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COVER PHOTOGRAPH

Object.....Veil Nebula NGC 6992

Photographer.....Robert C. Price

Instrument.....Tele Vue NP-101 (4 inch F/5.4 refractor)

Exposure/Instrument.....20 minutes/Hutech modified Canon 350D

Date.....21 June 2007

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Image Processing: Stacking Images

by

Robert Price

Computer processing of image files enables the enhancement of astronomical images that was impossible with film and darkroom techniques. Even the most elementary image processing programs enable the user to control image brightness, contrast, and levels. Most programs can eliminate defects by means of cloning or automatic scratch and dust removal. Image histograms can be adjusted, gamma can be changed, curves can adjust histograms in a non-linear way, and color saturation can be controlled. Most programs have layers that can further adjust images and correct for brightness changes across the image field. The better image processing programs such as Adobe Photoshop and Corel Paint Shop Pro allow image addition or subtraction.

Image addition or stacking has real application in astronomical photography. There are several advantages to making several short exposures and stacking them to make the equivalent of one longer exposure. If something goes wrong during a long exposure, the entire exposure is ruined or if the image can be salvaged the salvage effort requires a large amount of effort to fix. What can go wrong? A gust of wind causes the scope to move and cause the bright stars to create a trail. A cloud or airplane can cross the field of the image. Someone with a flashlight can come by to see what you are doing. The point is that if you are making several short exposures, only one short exposure need be repeated. There are some advantages in image appearance to using several short exposures over one long exposure. Image noise is added together with the addition of several short exposures, thus making the final image less noisy than a single long exposure.

Most image processing program with levels such a Adobe Photoshop allow several images to be aligned and stacked using the levels feature. The author used a program called CCDStack (available from www.ccdware.com) for this purpose because it has an easy to use alignment feature. On 20 June 2007 the author took four 5 minute exposures of M20 and one 20 minute exposure of M20. The au-

Above, Figure 1: Image Processing. Unprocessed image of a 5 minute exposure of M20 taken by the author on 20 June 2007 using a NP-101 refractor and Hutech modified Canon 350D camera at 400ASA.

thor used a Tele Vue NP-101 refractor and Hutech modified Canon 350D camera at 400 ASA. The reason for the selected exposure times is that the author has found that 20 minutes of exposure is the practical limit for sky background at this particular location in Pennsylvania, located just south of Blue Knob State Park. Two 5 minute exposures were taken first, then the 20 minute exposure, and then two more 5 minute exposures.

Figure 1 shows a portion of the unprocessed image from the 5 minute exposure and Figure 2 shows the same area of the unprocessed image from the 20 minute exposure. The first step the author takes in processing his long exposure images is to create a neutral background. When using image processing programs such a Adobe Photoshop the author accomplishes this by using levels and adjusting each color channel to utilize the entire histogram curve. Sometimes after this is done one color needs to be tweaked to produce a neutral background. The Program CCDStack has a "color adjust, set background" feature that gives a slightly better result. It was used with Figure 1 to produce Figure 3 and with Figure 2 to produce Figure 4. After this initial processing the author used levels and curves in Adobe Photoshop 7 to bring out faint stars and nebulosity and set a good black background. Figure 3 only needed some slight level adjustment to yield Figure 5, while Figure 4 needed more adjustments to the levels to bring out the nebulosity and darken the background to produce the image shown in Figure 6. The four 5 minute exposures that were stacked are shown in Figure 7 after the "color adjust, set background" feature of CCDStack was utilized. Figure 8 is an adjusted version of Figure 7 after level adjustment in Adobe Photoshop 7 to bring out faint nebulosity and set a good black background. Figure 6 and Figure 8 are a comparison of the result of a single 20 minute exposure (Figure 6) compared with a stack of four 5 minute exposures (Figure 8). In the author's opinion there is no clear cut better image. The single 20 minute exposure seems to show the blue nebulosity better, but the stacked image seems to have a better red/magenta saturation in the center part of the nebula. continued on page12

Above, Figure 2: Image Processing. Unprocessed image of a 20 minute exposure of M20 taken by the author on 20 June 2007 using a NP-101 refractor and Hutech modified Canon 350D camera at 400ASA.

Above, Figure 3: Image Processing. Initial processing of Figure 1 to create a neutral background. Processed using the "color adjust, set background" feature of CCDStack.

Above, Figure 4: Image Processing. Initial processing of Figure 2 to create a neutral background. Processed using the "color adjust, set background" feature of CCDStack.

Above, Figure 5: Image Processing. Additional processing of Figure 3 (the 5 minute exposure) using levels in Adobe Photoshop 7.

Above, Figure 6: Image Processing. Additional processing of Figure 4 (the 20 minute exposure) using levels in Adobe Photoshop 7.

Above, Figure 7: Image Processing. The above image was made using the stack feature of CCDStack. Four 5 minute exposures were processed (sumed) to made the above image. Figure 1 was one of the 5 minute exposures.

Above, Figure 8 Image Processing. Figure 7 after additional processing in CCDStack using the "color adjust, set background" feature and in Adobe Photoshop 7 using levels to bring out faint detail and set a black background.

