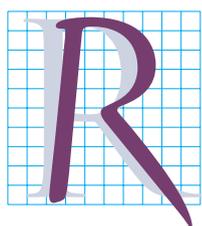




LAB by the Numbers

The structure of LAB is frightening: opponent-color channels; a zero in the middle of a curve; negative numbers for cool colors and positive numbers for warm ones; colors that are well outside the gamut of any output device. And outright imaginary colors, ones that don't and couldn't possibly exist anywhere but in the mind. But there's logic behind the lunacy, and with practice the system is easy to use.



Radical alternatives show up from time to time in politics. Usually they are harmful, occasionally appealing, but rarely do they solve all problems at once.

In recent years in the United States, two such radical alternatives actually became governors of populous states. One was a professional wrestler, the other a bodybuilder/actor. Each has much in common with LAB: great physical strength, a certain intuitive simplicity and ability to express things in a way that human emotions respond to, and a whole lot of baggage that one would rather not hear about.

LAB has the advantage that if we don't like what it has to offer, we can ignore it and stick with the old reliables. But to understand what it has to offer, we need to understand the logic under which it works, which is no mean feat.

* * *

The biggest problem in attempting to teach almost anything about imaging is that around half the world learns how to work in RGB and is deathly afraid of CMYK, thinking that it's some kind of black art instead of just RGB with a black channel attached. The other half learns CMYK first, thinks that RGB is for simpletons and that working in it is akin to performing brain surgery wearing boxing gloves. Both sides thereby miss a host of opportunities that work better in one space than the other.

Such colorspace chauvinism is particularly galling in that RGB and CMYK are exceedingly similar. If you know how to work in one, you already know how to work in the other. The one that's really different is LAB, as Figure 2.1 demonstrates.



Photoshop LAB Color: The Canyon
Conundrum
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Figure 2.1 Top right, the original picture of a pink rose. Top row, in order: the RGB channels, red, green, and blue. Second row: their CMYK counterparts, cyan, magenta, yellow, and black. Note the strong similarities between red and cyan, green and magenta, and blue and yellow. The LAB channels, bottom row, are decidedly different.

Three Pairs of Channels

At top right is the composite color image of this flower. There are identical-looking versions in all three of the colorspaces that Photoshop fully supports. The ten channels are arranged in three rows. From top to bottom, they are RGB, CMYK, and LAB. There's a striking relationship between each RGB channel and the CMY one directly underneath it.

In the magenta channel of CMYK, the flower is quite dark, because we need a lot of magenta ink to make it, and in CMYK, the darker a channel is, the more ink we get. The leaves are much lighter, because magenta ink kills green.

In RGB, the lighter a channel is, the more of that color of light is supposed to be hitting our eyes. Little, if any, green light should be doing so in the middle of a magenta flower. Hence, the flower in the green of RGB is as dark as it is in the magenta of CMYK. For the same reason, the leaves are about equally light in both channels. The magenta and green aren't identical because of such tiresome factors as dot gain, ink impurities, and the presence of a black channel, but still it's as easy to see their relation as it is to see the ones between red and cyan and blue and yellow.

The radical concept of LAB is to separate color and contrast completely, followed by a most unusual way of defining color. Even once you get the general idea, there are complications, exceptions, and nonobvious ramifications.

All channels in RGB and CMYK affect both color and contrast. In LAB, all the contrast goes into the L channel, all the color into the A and B. Consequently, the L is easy to understand, because, since it's colorless, we can think of it as a black and white version of the color photo, although for technical reasons the L is a bit lighter than a black and white would be. The A and B, which are color only, make zero sense to the casual observer.

If an image has no color at all—that is, if it's a black and white—the sensible thing would be blank A and B channels, right? Not in the weird world of LAB. If there's no color, the A and B have to be *gray*—a pure, 50% gray. The further they get away from gray—the more they move toward white and/or black—the more colorful the image gets.

The two are termed *opponent-color channels*. When the A is a lighter gray, it contributes magenta, but a darker gray represents green. And the lighter or darker it is, the more intense the color.

From that, you might surmise that the A channel's flower would have to be almost a white, since it would be hard to find an object more magenta and less green. But again, LAB has a trick. It is designed not just to encompass all the colors that we can print, put on film, or display on a monitor, and not just colors that are too intense for any of these media, but colors that are so intense as to be beyond our conception: imaginary colors, colors that couldn't possibly exist.

We'll get to the official LAB numbering system in a moment, but for now let's think of the A channel as though it were a grayscale image, with possible values from zero to 100%. A 50% value is neither magenta nor green; anything lighter favors magenta and darker favors green.

Treating the A channel as a grayscale, the rose's magenta is only about a 25%—in other words, about halfway as magenta as LAB can ask for. The dull green of the leaves is 57%, only slightly higher than the 50% that would denote something neither magenta nor green. And the background isn't gray, either. It's biased toward magenta, but it reads only 48% or 49%, just a point or two away from the neutral 50%.

Although the shapes are blurry, we see the flower as a light object and the leaves, just barely, as dark ones in the A channel.

In the B channel's opponent-color scheme,



light grays represent yellowness, dark grays are blue, and a 50% gray is neither. Inasmuch as nothing in this picture can be described as either yellow or blue, the B is subtler than the A, but it plays an important role in modifying other colors.

In the A channel, the flower is pretty much all of one darkness, but in the B, the edges are darker than the center. So, even though the B is much less intense than the A, it's helping create a different hue on the edges of the flower than in its center.

How we would describe that change in hue depends on how hoity-toity opponent-color we want to be about it. A person off the street might say, the flower is more purple around its edges and more red in the center.

