

Hittin' 'em Where They Ain't

Topic: Unsharp masking

Column first appeared: April 1998, *Electronic Publishing* magazine.

Source of this file: The author's draft as submitted to the magazine.

Author's comment: This second of two 1998 columns laid the groundwork for the soft mask-based sharpening in vogue today. It teaches that certain areas, like fleshtones, don't accept sharpening as well as others. It suggests taking advantage of channel structure to avoid problems.

This archive, to be released over several years, collects the columns that Dan Margulis wrote under the *Makeready* title between 1993 and 2006. In some cases the columns appear as written; in others the archive contains revised versions that appeared in later books.

Makeready in principle could cover anything related to graphic arts production, but it is best known for its contributions to Photoshop technique, particularly in the field of color correction. In its final years, the column was appearing in six different magazines worldwide (two in the United States).

Dan Margulis teaches small-group master classes in color correction. Information is available at <http://www.ledet.com/margulis>, which also has a selection of other articles and chapters from Dan's books, and more than a hundred edited threads from Dan's Applied Color Theory list.

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Hittin' 'em where they ain't

To avoid unsharp masking disasters, find the channels that contain noise and unwanted detail—and do your sharpening elsewhere.

By Dan Margulis

Willie Keeler, who 100 years ago was a Brooklyn Dodger, didn't look much like a professional baseball player. Standing only 5'4", he couldn't hit the ball very hard, and the 30-inch, 29-ounce bat he had to use remains the smallest in major league history.

When he got a hit, therefore, it was almost always only a single—but what a singles hitter he was: 2,513 of them over 19 years, a .341 lifetime batting average, and eight consecutive years with 200 or more hits, a record he still shares with one Pete Rose.

Wee Willie, as he was known, is, therefore, a member of the Hall of Fame. When asked his secret, he revealed it in the following memorably succinct form.

"I hit 'em where they ain't," he said.

In trying to make our images look as crisp as possible in print, we face our own set of physical disadvantages.

Printed pieces tend to look blurry and soft, as the center image below does. We have to take some kind of action to restore its focus. But many images throw us the digital equivalents of curveballs. Swing for the fences, and we strike out, as happened in the left-hand version.

Such disasters can be avoided if we remember the lesson of Willie Keeler: know where the opposition is—and aim somewhere else.

Are these crops tight enough?

This is the second column in a row on unsharp masking technique. Such attention is justifiable, in my opinion, because in the age of desktop scanning and digital photography, proper use of

USM is highly important, and highly misunderstood.

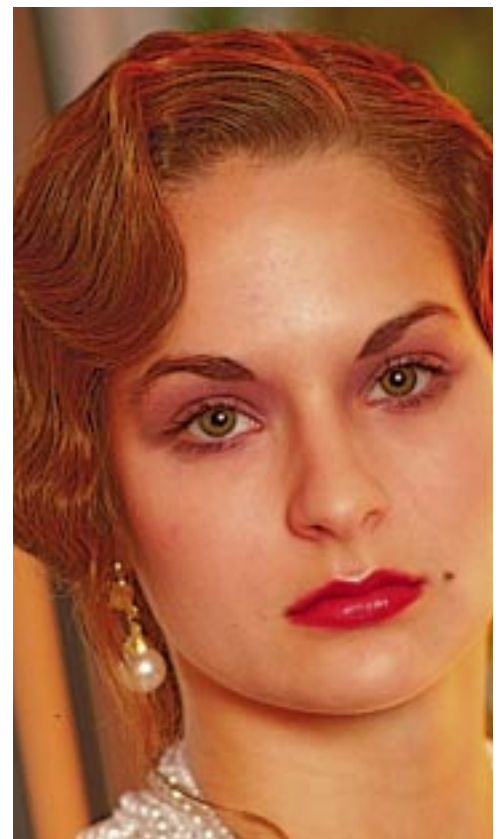
Highly important, especially for larger images, where judicious USM is every bit as potent as the other big weapons in the retoucher's arsenal: appropriate highlights and shadows; good allocation of contrast; and careful use of the black plate.

Highly misunderstood, for much the same reason. There are lots of USM options, but they aren't particularly important if the image is small. Small images do need sharpening, don't get me wrong, but the exact setting won't make or break quality, the way it will in large ones.

