life, and the "paper-doll" system of dressing your character means characters will almost never look alike. This massive animation doesn't come cheap—you'll need 261MB of free hard drive to install and run *UO*.

Massive spires and lowly huts are yours to explore.

How is all this multiplayer magic pulled off? Seven dedicated servers strewn throughout the U.S. run a virtual Britannia 24/7. Character information is saved on the server side.

Despite each server predicting movement, lag and warping is still prevalent. Depending on the time of day, we experienced everything from "warping" (objects magically jump due to latency), to lag (a total halt of on-screen action for 10 seconds or more), to getting kicked off the server for no reason at all. And logging in at peak hours can be as risky as slot machines—you may actually win and be able to play, but more often than not, you won't. And even if you do log in, expect to wander about finding empty treasure chests.

The sheer massiveness of the continent you're charged to explore may freak newcomers—where do you start? Considering the game is open-ended, you can get lost. You also have to fear the "player-killers" that lurk in the woods, waiting for newbies to wander along for a quick and one-sided fight. Even trying to pick a fight within a town is a one-way ticket to oblivion, with guards magically appearing and cracking you upside the skull. Even when you're dead, your troubles don't end—when's the last time you've heard of ghosts that can't go through objects?

Ultima Online attempts to live up to Origin's motto of "creating new worlds," and it's succeeded. Never has a virtual world been brought to living, breathing, silicon reality, where you can literally live a second life as a muscle-bound fighter, magic-endowed wizard, or even a blacksmith. But, living this alternate reality requires a lot of dedication on your part. With all the online hassle and imbalances within the game engine, Britannia isn't a fun place to be after the free 30-day trial period.

—Andrew Sanchez

Enter Ultima Online's thriving realms—but you won't be petting that dragon anytime soon.

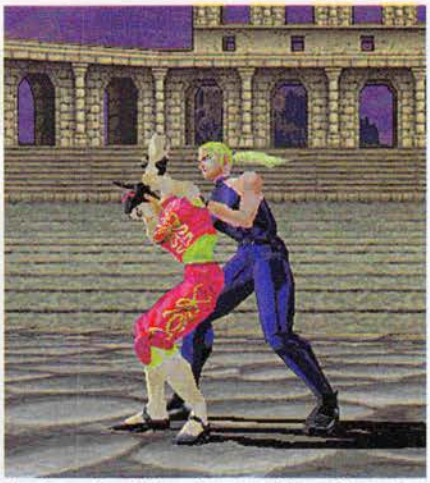
Price $40/$9.99 a month
Developer Origin Systems
Publisher Electronic Arts
Phone 800.245.4525
URL www.ea.com

Mortal **Kombat** Trilogy and **Virtua** Fighter **2**

Make love, not fatalities

Just when you thought the PC could drop kick any console, along come two PC fighting games that should never have seen the light of day. By failing to take advantage of the PC's inherent technologies, these games give the Sony Playstation and Sega Saturn reason to feel superior. Doubt us? Read on.

—Andrew Sanchez



Hot fem-on-fem violence is a part of* Virtua Fighter 2*'s polygon landscape.

Mortal **Kombat** Trilogy

Mortal Kombat Trilogy has arrived—wooptie doo. This arcade-to-console-to-PC conversion ranks up there with Sega's *Sega Rally* as one of the worst ever.

What makes this warrior-filled fistfight so lousy isn't the story or the animation (this version sports almost all the missing frames of animation from its console counterparts). It's the atrocious graphics.

Someone please enlighten developers about SVGA. *Trilogy*'s 320x240 graphics are pixeliciously atrocious. Is 640x480 too much to ask? Most modern video cards have really fast blitters for exceptional 2D performance—use it! Also, looking at these washed-out sprites makes you wonder whether there's life beyond 256 colors. Low-res graphics are stale, dated, and just plain ugly—no matter how many frames of animation you leave in.

Rest assured, all the special moves and gore that made *Mortal Kombat* infamous are intact. Gameplay remains true to the name, with multi-hit chain combos a flyin' and fatalities galore. Control is responsive and arcade-perfect, just as you'd expect. The PC version even allows network play and adds yet another secret character (yet another ninja, this time named Chameleon) to the already massive list of fighters. But the ultra-cheesy AI that plagued the *Ultimate Mortal Kombat 3* arcade game is in effect and cheap as ever—you walk toward your opponent, it walks away. You stand still, it stands still. You get the picture.

It may play like the arcade (minus the Pepsi-coated buttons), but it sure dinna look like it.

CHECKLIST

Mortal Kombat Trilogy
Version: 1.0

Maximum Resolution/Color	
320x240/8-bit	
Win95 Native	
DirectX	
DirectDraw	DirectSound
DirectPlay	DirectInput

Mortal Kombat Trilogy *puts you in the bowels of Hell—too bad it's really pixelated.*

Price ***$45***
Developer ***Point Of View/ Midway***
Publisher ***GT Interactive***
Phone ***800.469.5961***
URL ***www.gtinteractive.com***

boot verdict **2**

Virtua Fighter **2**

TRY IT ON THE DISC

Sega's benchmark 3D fighter comes to your PC, and hooo boy, does it need help.

This texture-mapped polygon fighting ring begs for 3D acceleration, with its blocky, low-resolution textures and less-than-stellar frame rates. Don't expect the solid 60fps of the Lockheed-Martin/AM2-powered arcade machine. It won't happen even on a P-II 300 with everything turned on. Sacrificing major visual quality for barely acceptable frame rates in the mid-teens may suit some people, but the PC can do so much more, given the right 3D-accelerated push. A Direct3D patch is promised, but this DirectDraw crap has gotta go.

Sluggish frame rates only compound the problem, making snappy combos and throws hard to execute. You can turn off shading, interlace your view, and adjust the polygon counts on the motion-captured fighters from the high count of AM2's arcade version to the lower-count PC, but why should you have to? The best balance you can reach between visual quality and frame rate makes this game barely palatable.

***Polygons will fly, but forget about smooth frame rates in* Virtua Fighter 2.**

CHECKLIST

Virtua Fighter
Version: 2.0

Maximum Resolution/Color		
640x480/16-bit		
Win95 Native		
3D Acceleration		
Direct3D		
DirectX		
DirectDraw	DirectSound	
DirectPlay	DirectInput	
Multiplayer		
Modem	Direct/serial	TCP/IP

Once you get the frame rates to acceptable levels, the three-button guard/punch/kick combo gets you brain bashing in no time. All your favorite *Virtua* fighters are here, ready for some serious button mashing and spine breaking. Throw in Team Battle mode and a host of other features not found in the original arcade version, and *VF2* has some redeeming qualities.

But if you put it up against the home conversion of *Mace: The Dark Age*, *VF2* winds up looking like something Ryu dragon-punched.

Price ***$40***
Developer ***AM2***
Publisher ***Sega***
Phone ***800.872.7342***
URL ***www.sega.com***

boot verdict **4**

Galapagos

Control freaks need not apply

TRY IT ON THE DISC

CHECKLIST

Galapagos Version: 1.0
Maximum Resolution/Color
640x480/16-bit
Win95 Native
3D Acceleration
Direct3D
DirectX
DirectDraw DirectSound DirectInput

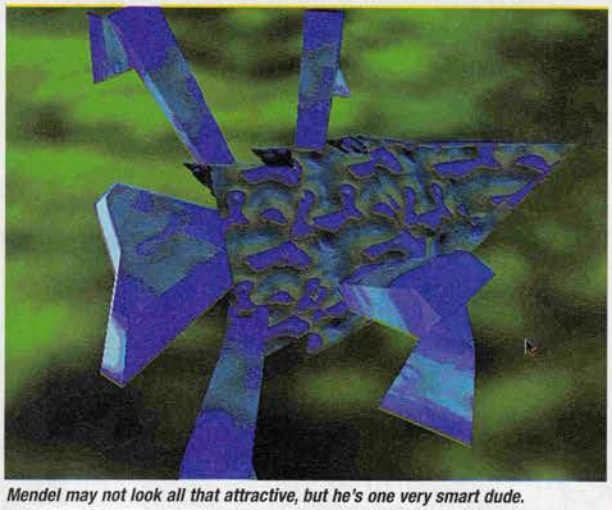
Galapagos doesn't use the Quake engine, it's not a first-person shoot 'em up, and its lead protagonist isn't a curvaceous female with heaving breasts.