An LAB aficionado would probably say the same thing, but would actually be thinking: the flower is always the same in its magenta-as-opposed-to-greenness; but it's more blue-as-opposed-to-yellow at its edges and more yellow-as-opposed-to-blue at the center.

In every category of image, this type of subtle variation in hue is critical to making the color believable. LAB establishes hue variation better than any other colorspace.

Now, let's do the exercise in reverse, starting with a normal image and examining what happens when certain LAB channels are weakened or omitted.

The Role of Each Channel

Figure 2.2A is the original autumn scene, and Figure 2.2F is a dirty trick with a lot of ramifications for future magic. The other four show the function of the channels by eliminating them one at a time. Or, rather, by weakening

Figure 2.2 Top left, the original. The next four show the effect of drastically reducing tonal variation in one or more. Top right, both the A and B channels are suppressed. Center left, the L only. Center right, the A. Bottom left, the B. The version at bottom right is the original with the A channel inverted, reversing the relation between magenta and green.

them severely. If I eliminated the A and B altogether by changing them to 50% gray, the picture would become a black and white. So, instead, in Figure 2.2B, I wiped out four-fifths of their variation. In the next three versions, I did the the same to a single channel at a time.

The ugliest version is doubtless Figure 2.2C, the one with the devastated L channel. When all luminosity contrast is gone, clouds are gray, not white, and autumn foliage is a color swatch in which individual trees can't be discerned. But the version with almost no color isn't much better. The interesting ones are those using only one of the color channels, because they tell us a lot about how each hue is constructed.

When the A channel is AWOL, magentas and greens are impossible. For that matter, so are cyans, which probably doesn't cause you much lack of sleep, and reds, which are colors we can't live without. A red occurs when both A and B are lighter than 50%. In Figure 2.2D, with the A almost nonexistent, the central trees and the grass are the same color, which is disconcerting given that one used to be red and the other green. But both were, and are, more yellow than they are blue.

An LAB person always needs to think in terms of what the secondary AB channel must be. For example, in Figure 2.2A, do you think that the sky should be more blue, or yellow? That, of course, is a stupid question. Naturally, the B channel is supposed to be darker than a 50% gray, because that's how you make things blue. But now, the secondary question: admitting that blue is the dominating color, should the sky be more green, or more magenta?

Figure 2.2E gives the answer, which you should squirrel away into your storehouse of knowledge. Skies almost always fall to the green, not the magenta, side of blue. And here's another one to remember, a lesson from Figure 2.2D: grass, and anything else that grows, is always to the yellow, never the

blue, side of green. Notice how Figure 2.2E's grass seems bluer than that of the original, Figure 2.2A. This is not because it was shot in Kentucky, but rather because it has no B channel to introduce the yellow component that the grass needs.

Finally, to change the original into Figure 2.2F, I selected the A channel (either by Command-2 Mac, Ctrl-2 PC, or by clicking the A icon after opening the Channels palette), and did Image: Adjustments>Invert. That is our first real piece of magic, because if you can somehow transport yourself to an imaginary planet with orange grass, purple skies, and green leaves in peak autumn foliage season, you must admit how persuasive Figure 2.2F is. Everything seems to fit in place. Unless you know that the colors are impossible, the illusion is undetectable.

The structure of the AB channels makes such trickery possible. The key is the definition of neutrality as 50% gray. The clouds in Figure 2.2F are just as white as they were in Figure 2.2A. Originally, they were neutral: neither magenta nor green, neither yellow nor blue. So, both AB channels had them at or near 50%, and inverting 50% doesn't change anything. The inversion affects only things that have color, whether slight or significant. As we saw when the B was suppressed in Figure 2.2E, the sky in the original tends slightly toward green. Inverting its A channel makes it tend slightly toward magenta, which is why the sky is purplish in Figure 2.2F. And in the original, most of the trees are red—heavily magenta as well as yellow—meaning that inverting the A makes them become heavily green.

It's high time to cease the impossibly verbose references to magenta-as-opposed-to-green and start using real LAB numbers. The value that we've been referring to as 50% gray is fundamental. It is expressed, in the weird language of the AB channels, as zero. Things that are lighter than 50% gray are

given positive values, the maximum being +127; things darker than 50% are negative, with the maximum -128.

This is the sort of news that makes people throw the mouse in the air and pray to whatever deity watches over graphic artists to deliver them into some more comprehensible discipline, such as differential equations. However, now that we're this far, you'll have to admit that there's a logic, however radical, however perverse, at work. Positive numbers always indicate warm colors: magenta, yellow, red. Negative numbers are cold colors: blue, green, cyan. And a zero is no color at all, a neutral.

By setting zero midway between the two opponents, we get an easy reference as to how colorful an object is: the further it is from zero, the more colorful. For example, in Figure 2.1 the flower averages around +65 in the A, while the leaves above it are in the neighborhood of -15. You don't need to know what exact colors are being called for to realize that the flower has to be more colorful than the leaves are.

It can be very convenient to represent all whites, blacks, and grays with a single number that doesn't depend on the values found in any other channel. Imagine a picture that's full of colors known to be neutral, but of different darkneses. A man wearing a tuxedo would qualify. The shirt would be white to light gray; the jacket, tie, and pants dark gray to black.

If we were working such a picture in RGB, every channel would have a big tonal range, because every channel contributes to lightness and darkness. That's unfortunate, because in RGB, neutral colors happen when all three channels have equal values. Many, many points would have to be compared channel-to-channel to be sure that the values were approximately equal in all three, regardless of the darkness.

