The following extract is part one of a guide to Photoshop 7.0 color management.

Photoshop 5.0 was justifiably praised as a ground-breaking upgrade when it was released in the summer of 1998. The changes made to the color management setup were less well received in some quarters. This was because the revised system was perceived to be extremely complex and unnecessary. Some color professionals felt we already had reliable methods of matching color and you did not need ICC profiles and the whole kaboodle of Photoshop ICC color management to achieve this. The aim of this chapter is to start off by introducing the basic concepts of color management – the first part will help you to understand the principles of why color management is necessary. And as you will discover, there are some important historical reasons why certain Photoshop users feel they have no need to use ICC profiled color management. We will be looking at the reasons for this and then go on to consider the advantages of an ICC profiled workflow and lastly, how to optimize the Photoshop color engine settings. This latter section will take you step by step through the Photoshop Color Settings interface.

The need for color management

An advertising agency art buyer was once invited to address a meeting of photographers for a discussion about photography and the Internet. The chair, Mike Laye, suggested we could ask him anything we wanted, except 'Would you like to see my book?' And if he had already seen your book, we couldn't ask him why he hadn't called it back in again. And if he had called it in again we were not allowed to ask why we didn't get the job. And finally, if we did get the job we were absolutely forbidden to ask him why the color in the printed ad looked nothing like the original transparency!

That in a nutshell is a problem which has bugged us all our working lives. And it is one which will be familiar to anyone who has ever experienced the difficulty of matching colors on a computer system with the original or a printed output. Figure 4.1 has two versions of the same photograph. One shows how the Photoshop image is previewed on the monitor and the other is an example of how a printer might interpret and reproduce those same colors. Why can there be such a marked difference between what is seen on the screen and the actual printed result? The computer monitor will have manual controls that allow you to adjust the brightness and contrast (and in some cases the RGB color as well), so we have some element of basic control there. And the printer will also probably allow you to make color balance adjustments, but is this really enough though? And if you are able to get the monitor and your printer to match, will the colors you are seeing in the image appear the same on another person's monitor?

Why not all RGB spaces are the same

Figure 4.1 The picture on the left shows how you would see the Photoshop image on your screen and the one on the right represents how that same image will print if sent directly to a proofing printer without applying any form of color management. This is an actual simulation of what happens when raw RGB data is sent without any form of compensation being applied to balance the output to what is seen on the screen.

You might think it is merely a matter of making the output color less blue in order to successfully match the original. Yes, that would get the colors closer, but when trying to match color between different digital devices, the story is actually a lot more complex than that. The color management system that was first introduced in Photoshop 5.0 will enable you to make use of ICC profiles and match these colors from the scanner to the screen and to the print proofer with extreme accuracy.

Client: Clipso. Model: Sheri at Nevs.

Figure 4.2 All digital devices have individual output characteristics, even if they look identical on the outside. In a TV showroom you will typically notice each television displaying a different colored image.

What you have just witnessed illustrates why color management is so important. It is all very well getting everything balanced to look OK on your monitor and knowing how to tweak your printer settings to look right. But there is a better way, one that will allow you to mix and match any number of digital devices. Go into any TV show room and you will probably see rows of televisions all tuned to the same broadcast source but each displaying the picture quite differently. This is a known problem that affects all digital imaging devices, be they digital cameras, scanners, monitors or printers. Each digital imaging device has its own unique characteristics. And unless you are able to quantify what those individual device characteristics are, you won't be able to communicate effectively with other device components and programs in your own computer setup, let alone anyone working outside your system color loop.

The way things were

What follows is a brief summary of working practices in the repro industry, but keen amateurs might also be interested to learn about some of the background history to color management. Ten years ago, most photographers only used their computers to do basic administration work and there were absolutely no digital imaging devices to be found in a photographer's studio (unless you counted the photocopier). At the end of a job we would supply transparencies or prints to the client and that was the limit of our responsibilities. Our photographs then went to the printer to be digitized using

a high-end drum scanner to produce a CMYK file. The scanner would be configured to produce a CMYK file ready to insert in a specific publication. If color corrections were required, the scanner operators carried this out themselves on the output file. These days a significant number of photographers, illustrators and artists are now originating their own files from digital cameras, desktop scanners or directly within Photoshop. This effectively removes the repro expert who previously did all the scanning and matching of the colors on the press. Imagine for a moment what would happen if our traffic laws permitted a sudden influx of inexperienced and unaccompanied teenage learner drivers on to our roads? This will give you some indication of the 'printer rage' that ensued when Photoshop users began delivering digital files instead of transparencies. There is no getting away from the fact that if you supply digital images to a printer, you will be deemed responsible should any problems occur in the printing. This may seem like a daunting task, but with Photoshop it is not hard to color manage your images with confidence. It need only take a few minutes to calibrate your monitor with the Adobe Gamma control panel and to configure the Photoshop Color Settings. But we'll come to that later on.

CMYK color management

Printers naturally have an 'output-centric' view of color management. Their main concern is getting the CMYK color to look right on a CMYK press. Accordingly, you will hear an argument that suggests you don't need ICC profiles to get accurate CMYK color. In fact, if you know your numbers, you don't even need a color monitor. In this respect you can say they are right. These proven techniques have served the printing industry well for many years. But most Photoshop users and especially those who are photographers, face a far more complex color management problem, because we don't all have the luxury of managing the one scanner linked to a single press. We quite often have to handle digital files sourced from many different types of RGB devices such as: digital cameras, desktop scanners, Photo CD, picture libraries etc.

RGB devices

If your production workflow is limited to working with the one high-end scanner and a known press output, then the number of variables in your workflow is limited and it would not be difficult to synchronize everything in-house. But this is not the experience of an average Photoshop user. Instead of handling color between a few known digital devices in a fixed loop, you are faced with files coming from any number of unknown digital devices. If we all worked with the same few pieces of digital capture devices (like in the old days when there were only a handful of high-end scanner devices) the problem would be not so bad. But in the last decade or so

the numbers of different types of capture devices has grown enormously. When you take into account all the different monitors that are in existence and other Photoshop users who supply you with files of unknown provenance, and well, you get the picture! Since the explosion of new desktop scanners and digital cameras arriving on the market, the publishing industry has been turned on its head. This is a relatively new phenomenon and the old way of doing things no longer holds all the answers when it comes to synchronizing color between so many unknown users and digital devices. On top of this our clients may expect us to output to digital proofing devices, Lambda printers, Pictrographs, Iris printers, web pages, and ultimately a four-color press. An appreciation of CMYK printing is important, but in addition to this, you will possibly have to control the input and output between many different RGB color devices before a file is ready to go to press.

