PRICE

Advanced Feature Set

Stencil Buffer

Image Quality

DVD

In the fast lane

They're off! We catch up with twelve graphics cards making their mark in a fast-moving market.

There's no denying that computer technology moves fast, with new components making the latest equipment look dated in a matter of weeks. Perhaps the fastest-moving market is graphics cards. Here, product life-spans are measured in mere months, and with so many players competing, prices are low and choice is wide.

Since our last graphics card group test in the November '98 issue, a host of new technologies and chipsets have hit the market. Already, last year's award winners are beginning to look jaded compared to the new entrants. The TNT chipset has made its mark, and 3Dfx has just released the Voodoo3.

For this group test, the emphasis is not on brute speed alone. To judge the winners, we considered factors like image quality, ease of installation, advanced feature set (e.g. 32-bit rendering, stencil buffer, DVD support) and price. Overall, we were trying to find the best graphics card for a general-purpose multimedia PC.
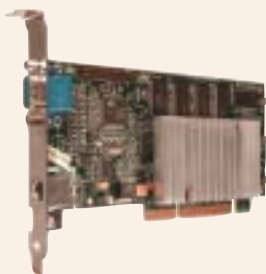
Ratings

★★★★★ **Highly recommended**
★★★★ **Great buy**
★★★ **Good buy**
★★ **Shop around**
★ **Not recommended**

Contents

☛ *Tested and reviewed by Ajith Ram*

Illustration by Dave Wood

3Dfx Voodoo3 3000

The Voodoo3 3000, unlike its predecessor, is aimed at the OEM market. It has 16Mb of memory which cannot be upgraded. Despite being 3Dfx's latest chipset, the Voodoo3 suffers from many of the limitations of the Banshee. It does not support 32-bit rendering, anisotropic filtering or motion compensation for DVD playback, and it lacks a stencil buffer. Neither does the chipset support AGP texturing during 3D rendering. However, the Voodoo3 3000 is extremely fast: the 3DMark99 score of 2798 demonstrates its extremely high fill rate and triangle throughput. But its lack of advanced features make it a less complete mainstream solution.

★★★

ASUS V3300
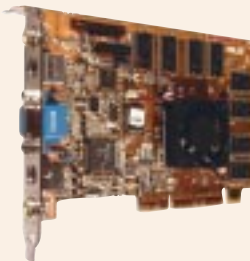
Asus is better known for motherboards than graphics cards. Built around the TNT chipset, in terms of sheer size, the V3300 is probably the largest card on the market. It has a huge fan, not just a heatsink. In addition to standard monitor and TV-out, the V3300 can capture video, although this is heavily dependent on the CPU. The Asus driver utilities are also quite impressive. As in the Hercules drivers, there are advanced settings for Direct3D and OpenGL. This card supports full 32-bit colour, anisotropic filtering and 16Mb of memory, but its Direct3D performance is not impressive.

★★★★

ATi Rage Fury
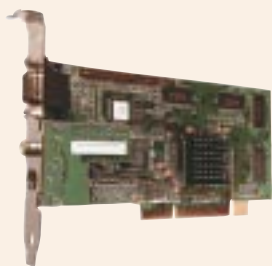
The Rage Fury, built around the Rage 128 chipset, is the successor to the highly successful ATi Xpert@Play. Like the Riva TNT chipset, the Rage 128 supports full 32-bit colour and a complete OpenGL ICD. To aid DVD playback, ATi has added IDCT (Inverse Discrete Cosine Transform) support in addition to motion compensation. This results in flawless MPEG-2 playback. As befitting a gamer's card, the Fury has a TV-out and a whopping 32Mb of memory. Its 3D speed, although well below the Voodoo3, is more than adequate for upcoming games. 2D performance is also very impressive.

