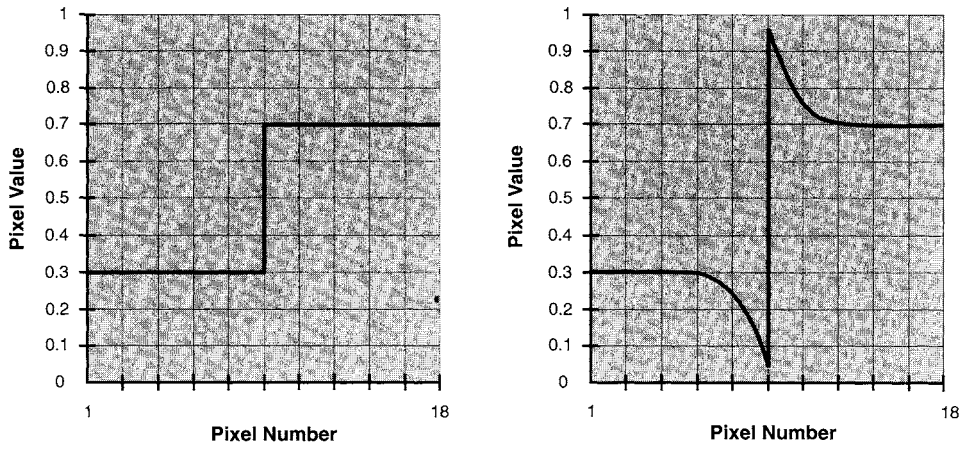


Figure 3.15 *(a) Graph of Figure 3.14a. (b) Graph of Figure 3.14b.*

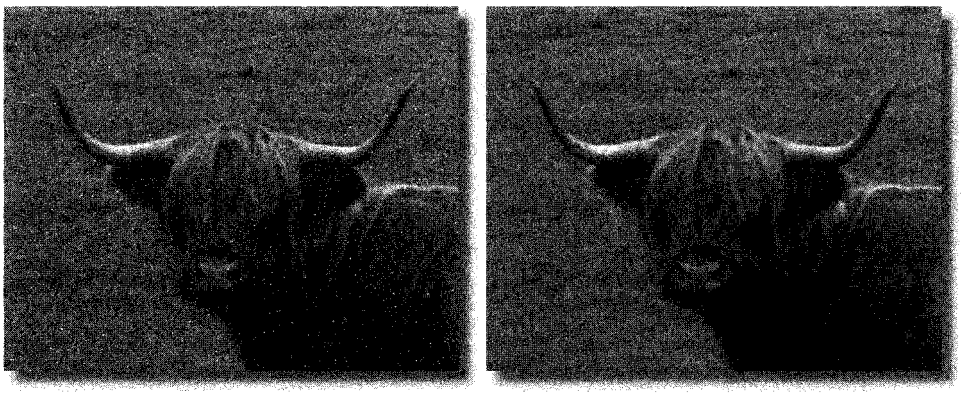
to do our sharpening, increased sharpening amounts would be produced by increasing the weights of the coefficients in our matrix, and an increased extent would be produced by using a larger matrix.

Plate 17a is an original image, with no sharpening applied. Plate 17b has had a slight sharpening applied, with subtle but noticeable results. Plate 17c has had a far greater amount of sharpening applied, to demonstrate the type of problems that can show up. Now that you are familiar with what sharpening is really doing, it should make sense that oversharpening will cause you to see noticeable **ringing** along strong transition areas, such as the edges of the stones against the sky in the example. You should also be able to see that the sharpening has increased the amount of apparent grain in the image—an artifact that would be even more noticeable if it occurred on a sequence of images.

Median Filter

Certain spatial filters do not use a specific weighted matrix to determine the way pixels are averaged together. Instead, they use other rules to determine their result. One such filter is the **median filter**. Quite simply, it ranks all of the pixels in the kernel in terms of brightness and then changes the value of the pixel in question to be the same as the median, or center value, of this ranking. The net result is that the median filter does an excellent job of removing single-pixel noise artifacts, while causing only a slight reduction in the sharpness of the image.

Figure 3.16a is an image with some noticeable noise spikes—small bright and dark spots. Figure 3.16b is the same image after the application of a median filter.



(a) (b)

Figure 3.16 *(a) Image with noticeable noise spikes. (b) Same image after application of a median filter.*

As you can see, the bulk of the noise has been eliminated. Applying the filter again in a second pass would probably eliminate the rest of the noise. This process does not come without a price, however, since each time a median filter is applied the image will be slightly softened. For this reason, median filtering is usually applied only within a certain threshold. The only pixels that will be replaced with the median of their neighbors are those pixels that vary by more than a certain amount from the original image. Areas that do not have any noise are not changed, and the overall image suffers far less softening than a normal median would produce.

GEOMETRIC TRANSFORMATIONS

The next class of operations we will be discussing all fall under the category of geometric transformations, or simply "transforms." A transform operation causes some or all of the pixels in a given image to change their existing location. Such effects include **panning**, **rotating**, **scaling**, **warping**, and various specialized distortion effects. We'll first consider the three simplest transformation effects: pan, rotate, and scale.

Whenever we talk about moving images around, we must realize that they have to be moved relative to something. It's easiest to just consider that the image is being moved relative to some predefined frame. In most day-to-day compositing work, the first thing we tend to do is define our working resolution, and everything is moved around inside of this frame. What we call a **working resolution** is typically the resolution of the image that will be produced once we are finished with our compositing operations.