Using Multi-Narrowband Filters on Monochrome Cameras

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Article – October 18th, 2023

Introduction:
The aspect of amateur astronomy that I partake in the most is Electronically Assisted Astronomy (EAA). This involves live observing using a camera instead of an eyepiece. There are many advantages to using this observing method, especially considering that I live in a large city and therefore have skies that are very light polluted – Bortle 9+. Using a camera versus my eye opens the opportunity of using optical filters to help improve the contrast of the object I am trying to observe. This fact was the impetus for my becoming an expert on filters in the first place.

My objective when doing EAA is to produce a low noise, high contrast image in as little time as possible. This objective is not unlike what many astrophotographers aim for, so it should not be surprising for filters that perform well when astro-imaging to also work well for EAA. Included at the top of the list of effective filters are multi-narrowband filters; those with narrow pass bands around O-III and H-α. Multi-narrowband filters have become very popular amongst users of one-shot colour (OSC) cameras as they allow one to very quickly produce full colour images without the need for a lot of image post-processing. I sometimes use a OSC camera for my EAA, but my preferred camera is monochrome because it delivers smoother and more detailed images, with less exposure time. Thus, the same reason serious astrophotographers prefer a monochrome camera is why I use one for EAA. This does not mean however that I am limited to using narrowband filters, passing only one nebula emission line at a time. As will be presented in this report, multi-narrowband filters work on monochrome cameras as well.

Background:
I first explored the topic of using light pollution (LP) filters on a monochrome camera back in September 2014. This was a time when filters were not widely used for EAA because of the perception that they darkened the image too much. I had been experimenting with filters on my own since 2010 but at the time I only had a colour Mallincam Xtreme to use in my testing. I suspected that filters would work the same on a monochrome camera, but it wasn't until my friend and fellow astronomy club member Simon H. volunteered to bring his monochrome Xtreme over one night that my suspicions were confirmed. Figure 1 illustrates some of the results from that night. Consequently, at the conclusion of that evening's testing, I had successfully converted Simon to using filters for EAA as well. It seems fitting then, years later, that Simon was successful convincing me of the virtues of using a monochrome camera for EAA!

Multi-Emission Line Objects:
OSC cameras really shine when the object being observed/imaged is multi-coloured, i.e. emits light at different wavelengths. Red-coloured emissions from ionized Hydrogen are by far the most commonly observed amongst deep sky objects, but green-coloured emissions from ionized Oxygen can also be observed in particular types of objects such as planetary nebulae and supernova remnants. Examples of these object types are presented in Figure 2. For both of these objects the greenish O-III emission and red H-α emission is clearly delineated in their images.