Not all RGB color devices are the same

Consider for a moment the scale of the color management task. We wish to capture a full color original subject, digitize it with a scanner or digital camera, examine the resulting image via a computer screen and finally reproduce it in print. It is possible with today's technology to simulate the expected print output of a digitized image on the screen with remarkable accuracy. Nevertheless, one should not underestimate the huge difference between the mechanics of all the various bits of equipment used in the above production process. Most digital devices work using RGB color and just like musical instruments, they all possess unique color tonal properties, such that no two devices are identical or will be able to reproduce color exactly the same way as another device can. Some equipment is capable of recording colors that are beyond the limits of human vision. Nor is it always possible to match in print all the colors which *are* visible to the human eye. Converting light into electrical signals via a device such as a CCD chip is not the same as projecting pixels onto a computer screen or the process of reproducing a photograph with colored ink on paper.

ICC profiled color management

We are all familiar with magazine reviews of digital cameras. At some point the magazine may print a spread of photos where a comparison is made of all the different models and the results achieved from photographing the same subject. The object of this exercise being to emphasize the difference in the capture quality of each camera when each file is brought directly into Photoshop, without any compensation being made. If you could quantify or 'characterize' those differences then it should be possible to accurately describe the color captured by any camera or scanner.

The International Color Consortium (ICC) is an industry body representing the manufacturers of imaging hardware and software who devised a common method of interpreting color between one device and another. The ICC profiling system has been adopted in a number of guises, such as Apple's ColorSync™. All ICC systems are basically able to translate the color gamut of the source space via a reference space and accurately convert these colors to the gamut of the destination space. The color conversion processing is carried out by the Color Matching Module or CMM. In Photoshop you have a choice of three CMMs: Adobe Color Engine (ACE), Apple or Heidelberg. Figure 4.8 shows a graphical illustration of a CMM at work.

So let's imagine a scenario where everyone is working in a profile-free, digital workflow. Who would have the hardest job of managing the color? The printer can color correct a CMYK image 'by the numbers' if they wish. Take a look at the photograph of the young model in Figure 4.3. Her Caucasian flesh tones should at least contain equal amounts of magenta and yellow ink with maybe a slightly greater amount of yellow, while the cyan ink should be a quarter to a third of the magenta. This rule will hold true for most CMYK press conditions. The accompanying table compares the CMYK and RGB space measurements of a flesh tone color. Unlike CMYK, there are no set formulae to describe the RGB pixel values of a flesh tone. If you were to write down the flesh tone numbers for every RGB device color space, you could in theory build an RGB color space reference table. And from this you could feasibly construct a system that would assign meaning to these RGB numbers for any given RGB space. This is basically what an ICC profile does except an ICC profile will contain maybe several hundred color reference points. These can be read and interpreted automatically by the Photoshop software.
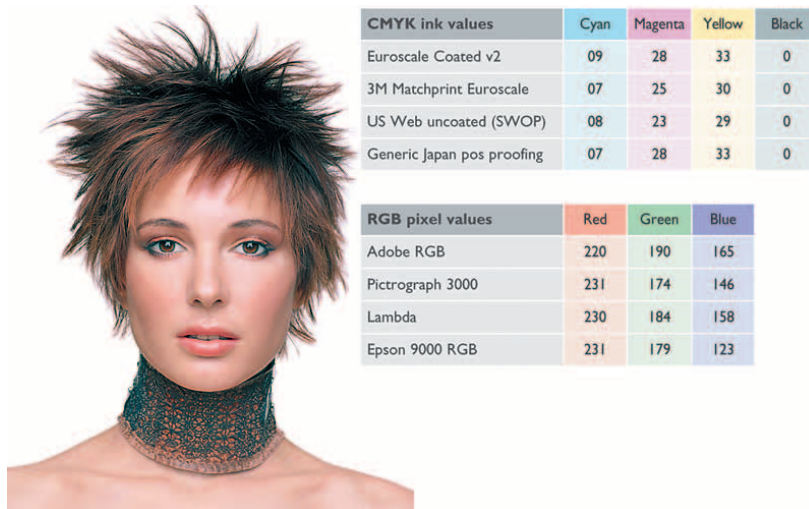
CMYK ink values	Cyan	Magenta	Yellow	Black
Euroscale Coated v2	09	28	33	0
3M Matchprint Euroscale	07	25	30	0
US Web uncoated (SWOP)	08	23	29	0
Generic Japan pos proofing	07	28	33	0

RGB pixel values	Red	Green	Blue
Adobe RGB	220	190	165
Pictrograph 3000	231	174	146
Lambda	230	184	158
Epson 9000 RGB	231	179	123

Figure 4.3 The above tables record the color readings for a flesh tone in RGB and CMYK color spaces.
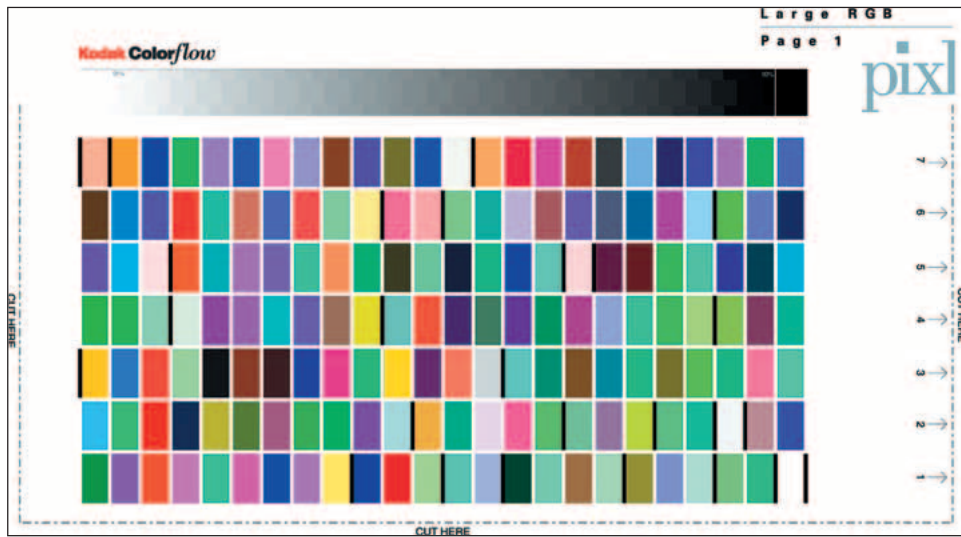
Figure 4.4 This is an example of a Kodak color target which is used to construct a color ICC profile. Thomas Holm of Pixl in Denmark sent me five separate files, including the one above. Each file was opened in Photoshop without any color conversion and the file was sent directly to the printer, again without any color modification. The print outputs, which contained over 800 color reference swatches, were then sent back to Pixl. They then measured all the color data information using an X-Rite spectrophotometer and from this constructed an accurate profile for my Pictrograph printer using Kodak ColorFlow 2.1 software and emailed the profile back to me.