★★★★

C. Labs Graphics Blaster Riva TNT

The name of the card says it all. This was one of the first graphics cards with the Riva TNT chipset to ship last year. Like the Viper V550, the Graphics Blaster Riva has 16Mb of SDRAM which is not upgradeable. The Riva TNT was designed to be fully compatible with DirectX 6, and this is evident in its impressive benchmark results. It also boasts a high-quality OpenGL ICD. Overall image quality is excellent. The Riva TNT has a stencil buffer, a feature used by Creative Labs to produce some nice shadow effects in one of the popular games. However, performance of this card lags behind many others.

★★★

Table of features

Manufacturer	3Dfx	Asus	ATi	Creative Labs
Model	Voodoo3 3000	V3300	Rage Fury	Graphics Blaster Riva TNT
Supplier	3Dfx	Dabs Direct	ATi	Creative Labs
Telephone	0171 546 8621	0870 129 3000	01628 533115	01245 265265
URL	www.3dfx.com	www.asustek.tw	www.atitech.ca	www.creaf.com
Price (ex VAT)	£120	£87	£120	£87
Price (inc VAT)	£141	£102.23	£141	£102.23
Interface	AGP	AGP	AGP	AGP
RAM/Max RAM	16Mb/16Mb	16Mb/16Mb	32Mb/32Mb	16Mb/16Mb
Chipset	Voodoo3	Riva TNT	Rage 128	Riva TNT
Ramdac	350Hz	250Hz	270Hz	250Hz
TV-out	✓	✓	✓	✗
Max resolution/colours	2054x1534/32-bit	1920x1200/32-bit	1920x1200/32-bit	1920x1200/32-bit
Max refresh (at max res)	60Hz	75Hz	85Hz	75Hz
Windows drivers	95, 98, NT	95, 98, NT	95, 98, NT	95, 98, NT

HIGHLY COMMENDED
PERSONAL COMPUTER WORLD

group test

DIAMOND **Monster Fusion**

Like the Maxi Gamer Phoenix [below], the Monster Fusion uses the Banshee chipset from 3Dfx. It therefore shares most of the limitations of the former. The Fusion has 16Mb of SDRAM but no TV-out. Interestingly, this card boasts a heatsink as well as a fan, which is useful, as the Banshee chipset tends to run very hot.

Despite being almost a year old, the Banshee still doesn't have a full OpenGL ICD, but it does use a MiniGL driver. Its DirectX support is quite solid. The high fill rate of the Banshee produces some very impressive benchmark results, but image quality is not the best.

★★★★

DIAMOND **Stealth 3**

EDITOR'S CHOICE
PERSONAL COMPUTER WORLD ✓

The Stealth 3 is built around the new Savage4 chipset from S3. This pre-production version has only 16Mb of RAM: the retail version will have twice that. The Stealth 3 also has a high Ramdac of 300Hz, and TV-out. The Savage4 supports 32-bit rendering, single-pass multitexturing and motion compensation for DVD playback. It's also the first AGP 4X chipset. Advanced features include an 8-bit stencil buffer, anisotropic filtering and bump mapping. Despite only beta drivers being available at the time of testing, stability was not a problem. Image quality is on a par with the Revolution IV and TNT. The Stealth 3 also has a digital flatpanel connector.

★★★★★

DIAMOND **Viper V550**

HIGHLY COMMENDED
PERSONAL COMPUTER WORLD ✓

Diamond Multimedia is one of the best known names in the graphics card market. Its Viper V550, based on the Riva TNT chipset, won our Editor's Choice award last year. And despite the emergence of new contenders, the Viper V550 is no pushover. The card has 16Mb of SDRAM but no TV-out. The TNT supports full 32-bit colour and an 8-bit stencil buffer, and both DirectX and OpenGL. Image quality is excellent at all colour depths. The Viper V550 is the fastest TNT-based card in our group test. However, there is no motion compensation support for DVD playback.