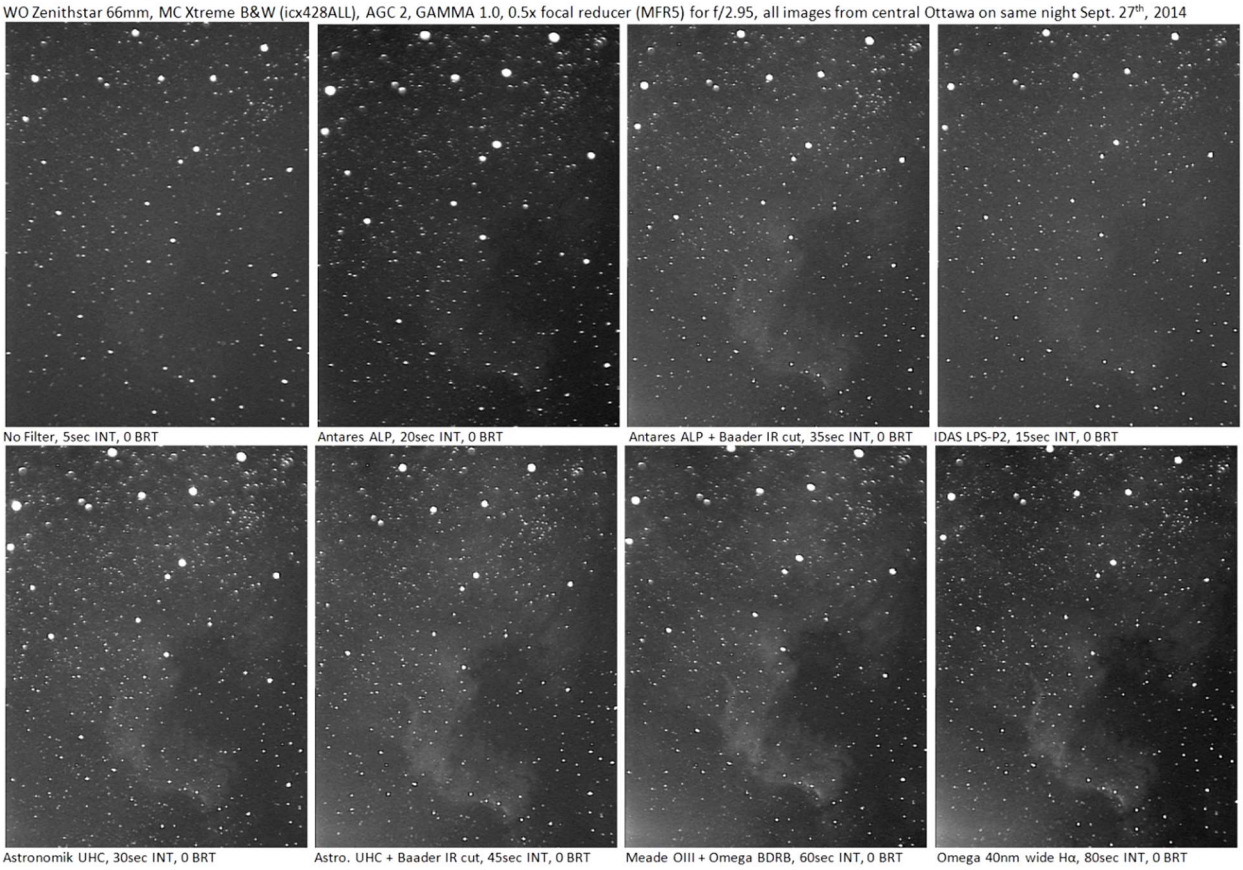

Figure 1 Screen Captures from 1st Experiment w/ LP Filters + Monochrome Cameras

(both images: ASI533MC Pro camera + Optolong L-uLtimate filter)

Figure 2 Examples of Multi-Emission Line Nebulae

Now consider what we would see using a monochrome camera and a narrowband filter. Only one of the emission lines could be observed at a time, resulting in views like those shown in Figure 3. Although still pleasing to observe, the whole picture of what is happening in the object is lost when only one of the emission lines is observed.