<email@pixl.dk>

Figure 4.4 shows an example of a Kodak test target which is used to build an ICC profile. A target like this can either be scanned or photographed with a digital camera and the input color values compared using special software. In this case, I printed out the targets without using any color management – this gave a picture of how the printer would reproduce raw digital data directly from Photoshop. The printed targets were then measured using a spectrophotometer, the results evaluated and used to build a color profile for the color printer. As you can see, the profiling method will tell us so much more about the characteristics of a digital device like a camera or a scanner than could ever be achieved by just tweaking the monitor RGB gamma values to match the color balance of a specific output.

All RGB device spaces are different and without an accompanying profile, the RGB number values will lack specific meaning. Without profiles, the only way to compensate the color between different RGB devices was to adjust the monitor to reflect the color of the print output. This is like profiling, but is using only the midrange color balance to adjust the color. The 'mess up the monitor to look like the print' approach is seriously flawed and if you take a look at the examples in Figure 4.5 you will see why. If you plot the color gamut of a device as a 3D shape, you will notice
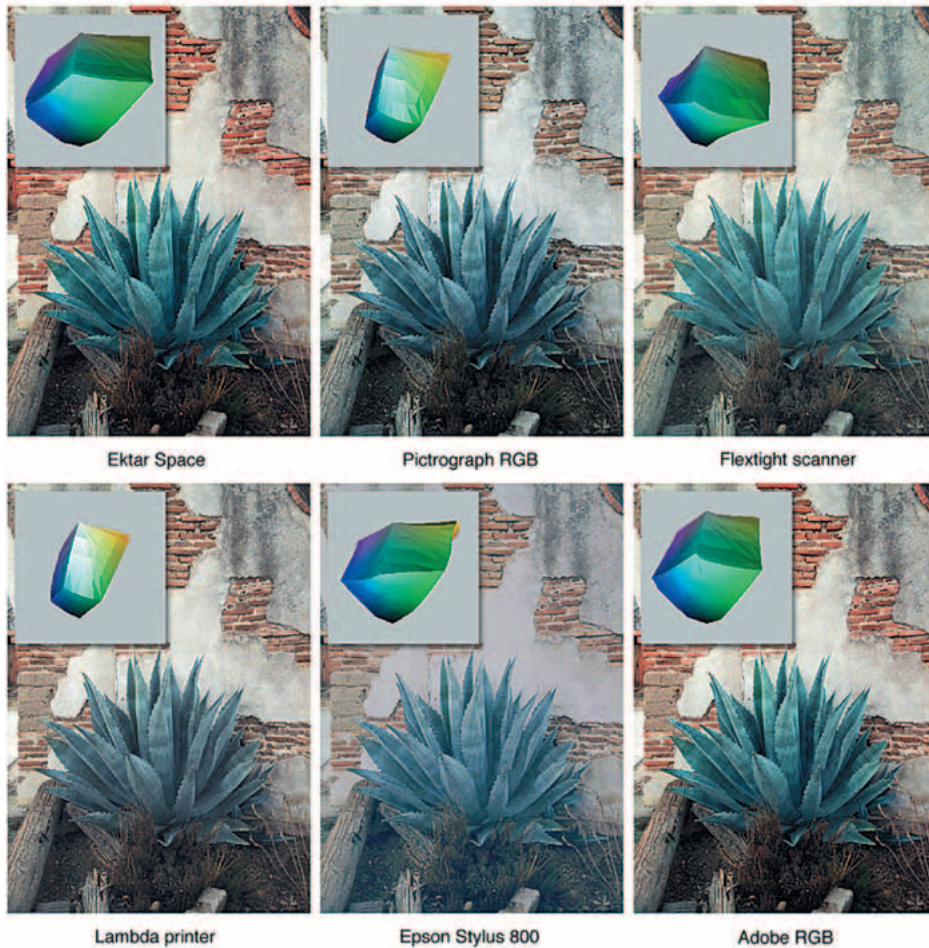
Figure 4.5 The above photographs have been reproduced without any color management being used. This illustrates not only how the color reproduction ends up being different from each color space, the gamut map of each space is also very different in character.

that the gamuts of these devices and edit spaces have their own distinctive signature shapes. It is not a simple a matter of making the screen a little more red to match the reddish print. Color managing your images in this way can be about as successful as hammering a square peg into a round hole!

In Daniel Defoe's book, Robinson Crusoe faced something of a furniture management problem. He tried to make the legs of his table stay level by sawing bits off some of the legs. As soon as he had managed to even up two or more of the legs, he found that one of the others would now be too long. And the more he attempted to fix the problem with his saw, the shorter the table became. A similar thing happens when you try to color manage through adjusting the monitor settings. You may be able to

obtain a good match for the skin tones, but if your subject is wearing a blue suit, the color might be way off and if you then compensate successfully for the blue clothing, the skin tones will no longer be true or some other color will reproduce incorrectly. You will not be able to achieve consistently matching results using this method of color management.

Switching on Photoshop ICC color management

A profile is therefore a useful piece of information that can be embedded in an image file. When a profile is read by Photoshop and color management is switched on, Photoshop is automatically able to find out everything it needs to know in order to manage the color correctly from there on. Note that this will also be dependent on you calibrating your monitor, but essentially all you have to do apart from that is to open the Photoshop Color Settings from the Edit menu and select a suitable preset such as the US Prepress Default setting. Do this and you are all set to start working in an ICC color managed workflow. Think of a profile as being like a ZIP code for images. For example, the address label shown in Figure 4.6 was rather optimistically sent to me at 'Flat 14, London', but thanks to the ZIP code it arrived safely! Some bureaux have been known to argue that profiles cause color management problems. This I am afraid is like a courier company explaining that the late delivery of your package was due to you including a ZIP code in the delivery address. A profile can be read or it can be ignored. It will certainly not be harmful to anyone who is using a non-ICC workflow.