So what does it have?

Well, uh, let's see. It has an artificial life form named Mendel, a synthetic organism that looks more like a cross between a spider and a cockroach than a metallic robot—in reality it's an artificial life technology known as NERM (Non-Stationary Entropic Reduction Mapping). It has five distinctive worlds, containing a total of 37 levels of increasing difficulty. And it has some very cool, wickedly designed, electric, industrial, techno-themed 3D levels equipped with such accouterments as lasers, shifting floors, and rotating camera angles.

That said, why is *Galapagos* such a snore to play?

Lack of interaction. Although you control Mendel's fate, you can't control his actions. You can make him jump on cue, nudge him in the right direction with a mouse click, and control some aspects of his environment (turning off force fields, moving floors, etc.), but you don't control his (or her?) little feet. You'll sit at your PC and watch Mendel slowly progress through the various levels in a valiant attempt to save the galaxy.



Mendel may not look all that attractive, but he's one very smart dude.

The levels are top-notch, very creative, and not as easy to complete as you might think.

The big gimmick is that because Mendel is a NERM, he can learn from his mistakes and adapt to his new surroundings. The NERM technology works in principle. Help Mendel avoid the deadly energy beams and laser mines, and you'll notice he keeps a wide berth the next time he encounters such hazards. Torment him long enough, however, and Mendel will turn into a quivering neurotic, presumably requiring a long stint in therapy to overcome your flagrant abusiveness.

As interesting as the NERM technology is, it's not enough to sustain gameplay. You'll be bored to tears as you watch Mendel explore his surroundings—alone. And since you can't control his direction, you'll be frustrated by the minimal interaction you have in completing the levels. Real robots aren't known for their speed, but Mendel's verrry slooow movement will have you reaching for a cup of java. Zzzzzz.

Galapagos sports extremely creative and smartly designed levels, and the mixture of 3D polygons and 128x128 texture-mapped, flat-shaded terrain is oddly appealing. However, the multiple camera angles are damn annoying, seemingly shifting positions at the most inopportune moments (just as you're about to jump off a moving ledge onto another moving ledge, for example). D3D acceleration is dutifully included, and the screen resolution (max 640x480) and window sizes can be adjusted dynamically during the game. The story by the way—involving interplanetary war and weapons of mass-destruction—is incidental, and pretty much irrelevant to the overall game.

With such clever and diabolical levels, *Galapagos* would have worked well as a free-roving/explore-the-environment type game, à la *Mario 64*. As it stands, *Galapagos*—and Mendel—are quite the bore.

—Bryan Del Rizzo

Galapagos *breaks new ground in game originality, but the whole AI gimmick bogs down the fun.*

Price $40
Developer Anark
Publisher Electronic Arts
Phone 800.245.4525
URL www.ea.com

boot verdict 5

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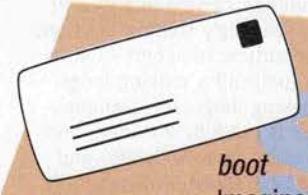

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Mice That Roar

They just keep getting better

To each his own pointer. Everyone has a preference he's usually unhealthily attached to. But open your mind, 'cause you might be missing something good. Here, we look at three products: two mice and a touchpad. While they're all customizable, each has a design that sets it apart from the rest. Take a look at what follows—you might find something that'll make you change your ways.

—Sarah Pirch

The Power Cat consumes a fair amount of real estate on your desk, but the comfort is worth it.

Logitech **MouseMan** for **Notebooks**

It seems illogical to attach a mouse to a machine that has a pointing device built in, but if you prefer a real mouse to a trackball or touchpad, this rodent makes sense. It moves smoothly, fits comfortably in the hand, weighs a mere 3.5 oz, and consumes a small 5x2.5-inch footprint. And it's backed by Logitech's kick-ass reputation and a stellar driver.

The MouseMan connects to your notebook's PS/2 port (or serial port via the included adapter) with a short two-foot cord. After installing MouseWare, you can configure those three buttons. In Win95, any button can be set to HyperJump, for window management; Task List, which represents the Win95 taskbar; CyberJump, for web browsing; or any of the 50 options Logitech lists in the control panel, including single- or double-clicking, f-keys, nav keys, etc.

That any button can be set to any option should make left-handers happy, but the MouseMan is ergonomically designed for righties. Logitech doesn't make a left-handed model, so lefties will just have to deal.

MouseMan for Notebooks is a solid mouse, driven by Logitech's terrific MouseWare software. While mobile users won't find anything special for them, they'll appreciate the unit's unobtrusiveness.

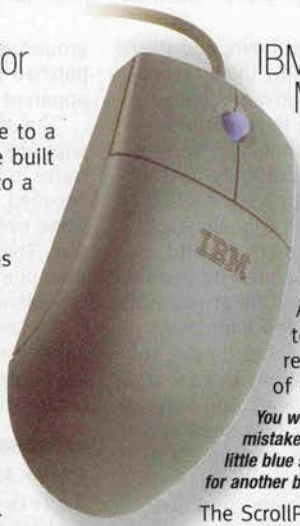
Lefties won't like the design of the MouseMan for Notebooks, but they'll love its configurability.

Price $50
Company Logitech
Phone 800.231.7717
URL www.logitech.com

boot verdict 8

IBM **ScrollPoint** Mouse

IBM calls the little blue stick on this mouse a scrollpoint, thinking you'll set it to autoscroll. We found another good use for it: double-clicking. Assigning this command to the mouse stick reduces your chances of double-clicking accidentally. But we really liked the 360-degree scrolling, too.



You won't mistake this little blue stick for another button.

The ScrollPoint mouse is driven by a customized version of Logitech's MouseWare software. Thus, you can set both buttons and the point to any of the 50 options provided in the MouseWare control panel (discussed in the Logitech MouseMan for Notebooks review). The ScrollPoint contrasts with other special-button (i.e., wheel) mice in that, when set to autoscroll, it can scroll in any direction, not just up and down.

We had some trouble installing the ScrollPoint. The unit connects only via a PS/2 port. We first tried to connect to our serial port with a Logitech PS/2-to-serial adapter we had on hand. This wouldn't work. A little research revealed that the ScrollPoint functions only when connected via a PS/2 port and will not function with a serial adapter. If your system doesn't have a PS/2 port, you can't use this mouse—a poor choice by IBM that freezes out potential users.

Overall, we liked the ScrollPoint. Because the stick isn't used for pointing the cursor, like on a laptop, you can use your masterful mouse skills while taking advantage of the unique nature of the mini-stick.

Price $60
Company IBM
Phone 800.426.7235
URL www.ibm.com

boot verdict 7

Cirque Power **Cat**

With this pressure-sensitive pad, a light touch gets you what you want—a heavy hand brings only frustration. The Power Cat, like any touchpad, takes a while to become accustomed to. A half day's use proves it's worth the effort, though.

The Power Cat attaches to your system via your serial port or the serial-to-PS/2 adapter. Cirque provides a robust driver that installs easily and lets you personalize the two buttons on either side of the touchpad, as well as the touchpad itself, including your tapping speed and style. You can assign any of 25 options, such as nav commands or keystrokes, to combinations of keystrokes with button clicks or pad taps.

