Jet Propulsion Laboratory

http://www.jpl.nasa.gov/news/features/3d.cfm

Spotlight: How to Make Your Own Eye-Popping 3-D Pictures

February 20, 2004

Since settling in on the red planet, the Mars Exploration Rovers Spirit and Opportunity have sent back a number of 3-D postcards to countless fans outfitted in red- and blue-tinted spectacles. To some, the realistic pictures of the rocky martian terrain may seem magical, but the concept behind the illusion is in fact quite simple.

"Basically, 3-D pictures trick your brain into doing what it does all the time in the real world," says Zareh Gorjian, a graphic artist at NASA's Jet Propulsion Laboratory who makes 3-D pictures and animations of Mars for a living, both the black-and-white kind and the more advanced color versions.

So simple is the trick that, with a little effort, anybody with a camera, a computer equipped with photo-editing software, and a pair of tinted glasses can make their own 3-D pictures of Mars, family members, pets or anything else worth placing in front of a lens.

Gorjian, who has been toying with the technique for 10 years, transforms all sorts of pictures into 3-D feasts for the eyes, including his latest vacation photos. "It's just fun," he says.

The key to 3-D imaging lies in simulating a left and right eye. For the Mars Exploration Rovers, this is accomplished with the aid of a left and right camera eye. Images from the rovers' stereo camera lenses (either the hazard-avoidance cameras, the navigation cameras or the panoramic cameras) are tinted in red and blue, then merged into one blurred picture, which pops off the page when viewed through a pair of red- and blue-tinted glasses.

"Your brain thinks it is seeing two separate left and right images and so does what it always does -- combines them into one picture," says Gorjian.

These basic 3-D photos are called anaglyphs and work best when viewed in black and white. Color anaglyphs are trickier because red and blue objects appear only to one eye. "You give up full color when you use the red and blue glasses," says Gorjian.

Instead, he and his colleagues at JPL's Multimission Image Processing Laboratory create 3-D color photos using two sophisticated techniques: polarization and infrared-transmission. In polarization, the light from left and right eye images is polarized, or made to travel in opposing, perpendicular directions. In infrared-transmission, left and right eye images are flickered back and forth on a special screen faster than an eye can blink. Both strategies require specialized glasses for viewing.

But black-and-white 3-D images do not require fancy tools or equipment and can be snapped and clicked into being by following these directions:

Step 1

Start out by picking a subject. People are a good place to begin because they tend to pop out in 3-D photos. Place the subject in a setting with a lot of angles and depth (not in front of a flat wall), and about 10 to 15 feet from the camera. Hold the camera steady by securing your elbows in your chest and snap a picture. Make sure your subject stays very still, then step just a tiny bit to the right, about the distance between your eyes or less, and take the same picture. When you slide over for the second shot, you -- and most importantly your camera -- should move in a parallel line.

Note: If Mars is your subject, the pictures have already been taken for you. Scan through the raw images on the JPL web site http://marsrovers.jpl.nasa.gov and pick out left and right eye images for your favorite photo (only images taken by the rovers' navigation cameras, hazard-avoidance cameras and panoramic cameras come in pairs). The stereo images will look identical, but you can tell if an individual image is from the left or right camera eye by clicking on it and looking at the file

name displayed in the web address bar. Left camera eye image file names will contain the letter "L" four characters in from the end, and right eye image file names will similarly carry an "R." Two raw image examples can be found at
http://marsrovers.jpl.nasa.gov/gallery/all/2/n/043/2N130199337EFF0700P1817R0M1.HTML,
and
http://marsrovers.jpl.nasa.gov/gallery/all/2/n/043/2N130199337EFF0700P1817L0M1.HTML .

Step 2

The next step involves transferring the images into photo-editing software. Any program will work as long it allows for red, blue and green color channels to be manipulated independently. The following instructions will refer to Adobe Photoshop. If your pictures are digital, just open them up in the software. If your pictures are hardcopies, transfer them to a computer using a scanner, or drop them off at a photo-developing store and ask for digital files (any file type will work).