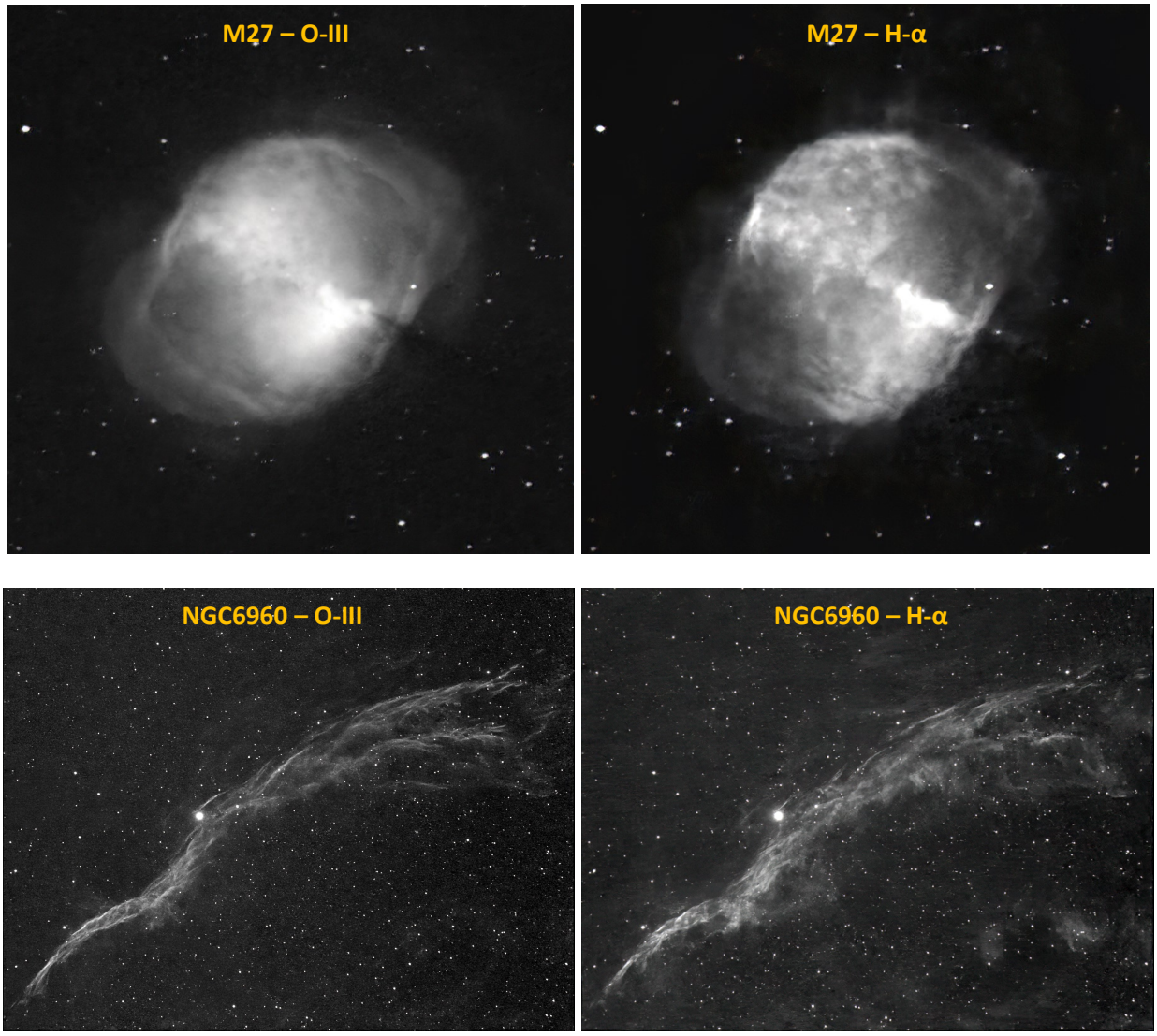

Figure 3 Multi-Emission Line Nebulae as Seen By a Narrowband Filter

When someone who is doing EAA with a monochrome camera knows they are going to observe objects with multiple emission lines, it may be prudent to use a multi-narrowband filter instead of a single narrowband. That way both the O-III and H-α emissions will be captured. The end result would look something like illustrated in Figure 4. An advantage of using a multi-narrowband filter on a monochrome camera is that all the camera's pixels will be collecting data in both emission bands equally, unlike a OSC camera that will be collecting O-III on two out of every four pixels, and H-α on one out of every four pixels. The result will be a more detailed image of the nebula using the monochrome camera.