The 2.2x3-inch pad surface is edged with a fine-textured area that lets you perform special functions. Sliding your finger up and down the right edge of the pad scrolls a document vertically without moving the cursor, while the bottom edge scrolls horizontally. In advanced apps such as *Office 97*, *Corel WordPerfect Suite 8*, and *Lotus Word Pro 97*, gliding along the left edge zooms in and out on a document. You can also go back and forward between web pages in Microsoft Internet Explorer and Netscape Navigator by sliding along the top edge of the pad.

The Power Cat comes with a brass-tipped stylus for creating signatures, notes, and small drawings. You access the drawing area by selecting the stylus icon on Win95's taskbar. This feature took some time to master, but it's tons of fun. Beware that the pen has a limited ink supply, so keep it brief.

Ergonomically, the Power Cat is a pleasure. It comes with a wrist rest that fits snugly against the curved bottom of the unit. so hand and wrist movement is minimal.

We really like this product. Cirque put effort into the hardware and software design, and it's paid off. But, the moderate learning curve reduces a possible bootVerdict of 9 to an 8.

Price $89
Company Cirque Corp
Phone 801.467.1100
URL www.glidepoint.com

boot verdict 8

Screen **Trollers**

Building a better View-Master

Ooh, pretty. Click. Wow, look. Click. Look at that! Click.

If this is the level of interaction you like, these two games are just right for you. You'd expect these sequels to use true-color images and high-resolution movies, yet they don't. Both games have opted for mass compatibility instead of the innovations that make a game a classic.

—Sean Cleveland

The polygon count for typical* Riven *screens is somewhere between 3 million and 11 million, and they are truly breathtaking.

Riven

Riven is not a ground-breaking sequel. High-res images that stop short of true color, full-screen movies that play back at low quality, and the same-old point-and-click interface aren't innovations.

Riven's screens are displayed at 640x480/16-bit, yet all you see is dithering. Everything has been meticulously rendered in true color, but the dithering is a travesty, especially considering each screen's lack of interactivity.

Stock side-wiping transitions between screens make the game look like a souped-up slide show. Poor seams don't help matters at all either.

True to *Myst* form, the puzzles are intricate. Much thought has gone into them, and they follow the storyline.

CHECKLIST

Riven **Version:** 1.0
Maximum Resolution/Color
640x480/16-bit
Win95 Native
3D Acceleration
OpenGL Direct3D
DirectX
DirectSound DirectPlay

Riven is based on four-year-old technology, and its interactivity has not improved. It's still just a lonely jaunt through a world inhabited by people who talk at you while you stand motionless. A few animations occur in the static images, but they're not as effective as the animations in *Zork* and don't happen in every screen. You may see occasional movement, such as sea life scampering away, but it's not enough to liven up this otherwise dead world.

The movies are made with Quicktime, and the ending frames match up nicely with the rendered stills that replace them, although movies don't coincide with background animations. Frames look hastily patched together, and seams are blatantly apparent when turning around.

The soundtrack is beautiful. DirectSound supports the ambient music and event tracks seamlessly. The music is digitally encoded and runs from the hard drive, while event sounds are keyed from the disc. The ability to detect discs in more than one CD-ROM drive is a good addition, considering the game runs off five discs.

The only reason to play this game is to finish the story of *Myst*. If you've never played *Myst*, put your money elsewhere.

Price ***$55***
Developer ***Cyan***
Publisher ***Red Orb***
Phone ***415.382.4777***
URL ***www.riven.com***

Zork Grand Inquisitor

Welcome back to *Zork*, with the humor and absurdity that made the original adventures so enjoyable. Z-Vision returns, allowing 360-degree panning movement at 640x480. Images are rendered in 16-bit, and the static screens contain more background animations such as swinging nooses and rippling water. Not only are there more animations, but they're more apparent. AVIs use True Motion's Duck code and can be played using line-skipped mode (interlaced) or pixel doubled, where each line is doubled. It's a shame they didn't use a better video format because Duck's results are very pixelated. The movies play concurrently with background environment animations, however—a very cool innovation.

True to *Zork* fashion, the puzzles often require items or spells picked up along the way. One requires you to be totemized (basically killed) just so you can get to Hades.

If we could animate this picture, you would see a bouncing fountain. Moving the mouse left or right allows you to pan the image a full 360 degrees, giving you the effect that you're actually in the room.

CHECKLIST

Zork Grand Inquisitor **Version:** 1.0
Maximum Resolution/Color
640x480/16-bit
Win95 Native
DirectX
DirectDraw DirectSound DirectPlay
Multiplayer
LAN Modem TCP/IP
Multiple CDs

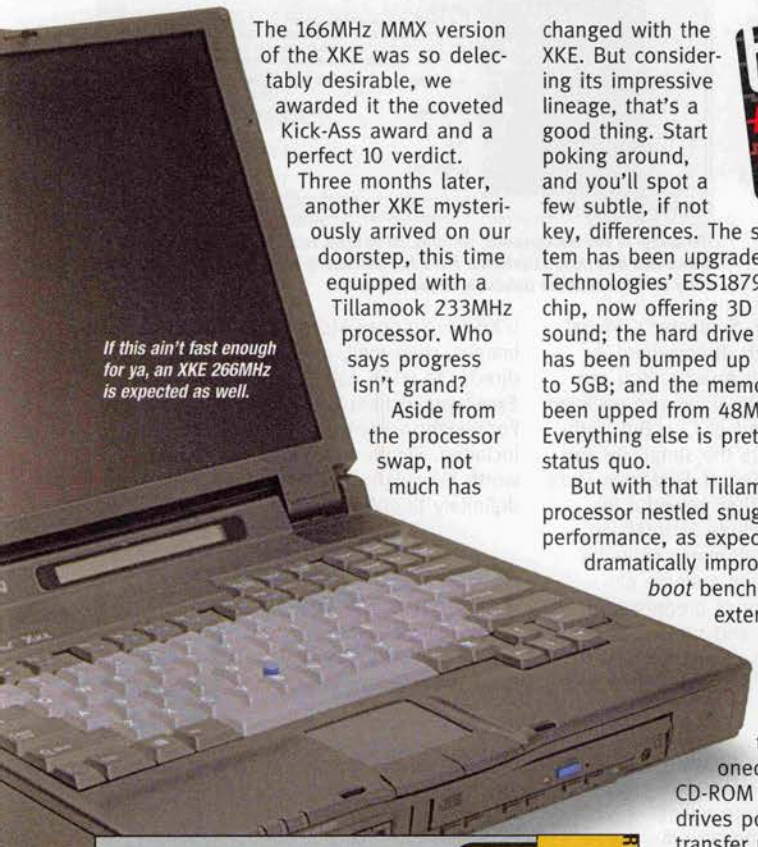
The soundtrack is a major portion of the installation to the hard drive. Concurrent sounds are increased to seven channels using either mixed mono or stereo, and it's very apparent. Ambient music, waves lapping the shore, an oppressive voice over a bullhorn, and a shop merchant yelling at you while making a racket with her goods all make the game more interactive. Sound support includes DirectSound with Q-Sound encoded areas that pan directionally.

Transitions between static images and movies aren't even as seamless as *Riven*'s, and the closing shots of movies look different from the rendered still with which they're replaced. Link Play, a multiplayer option, enables cooperative exploration where one player takes the role of the "Commentator" and the other the "Drive." A chat mode is set up, two cursors are enabled and roles can be switched at any time. Innovations like this separate a clever screen troller from just another interactive screen saver. *Zork Grand Inquisitor*'s immersive environment and interactive storyline go a long way to suck you in. Just take care not to be totemized.

Price ***$50***
Developer/Publisher ***Activision***
Phone ***310.255.2000***
URL ***www.activision.com***

Micron **Transport** XKE **233MHz**

Here We Go Again!



