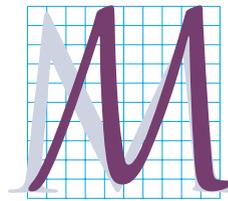


# 3

## Color by the Numbers

*Artistic judgment or monkey work? Convincing color correction isn't out of the reach of the color-blind, provided they follow certain numerical rules. The rest of us can do better, but those who don't base their technique on meeting the numbers will not even compete.*



Monkeying around with the color balance of photographic images is not a sport for the timid, or so goes the conventional wisdom. Believing this, people go through the most simian sorts of shenanigans trying to make their color look believable. They select this area, sharpen that one,

call up histograms, apply strange filters, and generally try to demonstrate that if an infinite number of art directors employ an infinite number of digital tweaks somebody somewhere may throw them a banana.

And yet, most color correction could be handled by monkeys. This chapter introduces a numerical, curve-based approach calling for little artistic judgment. To be sure, one can go much farther, but all the advanced techniques are inevitably based on these surpassingly simple ones.

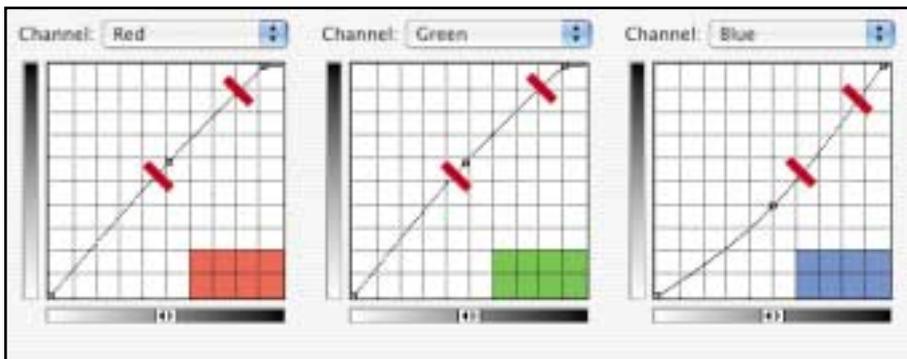
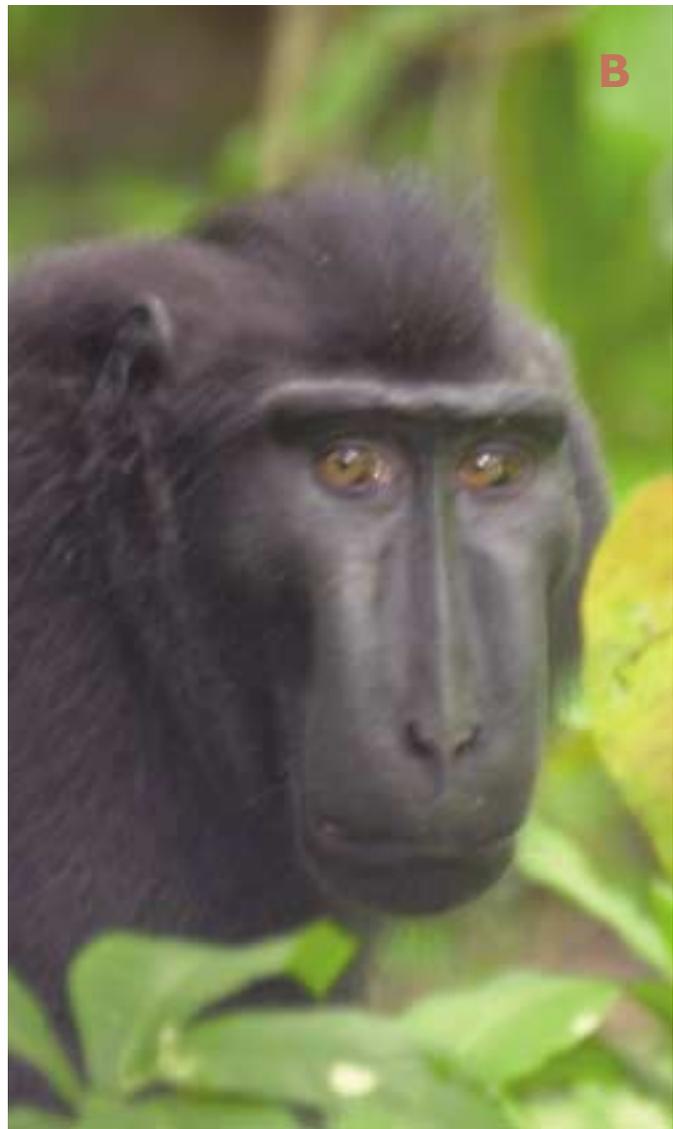
The by-the-numbers rules can be stated in a single sentence.

*Use the full range of available tones every time, and don't give viewers any colors that they will know better than to believe.*

\* \* \*

The itinerant color scientist Dr. Lemuel Gulliver once remarked, "Undoubtedly Philosophers are in the right when they tell us, that nothing is great or little otherwise than by Comparison." That's a good thing to keep in mind when we compare corrected versions to the original—not just with photographs, but with text.

The call to arms that starts this chapter exploded onto the graphic arts scene in 1994, in the first edition of *Professional Photoshop*. Not content with suggesting that a monkey could do this kind of work, I taught a



**Figure 3.1** In the original, left, the macaque is greenish yellow. The curves shown create a neutral animal, but do nothing to add contrast.

#1 R: 130/ 115	#2 R: 90/ 68
#1 G: 130/ 115	#2 G: 94/ 68
#1 B: 92/ 115	#2 B: 90/ 74
#3 R: 60/ 40	#4 R: 34/ 15
#3 G: 63/ 38	#4 G: 33/ 15
#3 B: 30/ 24	#4 B: 17/ 15

color-blind man to do it, and published some of his results, which were a good deal better than many professionals could produce at that benighted point in history.

Today, every professional accepts the need to set light and dark points, to maintain control of neutrals, and to use curves as the principal color-correction tool. In 1994, these

concepts were unknown to desktop publishers, although drum scanner operators were aware of them. It was an age of primitive desktop scanners, almost no digital cameras, a Photoshop with no layers, and very expensive preparation for print.

It was, in short, a Lilliputian world by today's standards, and by the numbers was

as revolutionary as a visiting giant. Those who adopted it made monkeys out of their competitors who didn't.



Since then, natural selection has done what it does best, and our Missing Link ancestors are extinct, helped along by cameras that set their own light and dark points and to some extent balance colors. In this more sophisticated world, saying that professional-level color correction can be done by apes is substantially less accurate than it was in the Photo-shop Stone Age.

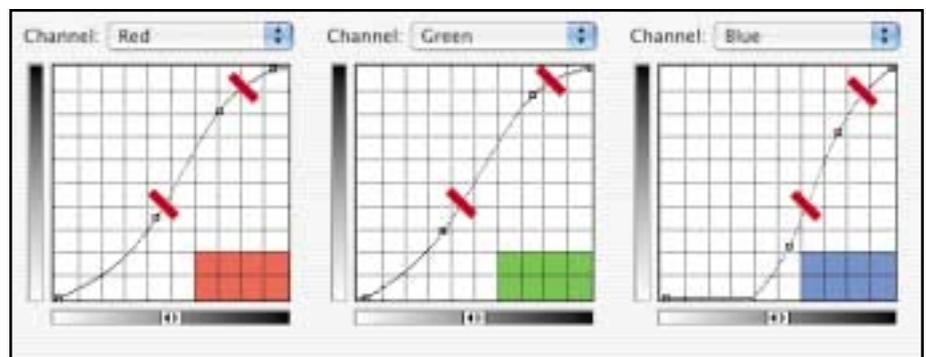
Nevertheless, by-the-numbers color correction remains the indispensable starting point. To see how it works in its simplest form, we'll travel farther than Gulliver ever did, into the forests of Indonesia.

Figure 3.1A is a portrait not of one of those vendors who says that all you need to get good color is a calibrated monitor, but rather of a primate known as a black macaque. I will indulge in the wild speculation that there may be a reason why he is not called a yellow-green macaque.

The camera faithfully recorded what it saw, but cameras don't have the sense of chromatic adaptation that we discussed in Chapter 1. This is a jungle scene, with lots of green light reflecting first off the leaves and then off the animal's face. If we were there ourselves, our self-calibrating vision would adjust to the lighting, and we'd see him as black.

#1 R: 132/146	#2 R: 88/ 68
#1 G: 138/145	#2 G: 94/ 72
#1 B: 92/146	#2 B: 60/ 68
#3 R: 69/ 32	#4 R: 34/ 12
#3 G: 63/ 31	#4 G: 33/ 13
#3 B: 30/ 26	#4 B: 17/ 13

**Figure 3.2** Substituting these curves for those of Figure 3.1 puts the macaque in steeper areas and results in better detail.



Black, white, and gray are described not as colors but as *neutrals*. In RGB, but not in CMYK, the rule is easy to remember: where all three channels are equal, the result is neutral. If all three channels are identical everywhere, the image is grayscale.