★★★★

GUILLEMOT **MaxiGamer Phoenix**
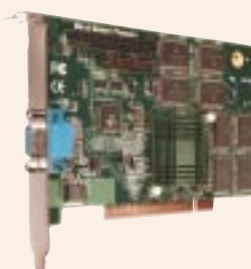
The not-so-enigmatic Phoenix from Guillemot uses the Banshee chipset from 3Dfx. Unlike all the other cards in this test, the Phoenix is strictly PCI. It doesn't support 32-bit colour, either. The Phoenix has 16Mb of SDRAM but the Banshee chipset has no OpenGL ICD; it makes do with a MiniGL driver used only by games. As with all cards using the Banshee chipset, this driver limits the functionality of the Phoenix. The Banshee does not support single-pass multitexturing, so there's a significant performance hit in games using this technique. The chipset does not support hardware DVD playback.

★★

Table of features

| MANUFACTURER	DIAMOND	DIAMOND	DIAMOND	GUILLEMOT
MODEL	MONSTER FUSION	STEALTH 3	VIPER V550	MAXIGAMER PHOENIX
Supplier	Diamond Multimedia	Diamond Multimedia	Diamond Multimedia	Guillemot
URL	01189 444400	01189 444400	01189 444400	0181 944 1940
Web address	www.diamondmm.co.uk	www.diamondmm.co.uk	www.diamondmm.co.uk	www.guillemot.com
Price (ex VAT)	£75	£99	£87	£75
Price (inc VAT)	£88.13	£116.32	£102.23	£88.13
Interface	AGP	AGP	AGP	PCI
RAM/Max RAM	16Mb/16Mb	32Mb/32Mb	16Mb/16Mb	16Mb/16Mb
Chipset	Banshee	Savage4	Riva TNT	Banshee
Ramdac	250Hz	300Hz	250Hz	250Hz
TV-out	✗	✓	✗	✗
Max resolution/colours	1920x1200/32-bit	1920x1600/32-bit	1920x1200/32-bit	1920x1200/32-bit
Max refresh (at max res)	75Hz	75Hz	75Hz	75Hz
Windows drivers	95, 98, NT	95, 98, NT	95, 98, NT	95, 98, NT

group test

HERCULES **Dynamite TNT**

Hercules' Dynamite was one of many TNT cards to be released last year, but its drivers set it apart from the crowd. The Hercules display panel provides access to advanced settings for both Direct3D and OpenGL: users can increase performance at the cost of overall image quality, or get a blend of both. You can even overclock the chipset and memory beyond its standard settings. The chipset is cooled by a fan rather than a heatsink. Like other TNT cards, the 16Mb of memory is not upgradeable. Image quality is excellent and performance is quite acceptable.

★★★★

HERCULES **Supercharger**
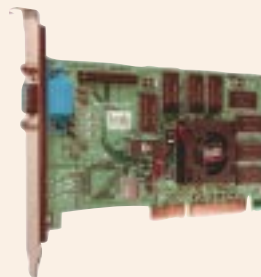
The Hercules Supercharger is actually a revised version of the original Terminator Beast graphics card. It has 8Mb of SGRAM which is not upgradeable. Despite being effectively almost a year old, this card is an impressive performer. Like the Riva TNT and the Rage 128, the Savage 3D supports full 32-bit colour. Both 2D and 3D image quality is on par with the best. The Supercharger has TV-out but no stencil buffer. Unlike the Banshee, the Savage 3D has a full OpenGL ICD. The chipset also supports motion compensation for flawless DVD playback.

★★★

NUMBER 9 **Revolution IV**

The Number 9 brand is well known for producing a wide variety of graphics cards, for the home and the workstation market. Like the TNT and Rage 128 chipsets, the Revolution IV supports full 32-bit colour and has a 250Hz Ramdac. The card supports resolutions as high as 1920x1200 and a whopping 32Mb of RAM. The HawkEye display utility provides powerful features such as multiple virtual desktops, colour exchange, hardware magnification and panning — very useful in desktop imaging environments. The Revolution IV is not a high-performance Direct3D or OpenGL gamer's card, but if you crave excellent image quality, you can't go wrong.