And yet, virtually all existing documentation, from Adobe's manuals to third-party Photoshop how-to books, illustrates the USM options with images the size of postage stamps. As Willie Keeler shows, baseball players can be effective even if they are small. Examples illustrating the effect of unsharp masking are another story.

The reason for the thumbnail approach is, of course, that it's expensive to print large color pictures on docu-

Faces are the biggest unsharp masking problem. The original image, center, is too soft. But a careless sharpen, left, can cause the illusion of a skin disease. By avoiding the sharpening of channels that contain facial detail, the hair and eyes can be made more realistic, as at right, without damaging the skin.



mentation. I have that limitation here, too: note the excruciatingly tight crops I've had to use to make everything fit. But it's just too hard to see the detail otherwise—and remember, if these images were printing larger, the sharpening defects would be even more evident than you see here.

A few new wrinkles

Last time, we discussed how to avoid exaggerating what might be termed artificiality—the grain of the film, or random noise in the image. The detail in the face of the young woman on the previous page, however, is not grain, not noise, nothing artificial at all, just the natural variation of her skin. Adult humans, even young ones, have skin constructed not of alabaster, but rather of a flexible organic material, highly useful for insulation and in resisting injury, but somewhat unforgiving of acne scars, and entirely too prone to wrinkling.

Careless USM of facial details, therefore, can make Cindy Crawford look like Louie the Lizard. While doing so would be all right with my wife and certain others, it's not too likely to be what an art director wants.

And yet, the original is too soft, especially in the hair. Note that even in the version with the reptilian skintone,

the hair is *not* overfocused. The question is, how to get such hair, and at the same time a natural-looking, yet not overdetailed, skin.

You may think of somehow selecting the hair, or rather deselecting the skin, before sharpening. That approach, in my experience, always falls short: one winds up with what looks like two images pasted together.

Better alternatives are to sharpen by luminosity only, which reduces the impact of the facial imperfections by not allowing them to get so red, and/or to employ a relatively high Threshold in Photoshop's USM dialog box. This will eliminate the sharpening of some of the subtler detail at the cost of limiting the sharpening of the hair. Some of the more pronounced wrinkles will still be accentuated.

But the best way of all is to finesse the whole problem, by doing the deed where it can do no harm—in other words, to hit the image where the facial detail ain't. And I can tell you exactly where it ain't, by means of a simple rule that applies not just to faces, but to *any* image:

In all things red, green, or blue, there

The older the face, the more care needs to be taken. The original, left, doesn't do justice to the man's pepper-and-salt hair. The key to getting it sharper, as in the second example, is to avoid the magenta plate (center) in favor of sharpening the cyan and black (right), which have detail in the hair but not in the face.

will be more subtle detailing in the two darkest channels than in the other(s).