Figure 4.6 Even if you have never been to London before, you know it's a fairly big place and 'Flat 14, London' was not going to help the postman much to locate my proper address. However, the all-important ZIP code or postcode was able to help identify exactly where the letter should have been delivered. An image profile is just like a ZIP code, it can tell Photoshop everything it needs to know about a file's provenance.
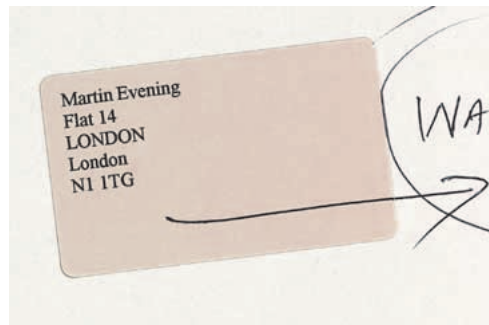
Monitor profiling

The first step to making color management work in Photoshop is to calibrate the monitor screen. There are several ways of doing this. As a minimum step towards monitor calibration and profile making, you are now advised to utilize the monitor calibration utilities provided by the Macintosh or use the Adobe Gamma control panel on a PC system to calibrate the screen and build a basic monitor profile. A

better solution, if you can afford it, is to purchase a hardware calibration device and software package. Some monitors like the Apple ColorSync and Barco feature built-in internal calibration. All these methods are doing the same thing – they optimize the monitor contrast and brightness, neutralize the color balance of the display and build a monitor profile. The aim is to standardize the monitor display and provide a report in the form of an ICC monitor profile. As shall be explained later, the monitor profile will then be automatically used by Photoshop to accurately display on the screen all profiled color files.

People often ask 'How can I be sure that the color I see is the same as what someone else is seeing?' How reliable are an individual person's eyes when it comes to determining how to neutralize the display? There are several factors which can determine color perception, not least the health of a person's eyes. As you get older the color vision of your eyes will change, plus some people are color blind and may not even be aware of this. For the most part, younger people in their twenties and with healthy vision will perceive colors more consistently and with greater precision. Then there is also the question of how we interpret color – human vision is adaptable and we tend to accommodate our vision to changes in lighting and color temperature and can be influenced by the presence of other colors around us.

Monitor calibration

Before you carry out any monitor calibration, the monitor should be left switched on for at least half an hour to give it a chance to warm up and stabilize. You should get rid of any distracting background colors or patterns on the computer desktop. You should ideally have a neutral gray desktop background and this is especially important when you are calibrating the screen by eye. One way to achieve this is to open an image up in Photoshop and set the screen display to full screen mode with the gray pasteboard filling the screen. Consider also the impact of lighting conditions and the viewing environment. The walls of the room you are working in should be a neutral color and the light levels kept low throughout the day. This will help to preserve the contrast of the monitor and lessen unwanted reflections from the screen.

With the advent of Photoshop 7.0, Adobe is no longer bundling a version of Adobe Gamma with the Macintosh package. It is assumed that ColorSync will handle everything in the Mac OS X, and leaves the field wide open for third parties to develop products for Mac OS 9.x. But the Adobe Gamma control panel is still available in the Goodies folder on the master CD, should you wish to continue using it. The following steps show you how to neutralize a cathode ray tube (CRT) monitor and create a monitor profile on the Mac OS X system.

Mac OS X calibration

To launch the Display Calibration Assistant, click on the Displays icon in the System preferences and click on the Calibrate button. The opening screen introduces the calibration utility and steps to create a monitor profile. Check the Expert Mode button at the bottom of the screen.
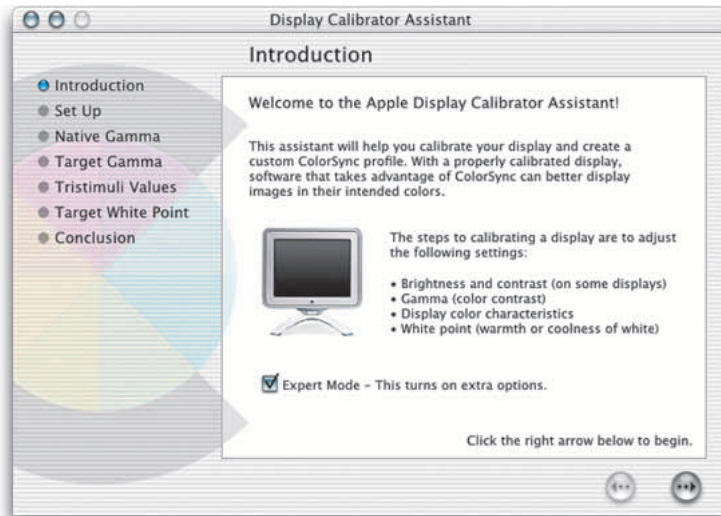

Contrast and brightness

You will then be asked to adjust the monitor brightness control so that the gray circle inside the larger box just becomes visible and the two darker halves of the square appear to be a solid black. This step optimizes the monitor to display at its full dynamic range and establishes the optimum brightness for the shadow tones.
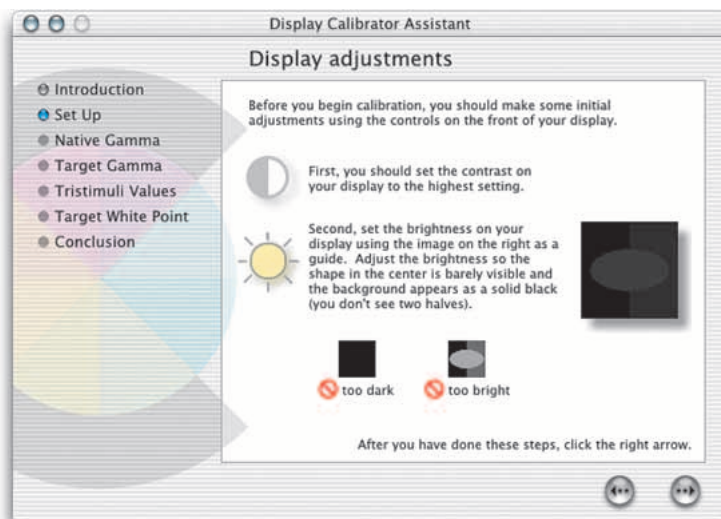
Neutralizing the color

