Capturing the Colors of the Moon

Here's a clever technique for enhancing your lunar images and revealing a new face of our closest astronomical companion. By Filipe Alves

USUALLY WE SEE the Moon as a monochromatic world of gray with only dark shadows and the occasional bright area deviating from the uniform hue of the lunar landscape. There is, however, an aspect of the Moon's surface mostly hidden to the naked eye that anyone can capture with a camera, be it film or digital: the colors of the Moon.

If we carefully observe features on the lunar surface through a telescope, we sometimes notice tiny differences in the hues of various regions. The reason is that there are many different geological formations composed of diverse minerals. These exhibit some differences in color, even though they're very subtle to our eyes. Digital and film images can capture these slight variations, and enhancement by digital processing will allow us to see them well. Many times lunar astrophotographers using color digital cameras convert their images to black and white without realizing that they are throwing away precious and nearly invisible information about our great satellite. Software programs such as *Adobe Photoshop, Paint Shop Pro, Images Plus,* and others are capable of extracting and enhancing these subtleties to reveal a colorful and surprisingly varied surface. These images even compare well to the color-enhanced images taken with planetary probes such as the Galileo spacecraft.

Shooting the Moon

To get the most out of our digital images, it's im-

Enhancing the subtle color differences in our nearest celestial neighbor can be a fun and enlightening project — while many lunar astrophotographers strive to achieve a more natural gray appearance, the differences in hues can reveal clues to the geologic history of the Moon itself. Shooting with a 10-inch Newtonian telescope and a Canon 300D digital SLR camera at prime focus, Filipe Alves combined 64 individual images *(above)* and enhanced the color using the techniques he describes in the accompanying text to create the vibrant portrait at left. All images are courtesy the author.

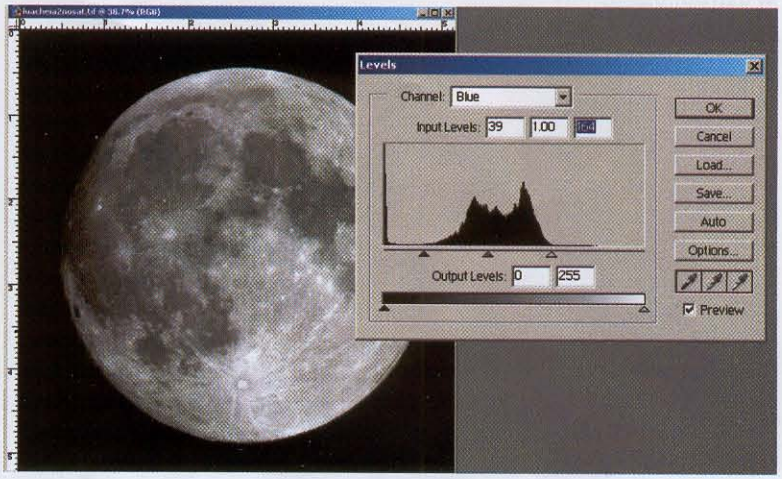
portant to avoid saving them with a "lossy" compression method. If your digital camera can save images in RAW format. This option preserves the highest amount of information of all the formats available. Nearly as useful is the TIFF format, which can be saved either uncompressed or with the lossless LZW compression method. TIFF is also the format to use if you are scanning film images. Astronomical CCD cameras can save files in FITS format, which is capable of storing more than 16-bit data. This format is especially good for images that are added together and thus may have brightness values that exceed the limits capable of being stored in TIFF or JPEG formats. If your camera can save images only in JPEG format, you'll be at a disadvantage compared to the results the other formats can give you. JPEG is a "lossy" compression algorithm — to make a file as small as possible, this format averages information and thus throws away some data. However, JPEG images can still be useful — just make sure you use the camera's highest-quality JPEG setting. You can also mitigate the effects of JPEG compression by combining multiple exposures with programs such as *RegiStax*, then saving the resulting image as a TIFF file. I'll describe this technique further on. Once you start shooting your lunar images, try not to overexpose the brightest regions, because the information in these areas is what you intend to extract. Try bracketing your exposures until you settle on one that works for your particular setup.