If this ain't fast enough for ya, an XKE 266MHz is expected as well.

The 166MHz MMX version of the XKE was so delectably desirable, we awarded it the coveted Kick-Ass award and a perfect 10 verdict. Three months later, another XKE mysteriously arrived on our doorstep, this time equipped with a Tillamook 233MHz processor. Who says progress isn't grand?

Aside from the processor swap, not much has changed with the XKE. But considering its impressive lineage, that's a good thing. Start poking around, and you'll spot a few subtle, if not key, differences. The sound system has been upgraded to ESS Technologies' ESS1879 wavetable chip, now offering 3D Spatializer sound; the hard drive capacity has been bumped up from 3GB to 5GB; and the memory has been upped from 48MB to 64MB. Everything else is pretty much status quo.

But with that Tillamook processor nestled snugly inside, performance, as expected, has dramatically improved. The *boot* benchmarks extend well into the next dimension and are clearly a force to be reckoned with. The CD-ROM and hard drives posted way-cool transfer rates, and the XKE's AVI and MPEG video playback was simply killer. One surprise though—the SYSmark32 score of 202 was 5 points lower than the original 166MHz-equipped XKE. Go figure.

With its introduction of the Tillamook processor, Micron has wisely adjusted the pricing of its XKE family of products, and this latest progeny is only $39 more than the original we reviewed in *boot* 14. In this case, however, the modest price increase is matched by gobs of performance.

Baby—welcome to the family!

—Bryan Del Rizzo

under the hood

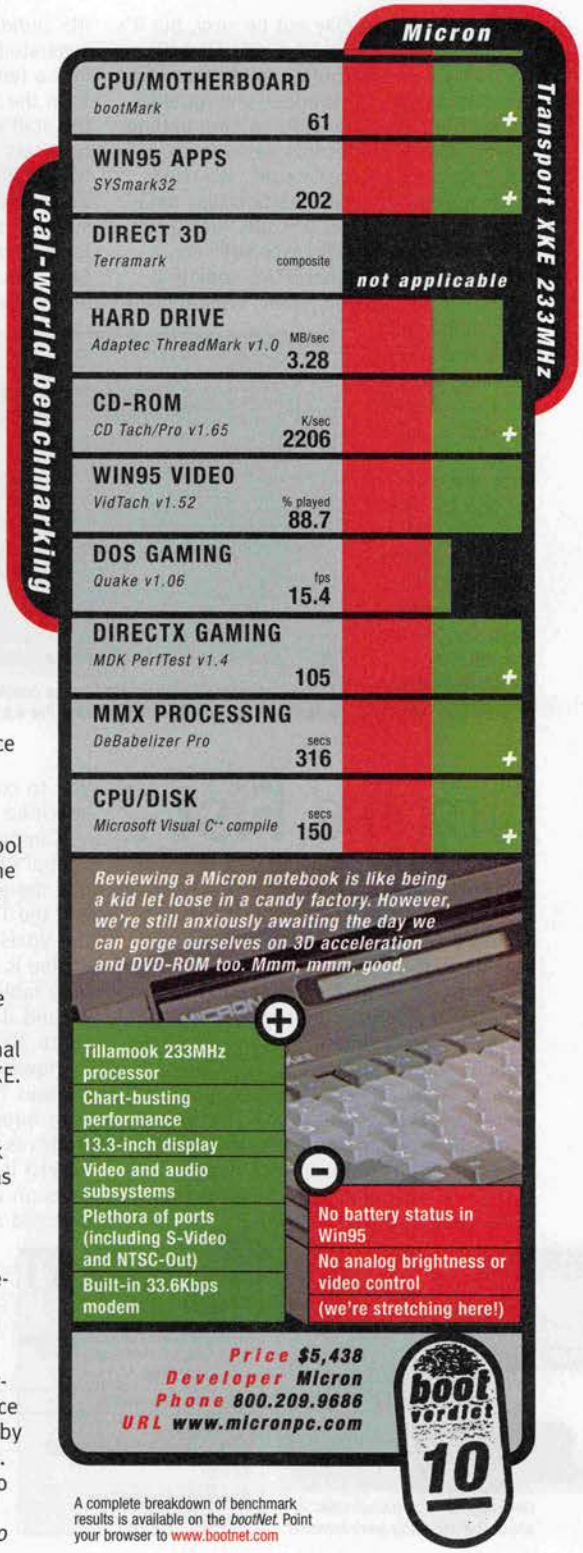
THE BRAINS	
CPU	Intel 233MHz Tillamook Pentium with MMX
L2 Cache	512K pipelined burst
RAM	64MB EDO DRAM (192 maximum)
Video	NeoMagic MagicGraph 128XD (2MB EDO DRAM)
THE BRAWN	
Hard Drive	IBM 5.0GB
CD-ROM	Sanyo 20x ATAPI
Expansion Bus	Two Type II, one Type III, CardBus-and-Zoomed-Video compatible
I/O Ports	One serial, one monitor, one parallel, game port, two PS/2, NTSC-Out, S-Video-Out, USB
Lap Weight	8 pounds, 7.2 ounces
Carrying Weight	10 pounds
THE BEAUTY	
Display	13.3-inch active-matrix screen
Sound	ESS 1879 FM-synth with hardware wavetable and 3D Spatializer
Video	1024x768, 16-bit color
Speakers	Stereo speakers, 3 watts per channel
Communication	Built-in Motorola 33.6Kbps fax/modem (software upgradable to 56.6Kbps), dual IrDA-II ports, cellular connector

REAL-WORLD BATTERY LIFE

THE BUNDLE Quicken ExpensAble 2.0 | Laplink for Windows 95 | FocalPoint | Greg Norman Ultimate Challenge Golf

boot	down
:43	:03

real-world benchmarking



Reviewing a Micron notebook is like being a kid let loose in a candy factory. However, we're still anxiously awaiting the day we can gorge ourselves on 3D acceleration and DVD-ROM too. Mmm, mmm, good.

+

- Tillamook 233MHz processor
- Chart-busting performance
- 13.3-inch display
- Video and audio subsystems
- Plethora of ports (including S-Video and NTSC-Out)
- Built-in 33.6Kbps modem

−

- No battery status in Win95
- No analog brightness or video control
- (we're stretching here!)

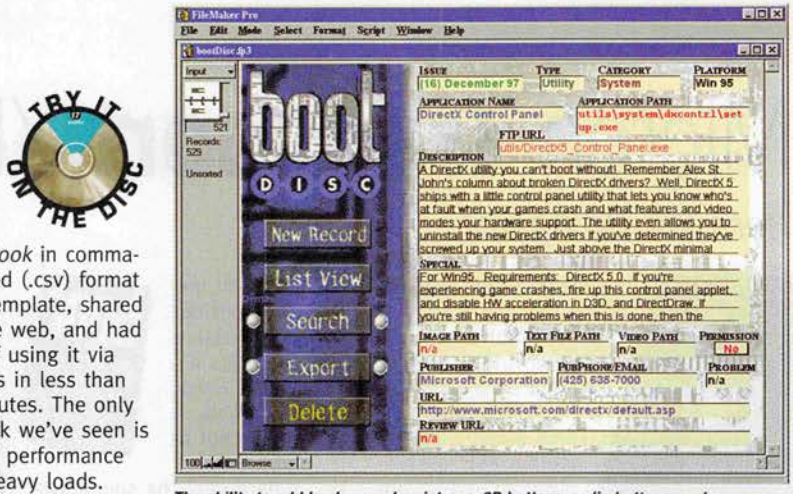
Price $5,438
Developer Micron
Phone 800.209.9686
URL www.micronpc.com

boot verdict 10

A complete breakdown of benchmark results is available on the *bootNet*. Point your browser to www.bootnet.com

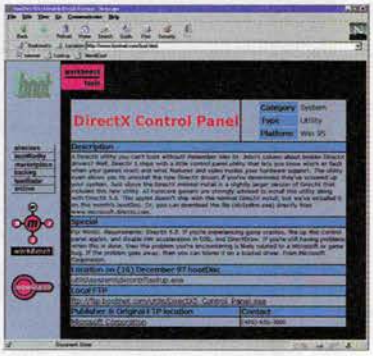
FileMaker **Pro** 4.0

File this



The ability to add backgrounds, pictures, 3D buttons, radio buttons, and pop-up menus and lists makes* FileMaker Pro *a fun package to work with. We went a little crazy with the bootDisc database, as you can see.