If you are using a cathode ray tube (CRT) monitor the calibration assistant will display the following dialog with the red, green and blue squares. This will allow you to adjust the gamma of the individual red, green and blue monitor colors. Squint your eyes as you adjust the individual color gamma sliders, so that the patterned stripes in the boxes appear to blend with the solid Apple logo in the middle.
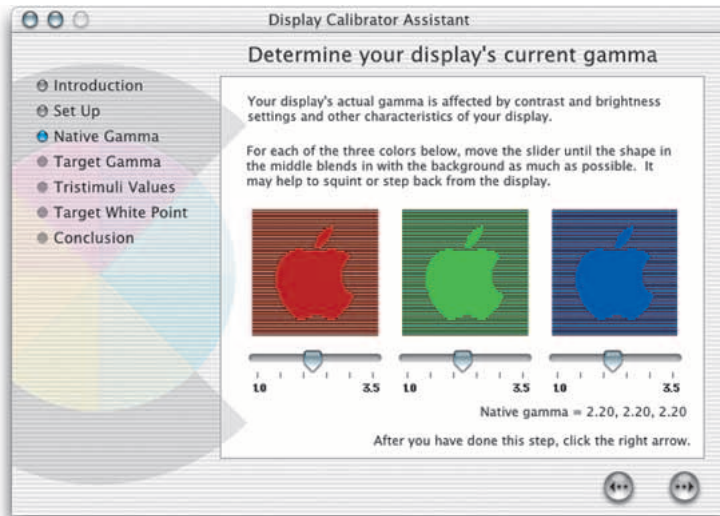

Target Gamma

if you have a flat screen monitor connected to your computer or you have already installed a third-party monitor calibration utility, the Calibration Assistant will recognize this and bypass the previous dialog, to display the target gamma screen. If you are using a Macintosh computer, select the Mac Standard 1.8 gamma.
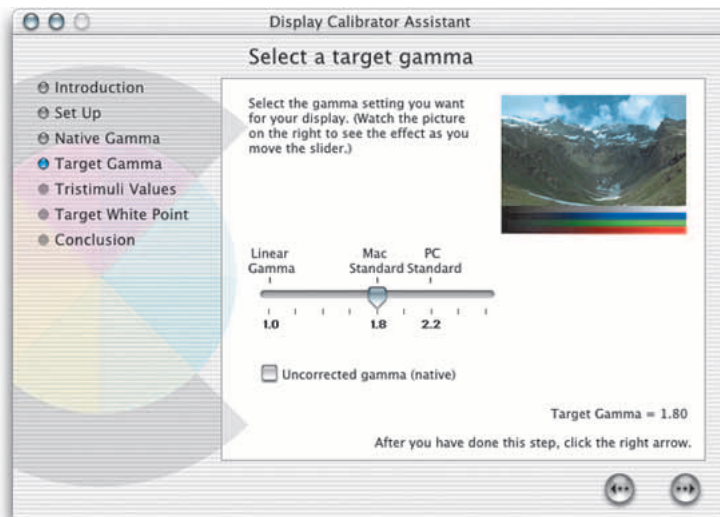
White point

Now we come to the white point settings. I would advise choosing a white point of 6500 K. You might be guided to choose a white point of 5000 K, because this is the color temperature of a calibrated, proofing lightbox, but the screen will look rather dull and have a slightly yellow cast, so stick to using a 6500 K white point.
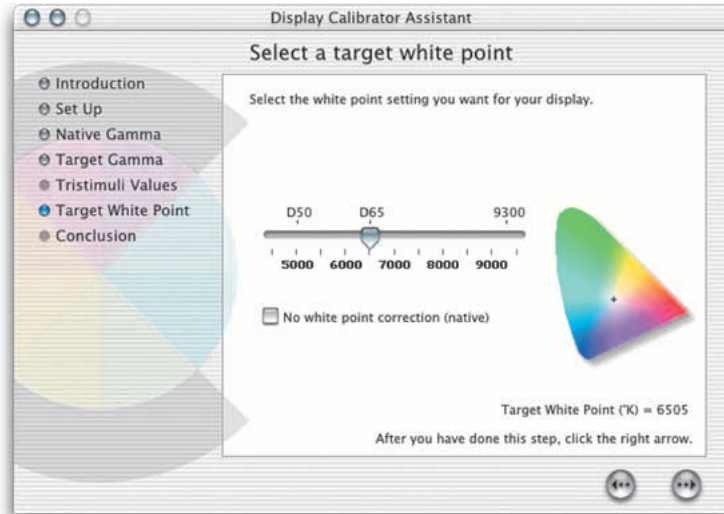
Conclusion

Name the new monitor profile and click on the Create button. You will have created an ICC profile that describes the current characteristics of the monitor and which Photoshop will automatically recognize. Photoshop will utilize this profile information in the color management process without further intervention. You have just successfully calibrated your monitor's brightness, contrast and color balance.
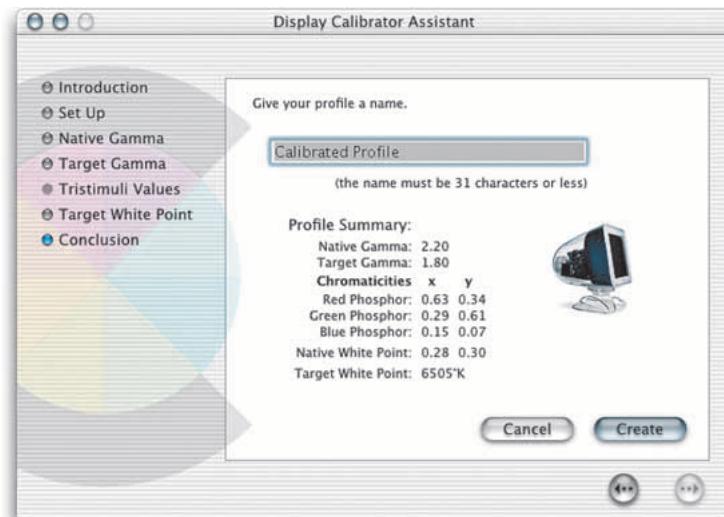
Calibrating a PC monitor with Adobe Gamma

The Adobe Gamma control panel should be located in the Program files/Common files/Adobe/Calibration folder which can be easily accessed on a PC by going to My Computer and selecting Control Panels. Adobe Gamma will now work with most PC computers, providing the video card will allow Adobe Gamma to interact with the monitor tube. Do not use the older Gamma control panel which shipped with Photoshop 4.0 or earlier. This older control panel must be discarded.