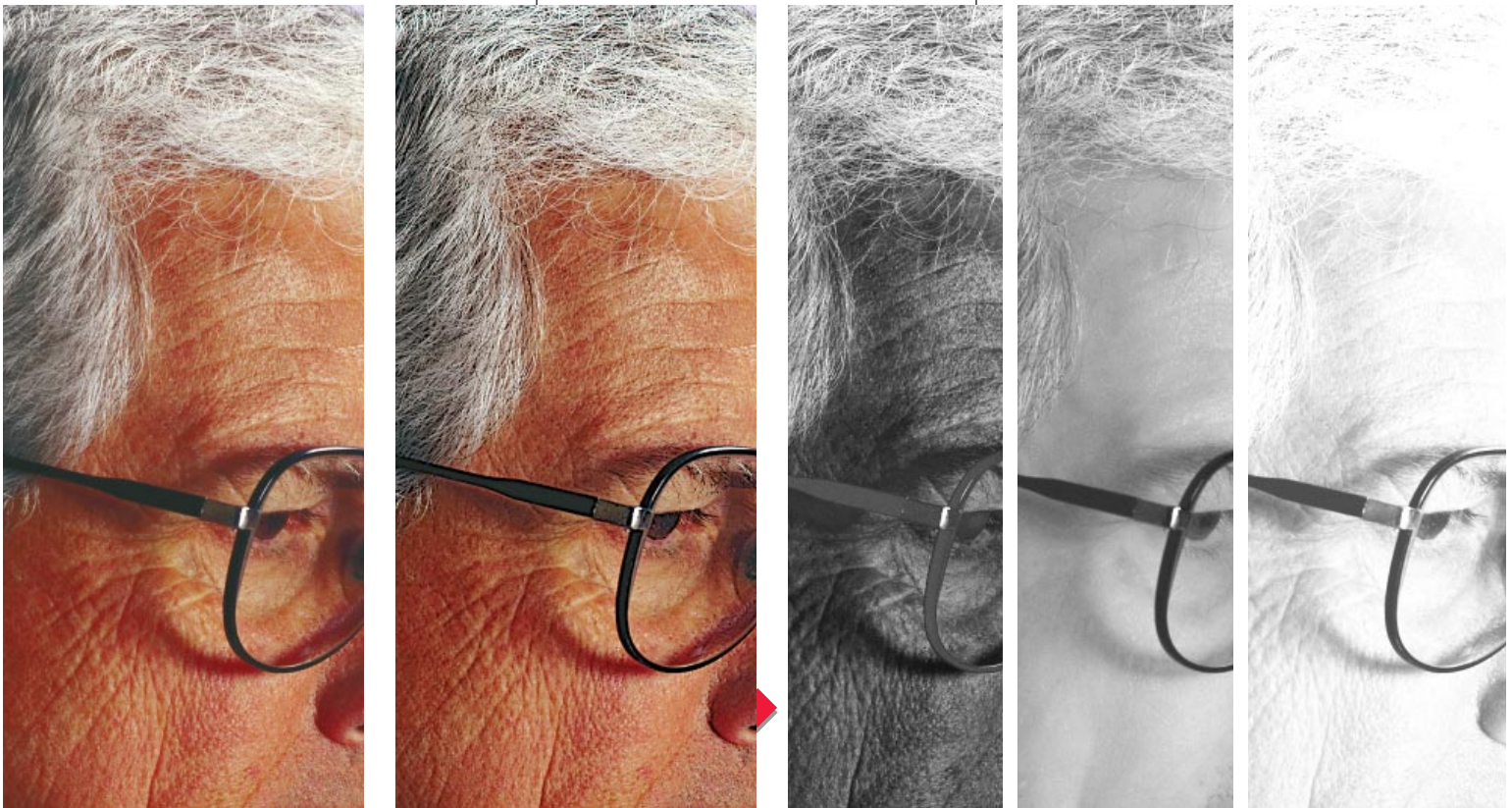
A face is red. The two dark channels are magenta and yellow, if we are in CMYK, or green and blue, if we are in RGB. These are the channels we would like to *avoid* sharpening.

USM is even more dangerous in the face of an older person, whose skin is always more irregular. The man on this page has pepper-and-salt hair. You wouldn't know this from the original, where it looks like a flat gray. That will never do. We must attack, but not at the cost of making him a Methuselah.

The leatherlike magenta plate shown below is therefore the absolutely last thing we would want to sharpen. Compare it to the cyan plate, and to the black, where the face is virtually a blank. These two channels can therefore be sharpened with a heavy hand. If there's no detail there to begin with, USM won't make it materialize out of thin air.

With the image of the woman on the first page, I didn't even bother with the cyan. The only channel I used was the black—but I really hammered it.

For those who are similarly moti-



vated to sharpen the weak channels, there is a huge advantage to sharpening in CMYK rather than RGB, where the weakest channel will still be heavier than either of its two CMYK counterparts. Generally, the best colorspace for sharpening is neither CMYK nor RGB but LAB. In cases like the ones shown here, though, one can get decidedly better results in CMYK.

The eyes have it

Knowing where to sharpen is one thing, and knowing how to do it another. Time, then, to shift our attention to Amount, Radius, and Threshold, the three variables in Photoshop's USM filter.

Threshold is the most straightforward. As the Threshold increases, Photoshop starts to ignore variations between areas of similar darkness, in favor of bigger-ticket items. This would work to some extent in the magenta plate on the opposite page: there's a huge difference between a white hair and a black one, but not so much between normal flesh and an old scar. A high Threshold setting is a good way to avoid sharpening mild amounts of noise. It is somewhat less effective in faces, where the idea is not to suppress noise but to avoid accentuating actual detail.

The Radius and Amount settings define what happens when Photoshop encounters a transition area. Both settings emphasize the transition, but in different ways, as the example on this page indicates.