Step 3

Once the left and right eye pictures are open, convert them both to grayscale by clicking on the 'Image' menu bar and selecting 'mode' then 'grayscale'. Next, assign the left eye image red, green and blue channels by going back to the 'Image' menu bar and selecting 'mode' then 'RGB' (the image will still appear gray). Do not repeat this step for the right eye image.

Step 4

Now you are ready to merge the left and right images. To begin, make sure the left eye image is still selected. Open the channels display menu by clicking on the 'Window' menu bar and choosing 'channels.' Highlight the blue and green channels (press the shift key to highlight both at the same time). Important: only the blue and green channels should be shaded blue. At this stage it doesn't matter which boxes to the left of the channels show eyeballs (eyeballs indicate which channels are displayed).

Step 5

Go back to the right eye image, select the whole thing (go to 'Select' menu bar, then press 'all') and copy it (go to 'Edit' menu bar, then press

'copy'). Switch back to the left eye image and paste (go to 'Edit' menu bar, then press 'paste'). Now, highlight the RGB color channel; an eyeball should appear in all four channel boxes. At this point, you should see a blurred red and blue picture.

An alternative to this step is to use only the blue channel instead of the blue and green when pasting into the left eye image.

Step 6

You are almost done. But first the left and right eye images need to be better aligned. Start by highlighting only the red channel in the channels display menu (it should be shaded blue). The next step is crucial because it allows the red-tinted picture to be shifted over while the blue-tinted picture is still visible. Go to the RGB channel and click only on the square box to the left. An eyeball should appear in all four boxes, but only the red channel should be shaded. Now pick a point in the center of the picture to match up; for example, if a person is your subject, eye pupils are a good target. Zoom in on the target by selecting the magnifying glass icon in the tool bar then click on the target until it appears fairly large.

Step 7

Next, select the 'move' tool located in the upper right corner of the tool bar. Using the up and down arrow keys, slide the red-tinted image over until your target matches up and no longer shows any rings of color.