Revealing the Color

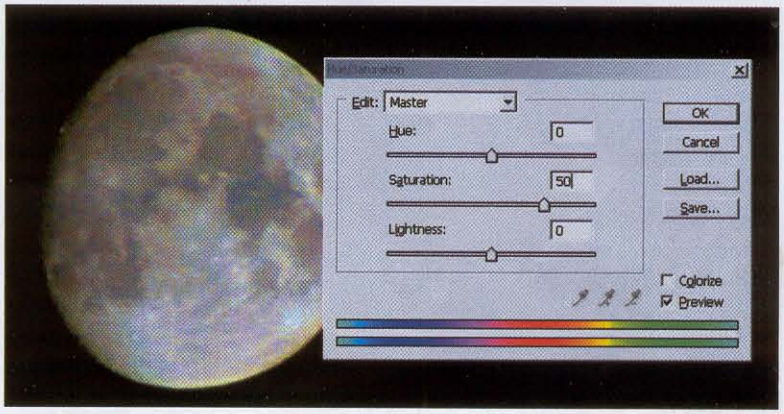
Once I've captured my images and moved them to my computer, I open them up in my favorite image-processing program and get to work. I use *Adobe Photoshop* for most of my processing, but other programs such as *Adobe Photoshop Elements* have many similar functions. With *Photoshop* I do an initial increase of the image's color saturation to see how well the color was recorded. Because my camera's automatic white balance very rarely defaults to the correct values when I shoot the Moon, one hue usually dominates all others, leaving me with a blue or orange Moon.

To repair this problem, I first undo the saturation step, then try balancing the color so that the red, green, and blue channels all have the same importance and the image achieves a neutral tone. There are several ways to do this, but none are perfect. I try using Auto Color (Control-Shift-B on a PC keyboard), Auto Levels (Control-Shift-L), or manually adjusting the red, green, and blue channels myself. I usually start with Auto Color, but sometimes it destroys information in the highlights. Once I am content with the color balance, I save the image as a new file — it's always best to keep a copy of my original unedited data so I can go back to it and start over if I feel the need.

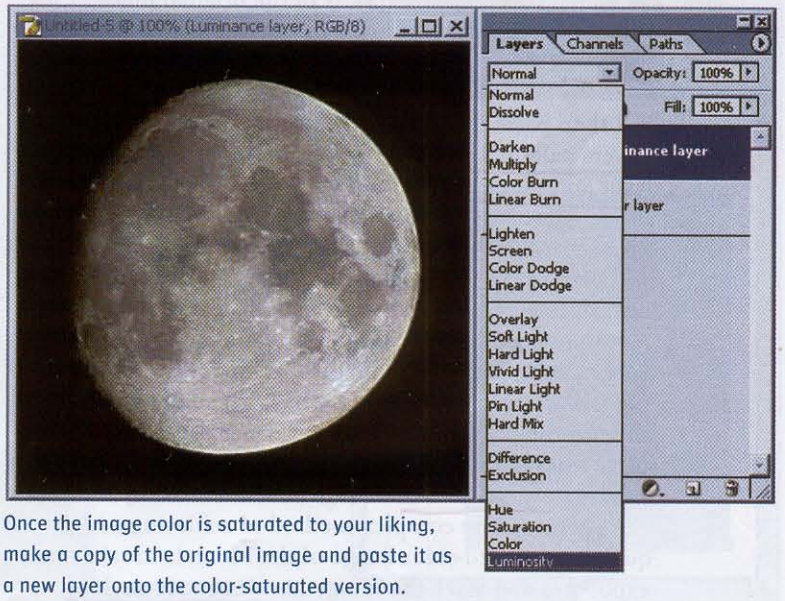
I then attempt to equalize the color channels manually with the Levels histogram (Control-L). When I'm content with this new color balance, I again adjust the color saturation. Usually I increase it by steps of +50 and try it two, three, or four times, as the result is quite different than if I boost it all at once. The image usually starts to look grainy as the saturation increases, because a single frame contains limited information about the subtle colors. JPEG images will be worse because the compression de-