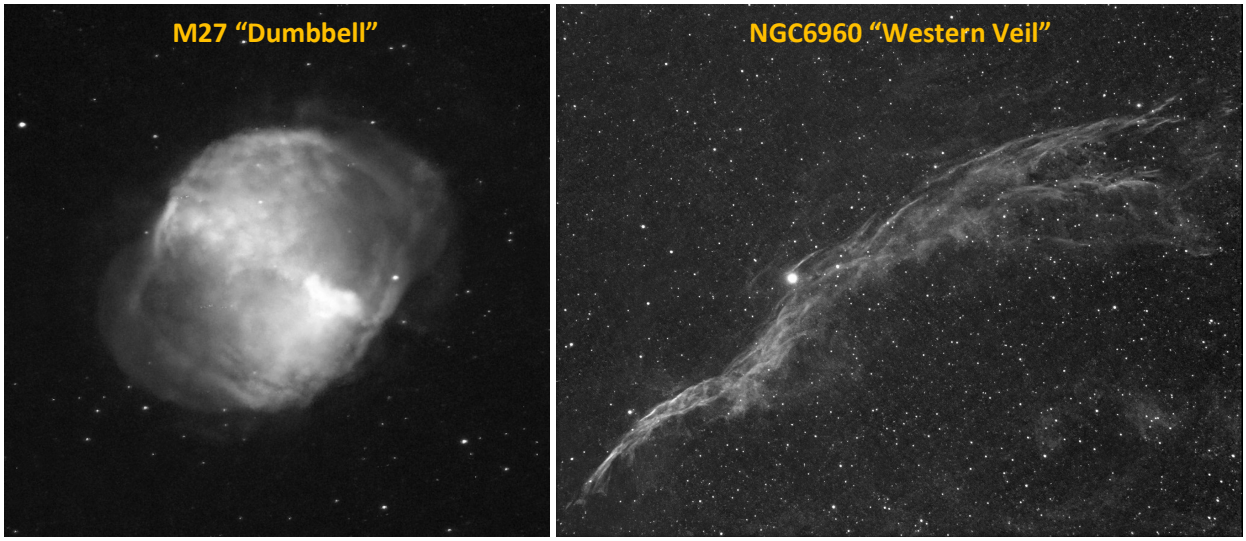

Figure 4 Multi-Emission Line Nebulae as Seen By a Multi-Narrowband Filter

Sample Observing Results:
Whenever I know that I will be observing a wide variety of emission nebulae, including ones that are known to have significant O-III emissions, I use a multi-narrowband filter. Specifically I have been having a lot of fun doing EAA using an Optolong L-uLtimate filter with my monochrome camera. The images that follow at the end of this report are all from an August 27th, 2023 observing session in my Bortle 9+ backyard. They were captured using my Mallincam DS432M-TEC camera with L-uLtimate filter on a William Optics Zenithstar 67 refractor reduced to f/4.2. Each image is a live stack of thirty 20 second sub-exposures, for a total exposure of 10 minutes.

Conclusions:
I personally find great enjoyment using a monochrome camera for EAA. The camera's low noise and high sensitivity, when combined with a multi-narrowband filter, delivers impressive images of deespsky objects from my highly light polluted backyard in only a few minutes. If you have not tried the combination of a monochrome camera and a multi-narrowband filter before, I urge you to give it a try.

If you have any questions, please feel free to contact me.

Cheers!