In LAB there is no such problem. The A

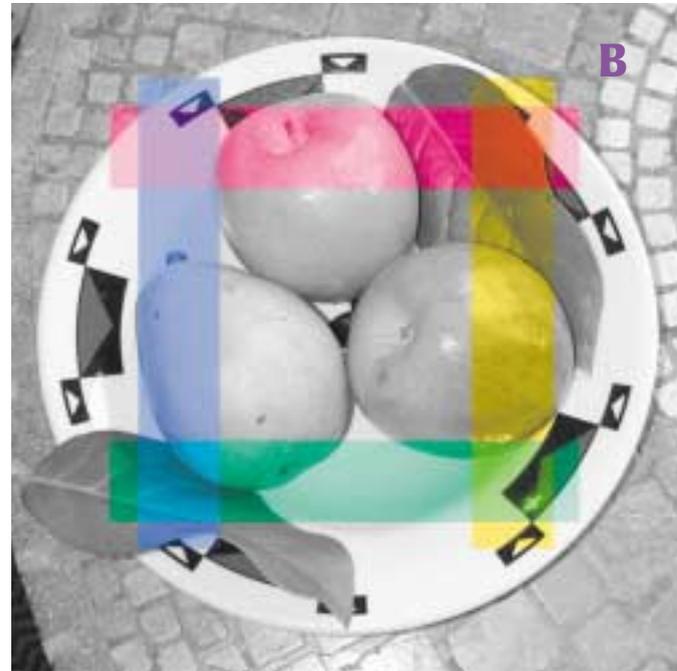
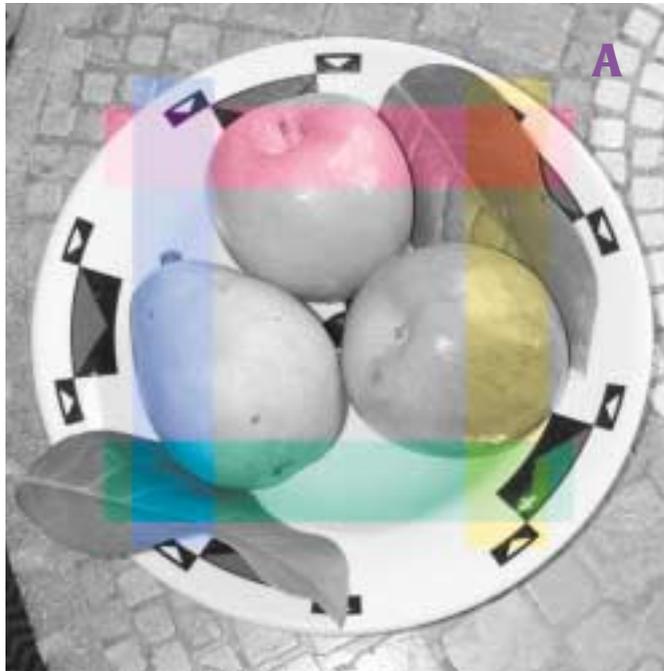


Figure 2.3 Colored bars are superimposed on an otherwise neutral (0^A0^B) image. Top left, the values are plus or minus 25 in the A and B. Top right, they are ± 50 , and bottom left the bars are ± 75 in the A and B.

The Easiest of the Three

After the complications of the AB, the L channel is relatively easy to understand once you get used to its being backward in relation to its close relative, a grayscale image. In the L, a value of zero is absolutely black, and 100 absolutely white. The L is slightly lighter, and higher in midtone contrast, in comparison to what we would get if we went Image: Mode>Grayscale, but for now it's enough to know that the lower the value, the darker.

The L doesn't have negative numbers. As the A and B do, there's a typographical problem in the LAB language that we're about to be speaking. Minus signs cause confusion, because people mix them up with dashes. Instead, we'll use parentheses to denote negative numbers when citing AB values. Earlier in this chapter, for example, we saw an object

channel should be just about zero throughout both the shirt and the tuxedo. If it is, we don't need to compare it with the B or anything else—the A is now known to be correct.

The idea of a fixed neutrality value of zero, independent of other channels, also makes certain kinds of color correction easier, as we'll see in Chapter 3.

that measured around $60^L(15)^A15^B$. Can you name what it was?

The 60^L suggests something in the middle range of darkness, probably equivalent to around a 50% gray in any other type of file. (Remember: the L channel is deceptively light.) The negative A reading tells us that the object is more green than magenta, and the positive B indicates more yellow than blue. AB values of plus or minus 15 aren't particularly high, so although the object has a distinct color, it certainly isn't unusually saturated or brilliant.

In short, the numbers describe a relatively dark, dull yellow-green. They are typical readings for the leaves in Figure 2.1.

For a final look at how the AB channels interact to construct color, Figure 2.3 is a gray-scale image except for the four colored bars. Therefore, to use proper language, everything other than the bars reads 0^A0^B . Each of the four bars is a pure AB color: magenta, green, yellow or blue. The L channel is unaffected and would look like a grayscale still-life picture without any bars.

The three versions of the image use different values for the bars. Figure 2.3A starts with ± 25 . That is, the magenta bar contributes 25^A to whatever the L value is, the green bar $(25)^A$, the yellow bar 25^B , and the blue bar $(25)^B$. Figure 2.3B has the bars at AB values of ± 50 , and 2.3C at ± 75 .

Before we get to the bad news, note how these channels work in tandem to produce intermediate colors. In the top right corner, where the bars intersect and both A and B are positive, we get red. At the bottom left, mixing the AB negatives, blue and green, gives us cyan. At top left, mixing blue and magenta yields a purple, and at bottom right is a yellow-green that's closer to the color of most things that grow than a pure LAB green is.

These images—in their original LAB form, not the CMYK conversion that was needed to print this book—are on the accompanying

CD. Open them, and they'll look very different from the printed page. Inasmuch as the printer of this book had difficulty acquiring opponent-color inks, I was obliged to supply CMYK files. And CMYK practicalities trump LAB theories much of the time.