When you launch Adobe Gamma, you have a choice of using it in either Control Panel or Step By Step (Assistant) mode. Select the Assistant radio button and click Next. If you already have a monitor profile, such as a canned profile supplied by the manufacturer, click the Load... button, locate this profile and use that as your starting point. Any existing monitor profiles should be found in the ICM Color Profiles folder. If not, any will do as a starting point here. You will be asked to set the monitor contrast to maximum. The single gamma display box will only allow you to adjust the relative brightness. But since you will want to neutralize the color as well, uncheck the View Single Gamma Only box and adjust the three color boxes as outlined in the Mac OS X calibration routine.

The Windows default gamma is 2.2 and this is the best monitor gamma setting for most Windows graphics cards. The white point should be 6500 K, if unsure, try clicking on the Measure... button and following the on-screen directions. The next screen asks if you want to work with a different white point other than that entered in the previous screen. Unless you have a particular need to alter the white point, leave this set to Same as Hardware.

Figure 4.7 If you are using a third-party method of profiling the monitor on the Macintosh, other than a system utility, you may be required to manually load this profile next to where it says Display Profile in the ColorSync Control Panel (OS 9), or in the ColorSync System preference (Mac OS X). On a PC, you will probably need to carefully consult the instructions which came with the calibration device. These should guide you through the intricacies of how to configure the Windows system setups.
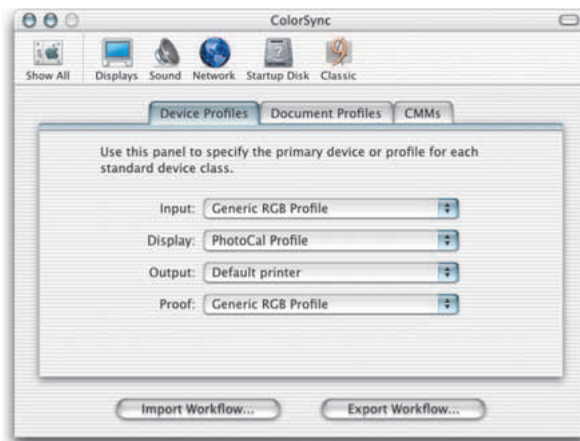
The value of a calibrated display

If you follow the steps just described, you will now have yourself a calibrated monitor. On the Macintosh, the profile should be saved in the System/ColorSync Profiles folder. On a PC machine, save to the Windows/System/Color folder. A standard calibration utility like the one just shown is the simplest way of checking that your screen is neutral and is making full use of the display contrast to fully render the shadow and highlight tones correctly. This will get you on the right track with regards being able to open up an image in Photoshop and seeing it with the same brightness and color neutrality as seen on someone else's calibrated system.

The display calibrator utility just shown is effective, but it is still rather basic. There are other, better monitor profiling solutions you might consider using. A hardware calibration device combined with a dedicated software utility will be able to build a much more accurate monitor profile. The LaCie bluescreen prepress monitors can be sold with an optional Blue Eye calibrator device. ColorVisions <www.colorcal.com> make several calibration units, starting with the very affordable Monitor Spyder and PhotoCal software bundle. For really accurate monitor calibration consider the X-Rite DTP 92 with OptiCal software or the very versatile Eye-One devices from Gretag Macbeth, which can be used to build profiles of almost everything in your studio. Monitor profiling devices are attached to the screen via rubber suckers. As I said in Chapter One, most LCD type screens cannot be profiled, apart from certain devices such as the Apple, Wacom and Formac displays. A normal calibrating device will easily damage the delicate screen surface, so a special calibrator must be used. These calibrators have a strap with a weight on the other end and are hung over the top of the screen and will gently rest the calibrator against the screen surface. The calibration software will display a series of color patches on the screen and these are read by the calibrating device and the information is used to build a profile. If you have a third-party device or a built-in monitor calibration system, always use this in preference to anything else. If you still have Adobe Gamma installed, disable it and do not try to use both systems. The performance of the monitor will fluctuate over time as well as on a daily basis. It is therefore important to check and calibrate the monitor at regular intervals. Remember, monitor calibration plays an essential part in establishing a first link in the color management chain.

The Photoshop color engine

Let's put all the pieces together – the diagram in Figure 4.8 illustrates the ICC color management route for handling ICC profiled files coming into Photoshop. It shows the different types of RGB input sources such as desktop scanner files or Photo CD images being brought into Photoshop. If an ICC profile is embedded in the file,
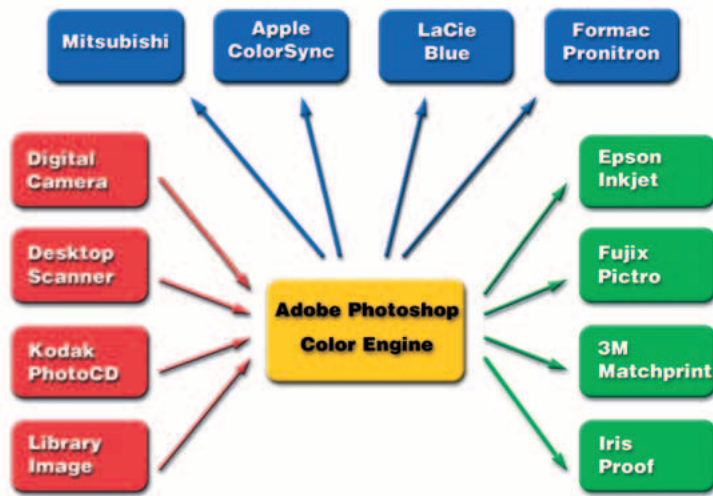
Figure 4.8 Photoshop's ICC color management system revolves around the use of profile information which will ideally accurately describe the characteristics of each digital device used in the chain from capture to print. In the above example, Photoshop can read or make use of the profile relating to any type of input source (the devices listed in the red boxes) and apply a conversion to the destination or output (the devices listed in the green boxes) and maintain consistent color throughout. Profiling the monitor (such as one of the monitors listed in the blue boxes at the top), using a third-party measuring device ensures accuracy of the display of the color data on screen.