In a few pages, we'll go over how to measure values, but for this exercise I'll just tell you what they are. We never measure just a single point, which can be deceptive. I've measured four points in the animal's face in this file, which arrives in an unspecified

## A Plan for Using This Book and Its CD

This book is divided into two halves. Chapters 1–10 stand independently of the rest of the book, giving the basics of global color correction. Chapter 1 is an introduction, and Chapters 9 and 10 suggest a workflow and how to analyze images before correcting them. Chapters 2–8 discuss the actual tools, which are almost entirely curves, channel blending, sharpening, and layer Blend If options. There are no selections or masks in use in the first half, nor is there anything from the toolbox except the color sampler tool. Nor do we discuss any calibration or resolution issues, or the possibility of using Camera Raw. We give only cursory attention to Color Settings. These things get covered in Chapters 11–15 because I believe it is helpful to understand the basics of image manipulation before attacking them. Chapters 16–20 are not particularly reader-friendly; enter at your own risk.

In contrast to previous editions, all but one of the images that are corrected on these pages are on the CD. They are, however, at lower resolutions, so the numbers you measure will not necessarily correspond exactly to those in the text. I recommend that you *not* use the CD for Chapters 2–6 and use your own images instead. The techniques in these chapters apply to almost all images. I think you'll be more impressed if you apply them to ones you're more familiar with. In later chapters, which show techniques that are right for certain images and not for others, you may wish to use the ones on the CD.

This book has a long history of being found both rewarding and frustrating. In order to help you avoid the second category, the following is advice that, after four editions, I can give with considerable confidence.

- Be sure you understand the terminology and the way numbers are used. From lightest to darkest, we say *highlight*, *quartertone*, *midtone*, *three-quartertone*, *shadow*. These are loose terms corresponding to regions on the curve: there is no firm line where the quartertone ends and the midtone begins. RGB and CMYK numbers are always positive, but LAB has negatives as well; numbers in parentheses, like  $50^L(10)^A10^B$ , denote this. In CMYK, we don't bother to attach values of  $0^K$  to the end of the CMY numbers.
- By the end of Chapter 4, which discusses LAB, you will need to be able to identify colors by their numbers in any of the three colorspaces. I am not talking about subtle distinctions between, say, greens. But you need to be able to distinguish a green from a cyan or a yellow. Without this ability, color correction will take much longer. If you need it, there's a cheat sheet on page 98.
- Few people are equally proficient in RGB and CMYK. Make it a point of trying to work in the one in which you consider yourself weaker. I recommend that you choose one lightness/darkness orientation for curves that you use in every colorspace.
- Most chapters have Stumbling Blocks boxes highlighting areas that have confused previous readers.
- Don't be afraid to disagree with me on aesthetic points. When I am stating a rule that I regard as absolute—for example, that you can't get competitive work without using a full range every time—I am not shy about saying so. Choices of color or blending percentages are a different story, and your mileage may vary.
- If you get completely stuck, just skip the section and move on, and if you find that suggestion to be intensely frustrating, Google any one of my previous books and check out how many readers were in your shoes and claim that it all became clear on a second reading.

RGB. Going from lightest to darkest, they read  $132^R138^G92^B$ ,  $88^R94^G60^B$ ,  $60^R63^G30^B$ , and  $34^R39^G17^B$ . That last value, found near the ear, is also the darkest significant point of the image. The lightest significant point is a large yellow area in a leaf under the chin, at  $245^R252^G173^B$ , remembering that pure white is  $255^R255^G255^B$  and pure black  $0^R0^G0^B$ .

We'd like to see three approximately equal numbers throughout the animal. Instead, the green is always highest, meaning that we see more green light. The blue is always lowest, meaning that we see less blue light, meaning more yellow. The darkest part of the face is also currently too light. We'd prefer  $15^R15^G15^B$ , for reasons to be discussed later.

The top half of each curve contains values from 128 to 0, the top quarter from 64 to 0. According to our numbers, the macaque lives mostly in the third quarter in the red and green, and in the top quarter in the blue. Recall that all curves in this book show darkness to the right, which is not the Photoshop default for RGB.

### By the Numbers vs. By the Numbers

The words *by the numbers* suggest a child's coloring book, a wooden, invariable approach. In reality, there are many types of by-the-numbers corrections, some of which are better than others.

Since the blue values are always darker than the other two, the logical approach would seem to be to bring them together by lightening the blue and darkening the red and green. That's what I did to make Figure 3.1B, moving the center points up or down, watching the Info palette change until I saw a properly neutral  $115^R115^G115^B$  where  $132^R138^G92^B$  had been. Then, I moved the top right point of each curve to the left, darkening what had been  $34^R39^G17^B$  into  $15^R15^G15^B$ . After verifying that the two other points I had looked at were also close to equal in all three channels, I called it quits.

By the numbers, Figure 3.1B is correct. There's nothing obviously wrong with it, which is more than can be said for Figure 3.1A. Yet there's something missing—more detail in the macaque.

Chapter 2 does not appear in this book because the publisher wanted me to inflate the page count so that the book would seem heftier. It's there because using curves to get better contrast is at least as important as using them to get better color.

When suddenly confronted by a wild animal that looks like it might be able to inflict bodily harm on us if so inclined, we don't stop to admire the background greenery. All our concentration is devoted to the creature. Our eyes open wider so that we can learn more about this dark potential threat, and we lose perception of anything that doesn't happen to be its color.

The pitiable camera, perhaps reasoning that even a monkey is not going to try to bite into a lens, has no such reaction. It sees only what's in front of it, with no special emphasis on nasty-looking foul-smelling bipeds with a sharp set of teeth. So there is a fundamental disconnect between what the camera saw and what *we* would have.

The response has to be a combination of the methods of this chapter and the last: the curves must be steepest where the macaque is, but the relation between the curves must result in a neutral animal. Hence, the subtler curves, and the better result, of Figure 3.2. Each curve establishes and lowers a point near the bottom of the macaque's range, forcing the entire top half of the curve to take on a steeper angle.

The tickmarks on the curves are in the same horizontal locations in Figures 3.1 and 3.2. Clearly, there's more distance between them vertically in Figure 3.2, and that's making all the difference. A color-blind person would have no difficulty achieving this result, as it's all numbers and logic.

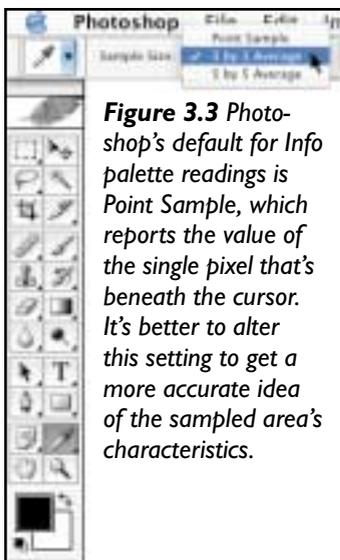
Not that I'm saying this is the perfect correction. The points on these curves could be placed in different areas or pulled up and down by different amounts. And in that case, you might get something you like better than Figure 3.2. That's the creative part of by the numbers. But you can't get by without the basics. Figure 3.1A violates both of the basic rules stated at the beginning of the chapter: it doesn't use full range, and it gives the viewers a color that they know better than to believe.

### Setting Up the System

By-the-numbers rules, as you might expect, encompass a lot more than neutral colors. But before we get into further specifics, we need to take care of some system housekeeping and to clarify why certain techniques are favored over others.

- The Info palette is our guide as we meander down the curving path. To make sure that it doesn't send you down a blind alley, click the eyedropper tool, and change the setting in the options bar (Figure 3.3) to something other than the default Point Sample. I use 3 by 3 myself, but the other option, 5 by 5, is workable.

This change is needed because we want the Info palette to report average values in an



**Figure 3.3** Photoshop's default for Info palette readings is Point Sample, which reports the value of the single pixel that's beneath the cursor. It's better to alter this setting to get a more accurate idea of the sampled area's characteristics.

area. Point Sample makes it report a single pixel, which for all we know can be a speck of dust on the camera lens. 3 by 3 reports an average of nine pixels; 5 by 5 averages 25.

- Now, we configure the Info palette itself. Its top half is divided into two sides, each of which can be defined with its own eyedropper.

One side should be set to Actual Color, so that the numbers being reported are those of the file's own colorspace. The other, in my opinion, should be set to whatever colorspace you are personally most comfortable in. We're going to be working in this chapter in both RGB and CMYK, and in the next chapter we'll be adding LAB. Few people can instantaneously assign a meaning to numbers in all three. Set the second side of the Info palette to give you equivalents in something you're certain of, as shown in Figure 3.4. Notice that, for ease in evaluating whether objects are really neutral, I've set the four fixed points to read in LAB. We'll talk about why in the next chapter.

Photoshop is a rich and often redundant program. There may be several ways of accomplishing the same thing. Sometimes they're equivalent and sometimes not. If I suggest doing things a certain way and you prefer something different, there are three possible outcomes, in my opinion.