The bars become more colorful as the distance from zero (neutrality) gets higher. Therefore, the bars in Figure 2.3C should be more intense than in Figure 2.3A. That much is true. But the bars theoretically don't affect contrast; the detailing in the two images should be the same. It's not. Under the magenta and blue bars, at least, the picture is distinctly darker than it was.

Certainly this is an artificial picture in the sense that the colors being called for can't possibly be right. Then again, so was Figure 2.2F, which was a lot more convincing.

That certain colors theoretically exist in LAB doesn't mean that we have the slightest hope of achieving them in CMYK, or even in RGB. Inability to print bright blues, particularly light, bright ones, is a notorious CMYK failing. But CMYK falls short in many other areas, particularly when colors are supposed to be very pure and yet either quite dark or quite light. It's a major issue. Remember: working in LAB is seldom the final step. The file almost always has to go back into RGB or CMYK at some point.

If the LAB file contains colors that the destination space can't reproduce, it takes a fair amount of experience to predict what will happen. The ability to create such colors is one of the big dangers—and big opportunities—of LAB. In the "Closer Look" section of this chapter, we'll dig deeper, but for now, we need to be careful when dealing with colors that exist in the warped world of LAB only.

In Chapter 1, we worked on canyon after canyon, having learned that canyons are a specialty of LAB. At this point, you should understand why. First, canyons have very subtle color differentiations that cameras

don't pick up as well as human observers do. Steepening the AB channels is extremely effective in bringing them out. Second, canyons don't have brilliant colors: the colors in Chapter 1 are far less vivid than in, say, Figure 2.2. It would be difficult to enhance canyon colors so much that they couldn't be reproduced accurately in CMYK or RGB. Canyons are therefore very good things to hit with AB curves. Something like Figure 2.2 needs to be approached with caution.

You should now be able to identify colors using LAB terminology. Check that you can by going over the "Review and Exercises" section, which offers a quick quiz. If you pass it, you can move on to Chapter 3 if you like. The remainder of this chapter goes into more detail about what happens when LAB produces the unreproducible, and more about why steepening the AB is a better way to emphasize color than attempting to do the same thing in RGB.

Review and Exercises

- ✓ If you're working with an RGB file, how would you know whether a certain object will reproduce as neutral—that is, white, gray, or black?
- ✓ How do you know that an object will reproduce as neutral if you are working in LAB?
- ✓ Why are the A and B channels, when viewed on their own as they are in Figure 2.2, never white or black, but only various shades of medium gray?
- ✓ How does the L channel, viewed alone, compare to a version of the file that's been converted into grayscale?
- ✓ Which colors are denoted by positive and negative numbers in the A and B channels?
- ✓ Refer back to Chapter 1. Match each item in the left column with its typical corresponding LAB value. (Answers in box on page 33.)

1. The sky in Figure 1.1A
2. The lake in Figure 1.10C
3. The pinkish background of the Review box on page 14
4. The large magenta circles in Figure 1.11
5. The African-American skintone in Figure 1.15A

- A. $86^L 8^A (8)^B$
- B. $49^L (4)^A (10)^B$
- C. $74^L 13^A 19^B$
- D. $52^L 81^A (7)^B$
- E. $67^L (3)^A (30)^B$

A Closer Look

I once attended a lecture in which the speaker warned against using LAB because, he said, fully a quarter of the colors that LAB can construct can't be reproduced in either RGB or CMYK. Both premise and conclusion are wrong. The number of LAB colors that are out of the gamut of other colorspaces is more like three-quarters; and no, it's not an argument against using LAB, quite the contrary.

The quaint idea that LAB wastes only a quarter of its values comes from a faulty analysis of the AB channels, which run from values of -128 to $+127$. Commonly used variants of RGB can't achieve these extremes of color purity, but under certain circumstances they can get to about three-quarters of it, or ± 90 . CMYK doesn't even get that close, except for its yellow: the other three colors rarely get higher than ± 70 .

The killer is that phrase *under certain circumstances*. If we are told that a certain object is supposed to be *dark green*, or *dark red*, no doubt we can visualize such a color. But what does *dark yellow* mean?

Yellow has to be light to be recognizable. The most intense yellow in real graphic-artist life is found in CMYK, not RGB. It's $0^C0^M100^Y$. Yellow is such a pure ink that solid coverage of it is beyond the gamut of most RGBs. It's rare to find CMYK colors that RGB can't reproduce, but yellow is the glaring exception.

In Photoshop's Color Picker (click on the foreground/background color icons in the toolbar to bring it up), if I enter $0^C0^M100^Y$, I learn that it is "equal" to $95^L(6)^A95^B$ or $255^R242^G0^B$. On your system, these values may vary somewhat if you aren't using the same CMYK and RGB definitions this book does, which we'll discuss in Chapter 3.

As we just discussed, however, the RGB values shown in Figure 2.4 don't really match the CMYK ones, because they can't—something that yellow doesn't exist in RGB. But LAB just yawns. It matches this yellow with 32 points to spare in the B channel, roughly a quarter of its possibilities, just like the man said.

95^B is therefore the maximum yellow-as-opposed-to-blue that can be equaled in CMYK. The rub is, we can only do that well at the extremely light value of 95^L . Any attempt to produce something lighter than that would have

to use less yellow ink. Anything darker would have to employ extra inks that would contaminate the yellow. For example, $25^C20^M100^Y$ equates to $75^L(5)^A67^B$. Now, the B is only about half its maximum value—and we're just a quarter of the way down the L scale of darkness. At 50^L , we can be no higher than 47^B without going outside the CMYK gamut. And at 20^L , the limit is about 28^B —not even a quarter of the maximum.