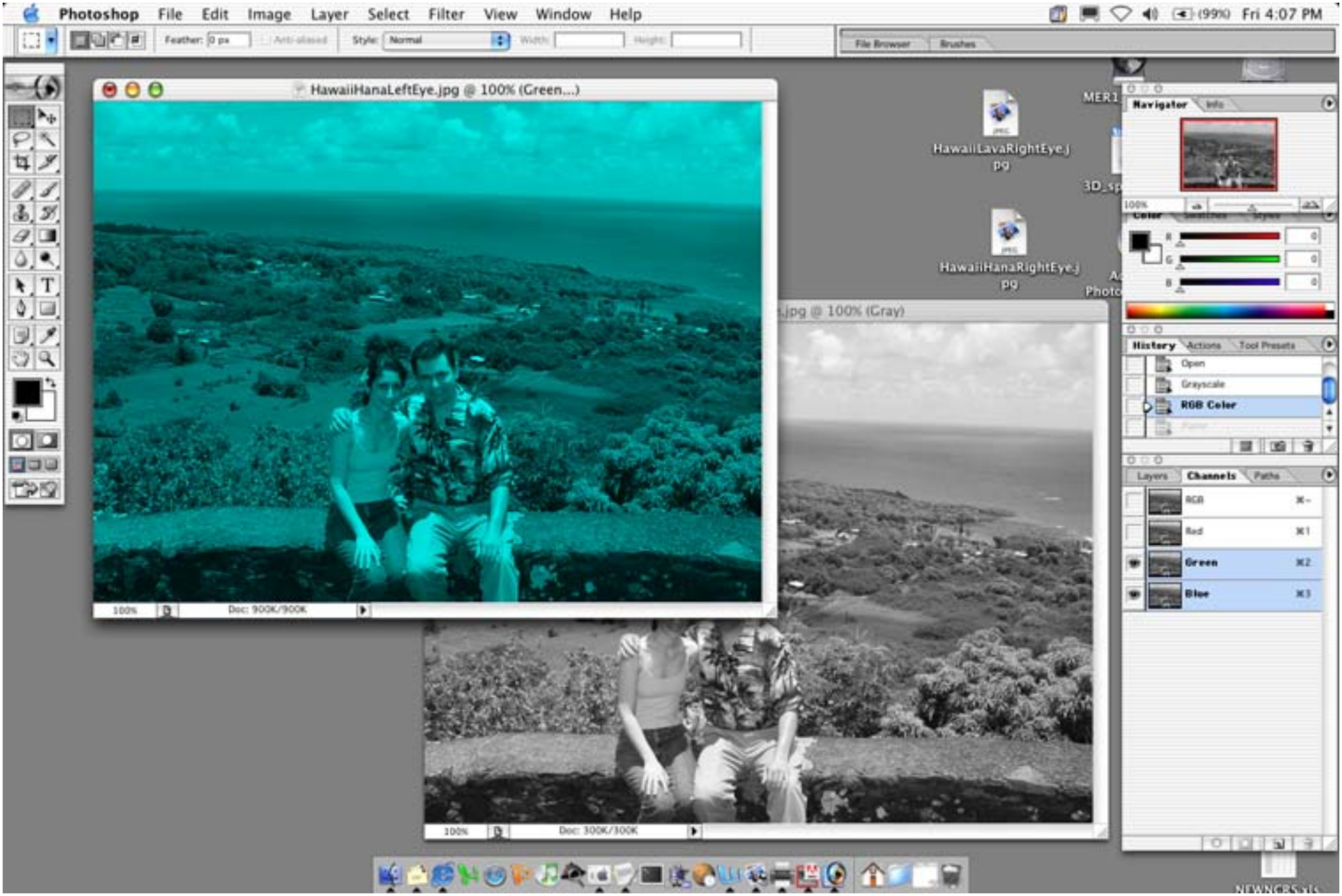
Step 8

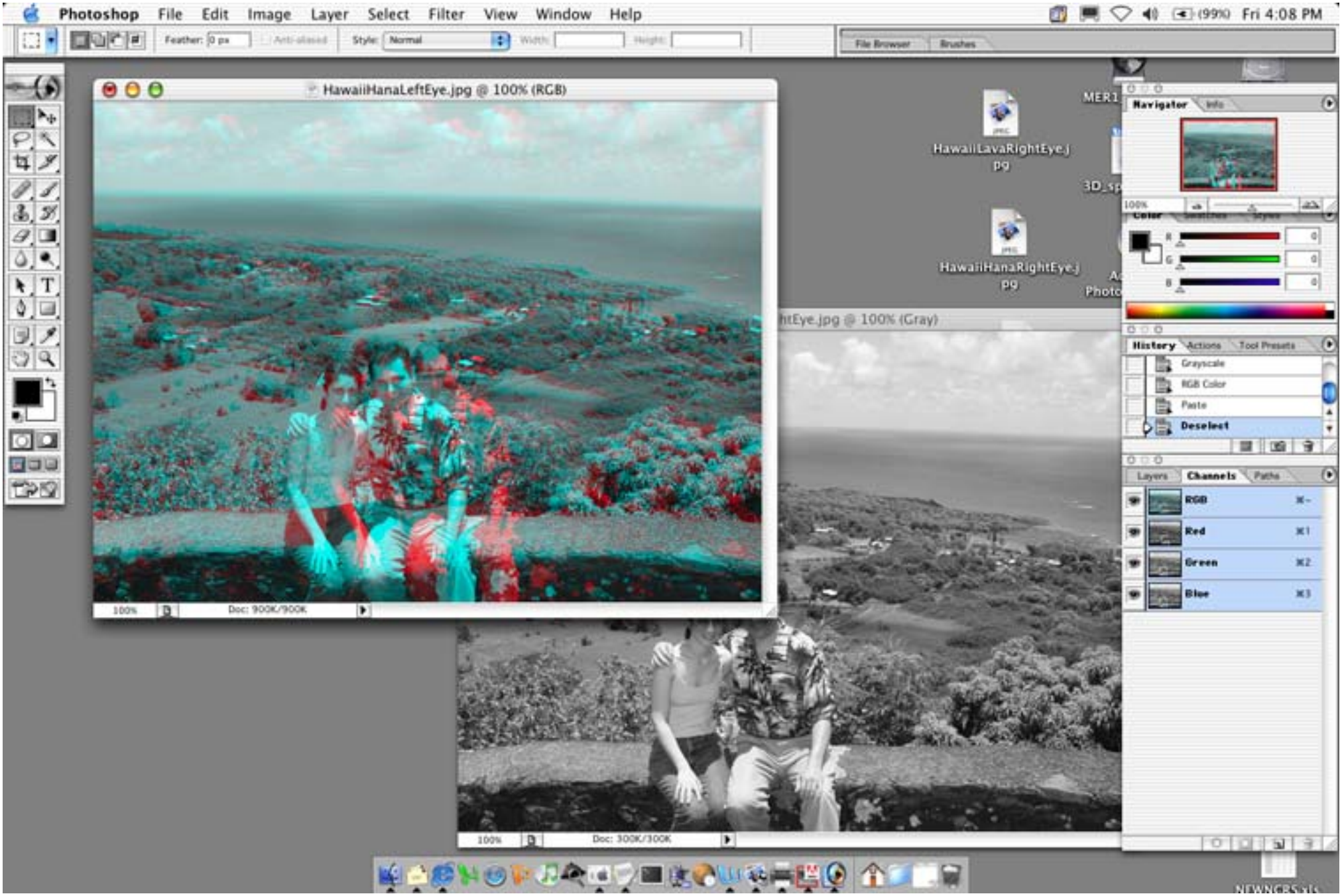
Zoom back out. Objects toward the outside of your picture should still be haloed in red or blue. In other words, the overall goal in this step is to limit the colored tints as much as possible. To cut out excess red or blue at the far edges of your picture, crop it using the crop tool, also located in the tool bar (once you've outlined your picture with the tool, go to the 'Image' menu bar then press 'crop').