Above: Area in central Auriga including M36, M37, and M38 photographed by Lee C. Coombs on 21 January 2007 using a 150mm f/4 lens. Exposure was 20 minutes on Kodak Ektachrome Professional 200 film.

Above: The Seagull Nebula, IC 2177, photographed by Lee C. Coombs on 10 March 2007 using a 70mm f/5.1 Tele Vue Pronto. Exposure was 30 minutes on Kodak Ektachrome Professional 200 film.

Astrophotography for August and September

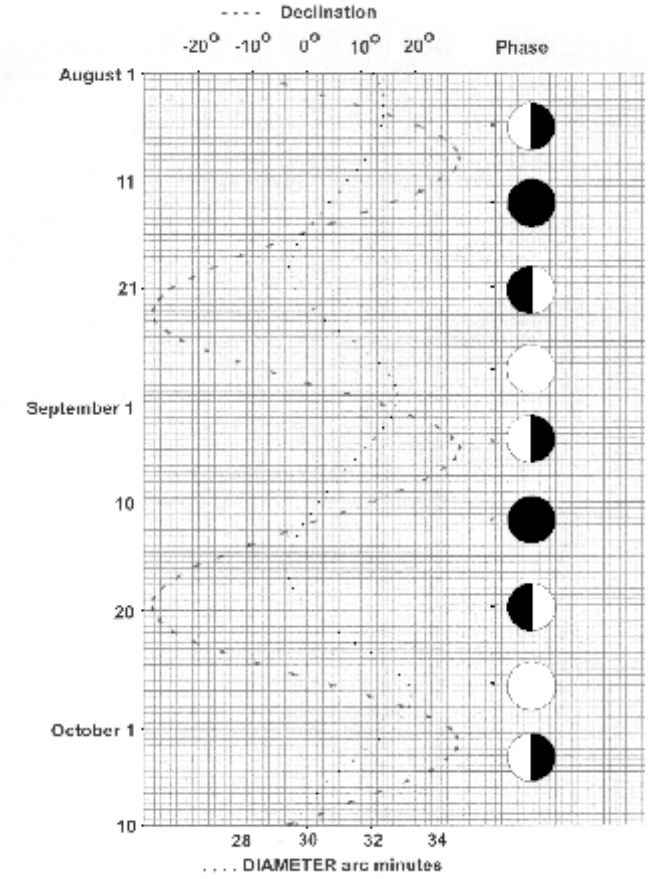
by

Ralph Proctor

Mercury begins August as a morning object low in the eastern sky. Mercury moves lower in the eastern sky and is quickly lost in the Sun's glare during the first week in August. Mercury reaches superior conjunction with the Sun on 15 August and emerges from the Sun's glare in early September as an evening object low in the western sky. Mercury reaches a greatest eastern elongation of 26 degrees on 29 September when it will be in poor photographic position with a declination of minus 15 degrees.

Venus begins August as an evening object low in the western sky. Venus moves lower in the western sky and is quickly lost in the Sun's glare during the first week in August. Venus reaches inferior conjunction with the Sun on 18 August and emerges from the Sun's glare in late August as a morning object low in the eastern sky.

Lunar Declination and Diameter:



The Moon's waning crescent and quarter phases will be located high on the ecliptic and in excellent photographic position during August (August 9) and September (September 5), with an apparent declination of up to +28 degrees.

Mars begins August as a morning object in the eastern sky in the constellation Taurus. Mars moves into the constellation Gemini in late September. During August and September Mars moves higher in the eastern sky, increases in brightness from magnitude +0.5 to -0.1, and increases in diameter from 7.0 to 9.7 arc seconds.

Jupiter begins August as an evening object high in the western sky in the constellation Ophiuchus, having reached opposition with the Sun on 5 July. During August and September Jupiter moves lower in the western sky, decreases in brightness from magnitude -2.4 to -2.0, and decreases in diameter from 42.1 to 35.3 arc seconds.

Saturn begins August as an evening object low in the western sky in the constellation Leo. Saturn moves lower in the eastern sky and is quickly lost in the Sun's glare during the first week in August. Saturn reaches conjunction with the Sun on 21 August and emerges from the Sun's glare in early September as a morning object low in the eastern sky. During August and September Saturn decreases in brightness from magnitude +0.6 to +0.7, and increases in diameter from 16.3 to 16.5 arc seconds.

Uranus begins August as a morning object high in the eastern sky in the constellation Aquarius and reaches opposition with the Sun on 9 September. During August and September Uranus moves higher in the eastern sky, remains constant in brightness at magnitude +5.7, and increases in diameter from 3.65 to 3.68 arc seconds. Uranus is located at R.A. 23 hours 16.0 minutes declination -05 degrees 36 minutes on 15 August and at R.A. 23 hours 11.6 minutes declination -06 degrees 05 minutes on 15 September.

Neptune begins August as a morning object high in the eastern sky in the constellation Capricornus, and reaches opposition with the Sun on 13 August. During August and September Neptune moves lower in the western sky, decreases in brightness from magnitude +7.8 to +7.9, and decreases in diameter from 2.35 to 2.33 arc seconds. Neptune is located at R.A. 21 hours 32.4 minutes declination -14

degrees 53 minutes on 15 August and at R.A. 21 hours 29.2 minutes declination -15 degrees 09 minutes on 15 September.