If it isn't light, it isn't yellow.

In CMYK and RGB, all colors operate in this fashion. They are most pronounced at a certain darkness level. Green is strongest at around 60^L , magenta at 50^L , and blue, the darkest of

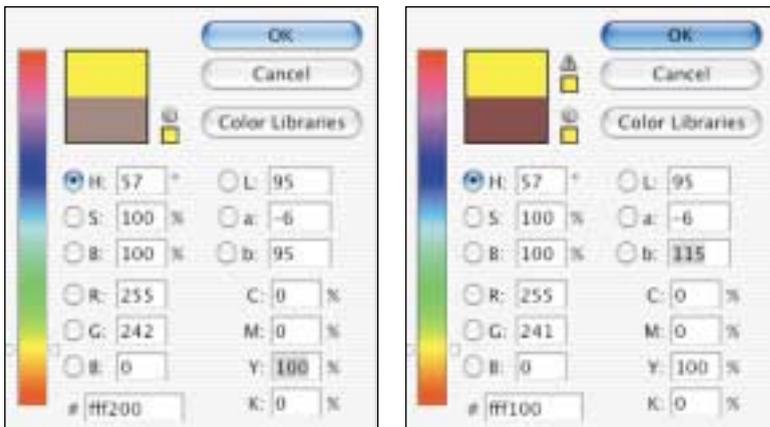


Figure 2.4 The Color Picker displays equivalencies in four different colorspaces, but sometimes a match between them is impossible. At left, there's no warning that the solid yellow CMYK ink can't be reproduced accurately in RGB. Note, though, that it isn't even close to the B channel limit of $+127$. When the B value is increased, the yellow leaves the CMYK gamut as well, but this time Photoshop lets us know—there's a small alert icon just to the left of the Cancel button.

all, at 40^L. A light rich blue is like a dark brilliant yellow, or a giant midget, or a rectangular circle.

Yet LAB permits us to ask for it.

Consider the yellow bar at the right of Figure 2.3C. Nominally it contributes 75^B to whatever's underneath it. But as we have just seen, such an intense yellow is only possible when the L is quite light—say, between values of 95^L and 85^L. Part of the center of the apple meets that description. Everything else that the yellow bar passes over is not merely out of CMYK gamut and undisplayable by any monitor. It portrays out-and-out imaginary colors—yellows that don't exist, couldn't possibly exist, and never will exist, such as the dark area of the plate where it intersects the lower edge of the yellow bar. That area should be around 5^L0^A75^B, and may be described as a brilliantly yellow dark black.

And now, the key question. Sooner or later, this file has to come out of LAB. What will happen to all these impossible, undisplayable combinations of color and darkness?

An Introduction to the Imaginary

When we translate an imaginary color out of LAB, we get a compromise—a compromise that doesn't match the original luminosity any more.

Figure 2.5 is Figure 2.3C converted to grayscale. To be more specific, it is converted to grayscale from the CMYK file needed to print this book, which itself had been converted from the LAB original. Had the conversion been done directly from LAB, there would have been no sign of the colored bars. But because of the intermediate conversion into CMYK, which had to bring certain colors into gamut, the compromises are readily seen.

Photoshop bravely fights the unbeatable foe by splitting the difference. The white plate gets darker where the bottom of the yellow bar surprints it. The dark leaf gets lighter where the yellow bar passes over it. And most of the apple stays about as it was.

The same thing takes place in reverse on the left side of the image. Very light blues aren't part



Figure 2.5 If any of the versions of Figure 2.3 were converted into grayscale directly from LAB, there would be no sign of the colored bars. This grayscale version, however, was converted from the CMYK file from which Figure 2.3C was printed, not the original LAB file. During the separation process, Photoshop often changes luminosity values when it confronts colors that can't be matched in CMYK.

Answers to Color Quiz

(Page 31)

The first value, 86^L8^A(8)^B, is quite light because the L is nearing 100^L. The slightly positive A makes it somewhat magenta and the negative B somewhat blue. This describes the pinkish background of the Review box.