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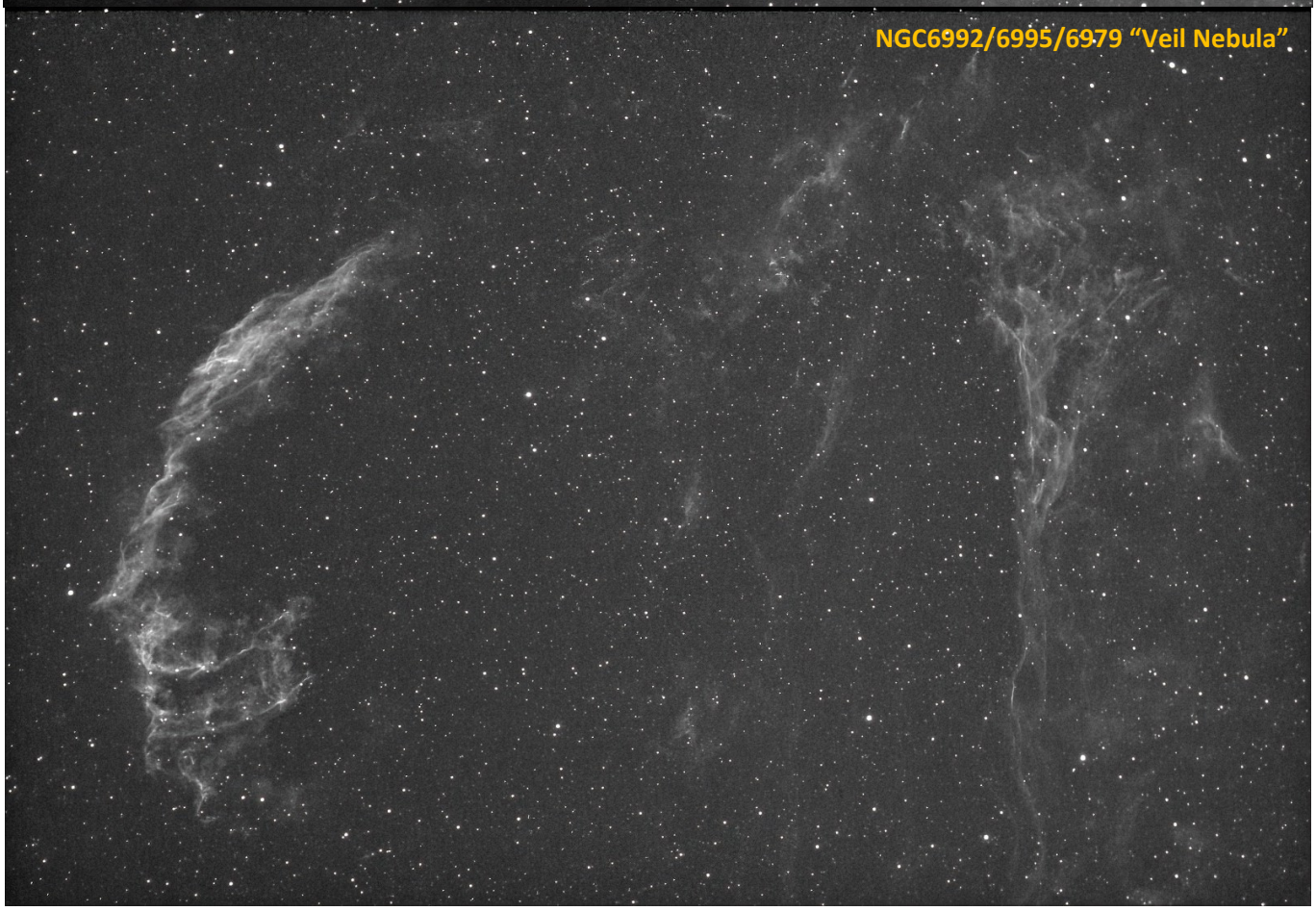
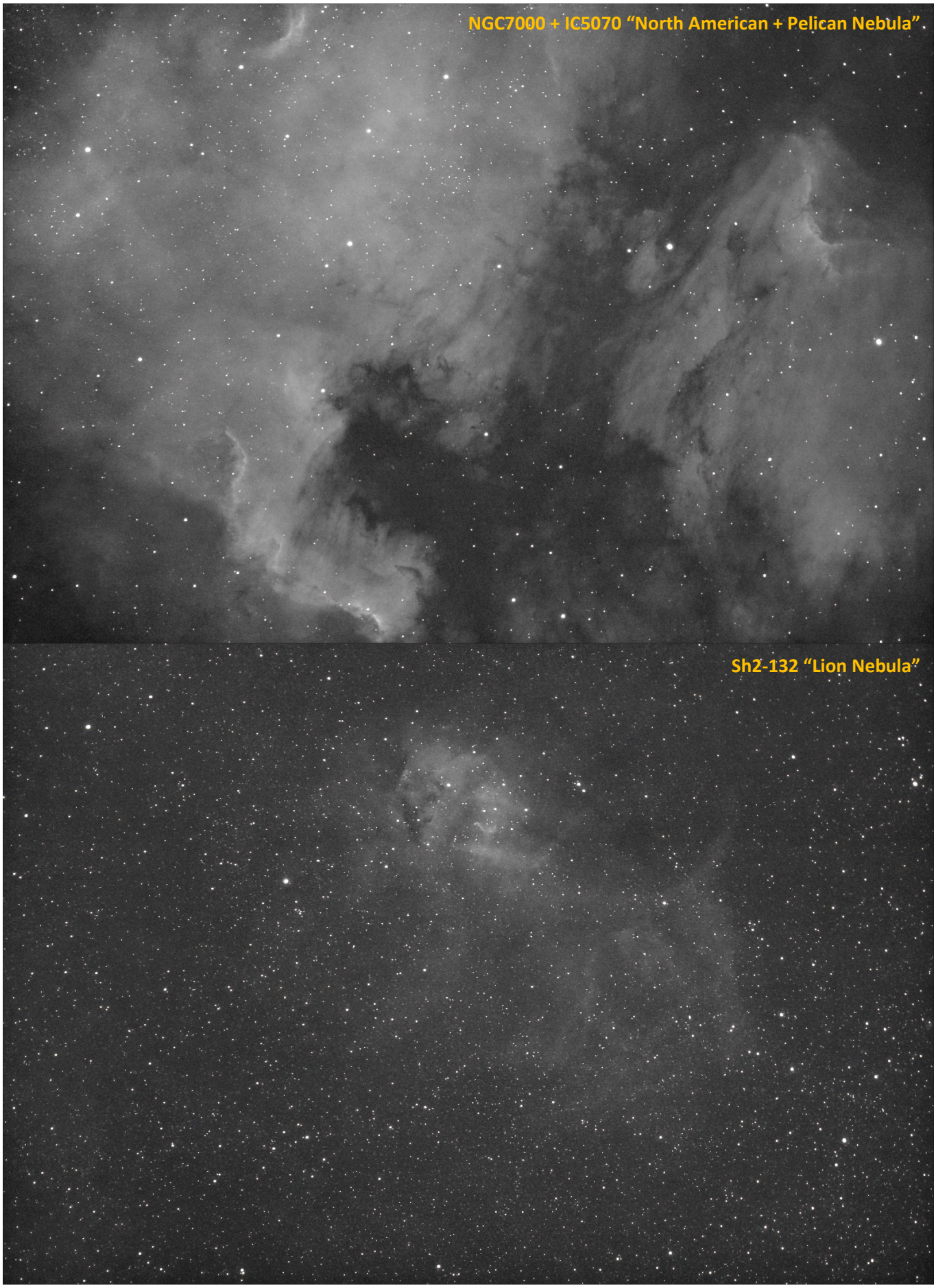
Sh2-101 “Tulip Nebula”