★★★

PACE **3D Edge**
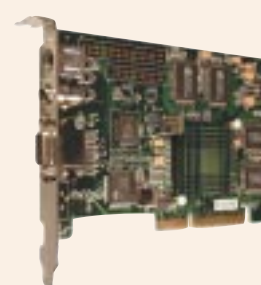
Despite its lack of advanced features like 32-bit rendering and stencil buffer, 3Dfx's Banshee has proved to be popular among board manufacturers. Pace's 3D Edge Banshee with 16Mb of memory has a TV-out port, and the m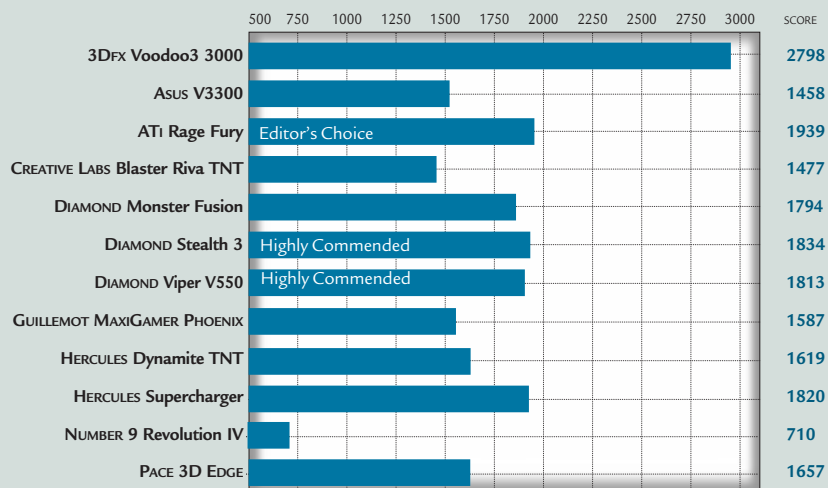emory is the superior SGRAM variety. Unlike the Rage 128 and the Riva TNT, the Banshee does not support single-pass multitexturing so there's a performance hit in some games. The Banshee also lacks a full OpenGL ICD and hardware DVD support. Like many other Banshee cards, image quality is good, but not the best. The game Wargasm is included.

★★★

Table of features

MANUFACTURER	HERCULES	HERCULES	NUMBER 9	PACE
MODEL	DYNAMITE TNT	SUPERCHARGER	REVOLUTION IV	3D EDGE
Supplier	Acal	Acal	Tai Computer Systems	Pace Communications
Telephone	01243 513434	01243 513434	0181 963 2900	01274 534333
URL	www.hercules.com	www.hercules.com	www.nine.com	www.pacecom.co.uk
Price (ex VAT)	£87	£75	£119	£85
Price (inc VAT)	£102.23	£88.13	£139.83	£99.88
Interface	AGP	AGP	AGP	AGP
RAM/Max RAM	16Mb/16Mb	8Mb/8Mb	32Mb/32Mb	16Mb/16Mb
Chipset	Riva TNT	Savage 3D	Revolution IV	Banshee
Ramdac	250Hz	250Hz	250Hz	250Hz
TV-out	✗	✔	✔	✔
Max resolution/colours	1920x1200/32-bit	1600x1200/32-bit	2054x1534/32-bit	1920x1200/32-bit
Max refresh (at max res)	75Hz	75Hz	60Hz	75Hz
Windows drivers	95, 98, NT	95, 98, NT	95, 98, NT	95, 98, NT

3Dmark99 Results

Card	Score
3DFx Voodoo3 3000	2798
Asus V3300	1458
ATi Rage Fury — Editor's Choice	1939
Creative Labs Blaster Riva TNT	1477
Diamond Monster Fusion	1794
Diamond Stealth 3 — Highly Commended	1834
Diamond Viper V550 — Highly Commended	1813
Guillemot MaxiGamer Phoenix	1587
Hercules Dynamite TNT	1619
Hercules Supercharger	1820
Number 9 Revolution IV	710
Pace 3D Edge	1657