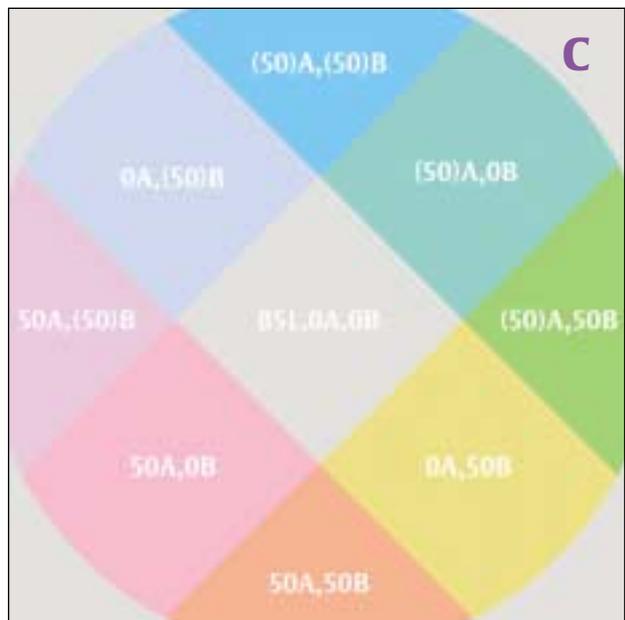
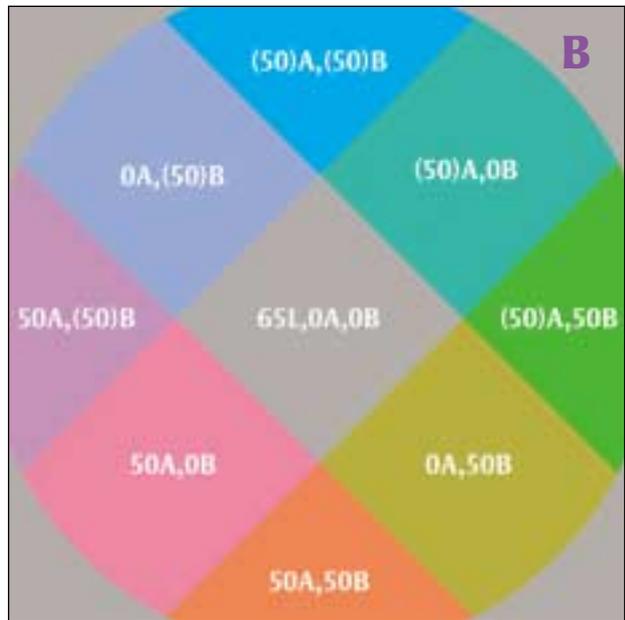
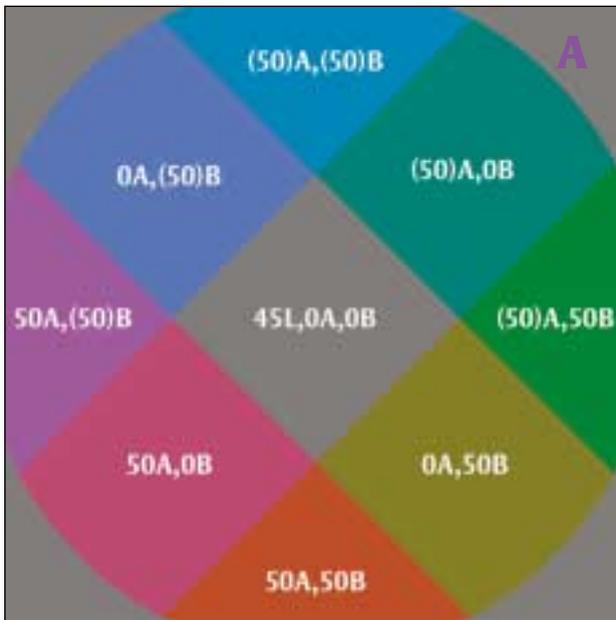
The second, 49^L(4)^A(10)^B is a medium-dark greenish blue, not very vivid. Sounds like the lake.

74^L13^A19^B is a fairly light red, tending toward yellow, very typical of a fleshtone.

52^L81^A(7)^B, extremely magenta with a slight hint of blueness, is by far the most vivid color in the quiz. It represents the artificial circles of Figure 1.11.

67^L(3)^A(30)^B is the second blue in the set, but it's much more intense than the first—(30)^B as opposed to (10)^B. It's the blue sky in Figure 1.1A.

The answers, therefore, are:
1=E; 2=B; 3=A; 4=D; 5=C.



of the CMYK repertoire. So the blue bar makes a lot of things darker, taking a nasty bite out of the pear. Both the magenta bar and the red corner almost wipe out what's beneath them.

If you don't like the idea of darkening and lightening when we are supposed to be affecting color only, consider the alternative. Or, better yet, consider how you would reverse-engineer Figure 2.3C. Suppose you are given only the grayscale version of the picture, and a copy of the printed page showing the color bars, and asked to duplicate the look, using only RGB.

There would be no problem creating the shapes of the bars, but things would bog down thereafter, because RGB can't construct colors that are out of its own gamut. Without them, attempts to blend with pure color can't change the underlying luminosity, and if you can't change the underlying luminosity you can't get any kind of yellow at all where it overprints a white object such as the plate.

Therefore, if you're trying to colorize all or part of a document, LAB will give a smoother look that's hard to duplicate elsewhere. Smoother is not always better. If you're trying to turn a photograph into a duotone, LAB may give you more consistent color, but that's not a

Figure 2.6 The structure of LAB's channels is logical but often produces colors that can't be matched in other color-spaces. Each of the above had no lightness variation when in LAB, but conversion to CMYK has produced some.

big traditional selling point for duotones. Most people will prefer the higher-contrast ones made by a simple mode change. On the other hand, if realism is what you're after, the impossible colors of LAB can be a major ally.

Figure 2.6 shows how the A and B interact—and offers a strong reminder of how color and



Figure 2.7 The originals of Figure 2.6 had no variation in their L channels. When converted to other colorspaces their luminosity did not remain constant, as Photoshop tried to compensate for the inability to match certain colors. The effect is particularly visible in the lightest of the three versions, where every colored area except yellow has been darkened. These images were converted to grayscale not from the LAB originals, but from the CMYK print files.

darkness can't be divorced altogether. Each of these graphics was constructed in LAB with a completely uniform L channel: 45^L , 65^L , and 85^L , from darkest to lightest. Covering it are the nine possible permutations of the values -50 , 0 , and $+50$ in the A and B. One of those nine produces gray. 0^A0^B . The other eight represent the four LAB primaries of blue, green, yellow, and magenta, plus the four LAB intermediate colors of cyan, yellow-green, red, and purple.

The lower right corner of Figure 2.6A demonstrates the truth of an earlier remark: if it isn't light, it isn't yellow. 0^A50^B , that's supposed to be yellow, and in Figure 2.6C, when 85^L is added, yellow is what I'd call it. If, instead, we use Figure 2.6A's 45^L , I'd call that color mushy brown.