- Your way is as good as mine. (Pride does not permit me to say it might be better.)
- Your way may work but it's a kludge.
- Your way is a bad one.

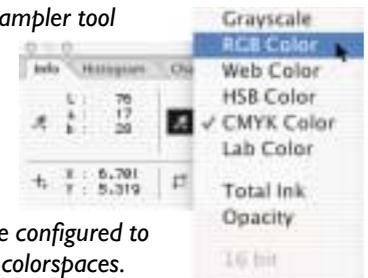
\* \* \*

The following practices are all acceptable and give substantially the same results as what I recommend.

- **Curves and adjustment layers.** People who need the flexibility to edit curves quickly put them on adjustment layers. Those who don't think they need to edit the curves but want to leave themselves an out save copies of the curves separately from the file. And those who are certain that their curves are final just apply the curves and move on. Your workflow may dictate one method or another.
- **Typing in the numbers.** To add a point to a curve, click where it's supposed to go and drag up or down. Or, Command-click inside the image, and the curve point will be placed automatically at the point in the



**Figure 3.4** Left, the color sampler tool places up to four fixed points (shown in the macaque). These points expand the Info palette and change as corrections are applied. Right, any section of the palette can be configured to display equivalents in other colorspace.



channel corresponding to what's underneath the cursor. If instead we Shift-Command-click, the point goes into the curves in all channels. It's also possible to click a random point and then key in input and output numbers in the bottom left corner of the Curves dialog. I don't like doing this because I hate when my hand leaves the mouse. If you are more coordinated, typing the numbers in works fine.

- **Fixed density points in the Info palette.** In the macaque image, I activated the color sampler tool (it lives in the same box as the eyedropper tool) and clicked four areas of different darkness in the animal's face. Those four were added to the Info palette, more than doubling its size, but enabling me to see what was happening to all four simultaneously as I adjusted curves. It was a useful move here so that you could see what was happening, but in real life I rarely use this feature, preferring to mouse over the affected area, looking at a lot more than four points.

- **Two sets of curves.** For efficiency's sake we try to get everything done with one set of curves. If the result isn't quite what you want, the world doesn't come to an end if you apply

a second set or even a third set. If the second and/or subsequent sets are drastic corrections, however, it probably means that the first set stunk more than a macaque does.

- **RGB and CMYK.** If you have an RGB file that is destined to remain in RGB, you should rarely go into CMYK with it—LAB, which we'll discuss in Chapter 4, is much more likely. But if the RGB file is eventually headed for CMYK, you could conceivably do most of the correcting in either space, or even in LAB. All these colorspace have strengths and weaknesses, but speaking generally, CMYK is the best curving space and RGB the worst. No matter how good the RGB or LAB original is, quality output almost invariably requires minor tweaks to the file after it enters CMYK. If you accept the necessity for minor tweaking afterward, there's no reason to avoid doing the tough part in RGB.

\* \* \*

The following practices are sometimes effective, but I turn my nose up at them.

- **The Levels crutch.** Levels is a weaker version of curves. It can be as effective in some cases, but it can't make an S curve, which is critical (see box, page 38). The sooner you jump into the deep water, the quicker you'll learn to swim. So I recommend using curves exclusively, particularly if you are currently not as agile at curvewriting as you'd like to be. Practice makes perfect.

- **Setting highlights and shadows with the eyedropper.** An eyedropper tool within the Curves dialog allows you to click the image area where you want to set an endpoint, and you can finish the curve from

there. It works fine, provided you in fact want the curve to start at that point—which you usually won't, because most of the time you'll want an S curve, not something that starts steep from the outset.

\* \* \*

The following practices identify you as a yahoo and should be avoided.

- **Using the master curve.** In CMYK, doing so always costs contrast because the black channel never resembles the other three. In RGB, at best it doesn't add detail as well as channel-by-channel curves; at worst it changes color and harms detail in highlights and shadows.
- **Using other commands too soon.** Getting all the numbers right always creates a perfect image—so goes the theory. You should give the theory a chance to prove itself before indulging in any monkeyshines that would derail subsequent by-the-numbers correction, particularly Image: Adjustments>Hue/Saturation or Selective Color. If your curves have produced correct numbers and you're still dissatisfied, then, and only then, should you use them.

Similarly, it's dangerous to sharpen or to use Image: Adjustments>Shadow/Highlight while there's still major curving to be done. These commands increase apparent focus by creating artifacts that are, we hope, too subtle to detect. Minor curve adjustments probably won't hurt, but big curves may emphasize these artifacts in a disagreeable way.

\* \* \*

If you're going to be doing your own separations into CMYK, for purposes of this book you'll need to check some of your choices under color settings. This topic is explored in Chapter 12; the complex CMYK choices are fleshed out in Chapter 13 and you should defer any final choice until you read it. However, if you are now using the Photoshop default CMYK definition, U.S. Web Coated (SWOP) v2, you need to make a change.

Otherwise, your separations will have too much black in them and will not be compatible with many of the methods in this book. As a quick fix, jump ahead to Figure 5.2 and copy it into your own settings.

The RGB setting is another controversial topic, but we don't have to address it yet. Many of the RGB originals in this book contain an embedded profile identifying the type of RGB that the photographer was using. Provided you have your RGB color management policy set to Preserve Embedded Profiles, you'll be working in that space too if you decide to open the file from the CD. If there isn't a profile, your guess is as good as mine; I have no more information about the file than you do. For what it's worth, I open such files in Apple RGB, for reasons explained in Chapter 12.

So much for theory. Let's roll up our sleeves and correct some color. Please remember that a lot of the high-octane stuff that you'll encounter in other chapters isn't in use yet. We will not consider sharpening, channel blending, false profiles, selections, masks, or layering shenanigans, or the use of LAB. Could some of those things make the corrected versions here even better? Undoubtedly. But this chapter is the foundation. Ignore it, and all those tools, powerful as they are, won't give you competitive results.

### The Magic Numbers

As most professionals today occasionally have to work in both CMYK and RGB, we'll do the same, with three examples coming up of each variety. RGB users who venture into CMYK often have difficulty with a particular concept, which should be clarified before giving suggested numbers.

The cyan ink throws a monkey wrench into the CMYK works. It reflects considerable red light, which it wouldn't do in a perfect world. Because of this, CMYK printing can't make good blues, a deficiency that is hard to adjust

to, and the neutrality definition is different, which is easy to manage with practice.

RGB users know that to create a neutral color—gray, white, black—the values of all three channels need to be the same. One would think that (ignoring black, which is neutral already) the same rule would apply in CMY. It doesn't. To make a neutral, magenta and yellow should be equal, but cyan higher. This explains the suggested shadow and highlight values below.

Make your images meet the following four guidelines, and be prepared for startling improvements.

- The **shadow** is the darkest significant neutral area of an image. Almost all images have *something* we can use for a shadow.

In principle, the shadow should be the heaviest value we believe can be held with detail. If your final file is RGB, use  $15^R15^G15^B$  unless you've seen that your output device retains detail well at a darker value. For CMYK, the value gets darker as printing conditions get better. For jobs printed on a web press, as this book is, I recommend  $80^C70^M70^Y70^K$ . Sheetfed presses could accept a higher shadow, but newspapers would need a lower one, at least in the CMY.

Most commercial printers impose a limit on the sum of all four inks, to avoid drying problems on press. The better the printing conditions, the higher the number they'll accept. SWOP, the industry-standard Specifications for Web Offset Publications, mandates a 300 maximum, which most magazines tweak down to 280. My  $80^C70^M70^Y70^K$  suggestion sums to 290, close enough.

However, 290 is not close enough when preparing images for a newspaper, which is apt to ask for 240, or even for some inkjet printers. If a lower number is necessary, we reduce the CMY colors and increase black in roughly equal amounts.

People don't have good color perception in areas this dark, so, if need be, we can take

liberties with one or two of the ink values. Don't do this without a good reason, though. An unbalanced shadow often is a symptom of a color cast that may be subtly hurting other parts of the image.

Also, your CMY values can be as high as you like in areas outside of shadows. Navy blue, for instance, might be  $95^C65^M15^Y30^K$ . The only reason cyan is limited to  $80^C$  in the shadows is that otherwise the ink limit might be exceeded because all four inks are heavy. The navy blue above sums to only 205, way below any possible ink limit.

- The **highlight** is the lightest significant part of the image, with two qualifications. First, it cannot be a reflection or a light source. These things are called *speculars*, *specular highlights*, or *catchlights*, and we ignore them. Second, it must be something that we are willing to represent to the viewer as being *white*. Assuming such an area can be found (and it isn't always there to be found) use  $245^R245^G245^B$  or  $5^C2^M2^Y$ .

