NIGHTFALL

A PUBLICATION OF THE HUACHUCA ASTRONOMY CLUB

THE FIRST PLANETARY DISTANCING EDITION

APRIL 2020

PRESIDENT'S NOTES

April and May General Meetings Cancelled. June, July Still Unknown

As HAC Begins Practicing Planetary Distancing

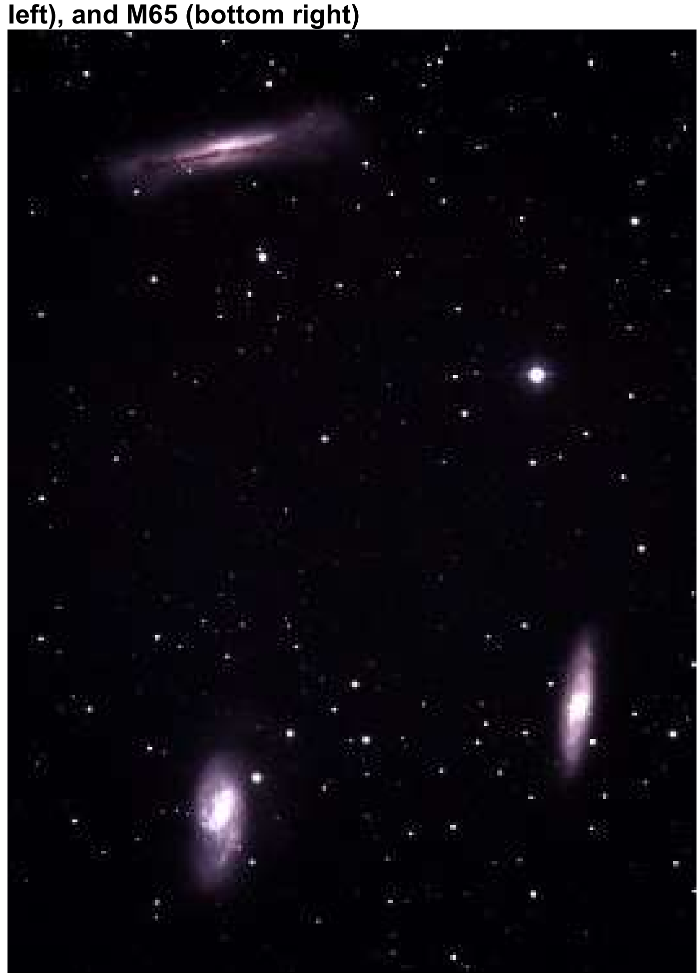
It is now April 2020, HACers. I hope this newsletter finds you clear-eyed and clear-lunged. A lot has changed in just a couple weeks, but not as much as it will in a couple months from now. COVID-19 has entered our world, if not our locale, and our families. For our part, HAC outreach events and general meetings are officially cancelled for the foreseeable future, as even small groups are to be discouraged. Fortunately, we have a great line-up of articles from HAC members that give an indication of what they've been up to. Chime in! We always have room for another article.

Hunker in place and social distancing are now, and should be, the new normal. But that doesn't mean that you should park either your brain or your telescope. The spring sky is up, and the air is clean, so let's think of some things to look at.

If you've been following the deep viewers on the HAC group site, you know of a very cool Excel sheet being passed around listing Ted's and others' favorite objects. You don't need a big telescope for all of them, although to see many of the fine features associated with them it helps. I've clipped a couple from the sheet and added one more from Messier's list to give you a start. As you can see from Ted's note in the nickname column, NGC 3628 is commonly associated with two other Messier objects that make up a galaxy group referred to as the Leo Triplet. So, you really have five objects with which to try your luck.

Primary ID	NGC 3242	NGC 3628	M 65	M 66	NGC5194
Cls	PNe	Gal	Gal	Gal	Gal
Con	Hya	Leo	Leo	Leo	Uma
RA (Ap)	10h25m44.9s	11h21m20.2s	11h 18m 56.0s	11h 20m 15.0s	13h29m52.7s
Dec (Ap)	-18°44'43"	+13°28'48"	+13°05′32″	+12°59′30″	+47°11′43″
Mag	8.6	10	10.3	9.7	8.4
Size	40"	12.3'x 3.3'		9.1′ × 4.2′	11′.2 × 6′.9
Nickname	Ghost of Jupiter	Third member of the Leo Triplet (w M65 &66)	NGC 3623 the other, other triplet	NGC 3627 the other triplet	Whirlpool Galaxy
Discoverer	W. Herschel	W. Herschel	C. Messier	C. Messier	C. Messier
Discovery Date	1785	1784	1780	1780	1773
Source: Ted Forte (mostly)					