Granted that the transition between colors in the original is razor-sharp, why do we need to emphasize it? The answer is surprisingly simple: the digital file may look great, but we print with halftone dots, and those dots are wider—a lot wider—than the line of transition between purple and gold. Result? Blursville.

If this were a real photograph and not something generated artificially, there would be a further complication. The line of transition would also be narrower than a *scanning sample*. So, the scanner would add even more

blurriness on top of the contribution of our lousy printing process. This, in short, is why *all* images need some kind of sharpening. The question is, of course, what kind.

The Radius setting, to my mind, is the most important of the three options. It regulates how wide the characteristic sharpening halo will be. The Amount setting, on the other hand, determines how ferocious the effect is, but not its width.

There is no such thing as an image that is too much in focus. The idea of sharpening is to do as much of it as possible without being detected. If we use too high an Amount, we will be detected, because the image will seem too noisy, even if the Radius is correct. And if we use too high a Radius, we will lose subtle detail, even if the Amount is right.

In their eternal search for mathematical verities, certain calibrationists have been known to suggest that the Radius should depend on totally on the resolution of the scan. This is like saying that the larger a suitcase is, the heavier it will be. There is a certain amount of truth there, but the fact is

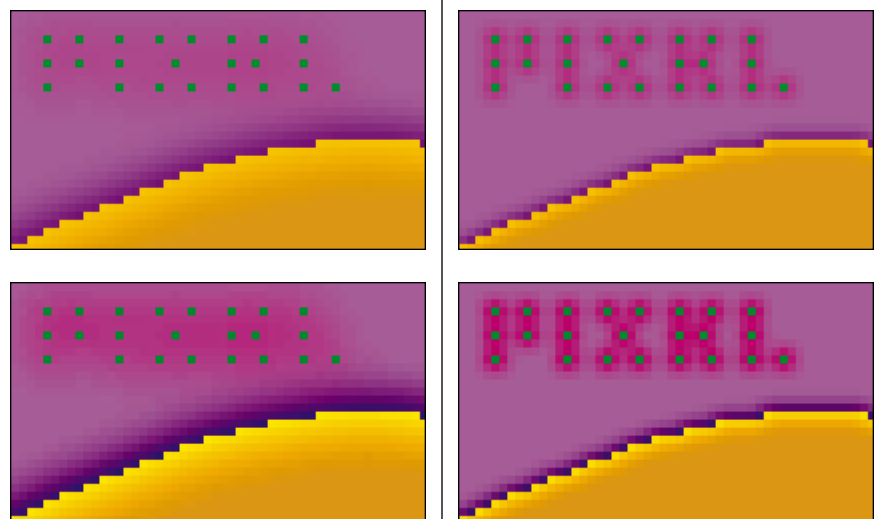
that the contents of the suitcase have a considerable impact, and that a smaller suitcase filled with lead is apt to weigh more than a larger one filled with clothes. And so it is with images, even if we set aside the obvious fact that certain photographs have more grain than others of the same size, and thus cannot be sharpened as much.