Other experts suggest different CMY values. They may say  $4^C2^M2^Y$ ,  $3^C1^M1^Y$ ,  $5^C3^M3^Y$ , or  $6^C3^M3^Y$ . But everyone agrees that magenta and yellow should be equal, and cyan a couple of points higher, to maintain neutrality. Such universal agreement exists because this highlight value is critical. We humans are quite sensitive to light colors. A variation of three or four points in any ink could result in an unacceptable cast.

Guessing is what we do when we aren't sure. And because we hate being tossed about in a sea of guesses, we always have to be on the lookout for anchors, sure things. The most common such anchor is a color that logic tells us must be neutral.

### Looking for the Sure Thing

- Areas that are supposed to appear **neutral**, that is, white, black, or any shade of gray, need to have equal values in all three channels in RGB. In CMYK, they need equal

magenta and yellow, higher cyan. Black ink, being neutral itself, is irrelevant.

In teaching classes, I've observed that around half the students think that locating neutrals is the easiest part of color correction. The other half drive themselves berserk. They force neutrals to happen where no neutral should be; they find one neutral and ignore another; and they often would be better off if they handed the file off to a gibbon who knew how to launch Auto Levels.

To try to prevent such monkey business, I offer Figure 3.5. The cat is in RGB, the statue in CMYK. Can you guess which has been sabotaged, intentionally given an incorrect color?

I trust that you have no difficulty with the question, no matter how little confidence you have in your ability to identify neutral colors—but you may be surprised at why.

We force neutrality when we are sure, by logic and experience, that we are looking for neutrality. We just had that experience with the macaque. If that animal isn't neutral, a very dark gray or black, he must be very close. And the same is true of Figure 3.5's cat. You may never have met him, but if you've ever seen a cat before, you know that the light fur on his face, paws, and belly has to be white. White—not lavender, not turquoise, not tangerine—and we force a

white if the original capture features one of these or any other impossible color.

In deciding that the cat picture was the sabotaged one, however, you weren't relying on the light fur, which is in fact white in this image. You were clued in by the *dark* fur, not because you know that it's neutral, but because you know that cats are never purple.

A cat with these tiger markings might indeed be gray, but we aren't sure of it in the sense that we're sure his lighter fur is white and the macaque is black. This is a standard quandary when dealing with near-neutrals. We don't know what color it is—but we know what it's not.

*Russian Blue* is the name of a breed of cat that is a lot more expensive than this one. The present cat could be a rich brown, or a mousy-looking brown, but he can't possibly be any other color than brown or gray. This gives us enough information to start looking at numbers.

If the cat is gray, then the RGB values are all equal. Brown is a species of red. If the cat is brown, then the red channel must be lighter than the other two. If either the green or blue shows a higher number than the red, it's an impossible color. Cats don't have even slightly green or blue fur.

We can go further. If the red is lighter and



**Figure 3.5** Even someone who's never seen these objects in real life can decide that certain colors are impossible—a purple cat, for example. But for these two cases, what color should we assume?

the other two are equal, the cat's a pure brown. If the other two aren't equal but the green is lighter than the blue, then the cat is a yellowish brown. I'll buy that as a possibility. But if the blue is lighter than the green, then it's a purplish brown. No sale, not to me.

To summarize: if you're going by the numbers, the white fur should have nearly equal RGB values. The dark fur may have equal values, too, but if it doesn't, then the red has to be the highest number of the three; the green value may be equal to the blue but it can't be lower. Anything else, you have to correct—but to what?

Like Gulliver, we are sometimes adrift in a sea without appropriate navigational tools and in doubt as to our destination. It's frustrating, perhaps, to learn that sometimes by-the-numbers means we have to wing it. I see no other internal indication of what color the cat is, so I would have to resort to the time-tested prepress technique of taking a guess. You might make a better one—but not if your numbers don't comply with those in the paragraph above.

Now, let's turn to the statue. It's currently gray. I've measured a point in the neck as  $20^C15^M15^Y$ ; other points are comparable.

But is this the only possibility? Could this not be yellowed with age as well, or perhaps brownish? Here's a quiz. Let's reduce each ink, in turn, by 5 percent. There are a total of six possibilities, counting combinations of two inks. For example,  $20^C10^M10^Y$  would imply a slight cyan cast.  $15^C15^M15^Y$  doesn't have the extra cyan that's needed for neutrality. It is therefore a reddish, or warm, or brownish feel, because it's unbalanced in favor of magenta and yellow, which combine to make red. I might accept one but not the other. Even slight cyan casts are disagreeable. Slight casts in the direction of a warm color are often pleasing.

The other four possibilities are  $20^C15^M10^Y$ ,  $20^C10^M15^Y$ ,  $15^C15^M10^Y$ , and  $15^C10^M15^Y$ . They

yield (but not in this order; you have to figure it out) yellow, green, magenta, and blue.

That part is so easy that I won't waste space on the answers. The harder question is, which, if any, of these six possibilities do you think is a reasonable alternative to pure gray? Come up with a response before you turn to Figure 3.6.

- **Fleshtones** should, in CMYK, have at least as much yellow as magenta, and up to a third again as much in extreme cases. Where the yellow is equal to or only slightly higher than the magenta, this implies a very light-skinned person, such as a small child or a blond. For Caucasians, the cyan value should be a fifth to a third as heavy as the magenta, depending upon how bronzed a person is. For someone dark-skinned,  $15^C50^M65^Y$  will do; lighter-skinned Caucasians can go  $6^C30^M35^Y$  or even lower.

Persons of Hispanic or Asian parentage share a skintone range that's smaller than Caucasians as a whole. Yellow is always significantly higher than magenta, commonly 10 to 15 points in those of Asian descent. Cyan begins at one-quarter the magenta value and can be greater even than one-third.

Beta reader André Lopes, who hails from São Paulo, offers this warning: "Hispanic or Asian parentage' is a dangerous expression. There are many 'mongolian Asians,' such as Chinese, Vietnamese, and Japanese. But there are also at least a billion Indians and Pakistanis who have 'brownish gray' skins, very different from northern Asians. And Latin American Hispanics who have some native blood (particularly in Central America and the Andes region) have skintones very similar to those of bronzed mongolians. But the inhabitants of Buenos Aires, if I may use some Brazilian humor, are a bunch of Italians who speak Spanish and believe they are British."

The race commonly (and inaccurately) referred to as *black* exhibits more diversity than any other group. Lighter-skinned



individuals compare to Hispanics, with yellow distinctly higher than magenta. However, as the skintone gets darker, the difference compresses. The darkest-skinned persons often have equal magenta and yellow. As for cyan and black, there is no limit.

References to the original human inhabitants of the North American continent brings up issues of political correctness. *Redskin* is considered pejorative by almost everyone except football fans. To me, that word is less offensive than people asking what the “typical” Native American fleshtone should be. Presumably for evolutionary reasons, large variations are seen depending upon the strength of the sun in the area. The Seminoles of Florida, and my own Chickasaw ancestors in Oklahoma, are accurately described as redskins—they have distinctly more of a magenta component than other ethnic groups. The Makah people of western Washington state have a lighter complexion than most Asians. Between a Seminole and a Makah the typical difference is greater than between a Swede and an Italian.

Locating and measuring suitable fleshtones is easy with experience,

**Figure 3.6** Even when the precise color of a near-neutral object is unknown, logic and experience can exclude certain possibilities. This garden statue could be gray, but it might have a slight color. Here are six possibilities, all generated by five-point increments in the CMY values at a certain point in the neck. Top row, red and magenta casts. Middle row, blue and cyan. Bottom row, green and yellow casts. Which ones do you think are plausible? And what is the impact of each on the sky?

but if you haven't tried it before, some snares must be avoided. Choose only normally lit skin, not a shadow or a semireflection. Also, avoid areas where makeup may have been applied, such as a woman's cheeks.

Except in persons of African descent, it is not customary to have black ink in a flesh-tone, but it sometimes happens, particularly when using nonstandard GCR settings (see Chapter 5 for more on this). If black is present, count it as additional cyan, because it does the same thing: it pushes the color away from red and toward gray.

You may notice that there are no RGB numbers given. They depend on your choice of working space. A spreadsheet on the CD will let you find equivalences. In the interim, you can always refer to the CMYK numbers even if working in RGB, by setting up one side of the Info palette to read CMYK values.

### Picking Significant Target Points

To start, we open the image and check the values in all of the key areas we've just been discussing. In simple pictures, we can keep these numbers straight in our heads, but as they get more complex, writing down the density values and what we propose to do with them can be helpful. To the extent the image does not meet our target numbers, we force it closer by applying curves.

To locate highlight

and shadow, I prefer to watch the Info palette as I run the cursor over several likely areas. This lets me choose the second-lightest area as a highlight, if I decide that the real lightest area is unimportant.

If you're uncomfortable with this, you can open Image: Adjustments>Threshold and move the slider until it becomes obvious where the light and dark points are. Remember, though, to look for the lightest and darkest *significant* areas, which are often a far cry from the areas that are *literally* lightest and darkest.

We'll now put that philosophy into action with four real-world images, two of which are reasonably good to start with and two of which aren't. We'll end with two CMYK images, and start with a pair of fleshtone exercises in RGB.