Most images will need to be properly color balanced before their color saturation is increased. While the Auto Color Adjustment in *Photoshop* sometimes works well, it's best to manually adjust each color histogram using the Levels function and to tweak the separate red, green, and blue channels to achieve a neutral color balance without "clipping" (blowing out) the highlight regions.

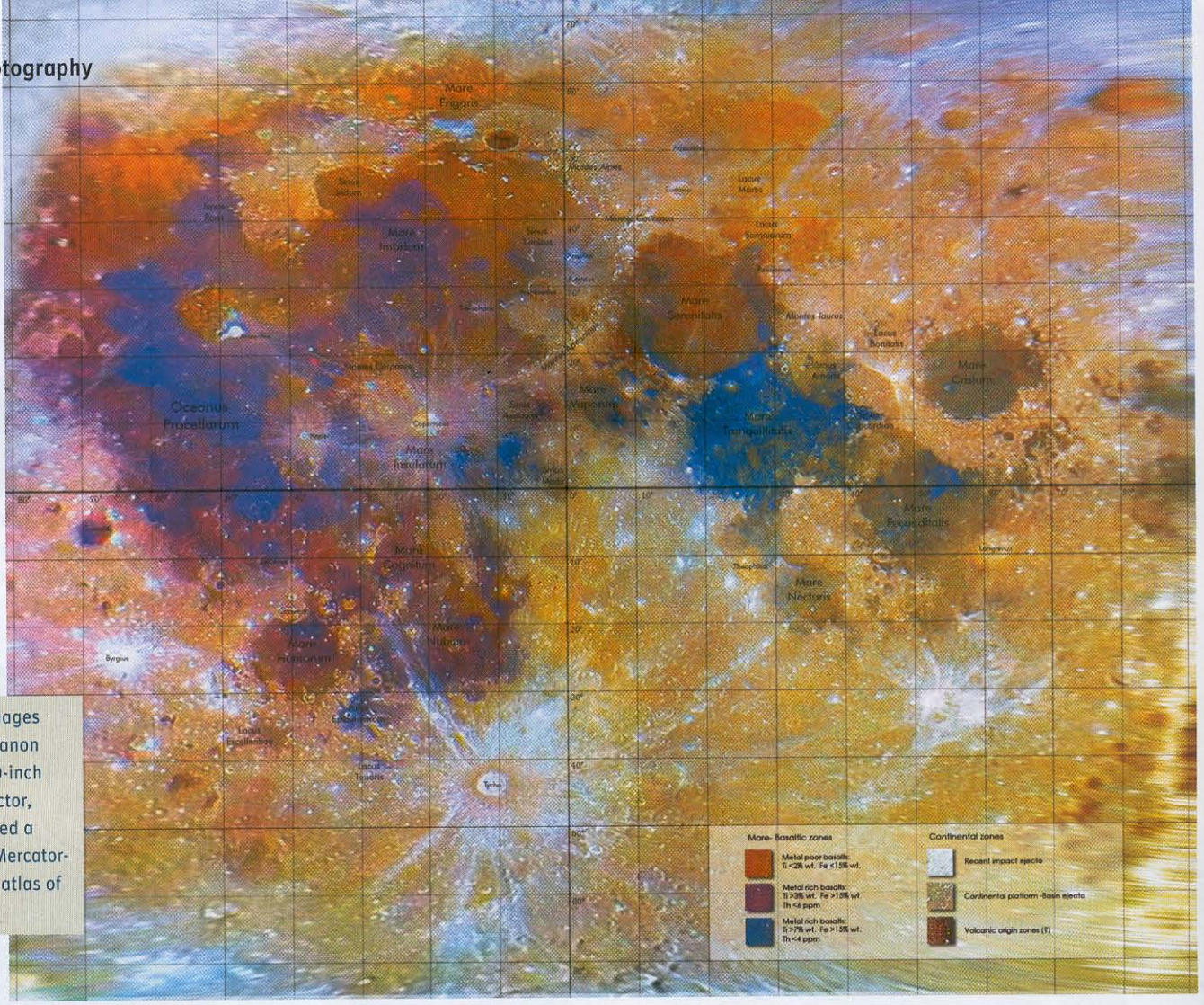


When increasing the image's saturation in *Adobe Photoshop*, use increments of +50 and repeat the step two to four times, because increasing by +100 in one step tends to add objectionable grain to the color data.



Once the image color is saturated to your liking, make a copy of the original image and paste it as a new layer onto the color-saturated version.

When you change the pasted layer from Normal mode to Luminosity, the sharpness of the original image is retained, while the new enhanced color shows through. By applying the Unsharp Mask filter to the Luminosity layer and Gaussian Blur to the color layer, you will help visually merge the best features of each version.



Using several images taken with the Canon 300D and his 10-inch Newtonian reflector, the author created a highly detailed Mercator-projection color atlas of the Moon.

stroys some of the color information.

At this point I have a rather grainy-looking but colorful image of the Moon. There are two ways to reduce the graininess and retain the sharpness of the original image. I use the following method when I'm working with only a single exposure. I save the saturated image as a new file and then open up the color-balanced (but not saturated) file and copy it. I then paste this onto my saturated file. Opening up the Layers palette, I now have my color file as the Background layer and my color-balanced version as Layer 1. Selecting Layer 1, I change the blending from Normal to Luminosity. By adding this luminance layer, I can recover the sharpness and detail of the original and keep the enhanced colors of my saturated version. I now have a sharp image of the Moon, but the colors still look a bit grainy. Selecting the Background layer, I'll apply the Gaussian Blur filter with the radius set to a few pixels, which is usually enough to smooth the grain out of the color. Once I'm happy with these results, I use the Unsharp Mask filter on the Luminosity layer, then flatten the image and save it as my final file.