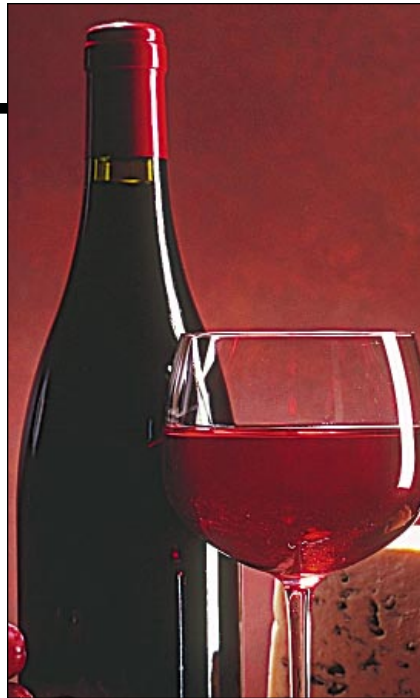
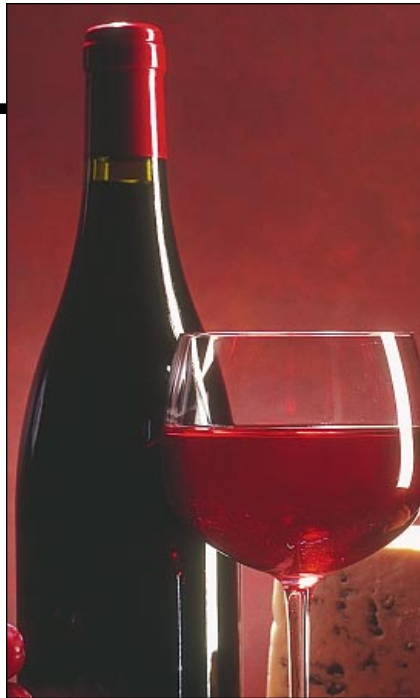
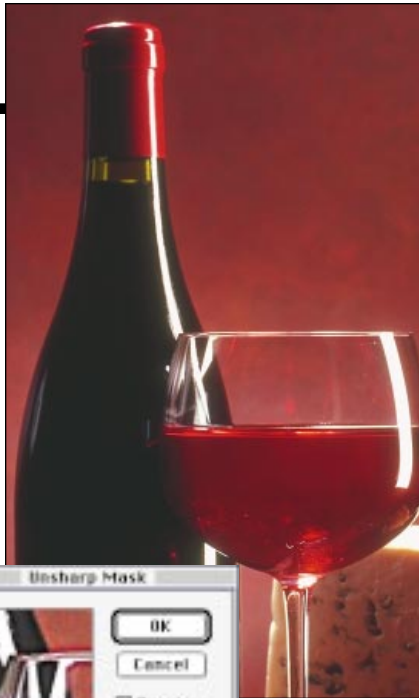
Imagine that the opening shot was a woman shown from the waist up, rather than in a tight closeup of the face. No advanced degree is required to realize that this would present two different sharpening problems, because the size of the detailing would not match, even if the images themselves were of identical resolution.

Accordingly, there is really no substitute for thinking. Given this tiresome necessity, here are some of the things you should think about.

Widening objects with a large Radius can be very effective. Notice that in spite of the softer face, the entire area of the eyes in the correctly sharpened image of the woman is better than in the oversharpened version. That's the Radius at work. The eyelashes are *wider*. So are the dark parts

Greatly enlarged, the differing effects of Photoshop's Radius and Amount settings are clearly visible. Clockwise from top right: the original; USM with 200% Amount and 1.0 pixel Radius; 400% and 1.0; 400% and 3.0; 200% and 3.0. Inset in this caption: the size at which such an image would usually appear.





When an image doesn't have subtle detail, consider a wider Radius setting. Above right, a version using a value of 3.0. Center, the same values with Radius reduced to 1.0. Left, the raw image.

of the iris. And there is a hint of added weight in the eyelids, digital eyeliner, if you will.

This is all very nice, but before wheeling out a big Radius, we have to be sure that there is nothing in what we are sharpening that has subtle detail, of which big Radii are the enemy.

Small and *subtle* are not the same thing. An eyelash is small, but not subtle. The variations in the skin of the man are subtle, but they are not small.

In larger images, the details are more crisply defined. Hence, in principle a larger Radius will do less damage. But don't be afraid to use a big Radius on a small image, provided you have the right small image. If you don't agree, check out the small wine bottle image on this page.

Where is the subtle detail inside the bottle? Where is the big color difference between bottle and background? If you don't see these things, I don't either, and I conclude that a wide Radius will work better. Do you agree?

The character of the image, therefore, plays a much bigger role in determining the best Radius than resolution does. Ask yourself, is there fine detail, or not? A person's hair, a wine bottle, the bubbles in a glass of soda: these things want a wide Radius. The

bark of a tree, the skin of a fruit, a field of grass, the fabric of the soldier's uniform on the next page, all have subtle detail that a large Radius would kill.

But where both kinds of detail appear, we are forced to go with the least common denominator, and choose a narrow Radius, even though it is a second-best way of sharpening gross objects. This is why the Willie Keeler method is so very important in images like the faces we have been working on. We need to find a channel that does *not* have subtle detail. In a face, that's the black, and often the cyan too. So, with the woman on the opening page, I was able to use a Radius of 3.0 in the black channel, because as a practical matter the black contains only the eye area and the hair. And the Amount? I used Photoshop's maximum, 500%. If you hit the ball accurately enough, how hard you hit it doesn't matter.