For an outdoor shot taken in a New England winter, Figure 3.7, which arrives in sRGB, isn't that bad. The camera has balanced the



**Figure 3.7** A cold-weather original can produce flesh-tones that are pinker than normal rules suggest.

highlights and shadows nicely. They comply with our rules, but other parts of the image don't. Let's take stock.

The window frame is clearly the lightest significant point in the image, and also apparently is white. The camera agreed. It's hard to know exactly which point is the most representative, but the one I chose measures 244<sup>R</sup>246<sup>G</sup>247<sup>B</sup>, right in step with my 245<sup>R</sup>245<sup>G</sup>245<sup>B</sup> recommendation.

The shadow is darker than we would like. The lining of her jacket and the area below her ear, below the hairline and just above the collar, are both in the neighborhood of 2<sup>R</sup>2<sup>G</sup>5<sup>B</sup>.

When measuring fleshtones, I usually around half a dozen readings just to make sure. Others make a rectangular selection of part of the forehead, run a huge blur filter, measure the result, and then cancel the blur. Definitely we don't want to measure this woman's cheeks because she might be wearing makeup. Also, we have to be careful because she has freckles. Anyway, the typical number I get is 173<sup>R</sup>132<sup>G</sup>130<sup>B</sup>. Since our rules require us to evaluate a CMYK number, the Info palette tells me that the equivalent is 32<sup>C</sup>50<sup>M</sup>39<sup>Y</sup>1<sup>K</sup>—too cyan, too magenta.

There's one last known color to measure. It's not her shirt, which looks like it's blue but could be green or purple as far as we know. It's her hair. Certain colors are as impossible for this woman as they would be for the fur of the cat in Figure 3.5.

Undyed human hair ranges from yellow to black. It can never be on the green or blue side of gray. Granted, this is an uncorrected original. But no matter how bad the colors are, we can still see that the woman's hair is much too dark for her to be a blond. She can't have black hair, either, because lighter streaks, which people with very dark hair don't have, are found throughout.

We have a suggestion of a cool cast from the fleshtone reading. Possibly that cast is

bad enough that this woman is actually a redhead. If not, her hair is brown. Either way, the red value has to be distinctly higher than either of the other two channels.

My reading, however, is 63<sup>R</sup>62<sup>G</sup>63<sup>B</sup>, equal values and therefore a pure gray. In the context of this image, that's an impossible color, a color that the viewer knows better than to believe.

The four by-the-numbers rules concern shadow, highlight, neutrals, and fleshtones. We ignore the third because there is nothing known to be neutral except for the window frame, which counts as a highlight. In the other three, we can use the rules as a starting point, but in each we should be careful not to take them too literally.

Neither the whites nor the blacks are an important part of this image, which distinguishes it from any of the three others we've seen in this chapter. I don't particularly care if the shadows plug around her collar area (you wouldn't say that about the macaque of Figure 3.1), and I don't particularly care if some of the whites blow out (you wouldn't say that about either the cat or the statue in Figure 3.5).

The skintone is too magenta for normal conditions, but these conditions may not be normal. If she were an athlete who'd just been exerting herself, we'd understand why—her skin would be redder than that of a fashion model shot in a studio. The same may apply here. This is a cold-weather shot; the color of her cheeks looks like a natural reaction to the temperature and not makeup. So while I would like to reduce the magenta component of the face, I'm not going to be doctrinaire about insisting that the yellow must be higher than the magenta, as it would in a normal photograph.

But I forgot—I'm using CMYK language, and this one will be corrected in RGB. If that's unfamiliar territory, just consider that the red is the cyan, the green the magenta, and the

**Figure 3.8** These curves increase contrast in the face and eliminate a bluish cast.

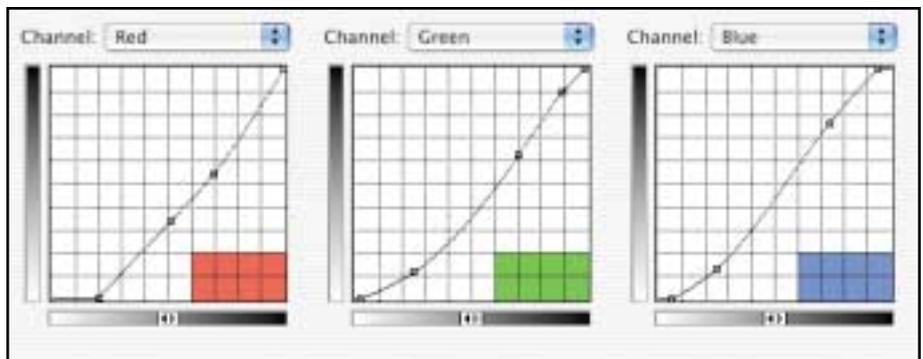
blue the yellow. Here are the curving objectives as I see them.

- Leave the shadows alone but be more aggressive in the highlights, remembering that they have to be kept neutral because the window frame is white.
- Put the woman's face into the steepest part of each curve, recognizing that it is the most important area of the picture.
- Adjust the color balance of the face and the hair.

The green and blue curves are alike in that the face falls roughly in their middle. I started by mousing over the face to locate the exact range, and then placed points to surround that range, roughly a quarter and three-quarters of the way up the green and blue grids. I lowered the lower point, which increased steepness in the facial range.

I would have liked to raise the upper point in both, too, but had to be content with doing it to the blue only, because the objective was to increase the yellow component to defeat the magenta cast measured earlier. At this stage, I was not trying for great precision, so I wasn't checking the Info palette.

The highlight in the green and blue had now been lightened. Also, because it fell in a flat part of the curves, it was losing contrast.



That's fine in the green and blue, but the face falls in a much lighter range in the red, and this curve shape would hurt it. So, in the red channel, rather than making an S, I moved the lower left point to the right, maintaining steepness in the lightest areas.

With the basic shapes of the curves established, it was time to fine-tune the color of the frame, the face, and the hair. My initial curve had wiped out the window frame in the red channel. As a result, the entire frame had a reddish cast. I countered this by raising the bottom point slightly from the bottom line

of the grid. Now the lightest value anywhere in the image was 253<sup>R</sup>, not 255<sup>R</sup>.

Finally, I monkeyed around with the middle points in all three curves, trying to get acceptable values in both hair and face. Unlike the frame, where nearly equal values are definitely needed, here there's room for differences of opinion. I wound up inserting another point near the top of the green curve to darken the hair, which I thought was getting too yellow and not brown enough.

Figure 3.8 is the final result. My key areas measure as follows: highlight 253<sup>R</sup>253<sup>G</sup>254<sup>B</sup>; face 220<sup>R</sup>171<sup>G</sup>148<sup>B</sup>, which equates on my system to 9<sup>C</sup>38<sup>M</sup>39<sup>Y</sup>; and hair 97<sup>R</sup>75<sup>G</sup>55<sup>B</sup>.

### The Lightest Significant Part

These by-the-numbers techniques work not just with originals of reasonable quality. When something is seriously wrong with the image, the results can be impressive.

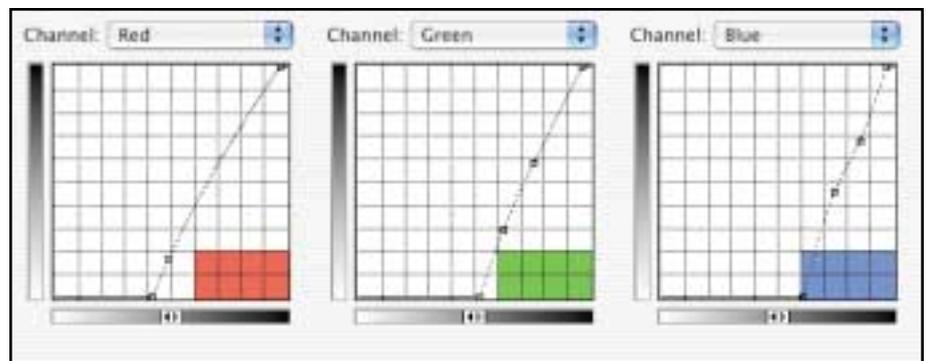
Figure 3.7 wasn't intended for publication. Figure 3.9, a much worse original, is. This is a newspaper photograph from a small town in Tennessee. The town's Methodist church had been founded long ago by the father of the older man, who himself had served as pastor for a quarter of a century before his retirement. The church has just been burned down by an arsonist; a local firefighter has been arrested and charged with the crime.

**Figure 3.9** In principle, overly dark images can be corrected without human intervention, by adjusting the range automatically. Here, Photoshop's Auto Color command (inset) actually makes the image worse, because it identifies an insignificant part of the image (the light area at upper right) as being a highlight.





**Figure 3.10** An aggressive correction of Figure 3.9, choosing the man's white hair as the highlight and allowing anything lighter to vanish, while balancing the skintone.



Naturally the photographer does not want to make himself obtrusive at this gut-wrenching moment; hence no flash. But the photo captures the emotion, and the newspaper wants to use it in print.