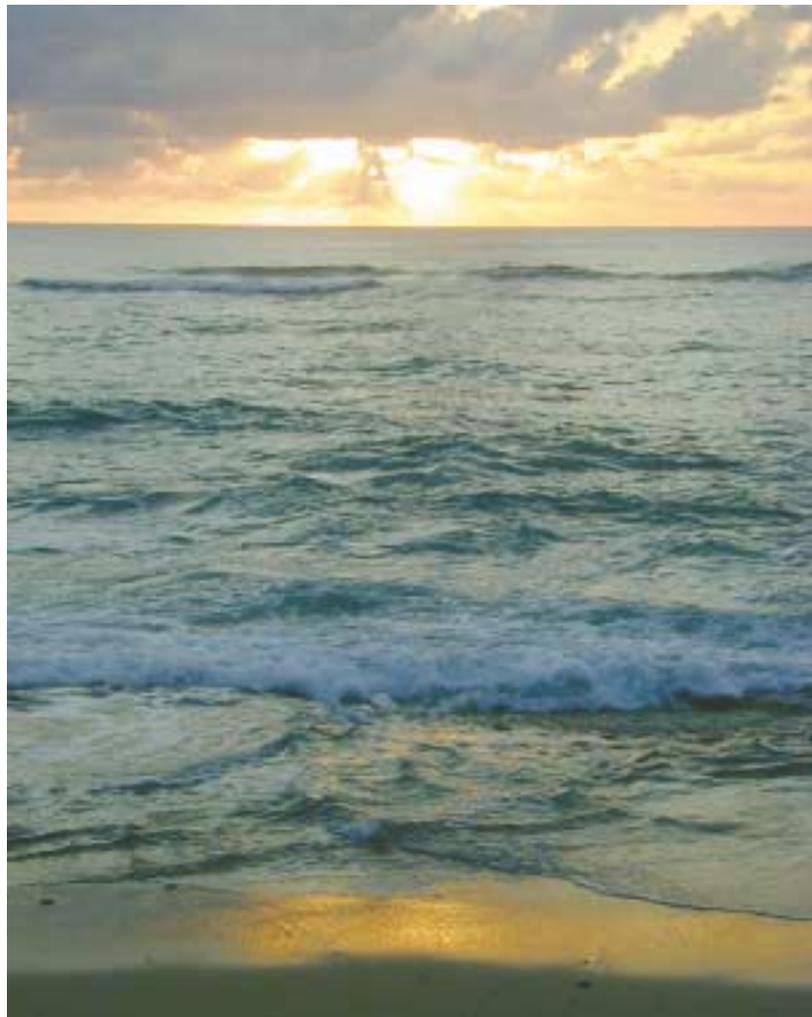
That's not the only surprise here: one primary and one intermediate color aren't quite the hue that one would expect, or at least they aren't what I would expect if I had never heard of LAB.

$(50)^A0^B$ is supposed to be green. That's not what I'd call it. In all three of these images, *teal* is a better description. To be

Figure 2.8 Steepening the AB channels is the most natural way of adding extra color to the brightest area, a common need in sunset images like this original.

considered green, I think that color has to move part or all the way toward the one at right center of each image, $(50)^A50^B$.

Also, 50^A50^B is supposedly *red*. This is a real orange-looking red to my way of thinking. Be



aware that most real reds, other than human faces, need a higher value in the A than in the B.

As with Figure 2.5, I've made grayscale conversions of each of the three CMYK files that make up Figure 2.6, to show how Photoshop is adjusting the luminosity of out-of-gamut colors in a desperate effort to match the unmatchable. If these grayscale images had been generated di-



rectly from the LAB files, each one would be an even, solid, flat gray without any tonal variation in the colored areas. They weren't, and they aren't. Where colored areas break away from the gray background in the actual files, it's an attempt to compensate for something out of gamut. And, the lighter (greater) the L value, the more out-of-gamut colors there will be.

Photoshop can't figure out how to make a dark cyan, so it substitutes a lighter one, but that's the only questionable area in Figure 2.7A. As the background gets lighter in Figure 2.7B, the blue and purple patches join the fun.

When the object gets as light as 85^L, as it does in Figure 2.7C, almost nothing works. The yellow patch is the only one of the eight colored areas that hasn't been significantly darkened.

So, where the image is light, and the LAB file calls for it to be colorful as well, it's apt to get darker when it enters either CMYK or RGB. This sounds like a strong incentive not to let such colors occur in LAB in the first place. In fact, it's an incredibly valuable, if perverse, part of the LAB magic, one that can enable effects not otherwise thinkable.

So Hurry Sundown, Be on Your Way

In print, we can't manufacture colors brighter than blank paper. This is unfortunate when the image contains the sun or some other extremely bright object, and explains why so many photographers expend so much time and energy trying to get the best artistic effect out of their sunset shots.

A setting sun is a brilliant yellow-orange.

That's the whole problem. In print, we only get to choose one of those two adjectives. Blank paper is the most

Figure 2.9 This corrected version of Figure 2.8 was produced by steepening the AB channels by an equal amount. The L channel was not altered. Below, an enlarged look at the area around the sun.

brilliant thing available to us. Add color, and it's no longer as bright.

Historically, those who enjoyed such limited success as is possible under these straitened circumstances have usually left the center of the sun blank but exaggerated the transition to orange around it, hoping to fool the viewer into perceiving a colorful sun. Any contrasting colors also get hiked.

Boosting colors by steepening the AB curves is technically better than any analogous move in RGB or CMYK. The advantage is never more clear than in images like Figure 2.8, as the following competing efforts demonstrate.

Figure 2.9 is the LAB entrant. It's nothing more than a repetition of the AB curves applied back in Figure 1.9 to the image of a desert scene. In the interest of a fair competition, one limited to color only, I did not touch the L channel. Also, I made sure that the A and B curves were identical, as no move in RGB easily duplicates the effect of different angles in the AB curves.