Quake2 Results

Card	Score
3DFx Voodoo3 3000	77.7
Asus V3300	37.3
ATi Rage Fury — Editor's Choice	40.8
Creative Labs Blaster Riva TNT	37.5
Diamond Monster Fusion	25.0
Diamond Stealth 3 — No ICD as yet	-
Diamond Viper V550 — Highly Commended	37.6
Guillemot MaxiGamer Phoenix	20.9
Hercules Dynamite TNT	41.9
Hercules Supercharger	21.8
Number 9 Revolution IV — Unable to complete tests	-
Pace 3D Edge	23.7

Final Reality 2D Results

Card	Score
3DFx Voodoo3 3000	4.078
Asus V3300	4.041
ATi Rage Fury — Editor's Choice	4.084
Creative Labs Blaster Riva TNT	4.008
Diamond Monster Fusion	4.135
Diamond Stealth 3 — Highly Commended	4.040
Diamond Viper V550 — Highly Commended	4.027
Guillemot MaxiGamer Phoenix	4.079
Hercules Dynamite TNT	4.061
Hercules Supercharger	4.024
Number 9 Revolution IVM	4.034
Pace 3D Edge	4.067

☛ **How we did the tests**

All three tests — Final Reality, 3Dmark99 and Quake2 — were run on a Pentium III 500MHz system with 128Mb RAM and a 7200rpm Maxtor hard drive. Some chipsets, like the Banshee, do not support 32-bit rendering. Therefore, in order to be fair to all, the tests were run at a resolution of 1024 x 768 at a colour depth of 16 bits. After the testing of each card, its drivers were removed before the next set of tests were run. All graphics cards were tested using the latest drivers available on their web sites.

☛ **3Dmark99**

This benchmark is fully DirectX 6 compatible and tests advanced 3D features like trilinear filtering, anisotropic filtering and multitexturing. In general, graphics cards with high fill rate and single-pass multitexturing show better results. For instance, the high score of the Voodoo3 3000 reflects its high fill rate and triangle throughput. On the other hand, the original Savage 3D used on the Hercules Supercharger is not quite as powerful. This is reflected in its lower score. This benchmark also provides a reference image which can be used for judging the image quality of various cards. [*For more on 3Dmark99, see this month's PC Group Test, p128.*]

☛ **Quake2**

Since its release, Id Software's Quake2 has become the industry standard benchmark for a real-world OpenGL application. In general, the Quake2 benchmarks go alongside the 3Dmark99 results. However, some of the results should be treated with caution: this is particularly true of graphics cards using 3Dfx chipsets. Instead of a full OpenGL ICD, 3Dfx chipsets like the Banshee and the Voodoo3 use a MiniGL driver. A subset of a full ICD, the MiniGL driver is highly optimised for Quake2, so those cards with this driver will run faster than those with a full ICD. The Diamond Stealth 3, as a beta card, did not yet have an OpenGL ICD, so could not run this test. The Number 9 Revolution IV also had problems, although this card is intended as a workstation card and is not meant to run games.