A slightly more complex method of achieving a high-quality enhanced-color image of the Moon is to take many exposures and stack them together. Programs such as *RegiStax* can precisely align and combine many separate frames. This is the key to achieving good results with JPEG files. Stacking multiple images will reduce the noise level in the images to almost imperceptible levels, while retaining the sharpness of the original picture, eliminating the need to blur the color data. I highly recommend *RegiStax*, which is freeware and has most of the tools needed for enhancing the color of Moon images, such as saturation adjustment, sharpening, and the ability to work in LRGB or RGB color mode.

Stacking does have some drawbacks. While even older computers can handle 3-megapixel images easily, stacking dozens or even hundreds of images can slow down a computer — you may want to plan on running your stacking software and take a break while it does its job. When saving my stacked file from *RegiStax*, I usually use 16-bit TIFF format to retain as much information as possible before going back to *Photoshop* to perform any final tweaks to the image.

Most digital cameras, webcams, or CCDs on the market today can capture impressive pictures of the colors of the Moon. Just remember a few basic tips: bracket your exposures to avoid overexposing the bright regions, don't use the gain control or any color enhancement built into your digital camera, shoot a lot of images, and avoid low-quality JPEG compression. While many backyard astrophotographers dislike observing and shooting during full Moon, this is the best time to try recording the Moon's colors. With a little time on the computer, an unfamiliar face of our closest neighbor and old friend can be revealed in a new light. ✶

When not surveying the Moon from Estoril, Portugal, Filipe Alves *studies architecture and is a 3-D animator for television.*