In this day and age, how can a professional camera deliver such a thing? The camera replies, "What makes you think it's bad?" And when we answer that it's way too dark, the camera says we're mistaken. And in its small mind, we are.

Image: Adjustments>Auto Color is a souped-up version of Auto Levels. Like Auto Levels, it sets proper endpoints, but it also tries to analyze and correct color casts. Yet as the inset shows, the Auto Color version is just as dark as the original and sports even worse color.

Such images make monkeys out of machines. The basis of Auto Color is a redacted version of by the numbers. To quote the definition given a few pages ago, "The

## Stumbling Blocks: Tricks Numbers Play

- Overreliance on a single sampling point.** If the highlight, or whatever it is you're sampling, is so small that only one point can be measured, then you shouldn't be worrying about it at all. It's better to run the cursor over several adjacent values, or similar areas elsewhere in the image, before deciding that the one you've chosen is correct.
- Highlights/shadows that aren't significant.** If you don't care whether a certain light point is blown out or a certain dark point is totally plugged, choose different endpoints. Maximize detail by choosing as highlight and shadow the lightest/darkest points in which you desire to hold detail, rather than the literally lightest and darkest points of the image.
- The curve that can only be made one way.** If a point must be changed from, say, 70% to 80%, this does not require that one choose specifically the 70% point on the curve and raise it. Other shapes are often necessary.
- The 70%–80% CMY “limit.”** Recommended shadow values of 80<sup>C</sup>70<sup>M</sup>70<sup>Y</sup> don't mean that CMY inks can't be higher elsewhere. They're artificially low in shadows to stay within a total ink limit, usually 300% or so. A fire engine might be 0<sup>C</sup>100<sup>M</sup>100<sup>Y</sup>, only 200% total ink as opposed to the 290% in the shadows.
- “The” neutral point.** Not every image has one, and some have more than one. If you can't find one, don't force one to occur. And if you do find one, look for another.
- Originals with high black values in the shadows.** These often indicate files that were separated using too high a black ink limit. Forcing the CMY values to 80<sup>C</sup>70<sup>M</sup>70<sup>Y</sup> in the shadows in such cases may cause problems. Either correct to a lighter CMY shadow or reparate the image using a proper setting.
- My curves are not the gospel.** Quality results are impossible if the numbers are seriously off. But there are many ways to achieve the same or similar numbers. The way shown here is not guaranteed to be the best. Your curves don't have to be identical to mine. Chances are, though, that their shapes will be similar.
- The magic fleshtone values.** The typical fleshtone values cited in this chapter are not target numbers for you to force all skin to match. Across all ethnicities, flesh can be light or dark. The relationship between the inks is what counts, not their exact values.
- The power of positive guesswork.** The by-the-numbers philosophy looks for areas of known color, or where certain colors are inconceivable. Sometimes neither one is available. At such times, there is nothing to do but guess, based on feedback from the monitor.

highlight is the lightest significant part of the image...”

The word *significant* is not there to make the sentence sound more impressive. It is in fact the most consequential, the most far-reaching word in the entire definition. That's too bad for the machine, in whose dictionary no entry for *significant* appears.

An algorithm, whether the camera's or the computer's, looks for the lightest point of the image—not the lightest *significant* point—and sets it to a predetermined value. Here, it moors itself to the lightest spots in the upper right corner, and wakes up to find itself bound head and hair to the ground, because it doesn't realize that you and I have no interest in said area.

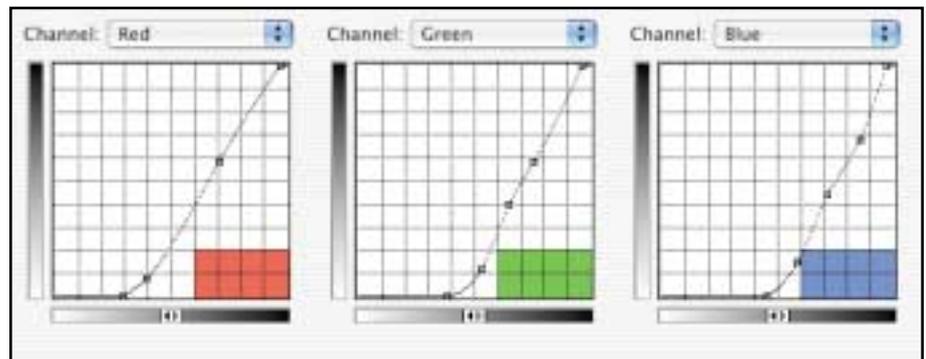
Dark as it is, the gray hair above the man's left ear is the lightest significant point of the image. Once we determine to set it to 245<sup>R</sup>245<sup>G</sup>245<sup>B</sup> (it starts at 143<sup>R</sup>123<sup>G</sup>95<sup>B</sup> in the sRGB original), the rest is easy. The curves in Figure 3.10 are similar to those of Figure 3.8, but simpler and more drastic. The bottom point in each curve sets the highlight, the next point ensures that the face falls in as steep an area as possible while maintaining a good color balance, and the upper point keeps the young man's hair brown.

### A Modest Proposal or Two

Curves, as we learned in Chapter 2, come with a price. They improve certain areas at the expense of others. My curves blew out the upper right background altogether. I don't care, any more than I care about the light spot by the older



**Figure 3.11** By changing the bottom of each curve to the beginning of an S shape, some highlight detail is preserved, creating a less stark look than in Figure 3.10.

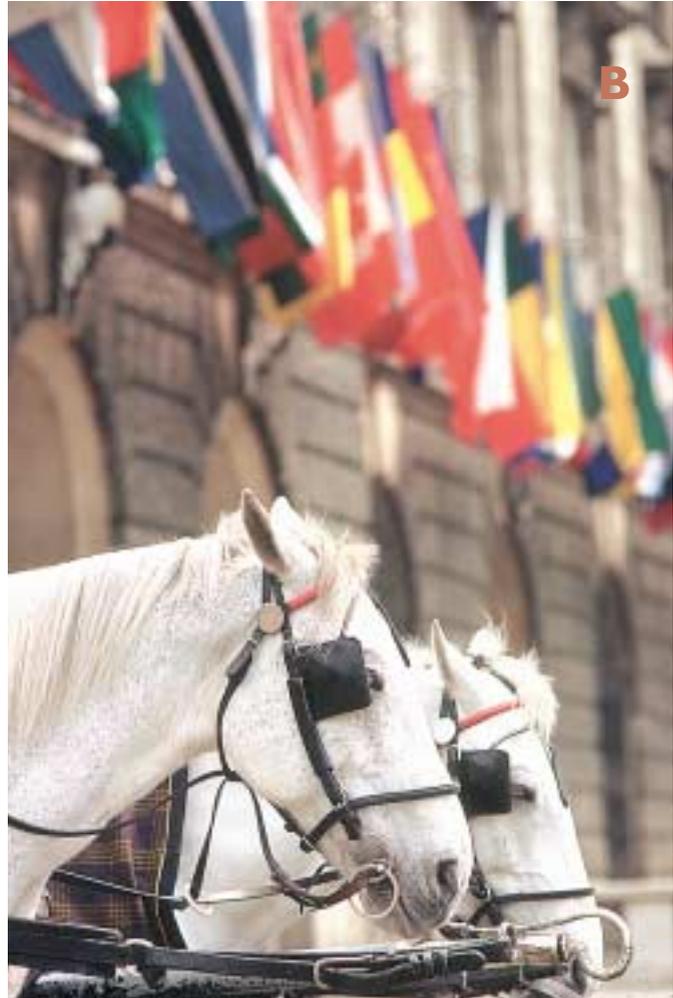


man's ear or the large reflections off his fingernails. I think the focus should be the man's emotions.

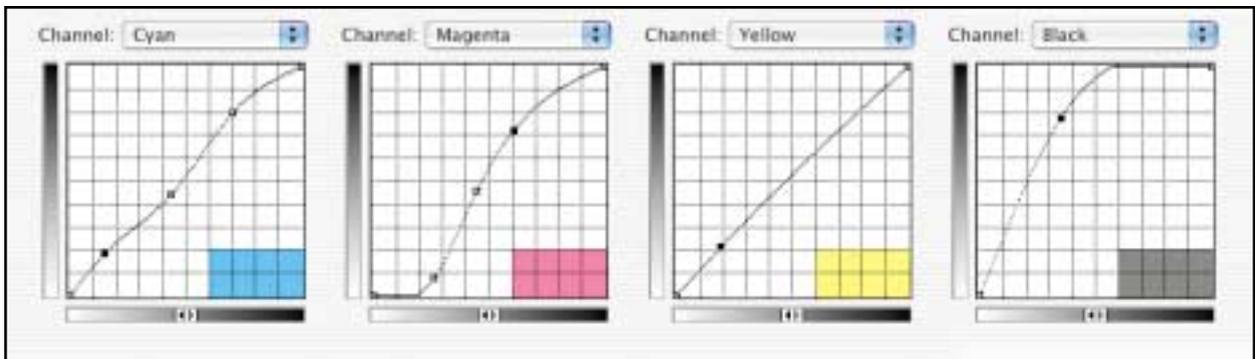
If any or all of these things bother you, there are two remedies. First, if you applied these curves on an adjustment layer, you already have a layer mask. By default, it's white, which means that it does nothing. If you activate a painting tool and paint a very light gray into the affected areas of the mask, it will bring back enough of the underlying

original to fool the viewer into thinking that there's still detail there.