☛ **Final Reality**

The 2D scores in this test reflect the card's ability to use DirectDraw, a part of Microsoft's DirectX API. As is evident from our results, all the graphics cards in this test are powerful enough to produce decent 2D performance, with minimal differences in the scores. A Ramdac above 230Hz, will provide a good flicker-free display at high resolutions — important in environments like desktop publishing where large monitors are often used.
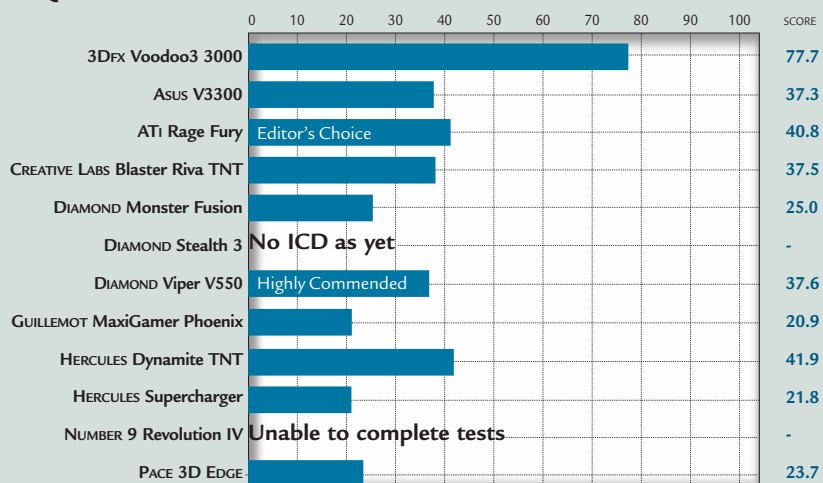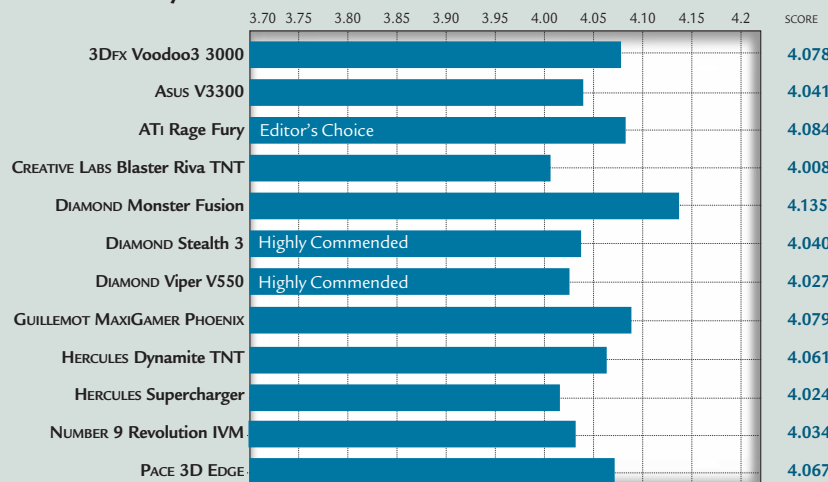
Editor's Choice

Speed has been the main focus of the graphics card industry for some time, sometimes at the expense of other features. While cards such as the Voodoo2 from 3Dfx were fast, 3D image quality suffered. But things have moved on. Newer chipsets like the Riva TNT and the Savage 3D introduced fast performance with excellent image quality, while the new TNT2 chipset previewed at Cebit (see our *News* section) combines great speed with outstanding quality.
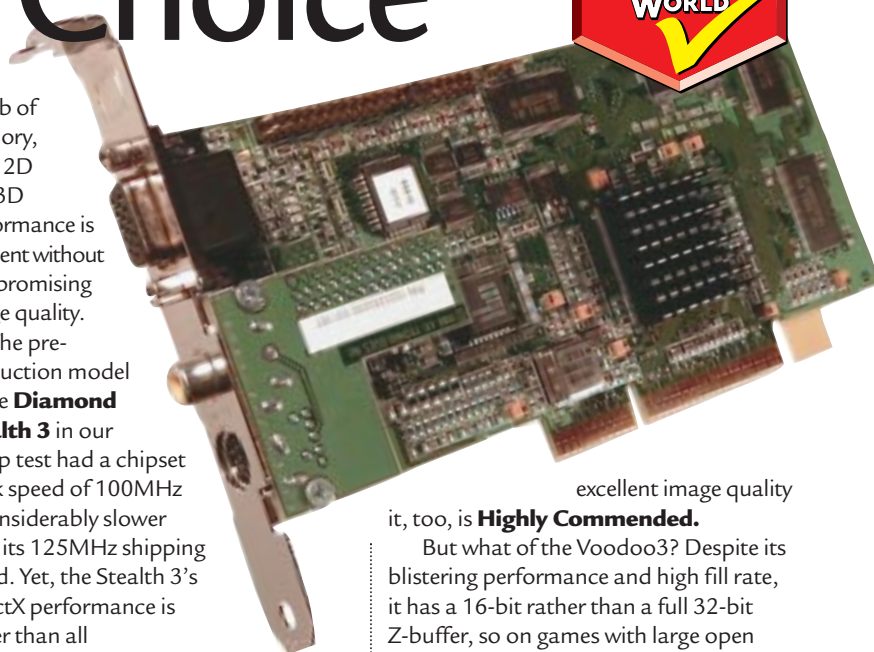
DVD support has also emerged as a feature no self-respecting graphics card can do without. Without graphics card support, MPEG-2 and Dolby Digital decoding can bring even the most powerful CPU to its knees. The motion compensation support provided by the Savage4 on the Diamond Stealth 3, and the Rage 128 on the ATi Rage Fury, lead to flawless performance. Both cards ship with their own DVD utilities to support on-board hardware MPEG decoding.