Pluto begins August as an evening object high in the western sky in the constellation Sagittarius. During August and September Pluto moves lower in the western sky, having reached opposition with the Sun on 19 June. During August and September Pluto remains constant in brightness at magnitude +13.9. Pluto is located at R.A. 17 hours 44.8 minutes declination -16 degrees 33 minutes on 15 August and at R.A. 17 hours 44.2 minutes declination -16 degrees 42 minutes on 15 September.

Events:

Antares will be occulted by the Moon on 22 August (01 hours universal time) for part of Antarctica, the southern oceans, and New Zealand; and on 18 September (08 hours universal time) for Antarctica, the southern oceans, and southern Madagascar.

Saturn will be occulted by the Moon on 10 September (04 hours universal time) for the southern Indian Ocean, the western tip of Australia, and part of Antarctica.

Regulus will be occulted by the Moon on 10 September (01 hours universal time) for Polynesia, Japan, and central Asia.

The Sun will undergo a partial eclipse on 11 September 2007 for parts of Antarctica, all but the northern portion of South America, and the south western part of the Atlantic Ocean. The eclipse begins at 10 hours 27.5 minutes and ends at 14 hours 36.5 minutes universal time. The greatest eclipse occurs at 12 hours 31.3 minutes universal time.

The Moon will undergo a total eclipse on 28 August 2007 for the Americas except the eastern portion of South America and the northeastern portion of North America, the Pacific Ocean, the eastern part of Asia, Australasia, and Antarctica. The eclipse begins (Penumbra contact) at 07 hours 52.2 minutes and ends at 13 hours 22.5 minutes universal time. Umbra contact begins at 08 hours 50.9 minutes and ends at 12 hours 23.8 minutes. Mid-eclipse occurs at 10 hours 37.3 minutes universal time.

MINOR PLANETS

		position			
		15 August		15 September	
Planet	Magnitude	R.A.	Decl.	R.A.	Decl.
Ceres	09.0 - 08.1	03 hr 21.1 min	+09 deg 09 min	03 hr 35.4 min	+09 deg 23 min
Pallas	09.4 - 09.2	22 hr 39.6 min	+07 deg 32 min	22 hr 17.0 min	+01 deg 27 min
Juno	11.3 - 11.5	13 hr 38.4 min	- 00 deg 48 min	14 hr 11.1 min	- 04 deg 06 min
Vesta	06.7 - 07.6	16 hr 22.2 min	- 19 deg 56 min	17 hr 01.9 min	- 22 deg 46 min

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Volume No. 10 issue 2, 3, 5, and 6
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Volume No. 12 issue 1, 2, 3, 4, 5, and 6
Volume No. 13 issue 1, 2, 3, 4, 5, and 6
Volume No. 14 issue 1, 2, 3, 4, 5, and 6
Volume No. 15 issue 1, 2, 3, 4, 5, and 6
Volume No. 16 issue 1, 2, 3, 4, 5, and 6
Volume No. 17 issue 1, 2, 3[2], 4, 5, and 6
Volume No. 18 issue 1, 4, 5, and 6
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Volume No. 26 issue 1, 2, 3, 5, and 6
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Volume No. 28 issue 5 and 6
Volume No. 29 issue 1, 2, 3, 4, 5, and 6
Volume No. 30 issue 1, 2, 3, 4[1], 5, and 6
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The next 4 pages contain images that compare a single 5 minute exposure of M42 with a stack of five 1 minute exposures of M42.

Figure 9 is an unprocessed 1 minute exposure of the Orion Nebula., M42.

Figure 10 is an unprocessed 5 minute exposure of M42

Figure 11 is the processed image of Figure 10 using the same process described for the images of M20.

Figure 12 is a processed image created by stacking five 1 minuted exposures.

Note the same differences between Figures 11 and Figure 12 observed with the images of M20. The single 5 minute exposure, Figure 11, has better color while the stacked image (five 1 minute exposures), Figure 12, has better exposure depth.

Above, Figure 9: Image Processing. Unprocessed 1 minute exposure of the Orion Nebula taken from the author's back yard 28 miles south of Washington D.C.

Above, Figure 10: Image Processing. Unprocessed 5 minute exposure of the Orion Nebula taken from the author's back yard 28 miles south of Washington D.C. The author used a NP-101 refractor and Hutech modified Canon 350D camera at 400ASA for this image.

Above, Figure 11: Image Processing. Image 10 after processing using CCDStack to set the background color and Adobe Photoshop 7 to adjust levels.

Above, Figure 12: Image Processing. Final image after processing a stack of five 1 minute exposures of the Orion Nebula. Each exposure was almost identical to the image in Figure 9.

Above: North American and Pelican Nebula (center) photographed by Lee C. Coombs on 17 September 2006 using a 70mm f/5.1 Tele Vue Pronto. Exposure was 50 minutes on Kodak Ektachrome Professional 200 film.