Glitter and be gay
The unsharp masking filter by itself does not yield a perfectly sharpened image. The careful artist needs to work with Photoshop's sharpening tool as well. The tool isn't nearly as flexible as the filter, but it's highly useful in dealing with small areas, to add that last touch of believability. At the very top of the wine glass, there is a tiny sparkle of reflection on the left side where the

glass touches the background. That little highlight should be sharpened. The sharpening tool will make it lighter and wider.

In fact, we don't care if there should be no dot at all in this particular sparkle. And that is the key rule for the use of the tool. Use it on anything that glints, because for such the brighter the better, meaning a zero dot.

More of these targets are hanging around than you might think. Let's take a quick look at the images in this column, starting with the young woman. She is wearing earrings. They glint. They should be sharpened with the tool. There is a sparkle in the center of her eyes, very important in seeming to wake the face up. That, too, should be sharpened. And, just as we should sharpen small areas where a pure white is desirable, so should we attach those where we wouldn't mind a pure black. Namely, the eyelashes, eyelids, and possibly parts of the eyebrows as well.

The older man is not kind enough to be looking at the camera, so we can't sharpen the center of his eyes. But wire-rimmed glasses are a tempting target, especially the lighter metal of the hinge. This guy's frames are black. If they were the more typical gold, it would be even more important to sharpen them. Such glasses vanish right into the skin without it.

There are a couple of places in the stem of the wine glass that could stand sharpening, in addition to the area pointed out previously. And the image of the soldier on this page has more objects that glint than the White House has subpoenas.

It's more than a little doctrinaire to sharpen the soldier *only* with the tool and not the filter, as I have done here, (and I wouldn't do it in real life) but it isn't hard. The tool is crude enough that we don't need to vary its settings much, the way we do with the USM filter. Personally I vary the brush size, but I always use 40% pressure with method set to Luminosity.

As for the numbers one should use with the USM filter, I will admit to having been somewhat evasive. Unlike most other areas of color corrections, fixed formulas and rules don't apply. A certain amount of playing around is necessary.

Also unlike most other areas of color correction, here we really have to rely on the monitor to figure out whether our sharpening settings are sufficient or whether we have gone overboard. That's a tall order, since the phosphors of a monitor don't correspond to the realities of either desktop printers or presses. We have to make the best of it, though, by being resolution-savvy. First of all, we should be viewing the image in Photoshop at 100%. Lower magnifications are unreliable on most monitors; higher ones cause needless ulcers by displaying defects that will not be visible in print.

More important, though, if our file departs from the normal rules of resolution we need to make an adjustment for it in our minds. Normal resolution, by universal agreement of the experts, is between 1.5 and 2 times the screen ruling, times the magnification percentage. This magazine, for example, uses a 133-line screen, so normal resolution for my digital file is between 200 and 266 pixels per inch. My images here are all around 225, and I am printing them all at 100% magnification. If I were printing one at 75% magnification, that would result in a higher than



Local areas that sparkle are natural targets for Photoshop's sharpen tool. Note, at left, how many such areas there are. The image at right is sharpened only with the tool, and not with the more powerful USM filter.

normal range (225/.75=300).

When resolution is higher than normal, the printed image will appear markedly softer than it will on the monitor. When resolution is lower than normal, the printed image will appear harsher. Be warned! If, as so many people do, you work with 300 ppi scans regardless of the screen ruling, your monitor will be lying to you about how effective your USM is.

Location, location, location

If you are working with large, important images, it is well worth the time to experiment with different sharpening settings. With experience, adjusting the three numbers becomes intuitive. But if you are (for the moment) uncomfortable with how they interrelate, here is a tip.

The Amount setting is a lot more obvious than the other two. So, save it for last. Start with a setting of 500%, the maximum, and with a 1.0 pixel Radius and a Threshold of zero. Although this will normally seem hideously harsh, it will also show

whether you are sharpening noise and/or unwanted detail. If so, start adjusting the Threshold upward.

After the Threshold is set, turn to Radius. Increase it until it seems to you to be starting to obliterate needed detail rather than emphasizing it. And once you know the proper Threshold and Radius values, it's pretty easy to adjust the Amount down. But if you start with a proper Amount, it's not so simple to figure out what the right Radius and Threshold should be.

As Wee Willie Keeler demonstrated, brute force is no match for intelligence. The biggest gain in sharpening remains avoiding the channels with unwanted detail, allowing a much heavier sharpen of the weaker ones that add contrast. In baseball and in unsharp masking, raw power is good. Accurate placement is better.

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