For all-round performance and features, the **ATi Rage Fury** fully deserves our **Editor's Choice** award. It supports full 32-bit colour, has a complete OpenGL ICD, and sports TV-out to complement the DVD playback. With a whopping 32Mb of memory, both 2D and 3D performance is excellent without compromising image quality.

The pre-production model of the **Diamond Stealth 3** in our group test had a chipset clock speed of 100MHz — considerably slower than its 125MHz shipping speed. Yet, the Stealth 3's DirectX performance is better than all the TNT cards and only slightly slower than the ATi Rage Fury. With its impressive 3Dmark99 performance and low price, the Diamond Stealth 3 is the card to watch. So, for an outstanding performance achieved by a beta card, it wins a **Highly Commended** award.

The TNT-based **Diamond Viper V550**, despite being a generation older than the Rage Fury and the Stealth 3, is no slouch. For good performance and excellent image quality it, too, is **Highly Commended.**

But what of the Voodoo3? Despite its blistering performance and high fill rate, it has a 16-bit rather than a full 32-bit Z-buffer, so on games with large open spaces like mountains and valleys, it might display some annoying visual glitches. It might also create ugly banding at high resolutions. The 3Dfx card also lacks DVD motion compensation support and has no TV-out — both features that most users would want to see on their graphics card. With upcoming TNT2-based cards, such as the VideoLogic Neon250, producing even higher speeds, the Voodoo3 doesn't cut the mustard.

Bump mapping: a straight answer

Every once in a while, a certain concept, accompanied by a buzzword, captures the imagination of the graphics-card market. Last year, to a large extent, this was epitomised by the debate over different forms of multitexturing. The familiar cycle is now repeating itself with another vaguely defined concept — that of bump mapping.

Bump mapping is a technique which enhances the visual realism of textures or objects in a three-dimensional environment. A bump map provides the illusion of depth on an otherwise bland surface. For instance, without bump mapping, a mountain within a 3D environment would look something like a series of interconnected pyramids, but a bump-mapped mountain can have realistic ledges and protrusions.

The concept of bump mapping itself is not new: high-end 3D animation packages such as Lightwave 3D and SoftImage have long included it as a standard feature. What's new is the inclusion of this feature in Microsoft's DirectX API.

The inclusion of bump mapping in DirectX 6 meant that the large community of games developers could take advantage of it. This in turn put pressure on graphics chipset manufacturers to support this feature.

DirectX 6 supports various forms of bump mapping, one of which is a specialised form of multitexturing, or embossing. Some graphics chipsets, like the Rage 128 from ATi, use this method.

This embossing method has a few disadvantages. One of the problems is that it is a form of software bump mapping; in other words, it's extremely CPU intensive. True bump mapping is dependent on the source, or sources, of light. Software bump mapping doesn't take any light source into consideration, which often leads to some very unrealistic results. Software bump mapping also requires the programmer to manipulate each effect individually, which is extremely time consuming.

Hardware bump mapping in DirectX 6 is often called environment mapping. Because it is handled by the graphics chipset, hardware bump mapping is much less CPU intensive.

Buyers who are on the lookout for new graphics cards would do well to look for chipsets which support true hardware bump mapping. The G400 chipset from Matrox and the Permedia 3 from 3D Labs are good examples. □