Rather than lessen the adjustment layer's opacity, another way to soften the blow is to modify the curves as in Figure 3.11, making their bottoms into the start of an S. This hurts detail in the lightest parts of the image but doesn't eliminate it altogether. Of course, it doesn't get the man's hair as white as in Figure 3.10, because nominally the highlight is now something else.



**Figure 3.12** The 1994 original at left features many colors that are known to be neutral, and one that some people mistakenly take to be so. The curves below produce the corrected version, right.



**Of Free Speech and Figures of Speech**

Gulliver was no great admirer of freedom of expression. He quoted “a Philosopher” as saying that “He knew no Reason, why those who entertain Opinions prejudicial to the Publick should be obliged to change, or should not be obliged to conceal them. And as it was Tyranny in any Government to require the first, so it was Weakness not to enforce the second: For, a Man may be

allowed to keep Poisons in his Closet, but not to vend them about as Cordials.”

If Gulliver had been in charge in 1994, not only would he have approved of my monkey comments, but he probably would have pushed for government scrutiny of stock photo agencies, because some of the things that were being vended around as cordials were poisonous indeed, as we will step back in time to discover.

Figure 3.12A, believe it or not, came from the biggest and theoretically most quality-oriented vendor in the then-novel field of royalty-free stock. It was delivered in CMYK, as most files were in those days, so that's where we'll work on it.

Before giving the measurements, the literally lightest area of Figure 3.12A is the near horse's forehead. The darkest area is a tie between the black stripe of the flag at top left and the harness at extreme lower left. Are these the areas we really want to use for highlight and shadow?

I say yes to the horse's forehead, but no to the flag and the harness. That horse is the whole focus of attention in the image. We want to retain detail throughout, and furthermore we know that he's white. If the stripe in the flag plugs, though, who cares? It's not a significant part of the image. The shadow should be the near blinder. It's dark, it's neutral, and it's significant.

There's no shortage of things that seem like they should be neutral in this image. Going from darkest to lightest, the original readings are: highlight in forehead,  $2^C6^M2^Y$ ; closest horse's neck, beneath the mane,  $7^C28^M6^Y$ ; background wall,  $35^C40^M40^Y1^K$ ; and near blinder,  $72^C58^M68^Y30^K$ .

This is the easiest correction of the chapter, provided we work by the numbers. People who don't do so often try to select the horses. Such an action is to remove the horses from the context of the image and effectively paste them into a background to which they have no relation. The horses may be the most blatant things that are too pink in the original, but they aren't the only things.

Or, people might conclude that the whole image is too pink and drastically reduce magenta. That wouldn't work, because, presumably owing to the efforts of the baboon who "corrected" the image originally, the magenta cast affects only the light half. The dark half is actually too green. If you don't

believe it, check the blinder numbers again. Magenta and yellow are supposed to be equal in a neutral area, but here the magenta is 10 points too low. And if you still don't believe it, look at the Canadian flag in the background. If there were really a magenta cast, the flag would be too purple, instead of too orange.

There are two key curves here, one for color, one for contrast. The S curve in the magenta corrects the color, eliminating the pinkness in the horses while establishing  $70^M$  in the blinder. And the ultra-steep curve that adds  $40^K$  to the shadow provides punch.

The yellow curve needs nothing more than a slight increase in the light area where the horses are found, because the shadow value is near the desired  $70^Y$  already. And the cyan needs slight increases both in the highlight and the shadow, nothing nearly as radical as what happened to the magenta. There's just one final trap to avoid.

### Betting the Image

Our language is replete with misleading phrases involving color. The *whites of our eyes* are in reality pink. *Red wine* is purple, and *white wine* greenish yellow. *White people* and *black people* are both red.

Sometimes, however, the adjective needs to be taken seriously. That *black macaque* was, in fact, black. And Figure 3.12A was shot in New York City. The architectural material is typical of the area. It is known as *brownstone*. New Yorkers don't call it that because it's gray. Yet lots of professionals would take it for granted that it is, and would wreck the image by omitting the points in the center of the magenta and cyan curves that keep it brown.

If we've never heard of brownstone, we should ask ourselves whether this building is really gray. The answer to that is yes—probably. Most such walls would be close to gray. But the next question is the big one: are we really ready to bet the image that we're right?

I'm not willing to bet that the building is neutral, but I am willing to risk the image that the horses are. I'll also gladly bet that the light parts of the flags are neutral and that the horses' blinders are, too.

This image is the only one in this book that also appeared in the 1994 first edition of *Professional Photoshop*, the others having gone the way of Blefuscu's navy. In addition to being a good illustration of how to handle casts that change color as the image gets darker, it reminds us how far we've come as a field in a dozen years—and perhaps how far

we haven't gone. We'd never get such an image from a professional source today.

Every professional now knows to set a dark point somewhere in the image, so we have gotten the monkey of wildly flat images like Figure 3.12A off our backs. Color, I regret to say, remains a problem.

Some 21st-century people still open the image, discover that the horses are pink, and immediately wheel out the selection tools. The normal result is white horses that look like they've been cut out and pasted into a pink background.

### Avoiding the Impossible: How the Pros Know the Numbers

There's a popular misconception that the best retouchers know exactly what numbers to shoot for no matter how esoteric the subject matter. In real life, the key is more to avoid numbers that can't possibly be right. If we find any such in the image, we have to twist curves or whatever to avoid them. Here's a brief guide to familiar colors, starting with the easiest.

**GREENS** almost always favor their yellow neighbor. Cyanish greens are rare. Often yellow is as much as half again higher than cyan. In the natural "green" of a plant, equal cyan and yellow would be impossible in CMYK, equal red and blue impossible in RGB. On the other hand, if the cyan/red is so light that it's closer to the magenta/green value than it is to the yellow/blue, then the resulting color is a greenish yellow rather than a yellowish green. That's impossible, too. If we discover either situation in our picture, we have to correct.

**REDS** are, in principle, equal combinations of magenta and yellow, with much less cyan. If the magenta is slightly higher than yellow, it's a rosier red. If yellow is higher, it's an angrier, more orange color. Faces are close to equal, but when they aren't, it's always a yellowish red. Reddish yellows, and magentaish reds, are impossible in faces. In other things that are red, anything goes.

**BLUES** would, in a perfect world, have equal amounts of cyan and magenta. Photoshop commands like Hue/Saturation and Selective Color that are capable of targeting "blues" in fact make this assumption. The sad fact is that equal cyan and magenta makes purple, so any real blue will have decidedly more cyan. The color of most skies is even more heavily skewed; many skies are better described as bluish cyan than cyanish blue.

Note that I am using CMYK numbers, because, at least for greens and reds, simple rules are available that don't work in RGB—namely, faces are never more magenta than yellow, growing things are never as cyan as yellow. These rules don't apply to the RGB cognates, because the blue channel is lighter than a CMYK user familiar with yellow channels would expect. Therefore, when working with fleshtones or natural greens, I recommend setting the right half of the Info palette to read CMYK, even when working in RGB.

Intelligent retouchers look at suspect areas of an image and ask, are these color values even *possible*? If they are, we don't try to mastermind the operation by guessing at how they might be better. But if the colors are impossible, we have to change them, even if we aren't positive of what to change them to.

For example, if you were asked to define the hair color known as *blond*, you would probably say it was yellow. Pure CMYK yellow, in the sense of equal cyan and magenta, is in fact possible if the hair is very light. More commonly, though, the hair is a *reddish* yellow, meaning yellow first, magenta second, cyan third. A greenish yellow, with cyan higher than magenta, is impossible. If the image features greenish yellow hair, this has to be changed. I can't tell you to what, but you can't let it stay where it is.

Others still recite the tired old mantra, “But it didn’t look that pink on my calibrated monitor!” Of course it didn’t—the viewer’s villainous visual system calibrated itself to the picture on the screen. Chromatic adaptation, our subconscious determination to neutralize all incoming light, is why we have to correct casts in images where the camera failed to adjust as a human would have. It’s also why a lot of pictures have to be recorrected due to objectionable casts that somebody who trusted the screen overlooked. The question is not whether the monitor is “calibrated” but whether the Info palette is.

And certainly, people still try too hard to find neutrals. I give this image as a class exercise, and way too many people force the brown walls to be gray, and then wonder why the whole image looks too cold. If you don’t know for a fact that the object is neutral (and we *do* know this about the horses, the white part of the Canadian flag, the black stripe, and the leather blinder), leave it alone.