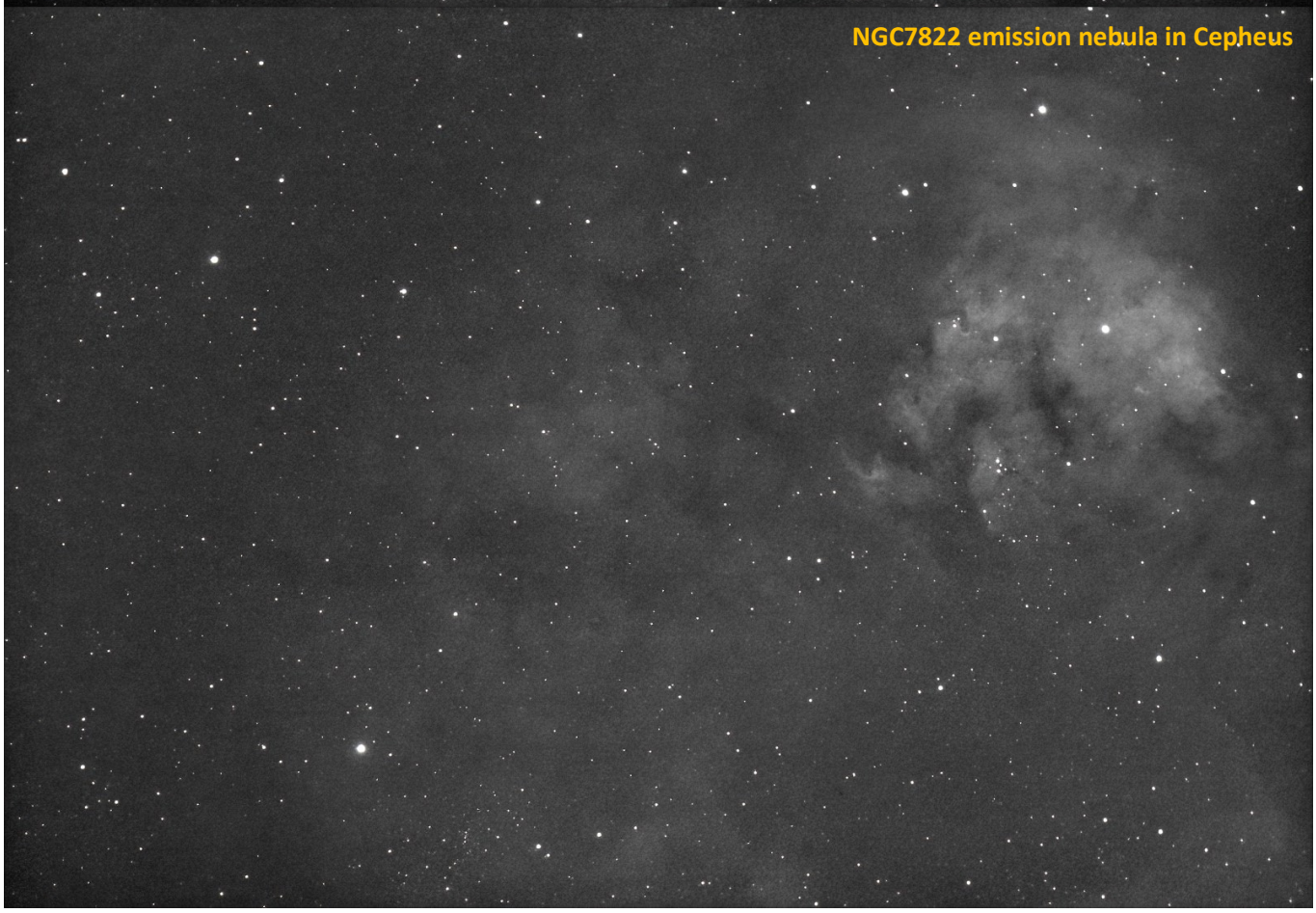

NGC6888 “Crescent Nebula”


IC1318 “Asian Dragon Nebula”


NGC6992/6995/6979 “Veil Nebula”


NGC7000 + IC5070 “North American + Pelican Nebula”
Sh2-132 “Lion Nebula”


IC1396 “Elephant’s Trunk Nebula”


NGC7822 emission nebula in Cepheus