Database software may not be sexy, but it's become alluringly powerful, and *FileMaker Pro 4.0* is a case in point. Building on *3.0*'s firm foundation, Claris added web publishing support, enabling users to add, update, search, and delete records easily using a web browser over the Internet. We used the feature to integrate the bootDisc database with the bootNet website. Previously, it required blueworld's *Lasso* software, a web server, and manual HTML coding. It could only be done on a Mac. What a headache. Apparently, Claris was paying attention because the Lasso technology and a web server are now integrated, allowing you to share a database with the click of a button—literally. HTML pages are automatically created as well.



***The search-only databases used on the bootNet website are all powered by* FileMaker Pro 4.0.**

We imported a phone list from *MS Outlook* in comma-separated (.csv) format into a template, shared it on the web, and had the staff using it via browsers in less than five minutes. The only drawback we've seen is sluggish performance under heavy loads. Sure, other packages are available, such as *Access*, *Paradox*, Symantec's *Visual Café* with dbAnywhere, or *SQL* with Apache. You can even write your own package using Perl or C++. But nothing offers the simplicity and integration at *FileMaker Pro*'s price. Other powerful features include ScriptMaker, which automates tasks by performing a single or sequence of predefined actions, and true cross-platform compatibility with support for both TCP/IP and IPX/SPX. You can store GIF and JPEG images, send mail, open URLs, export data directly to HTML tables, and convert an *Excel* spreadsheet with drag-and-drop ease. Forty-eight ready-to-run templates are also included. Simply put, *FileMaker Pro 4.0* is worth its weight in gold and is definitely bootWorthy.

—Sean Cleveland

Price $199; $99 Upgrade
Company Claris
Phone 800.325.2747
URL www.claris.com

boot verdict 8

Armored **Fist** 2

Smell the glove

Armored Fist 2 has a logical control scheme that actually makes it fun to handle up to 32 tanks simultaneously. An optional "realistic" mode creates a separation between gunner, driver, and commander control stations in each tank. Unfortunately, the controls are somewhat confusing. The game has a collection of 44 missions, depicting believable scenarios such as base attacks and convoy escorts. A waypoint system makes missions easy to follow, allowing you to concentrate on clearly specified victory conditions.

Campaigns take you to rolling Central African hills, Siberian tundra, the green hills of Belarus, and the Turkish desert. Visually, the Voxel Space 2 graphics engine is perfect for a down-and-dirty tank sim, allowing profuse ground detail and amazingly sharp 3D targets at 640x480.

However, while the rough textures feel right, the performance boost of 3D acceleration (which is not an option with voxels) is sorely missed. Frame rates on our P166 never motored out of single digits.

Armored Fist's *Voxel terrain shows lots of detail but lacks acceleration.*

While the game runs well under Windows 95, DOS implementation is a disappointment. In-game sound is realistic and implemented in Dolby SurroundSound.

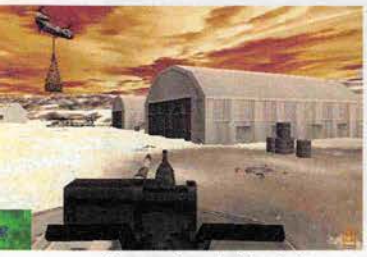
Internet play is supported only via Kali, which requires a separate registration fee. On the plus side, you get 16 multiplayer missions, split among cooperative, team, and deathmatch play.

This modern battle-tank sim combines complexity, playability, and a merciless hardware appetite. If you have the hardware to drive it, *Armored Fist 2* packs enough of a wallop to justify its minor rough edges.

—Frank Lenk

Price $60
Developer/Publisher Novalogic
Phone 800.858.1322
URL www.novalogic.com

boot verdict 7



Commander unbuttoned view shows off stunning environments.

CHECKLIST

Armored Fist 2
Version: 2.0

Maximum Resolution/Color
640x480/8-bit

MS-DOS Executable

Multiplayer
LAN Modem Direct/serial TCP/IP

Specialty Controllers
Throttle Rudder

Ice Capades

Hockey sims that want to puck you up

The competition in the PC hockey arena heated up last year, when Virgin's NHL Powerplay *'96 challenged EA's* NHL 97 *on one very important point: gameplay. But thanks to a killer 3D graphics engine and a ton of bells and whistles, EA managed to squeak by the newcomer. This year, the competition doesn't figure to be that close.*

—Mike Ryan

***The 3D-modeled players in* NHL Powerplay '98 *just can't compete with the lifelike skating avatars in* NHL 98.**

NHL **Powerplay** '98

Even with a beefed-up 3D engine and some much-needed new features, *NHL Powerplay '98* somehow manages to look and play worse than last year's 2D version.

Thanks to official licensing from the NHL and NHLPA, the game accurately depicts all 26 teams' names, uniforms, and rink art.

Showing its console roots (and the developer's inability to grasp the realities of the PC), the game is for single-PC use only. No modem, LAN, or Internet support, but one to six players (some of whom are relegated to keyboard use) can crowd around one machine. Serial links are also supported.

The game's D3D resolutions don't even come close to *NHL 98*'s lifelike realism. Clipping problems and missing textures are among the more grievous eyesores. Player animations are few and plain even though they're motion-captured. The players' pointy heads and constipated postures don't help the game's realism much either.

NHL Powerplay '98 isn't entirely without merit. The gameplay is decent, and the AI can be challenging for a while. Unfortunately, there's no difficulty setting and it doesn't take long to knock in ten or more goals a game. Unlike last year's version, the game now tracks stats over an entire season. Numerous coaching options are available, including dump-and-chase, pinching defensemen, and specialized power-play tactics. In addition, you can create, trade, and release players to fine-tune your roster. But *NHL 98* also does these things—and it does them much, much better.

CHECKLIST

NHL Powerplay '98
Version: 1.0

Maximum Resolution/Color
1024x768/16-bit
Win95 Native
3D Acceleration
Direct3D
DirectX
DirectDraw DirectSound
DirectPlay DirectInput
Multiplayer
Direct/serial
Specialty Controllers
Gravis Grip
Win95 compatible

***Price* $35**
***Developer* Radical Entertainment**
***Publisher* Virgin Interactive**
***Phone* 888.843.2661**
***URL* www.vie.com**

NHL **98**

With better graphics and animations, new coaching options, world tournament and shootout play, and much better AI, *NHL 98* is again the undisputed champion of the digital ice rink.

NHL 98 is fully licensed by the league and the NHLPA, and includes all 26 teams. In fact, this game not only includes the players and rink art for each team, but special third jerseys and accurate championship banners hang in each stadium. The players' real faces are even texture-mapped onto their polygon heads.

The game's 3D engine is breathtaking, and the motion-captured player animations make the action look and feel like a live event, particularly on a 3Dfx card. Every shot, check, and save looks and sounds real, making for incredibly immersive gameplay. The play-by-play announcer and color commentator, though somewhat repetitive, add to the effect, as do the rink music and PA announcer. *NHL 98*'s AI is much improved. Shots-on-goal are still too high and the Rookie difficulty level is a joke, but the Pro and All-Star settings provide stiff challenges. The new coaching menu lets you customize your team's style of play, and your management options include the ability to create, trade, and release players at will.