The bottom line about this image is the same as about the others in this chapter, and the same as it was in 1994. To be successful, we need a full range of tone, and Figure 3.12A doesn’t give it to us. We can’t give viewers colors that they know better than to believe. Pink horses qualify. So does gray brownstone—at least to New Yorkers.

Before going even further back in time

for a different type of brownstone, a final example of by-the-numbers correction, we’ll conclude discussion of these horses with a few words about them from the 1994 edition of *Professional Photoshop*.

In short, once he got the hang of curves, there is absolutely no reason that an orangutan could not get these results. Years of retouching experience, artistic talent, and mathematical aptitude wouldn’t hurt him, but they are not really needed.

Notice how these numerical adjustments have the habit of helping areas of the image that we never even thought about. Things like the flags behind the horses...

Artists who worry their images to death tend to see such shortcomings immediately and plunge happily and vigorously into a morass of individual moves. They isolate the horses and work on them; they fix up the flags one by one; they tediously darken the harnesses, and after eight hours they have something nearly as good as what the orangutan would have gotten in 35 seconds. That may be the most persuasive kind of number there is.

### When an Emerald Isle Turns Yellow

Gulliver was English, but his creator was Irish. Hundreds of years before Jonathan Swift was born, Dunluce Castle commanded the cliffs of the Antrim coast. The picture of it

## Review and Exercises

- ✓ If you discover that a highlight area is too dark, what’s the difference between lightening it by moving the lower left point of the curve to the right, and lowering a different, higher point?
- ✓ Why are there 256 steps in RGB (0–255) but only 101 in CMYK (0%–100%)? Does this make RGB correction more accurate?
- ✓ Why do we not set the shadow to the darkest possible value, 0<sup>R</sup>0<sup>G</sup>0<sup>B</sup>? Are there any circumstances under which we might do it, and if so, what are they?

in Figure 3.13, however, is as modern as it gets: a professional-quality digicam with a professional standing behind it, aided by good lighting conditions.

This image arrives in CMYK. Nothing large enough to be measured (and therefore nothing large enough to be significant) is white. The lightest measurable area is in the sky,  $16^C7^M2^Y$ . The shadow is in the large opening at the lower right of the near tower, at  $80^C64^M71^Y75^K$ . The grass near the rear fence measures  $37^C21^M86^Y1^K$ . A brown area in the castle is  $39^C48^M70^Y$ . The sea is  $52^C28^M13^Y1^K$  about halfway up the picture.

The shadow value is slightly off. The yellow and magenta should be equal, but the magenta is seven points lower. Doesn't sound like a big deal, and certainly no sweat to correct, but it suggests that the dark parts of the image, at least, may be getting too green-yellow. And the suspicion is confirmed

elsewhere—in the trickiest part of the by-the-numbers technique.

Back in Figure 3.6, we looked at six different casts: cyan, magenta, yellow, red, green, blue. How did I identify which of the six was which before placing them in the page?

Here's a quick formula. Look at the CMY values, even if you're in some other color-space. The highest of the three is the dominating ink; the lowest, in combination with the black, is a contaminant and is sometimes known as the *unwanted color*.

The ink in the middle is the key. If it's closer to the contaminating ink, we're looking at a yellow, magenta, or cyan object. If closer to the dominating ink, the object is red, green, or blue. Therefore,  $30^C80^M90^Y$  is a red—a yellowish, desaturated red. But  $30^C50^M90^Y$  is a reddish yellow.

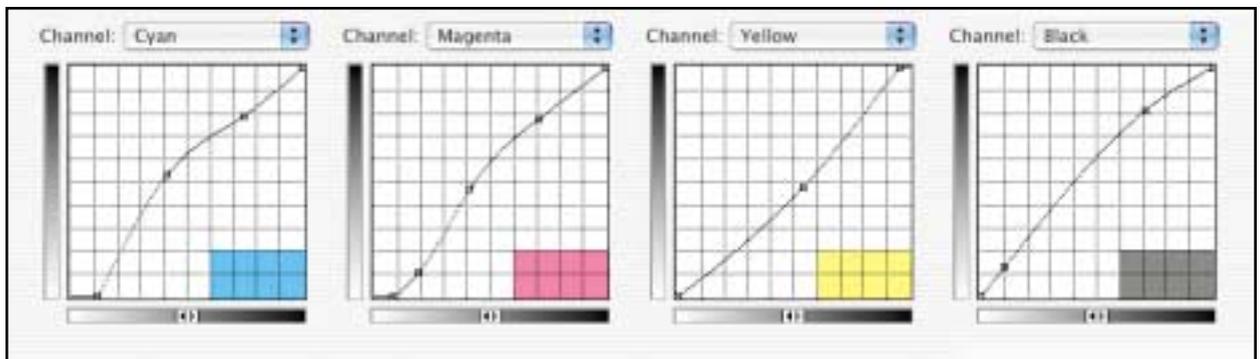
Do you see the problems in the readings for this image? I don't know specific numbers

**Figure 3.13** Dunluce Castle, County Antrim, Ireland.





**Figure 3.14** A corrected version of Figure 3.13, produced by the curves below.



for Irish grass. However, one need not be a leprechaun to speculate that it's probably green. The measured values are not. As the middle ink, the cyan is 15 points away from the sum of the contaminating inks (magenta and black) but 49 points away from the dominant; the grass in the original is yellow, a greenish yellow admittedly, but still yellow and not green.

In the same way, the castle should be brown, which is a very desaturated red. Cyan must be the lowest CMY ink, as it is. The

further the magenta and yellow are away from it, the more saturated the red is.

Like most browns, including all those we've seen in this chapter, if it isn't pure red (magenta and yellow equal), then we'd expect a yellowish brown rather than a purplish one. That is the case here, almost. The yellow is higher than the magenta—so much so that the color is no longer a red. Nine points separate cyan and magenta, but 22 are between magenta and yellow. It's a reddish yellow castle, not a yellowish red, not a brown one.

### Otherwise Than by Comparison

We're about ready for the curves, but there's one last item, this time affecting contrast. As noted earlier, the sky is the lightest significant part of the image. If it were white, we'd know what to do, but you don't have to be Joyce or Shaw to realize that it isn't. It's currently cyan tending toward blue, which sounds right.

Nevertheless, we should change it, not to a different color, but to a different lightness. If we can't hit  $5^{C2M2Y}$  because that would be white, fine, but we should try for something just as light.  $6^{C2M0Y}$  or  $7^{C3M0Y}$  ought to do it.

The final curves that produce Figure 3.14, then, are:

- Cyan: highlight gets lighter; midtone bulges upward to put more cyan in the grass, but also to get the castle in a steep area of the curve.
- Magenta: Lighter in the highlight, then reduced in the quartertone to take magenta out of the grass, and increased in the three-quartertone to put it into the castle.
- Yellow: reduced everywhere to lessen the imbalance in the castle and the grass.
- Black: bulges up, creating a steeper half

## The Bottom Line

Much of color correction can be reduced to simple numerical rules. Images must have full range, which is accomplished by setting proper highlights and shadows coupled with the steepening techniques of Chapter 2. And they must avoid impossible colors. Sometimes we specifically know the desired color, as in a person whose hair clearly should be gray. At other times we don't know what the color is, but we know what it is not. A person's dark hair may be black or it may be brown, but it can't be dark green. A forest must always be green, even if we don't know the specific green.

By the numbers is not a wooden philosophy, but a means of avoiding obvious errors. Many different-looking versions of the same image can comply with the numerical requirements.

where the grass and castle are found. With so little shadow detail, there's no problem with going over the nominal  $70^K$  limit.

\* \* \*

Working by the numbers does not replace artistic judgment. It does replace a lot of bad color. The basic concepts are readily absorbed by the color-blind, if not by monkeys. In fact, around a dozen color-blind people have taken my three-day hands-on course, which is aimed at people who are very serious about color correction indeed. One of the beta readers of this book is color-blind, yet corrects color, by the numbers perforce.

It's understandable, I think. I certainly get a rush when I make something like Figure 3.9 look better than a nonexpert thinks is possible, and I suspect that most readers feel similar elation when they get praised for their work. Imagine how much more adrenaline flows when the viewer's jaw drops at learning that a color-blind person did the work!

Gulliver traveled for a little over 16 years. The journey of those doing professional color correction in Photoshop has a few years to go yet to meet that number. We have, however, met many strange life forms and learned a great deal, so much so that the practices of 1994 now seem to us to be Lilliputian.

If you find the challenges and intricacies of color correction to be Brobdingnagian, let me complete a quotation begun earlier. Here are Gulliver's thoughts upon encountering that gigantic species.

"Undoubtedly Philosophers are in the right when they tell us, that nothing is great or little otherwise than by Comparison. It might have pleased Fortune to let the *Lilliputians* find some Nation, where the People were as diminutive with respect to them, as they were to me. And who knows but that even this prodigious Race of Mortals might be equally over-matched in some distant Part of the World, whereof we have yet no Discovery?"