Figure 2.10 tries to achieve the same thing in RGB, using the master saturation control in Photoshop's Image: Adjustments>Hue/Saturation command. I was trying to match the general appearance of Figure 2.9, but couldn't come close. In LAB, most of the extra golden tone goes into the area around the sun, where it belongs. In Figure 2.10 it goes into the foreground beach. And the water winds up being too blue as well. We call them *whitecaps* for a reason.

The magnified versions highlight another major problem. As is common with digital captures in vicious lighting conditions, there's a lot of artifacting: strangely

colored noise, particularly in the clouds around the sun. The enlarged pieces show that Figure 2.10 is a disaster area in this respect, while Figure 2.9 is reasonable.

People who know their LAB recognize immediately that this is a case for blurring the A, and especially the B channel. We'll be discussing that topic in Chapter 5, but no blurring was done here. The simple straight-line curve in these two

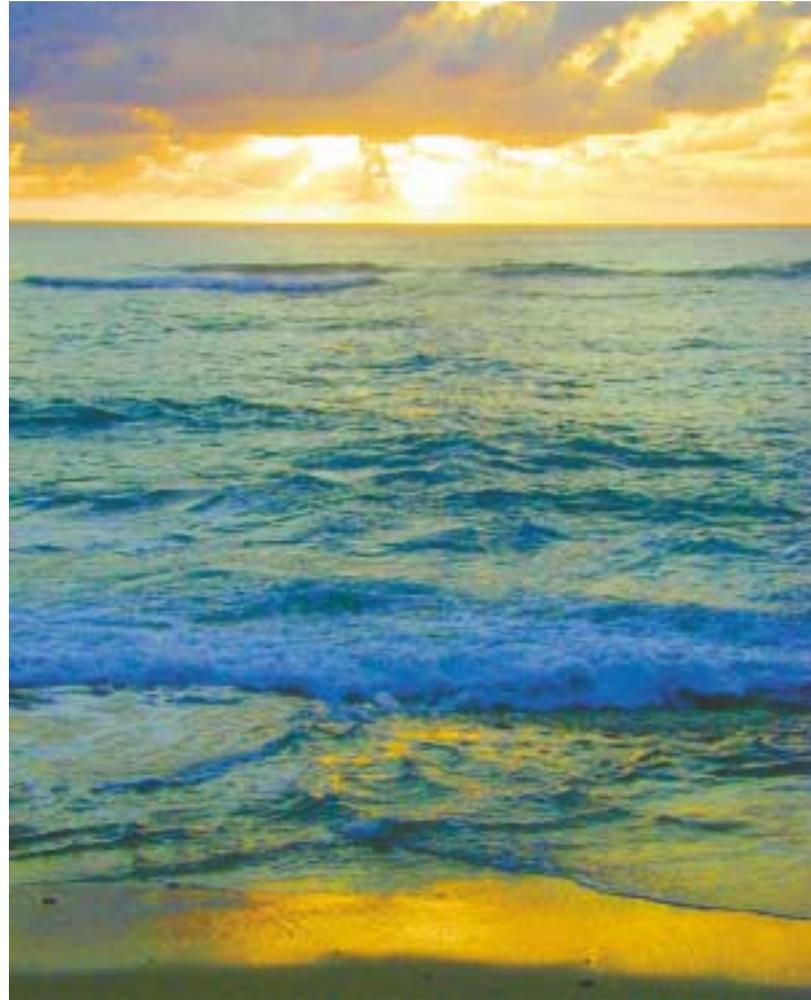


Figure 2.10 This version was produced in RGB, using the Hue/Saturation command. Although many colors have been exaggerated more than in Figure 2.9, the critical sun area is much less intense. Also, there is serious artifacting in the sky.

color channels brought up the color variation without also bringing the defects out.

This picture exploits LAB's propensity to make impossible colors. In RGB, the brightest color is and must be a pure white, $255^R255^G255^B$, and any attempt to add color must also darken.

In LAB, where color and contrast live apart, pure lightness— 100^L , in LABspeak—*can* be

The Bottom Line

The LAB way of defining color by two opponent-color channels is not exactly intuitive, but it makes eminent sense once you get used to it. Positive values represent warm colors: magenta in the A, yellow in the B. Negative numbers are cool colors: green in the A, blue in the B. And values of zero are neutral.

The L channel can best be understood as a black and white rendition of the document, although somewhat lighter. Its numbering system is the reverse of grayscale: 0 for darkness, 100 for lightness.

Many LAB formulations are out of the gamut of either CMYK, RGB, or both. On conversion out of LAB, Photoshop usually adjusts their luminosity in a futile attempt to match the color.

accompanied by a color value, even a totally obscene one. A value of $0^L120^A100^B$, for example, would be totally black but simultaneously more brilliantly red than a laser beam. I doubt that such color exists in real life, but LAB thinks it does, and can call for it.

Here, the demand—a color as brilliant as possible, but orange—isn't quite so unreasonable, but it's still asking for the impossible. Photoshop, scrambling to comply, splits the difference, adding a gradual move toward yellow and thus allowing some darkening. Figure 2.10 lacks the pleasing impact of Figure 2.9, because when working in RGB, we can't call for any colors that RGB is incapable of producing.

Using an imaginary color in LAB to enable an otherwise impossible effect in print is an idea that will be getting quite a workout in the following pages, particularly in Chapter 8. The idea that we should try to fix real pictures by adding imaginary colors that can't be seen or printed is, to put it mildly, a radical alternative. But, like most radical alternatives, it has an attractive side. I wish we could steer clear of the *other* side as easily with politicians as we can with LAB.