Photoshop will recognize this and know how to correctly interpret the color data. The same thing applies to profiled CMYK files as well. Photoshop uses the monitor profile information to render a color correct preview on the monitor screen. It helps to understand here that in an ICC color managed workflow in Photoshop, what you see on the monitor is always a color corrected preview and you are not viewing the actual file data. This is what we call 'device-independent color'. When an image is in Adobe RGB and color management is switched on, what you see on the screen is an RGB preview that has been converted from Adobe RGB to your profiled monitor RGB. The same thing happens when Photoshop previews CMYK data on the screen. The Photoshop color management system calculates a conversion from the file CMYK space to the monitor space. Photoshop therefore carries out all its color calculations in virtual color spaces. For example, the RGB color space you edit within can be exactly the same as the work space set on another user's Photoshop system. If you are both viewing the same file, and your monitors are correctly calibrated and profiled, you should be seeing near enough the exact same colors on the screen in Photoshop.

The profiled approach

To output a file from Photoshop in a color managed workflow, you will need to carry out a further profile conversion from the current work space or file space, to the printer's color space. We will be looking at color managed file outputs in deservedly more detail later on in Chapter Five. In the meantime, Figure 4.9 reexamines the problem encountered at the beginning of this chapter where the skin tones in the original image printed too blue. The profile created for this particular printer describes the variance. The (normally hidden) color shifting which occurs during the profile conversion process will compensate by making the skin tone colors more red, but apply less color compensation to other colors. The result is an output that more closely matches the original. That is a simple illustration of the ICC-based color management system at work. All color can be managed this way in Photoshop from capture source to the monitor display and the final proof.
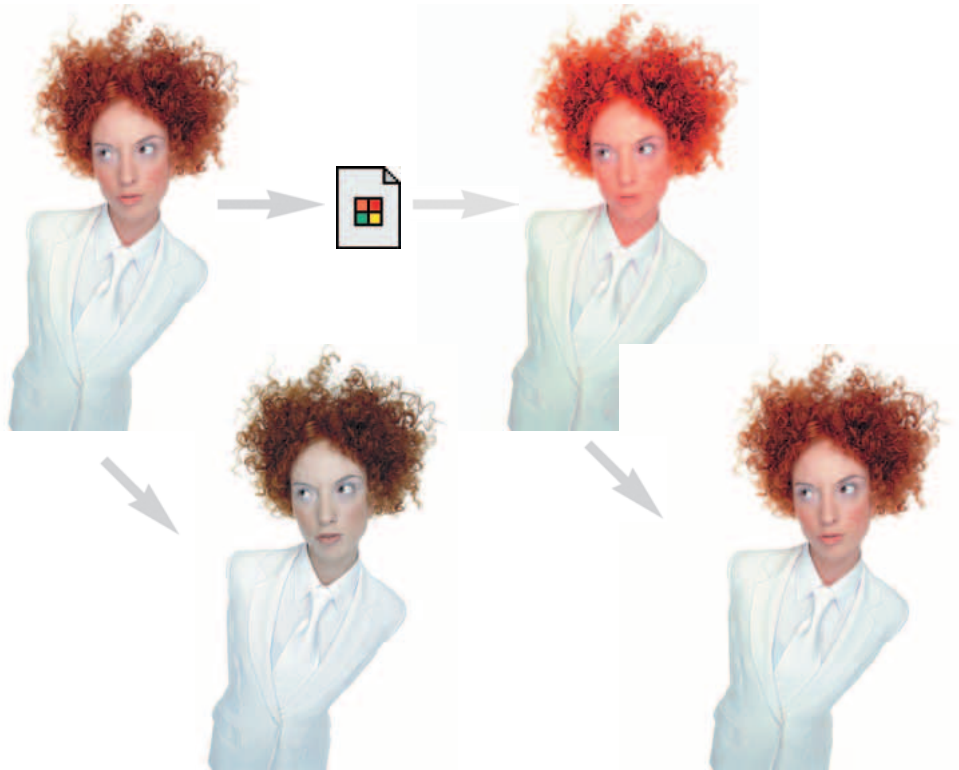

Figure 4.9 As was shown in Figure 4.1, sending the color data direct to the printer without applying any compensation will produce an incorrect color result. But applying a profile conversion with a custom profile for the proof printer will invisibly convert the colors to compensate for the specific characteristics of the printer and thereby produce a much more representative print of the original. The bright red 'profile converted' image will compensate for the color space deficiencies of the output device.

The versatility of RGB

There are those who remain critical of the introduction of ICC-based color management in Photoshop. They look at the needs of their own setup and figure that what works well for them has got to be right for everyone else. I travel quite a lot and once I was driving off the normal tourist track and needed to find a decent road map, but couldn't find any local gas stations that sold one. When I enquired why, I was told 'Because we all know where everything is around here!' It seemed the locals had no need to accommodate lost strangers around those parts.

You could say the same of some bureaux and printers because they work exclusively at the final stage of the print process. If your main area of business revolves around the preparation of CMYK separations for print, then I do recommend you invest in a training course or book that deals with CMYK repro issues. I can highly recommend the *Real World Photoshop* series by Bruce Fraser and David Blatner. Conversely, photographers are mainly involved in the RGB capture end of the business. This is one of the reasons why I devote so much attention to the managing of RGB color, here and elsewhere in the book. But nevertheless, if any work you create is intended for print, the issue of RGB to CMYK conversion must be addressed at some point.

The proliferation of Photoshop use and the advent of high quality digital cameras is also another important factor to consider. If photographers are more likely to want to supply a digital file at the end of a job, how will this fit in with existing workflows? Printers have argued in the past that they would prefer the digital files turned back into transparencies, so they can maintain the opportunity to scan it again themselves. Most of their work is currently handled using original transparency film and therefore this is more convenient for them (and of course they maintain the scanning business). But at what cost to the client? Since digital capture has clearly taken off in a big way, that option will no longer exist. One way or another the RGB to CMYK issue will have to be resolved. The early adopters of digital camera systems were repro houses and they are therefore having to investigate ways and means of handling RGB files and the use of independent hardware/software solutions to carry out the conversion to CMYK. If, as has been proved, professional quality digital cameras become more widely used, photographers will either be turning those digital files back into transparencies to be scanned again by the printer, or supplying digital files direct. As I see it, the latter is the only viable option and the real issue is whether the files should be converted to CMYK by the originator or the printer.