NHL 98 isn't perfect. Some clipping problems occur in 3Dfx mode, and there are a few guaranteed scoring methods (shoot for the top, near corner from either faceoff dot). Also, the game computes goaltenders' goals-against-average statistics incorrectly when you play five- and ten-minute periods.

None of this seriously affects the gameplay, which is excellent. Nor does it change the fact that *NHL 98* is the best hockey game available and one of the best PC sports games ever.

Check out the detail as this good-looking rookie sails one past Sean Burke.

CHECKLIST

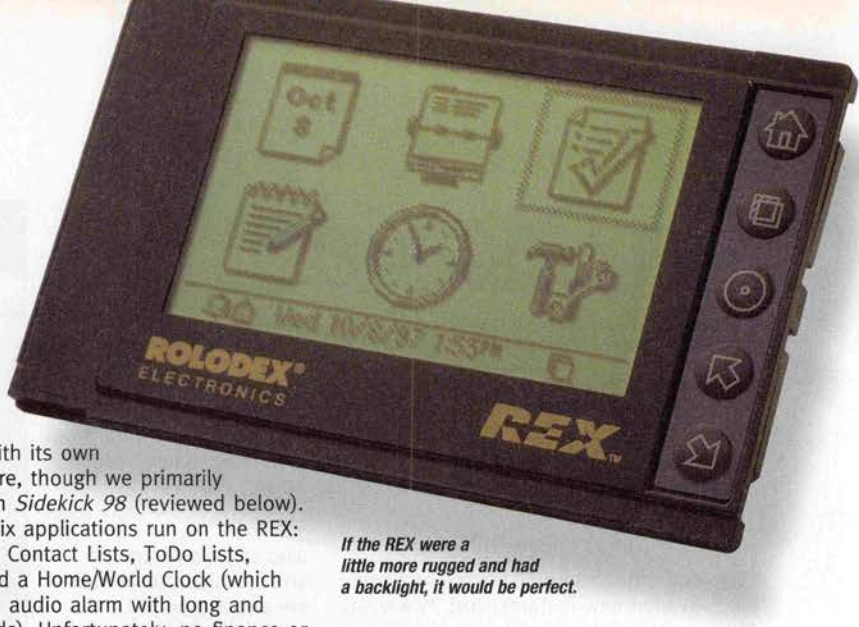
NHL 98
Version: 1.0

Maximum Resolution/Color
640x480/16-bit
Win95 Native
Native 3D Hardware Support
3Dfx GLIDE
DirectX
DirectDraw DirectSound
DirectPlay
Multiplayer
LAN Modem Direct/serial
Specialty Controllers
Gravis Grip
Win95 compatible

***Price* $45**
***Developer* EA Canada**
***Publisher* Electronic Arts**
***Phone* 800.425.4525**
***URL* www.easports.com**

REX

Fetch a REX

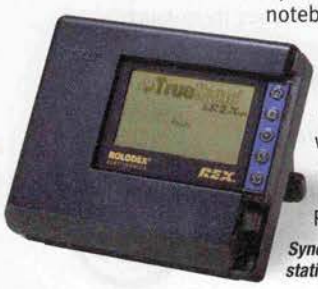


If the REX were a little more rugged and had a backlight, it would be perfect.

Franklin's REX is not a cut-down PalmPilot—it doesn't have that kind of power. For one thing, information can be input only via a computer; you can't enter information directly into the card. All the card does is store information, including names and addresses, calendar specifics, and small, memolike text files. That's all it does.

And the Grand Canyon is just a big hole in the ground.

The REX's metal body is the size of a credit card (most of the card's face is an LCD screen) and about two or three times as thick, weighing a mere 1.2 ounces. The 256K REX-3 we reviewed holds up to 3,000 records. Like all the REX models, it interfaces with your computer via a docking station tethered to the serial port, or it can be inserted directly into one of your notebook's card slots. (Our Toshiba notebook initially wondered what the REX was. Its card wizard accepted the notion that the REX was a hard drive, and everything was fine after that.)



Syncing data to the REX through the docking station is a painless ten-second process.

It comes with its own PIM software, though we primarily used it with *Sidekick 98* (reviewed below). Currently, six applications run on the REX: a Calendar, Contact Lists, ToDo Lists, Memos, and a Home/World Clock (which includes an audio alarm with long and short sounds). Unfortunately, no finance or expense-tracking software is included.

The REX is powered by two CR2025 3-volt, button-type batteries that should last up to six months with normal use.

Once on the card, you navigate your info with the five buttons down the right-hand of the screen. The REX's screen is not touch sensitive, and the interface is text mixed with icons. The REX accepted information from *Sidekick 98* without a murmur when connected to both the laptop and the docking port; transferring information took less than a minute.

On the downside, left-handed folks might find the button arrangement less than ideal. And unfortunately, the LCD screen isn't backlit. There's no search function, so it can take numerous button presses (into the double digits—and beyond) and a few minutes to bring up a specific contact. The somewhat fragile nature of the card means no putting it in your back pocket.

At the same time, the REX is very good at what it does. It's a great alternative for those looking for a portable extension of their PIM who don't need the power and bulk of a PalmPilot.

—Tara Calishain

Price $149.95, $179.95 with serial docking station
Company Franklin Corp.
Phone 800.7393.6400
URL www.franklin.com/rex

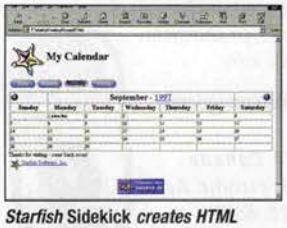
boot verdict 8

Sidekick 98

Your PDA's new boy wonder

Starfish *Sidekick 98* is for people who are busy—but not frantic—and don't need lots of bells and whistles. It's a middleweight PIM with an Internet publishing wizard that can't be beat at this price.

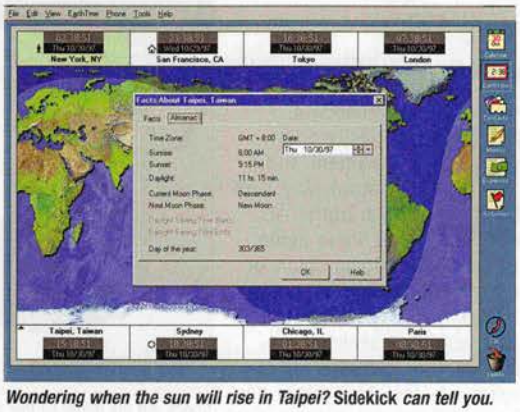
Sidekick 98 offers the standard fare: a calendar, memos, expense reports, and an Earth Time screen, all available via a tab down one side of the screen. While *Sidekick*'s calendar and Earth Time screen are great, and the other elements satisfactory, its contact database is built like a card file, which is awkward, since almost half the screen is taken up with the contact list and only half is used for information and contact history.



Starfish* Sidekick *creates HTML calendars quickly and easily.

We do like *Sidekick*'s sync software and Internet publisher, though. The sync software works with the PalmPilot and WinCE 2.0 devices. It worked well with the REX with one caveat. You must save the calendar or card file you're adding information to before syncs. And *Sidekick* doesn't prompt you to save before syncing; it assumes you'll remember. If our memory worked that well, we wouldn't need a PIM.

Sidekick's Internet publisher is a treat. A publishing wizard walks you through putting all or part of your contact database or calendar online. We were impressed with how fast *Sidekick* created HTML files and pleased with the resulting pages, which are suitable for framing or posting on your web site.



Wondering when the sun will rise in Taipei?* Sidekick *can tell you.

Sidekick 98 is not the PIM-to-end-all-PIMs. But if you need solid contact management without lots of extras you can't beat its price.