Your creation is ready to be viewed! Just don your paper glasses (the left eye should be tinted red) and watch the picture jump out at you from your monitor screen or a printed picture.

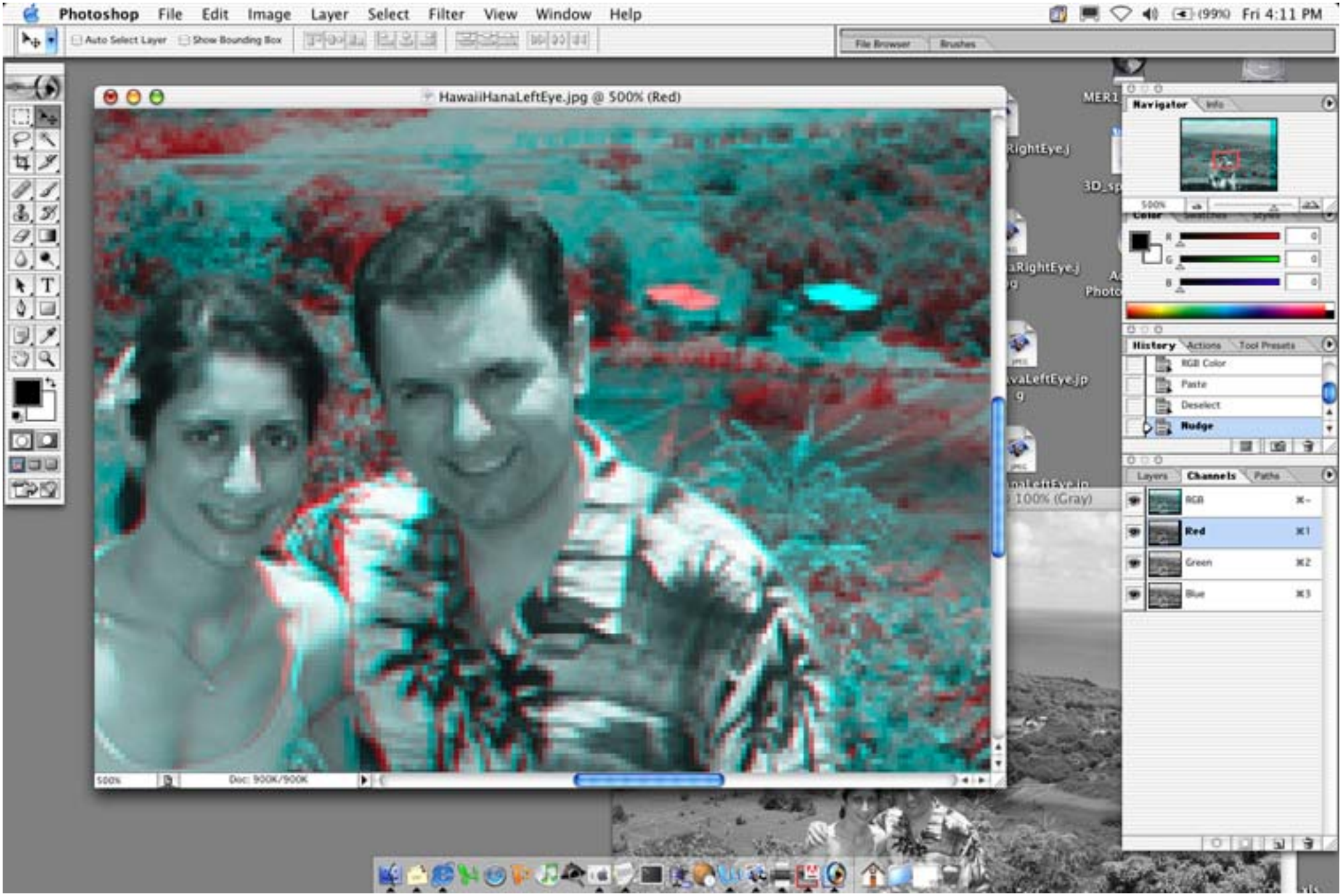
The following series of screenshots demonstrates how to make 3-D images using one of Gorjian's Hawaiian vacation photos.