A major advantage of working in RGB is that you can access all the bells and whistles of Photoshop which would otherwise be hidden or grayed out in CMYK mode. Mixed final usage also needs to be taken into account – a photograph may get used in a variety of ways and multiple CMYK separations will need to be made to suit several

publications, each requiring a slightly different CMYK conversion because CMYK is not a 'one size fits all' color space. High-end retouching for advertising usage is usually done in RGB mode and a large format transparency output produced. That transparency can be used as an original to be scanned again and converted to CMYK but the usual practice is to use the transparency output for client approval only. The CMYK conversions and film separations are produced working directly from the digital file to suit the various media usages. When you think about it, a transparency proof for all its glory is actually quite useless considering the end product is to be printed on paper. The ideal proof should be a CMYK output printed to match the expected output of the final publication. At the same time, the RGB original can and should be preserved in RGB mode as a master archive image.

There is life beyond CMYK. Hexachrome is a six-color ink printing process that extends the range of color depth attainable beyond conventional limitations of CMYK. This advanced process is currently available only through specialist print shops and is suitable for high quality design print jobs. Millions have been invested in the presses currently used to print magazines and brochures, so expect four-color printing to still be around for a long time to come, but Hexachrome will open the way for improved color reproduction from RGB originals. Photoshop supports six-color channel output conversions from RGB, but you will need to buy a separate plug-in utility like HexWrench. Spot color channels can be added and previewed on screen – spot color files can be saved in DCS 2.0 or TIFF format. Screen publishing is able to take advantage of the full depth of the RGB color range. If you are working in a screen-based environment for CD, DVD and web publishing RGB is ideal, and with today's browsers color management can be turned on to take advantage of the enhanced color control they now offer.

Choosing an RGB work space

Although I highly recommended that you switch on the color management settings in Photoshop, you cannot assume that everyone else will. There are many other Photoshop users and bureaux running outputs from files who will have Photoshop color management switched off and probably not bothering to calibrate their monitors properly. If you are using Photoshop 6.0 or later it matters less individually which RGB color space you choose in the RGB setup, as long as you stick to using the same space for all your work. Photoshop can safely convert between RGB spaces with minimal loss of data, but the space you plump for does matter. Once chosen you should not really change it, except when preparing images to go on the Web. Whichever color work space you select in the RGB color settings, you will have to be conscious of how your profiled Photoshop RGB files may appear on a non-ICC savvy Photoshop system. What follows is a guide to the listed RGB choices.

Apple RGB

This is the old Apple 13" monitor standard. In the early days of Photoshop this was used as the default RGB editing space where the editing space was the same as the monitor space. If you have legacy images created in Photoshop on a Macintosh computer using a gamma of 1.8, you can assume Apple RGB to be the missing profile space.

sRGB IEC-61966-2.1

sRGB was conceived as a multi-purpose color space standard that consumer digital devices could all standardize to. It is essentially a compromise color space that provides a uniform color space that all digital cameras and inkjet printers and monitors can match to. sRGB aims to match the color gamut of a typical 2.2 gamma PC monitor. Therefore if you are opening a file from a consumer digital camera or scanner and there is no profile embedded, you can assume that the missing profile should be sRGB. It is an ideal color space for web design but unsuitable for repro quality work. The sRGB space clips the CMYK gamut and you will never get more than 75%–85% cyan in your CMYK separations.

ColorMatch RGB

ColorMatch is an open standard monitor RGB space that was implemented by Radius. ColorMatch has a gamma of 1.8 and is favored by certain Mac users as the RGB working space. Although not much larger than the gamut of a typical monitor space, it is a known standard and more compatible with legacy, 1.8 gamma Macintosh files.

ProPhoto RGB

This is a large gamut RGB space that is suited for image editing that is intended for output to photographic materials such as transparency emulsion or taking full advantage of the color gamut of photo quality inkjet printers. Any image editing in a wide gamut space should ideally only be done using 16 bits per channel mode.

Adobe RGB (1998)

Adobe RGB (1998) has become established as the recommended RGB editing space for RGB files that are destined to be converted to CMYK. For example, the Photoshop prepress color settings all use Adobe RGB as the RGB working space. Adobe RGB

was initially labeled as SMPTE-240M which was a color gamut proposed for HDTV production. As it happens, the coordinates Adobe used did not exactly match the actual SMPTE-240M specification. Nevertheless, it proved a popular space for prepress editing space for repro work and soon became known as Adobe RGB (1998). I have adopted Adobe RGB as my RGB working space, because it has a larger color gamut that is particularly suited for RGB to CMYK color conversions.

Figure 4.10 The CD-ROM accompanying the *Adobe Photoshop 7.0 for Photographers* book contains a short movie which helps to explain the RGB space issue by graphically comparing some of the main RGB spaces.
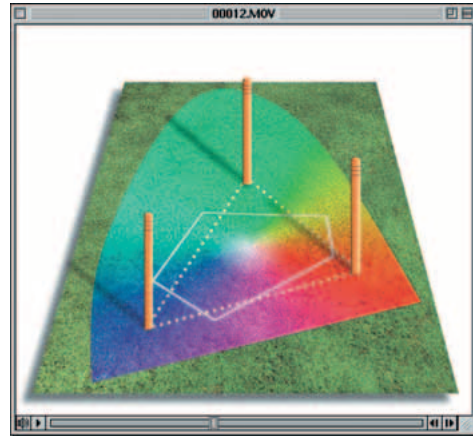
The ideal RGB working space

If you select an RGB work space which is the same size as the monitor space, you are not using Photoshop to its full potential and more importantly you are probably clipping parts of the CMYK gamut. Select too wide a space, like Wide Gamut RGB, and there will be large gaps in color tone between one data point and the next, as each color channel can only represent up to 256 data points. Although you can safely use a wide gamut space as long as you are editing in 16 bits per channel mode. But for 24-bit image editing I advise you don't use anything larger than Adobe RGB.

Figure 4.11 A CMYK color space is mostly smaller than the monitor RGB color space. Not all CMYK colors can be displayed accurately due to the physical display limitations of the average computer monitor. This screen shot shows a continuous spectrum going through shades of cyan, magenta and yellow. The image was then deliberately posterized in Photoshop. Notice how the posterized steps grow wider in the Yellow and Cyan portions of the spectrum. This sample gradient pinpoints the areas of the CMYK spectrum which fall outside the gamut of a typical RGB monitor.