—Tara Calishain

Price $50
Developer/Publisher Starfish Software
Phone 800.782.7347
URL www.starfish.com

boot verdict 6

Sharp **SE-500**

Backfire

After using the new SE-500 for a week, one can't help but think some bright egg at Sharp saw the PalmPilot kicking the Zaurus' ass and set out to clone the pocketable PDA. Too bad Sharp couldn't get close enough to actually see what makes 3Com's offering a winner.

Like Grafitti. The PalmPilot has the most intuitive implementation of handwriting recognition. The SE-500 has none. It feigns the feature with a free-form bitmapped memo feature, but this doesn't create text that can be cut and pasted across documents or applications. Instead, text entry is confined to a tiny on-screen QWERTY keyboard that's no more than 2-inches wide. To enter data, you must peck out your message with the included stylus. Even the shortest memos are guaranteed to induce carpal tunnel strain akin to that invoked by the classic board game Operation.

Also MIA is the ability to add new apps. The SE-500 ships with only a handful of PIM apps, such as a memo pad, calculator, world clock, sketch-style notepad, calendar, expense tracker, and contact manager. There's also an e-mail app that works with the unit's built-in 14.4 modem. Central to the success of any PDA is the availability and ingenuity of third-party software. In this regard, the SE-500 is a dead-end. No *Tetris* clones (or databases, or loan calculators, or web browsers) for you!

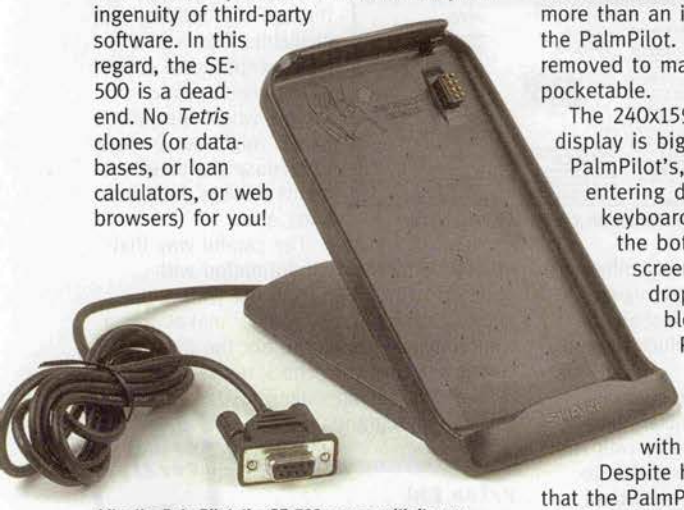
The SE-500 comes with a handy hardcase that does gymnastics to flip out of the way when the unit's in use. To bad what's underneath is hardly worth using.

Even when the SE-500 goes the extra yard, it comes back to bite you on the ass. Take the built-in modem. Sure it's handy, but it also makes the SE-500 more than an inch longer than the PalmPilot. And it can't be removed to make the unit more pocketable.

The 240x159 backlit LCD display is bigger than the PalmPilot's, but when you're entering data on the tiny keyboard that chews up the bottom of the screen, usable space drops to a comparable size. And like the PalmPilot, the SE-500 comes with 1MB of memory and a docking station for synchronizing files with your PC.

Despite having a few cool features that the PalmPilot should've had, such as an IrDA port for wireless syncs, the SE-500 comes up wildly short with its clunky graphic interface littered with micro-icons and its lagging performance on data saves and accesses. As a "Pilot-killer" the SE-500 is more Squeaky Fromme than John Wilkes Booth.

—Brad Dosland



Like the PalmPilot, the SE-500 comes with its own docking station for synchronizing data with your desktop PC. Unlike the PalmPilot, the SE-500 also comes with an IrDA port for wireless syncs, which, while slower, are the way to go.

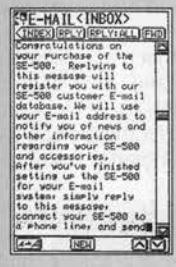
The Many Faces of the SE-500

And none of them are pretty

It's not how big you are, it's how you use what you've got. That's particularly true in the case of PDAs. Their diminutive form-factor places screen real estate at a premium. The SE-500 gives you more raw pixels than the PalmPilot, but then forces you to chew on this grisly interface.

This problem is especially evident in the SE-500's memo application, where so much screen space is wasted on cryptic tiny icons and the mini-keyboard needed to enter text that you end up with only six lines of text visible. The "minicons" and keys are only 8x8 pixels big, so steady those nerves with a shot of Jack before attempting any serious text entry on the SE-500!

Instead of the intuitive Graffiti handwriting recognition used by the PalmPilot (and less successfully by the Newton and some HP PDAs), the SE-500 gives you a mini-paint program to insert bitmapped diagrams, maps, caricatures, suicide notes, etc. into your memos. Unfortunately, these aren't translated into editable text at any point, and tracking is frustratingly inaccurate.



The SE-500's e-mail application is surprisingly robust (although problematic if you're trying to work with AOL, CompuServe, or any of the national online services), and you'll get nearly 20 lines of text onscreen simultaneously. Unfortunately, this smaller version of the SE-500's font is teensy, and creative pixel sculpting has packed descenders above the baseline resulting in deformed letters that don't make reading on-screen any easier.

Price $299
Company Sharp Electronics
Phone 800.237.4277
URL www.sharp-usa.com

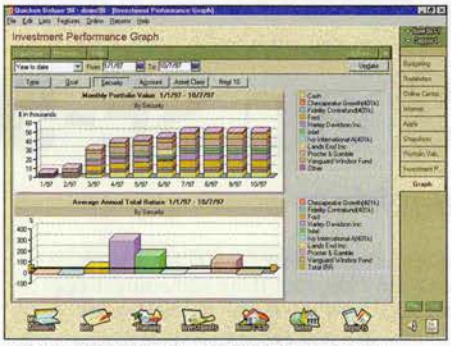
How to be a **Millionaire**

The ABCs of money management

If your checkbook has ever been out of control, consider a software package to help you find balance. It's so easy to track where your money goes, you'll obsess over every penny.

Just check out these updates of two popular programs: Intuit Quicken *and Microsoft* Money. *What can they do for you? Read on...*

—Tara Calishain



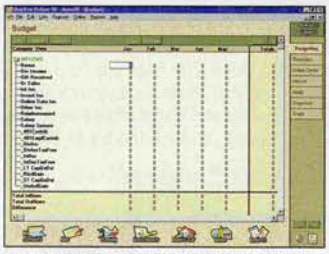
Quicken ***offers graphs to track the progress of your investments as well as your checking accounts.***

Quicken Deluxe **98**

Over the last several years, *Quicken* has become much friendlier, with one-click check paying, easy-to-read graphs, and beautifully rendered registers.

Well, break out the neurons because *Quicken Deluxe 98* has a steep learning curve. But that's OK, because in addition to a little extra learning time, *Quicken* offers a host of money-management tools and a decent array of online services.

The checkbook register, the core of the *Quicken* legacy, is as it was in *Quicken 6*. But the new *Quicken* offers expanded category names, improved bill reminders, and an enlarged number capacity of $99,999,999.99. (Somehow we suspect we'll never have to worry about outgrowing this feature.)



This budget will take a while, but you'll have a hammerlock on your moola.

From the middle-of-the-screen data to the toolbar at the bottom, the whole package is familiar, although it has some oddities. The items in the text menu at the top of the screen don't match the items in the icon bar at the bottom of the screen. For example, to get to the savings goals function from the top of the screen, you choose Feature Planning Savings Goals. From the icon bar, you choose Planning, then Financial Planning Calculators. Once accessed, these functions perform nicely.

The program offers various life-management tools such as 401(k) tracking, a tax-deduction finder (with simple questions to help clarify the expenses you're not sure about), and emergency records management.