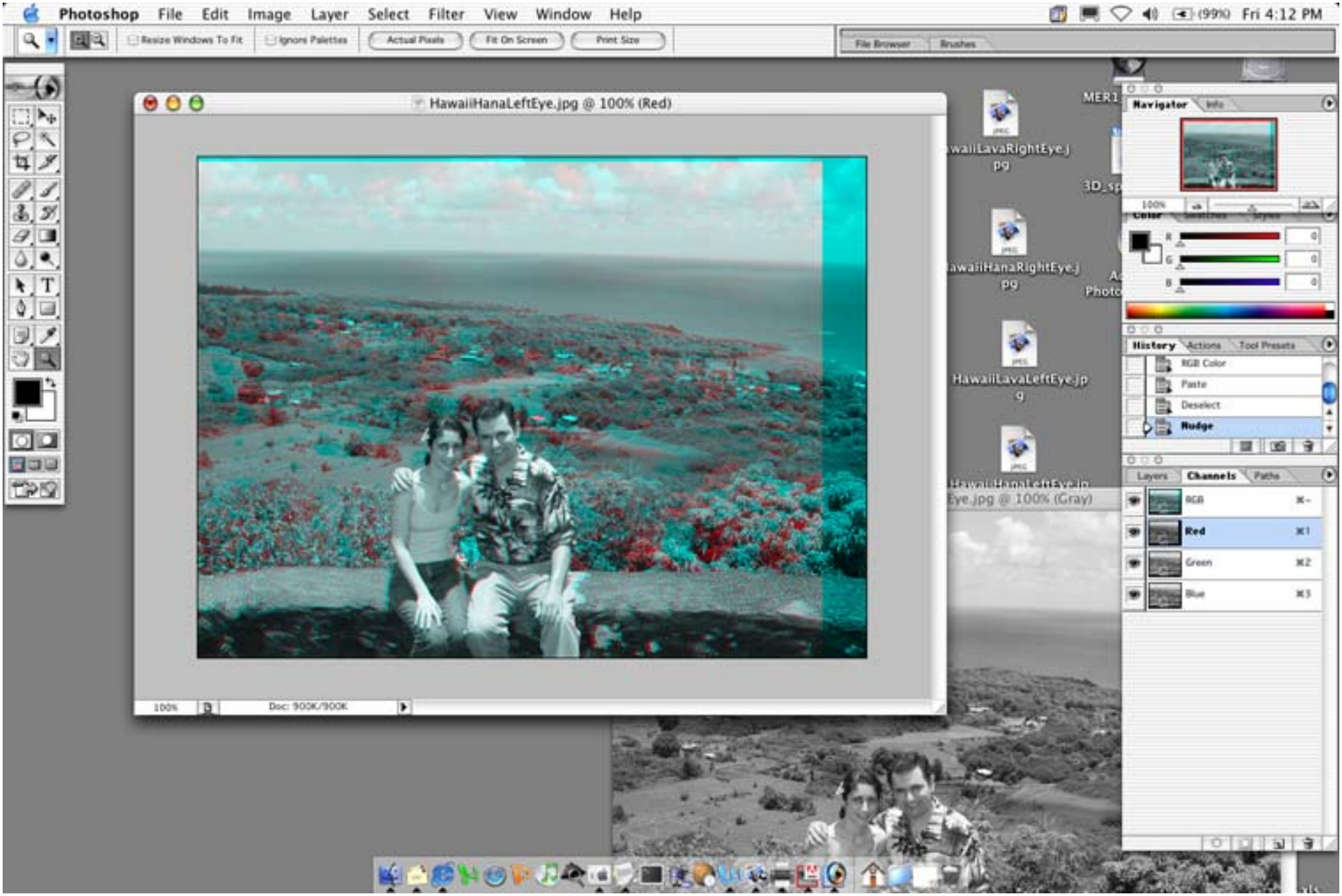

Photoshop File Edit Image Layer Select Filter View Window Help
Fri 3:47 PM
HawaiiHanaLeftEye.jpg @ 100% (Gray)
HawaiiHanaRightEye.jpg @ 100% (RGB)
HawaiiLavaRightEye.jpg
HawaiiHanaRightEye.jpg
Navigator
Color
History
Open
Channels
RGB
Red
Green
Blue


Photoshop File Edit Image Layer Select Filter View Window Help
Fri 4:07 PM
HawaiiHanaLeftEye.jpg @ 100% (Green...)
HawaiiLavaRightEye.jpg
HawaiiHanaRightEye.jpg
Navigator
History
Actions
Tool Presets
Open
Grayscale
RGB Color
Layers
Channels
Paths
RGB
Red
Green
Blue
Doc: 900K/900K
Doc: 300K/300K


Photoshop File Edit Image Layer Select Filter View Window Help
Fri 4:08 PM
HawaiiHanaLeftEye.jpg @ 100% (RGB)
HawaiiLavaRightEye.jpg
HawaiiHanaRightEye.jpg
Navigator
History
Actions
Tool Presets
Grayscale
RGB Color
Paste
Deselect
Layers
Channels
Paths
RGB
Red
Green
Blue
Doc: 900K/900K
Doc: 300K/300K


Photoshop File Edit Image Layer Select Filter View Window Help
Fri 4:11 PM
HawaiiHanaLeftEye.jpg @ 500% (Red)
Navigator
History
Layers
Channels
Paths
RGB
Red
Green
Blue


Photoshop File Edit Image Layer Select Filter View Window Help
Fri 4:11 PM
HawaiiHanaLeftEye.jpg @ 500% (Red)
Navigator
History
Actions
Layers
Channels
Paths
RGB
Red
Green
Blue


Photoshop File Edit Image Layer Select Filter View Window Help
Fri 4:12 PM
Resize Windows To Fit
Ignore Palettes
Actual Pixels
Fit On Screen
Print Size
File Browser
Brushes
HawaiiHanaLeftEye.jpg @ 100% (Red)
100%
Doc: 900K/900K
Navigator
Info
History
Actions
Tool Presets
RGB Color
Paste
Deselect
Nudge
Layers
Channels
Paths
RGB
Red
Green
Blue
HawaiiLavaRightEye.jpg
HawaiiHanaRightEye.jpg
HawaiiLavaLeftEye.jpg
Eye.jpg @ 100% (Gray)


Photoshop File Edit Image Layer Select Filter View Window Help
Fri 4:15 PM
HawaiiHanaLeftEye.jpg @ 100% (Red)
HawaiiLavaRightEye.jpg
HawaiiHanaRightEye.jpg
HawaiiLavaLeftEye.jpg
Navigator
History
Paste
Deselect
Nudge
Crop
Channels
Layers
Paths
RGB
Red
Green
Blue