Those who don't buy anything unless it's connected to the Internet will be pleased with *Quicken Deluxe 98*. Users can choose between the embedded browser and an external browser. Quicken.Com offers a variety of information, including stock quotes, a glossary (vital for newbies confronted with *Quicken*'s mutual fund finder), and comparison shopping for insurance. If you want to bank online, *Quicken* works with more than four dozen financial institutions.

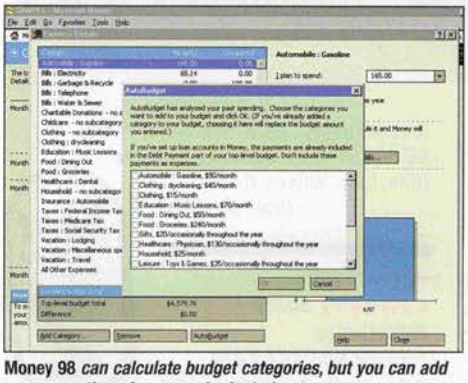
Anyone interested in securing his financial future will appreciate *Quicken Deluxe 98*, but be prepared to invest some time to get all you can out of it.

Price ***$60***
Developer/Publisher ***Intuit***
Phone ***800.446.8848***
URL ***www.intuit.com***

Money 98

The financial management powers of *Money 98* are impressive, with a couple of caveats: Get used to a web-like experience and have an Internet connection.

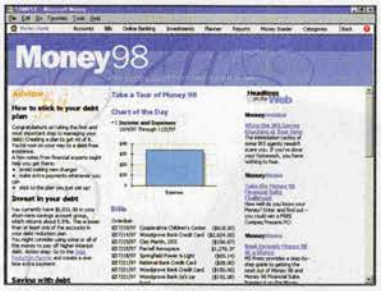
Money 98 opens with a screen that contains teasers for finance stories and news you can access via the Internet, as well as information about current bills that are due and overdue, and monthly reports when available.



Money 98 ***can calculate budget categories, but you can add or remove them from your budget plans.***

This web motif makes a lot of information available in an easily updatable format. *Money 98* continues this format by presenting the accounts available to you as a series of icons. Once clicked on, checking and other standard accounts look much like *Quicken*. A very big difference is that you add items to the register at the bottom of the screen, instead of within the register itself, which proved to be a bit awkward.

Money has many features you should expect from a financial manager. The budget planner integrates well with your existing financial information to give you meaningful feedback about your spending habits. Online banking features a wide variety of institutions. And an intimidatingly complete bill calendar offers numerous reports.



Money ***starts with a web page-like screen.***

In most screens, a tab on the left side helps you navigate through the options available. This works well except in the case of the investments screen, where the tab names might serve more to confuse the investments newbie than anything else.

The careful way that *Money 98* blends its information with updated information from the web and information input by the user makes this a comprehensive program, but the iconized layout and awkward check register make it less appealing for *Quicken* immigrants.

Price ***$30***
Developer/Publisher ***Microsoft***
Phone ***800.426.9400***
URL ***www.microsoft.com***

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PSION SERIES 5 HANDHELD COMPUTER

Product Information Number 254

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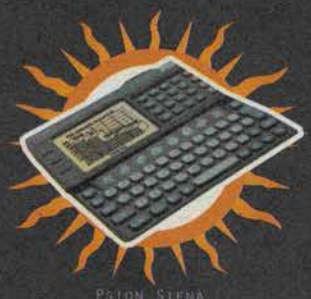

PSION SIENA

Vcam

Eye For PC

Specification

- Color CCD sensor
- Data interface: parallel port (SPP, ECP, or EPP mode)
- 12 frames/sec. at 160(h)x120(v)
- 16.8 million true color
- O.S.: Windows 3.1 or Windows 95
- AVI Interface
- TWAIN Interface device driver
- Dynamic Printer Port Switcher: printer pass-through adaptor
- "Vcam" application utility
- Bundled software: full version for Internet PHONE
  30min. bonus for CU-SeeMe

Feature

- Motion & still pictures capturing
- User-friendly, no capture card needed
- Flicker-free capture
- Fully compatible with parallel port mode of SPP, ECP and EPP
- PC camera and printer share the same parallel port (printer port sharing)
- No power adaptor needed
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- CE, FCC approved

Product Information Number 90

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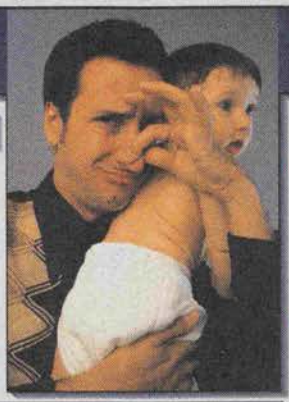

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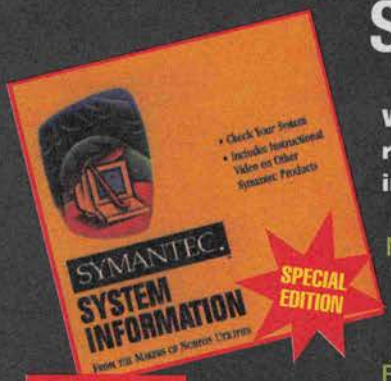

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9. 50-foot shimmy duct leading to clandestine Imagine Media koi pond
10. The shoe retrieved from S3's ass
11. The shoe that crushed the Matrox dream
12. Eeny
13. Meeny
14. Miney
15. Moe
16. Jimmy Hoffa
17. Amelia Earhart
18. D.B. Cooper
19. Michael Brown (disassembled)
20. Ned and Stacey
21. Handy Andy the Randy Pandy
22. Handy Andy's House of Hentai
23. Anti-static mat (not to be used as an offensive weapon)
24. Jenga!
25. Pull the blind for a quick peek at our emergency eye shower!

PHOTOGRAPH BY AARON LAUER

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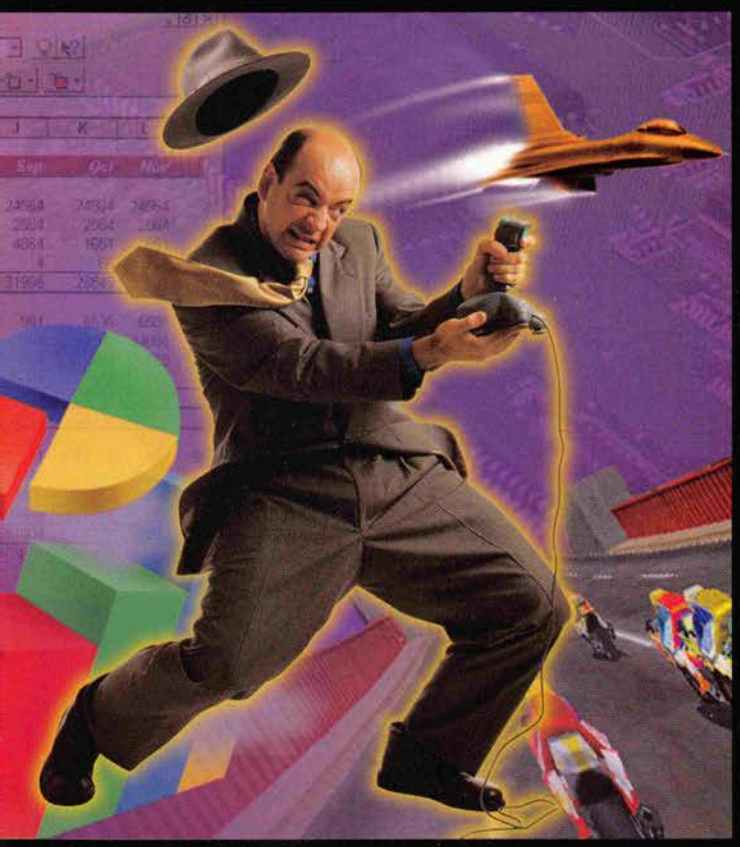

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