The Leo Triplet, with NGC 3628 (top), M66 (bottom left), and M65 (bottom right)



Source: David R

As to the Leo Triplet, in modern telescopes and even large binoculars, the triplet's members can all be seen in the same low power field using today's ultra-wide and moderately wide-field eyepieces. And when you do see them this way, they seem to make a group. They are nearly the same perceived size, brightness, and their angles towards one another leads you to think of them as members of a group, perhaps even interacting. But this would not be so intuitive back in the days of Messier and Herschel. In their small aperture, slow focal ratio refractors and Newtonians, with simple narrow-field eyepieces, a patch of sky was only seen as some narrow set of separate points in the heavens. Objects (remember we knew only stars, planets and nebulae) were nearly always seen alone, without any context of nearby associations. This was a major reason for the need of right ascension and declination, to fix objects in a location that could be returned to later for further examination, and to map them. Only after mapping many of these solitary objects did we gain context, and associations began to become manifest. I'm not going to give you any descriptions of these objects other than the data table below. Instead, look at these as Charlie or "Hersch" did with inadequate optical equipment, blank books, and an open mind.

Let's start our little tour with a planetary nebula: NGC 3242. I include this because, as I stated earlier, there were only stars, planets and nebulae. So, what happens when you see something shaped kinda like a planet, yet soft, cloudy, and wispy; kinda like a nebula? Well, you probably fret a bit, question if all planets formed out of the ether the same way, wonder if a deity is currently working in that neighborhood of space, toss around a few dozen ideas (more or less outlandish), then, after encountering a few more examples, create a new category of thing: Planetary Nebulae.

For the most part I don't keep written notes, nor do I draw anymore (yep, I did). The computer and images have superseded my old logbooks. But keeping logs serves several important functions. Beyond the *when* and *where*, there is the *what* and *how*. What was it you saw? Was it a bright comet with a spiky anti-tail, as well as a wide fanning dust tail? Or a very dim, thin oval ring of smoky gray, with a thicker brighter section to the north and west, with no sign of a central star? Did the galaxy look to be face-on and show one, two or more arms? Did it have a bright diffused core, dimming slowly to its outer edges? Did you see any sign of the polar caps as you viewed Mars?

A few notes on *how* you saw it can also be important. Simply giving the date and time (local or UT), your telescope (objective size, focal length, maybe mount), eyepiece, filter and the objects' general coordinates helps a lot. These sorts of facts can be summarized quite a bit, as you will find you only have a finite set of telescopes and eyepieces you routinely use. Also, adding how high the object was in your sky and the general weather conditions can help to fine tune what you bother to try to look at. No need to try for that Mag 12 comet when its only 15 degrees up in the northwest, near the light plume of Sierra Vista, unless it is just after a cold front has moved in. Or, by all means, go for Mars (even if it is small), when the air is still and the planet is higher than 30 degrees in the southeast, away from the mountains.

These descriptions can be long, well written prose or short cryptic abbreviations. Yes, probably everything you write, and draw, has been done before, but that is note the point. The point is *you* have never done this before. And your location and equipment and seeing conditions are unique. Also, your putting pencil to paper will reinforce your observations and improve the overall quality of your observations. Lastly, send in your results to us. We promise no vicious critiques, only positive reinforcement and developmental pointers.

Until next time, stay well, get out there and stare.

The Shaping of Planetary Nebulae Part 2

Ted Forte

In part 1 we saw how an accumulating cloud of material expelled by an aging star at differential speeds can be compressed, and then ionized to form a glowing nebula: a planetary nebula. But the Generalized Interacting Stellar Winds theory that describes and explains the process is unable to adequately account for the 80% or so PNe that exhibit non-spherical morphologies. Last month, we asked: "how can a presumably spherical star create a decidedly non-spherical planetary nebula?"

Over the past several decades, many mechanisms have been postulated to account for the observed shapes of PNe. A number of scenarios were proposed to invoke the star's rotating magnetic field as the source of asymmetrical jets that would lead to bi-polar structures. Asymmetric outflows (explosive mass ejections) were another idea, as was the possibility that expansion into an inhomogeneous interstellar medium could sculpt PNe into a variety of non-spherical shapes. Suffice it to say, that the physics just doesn't work. The hydrodynamical modeling of these and a few other proposed mechanisms are unable to sustain the forces necessary to reproduce the observed morphologies. Slowly, over time, the idea that a stellar partner was necessary to the formation of these non-spherical PNe came to dominate the argument.

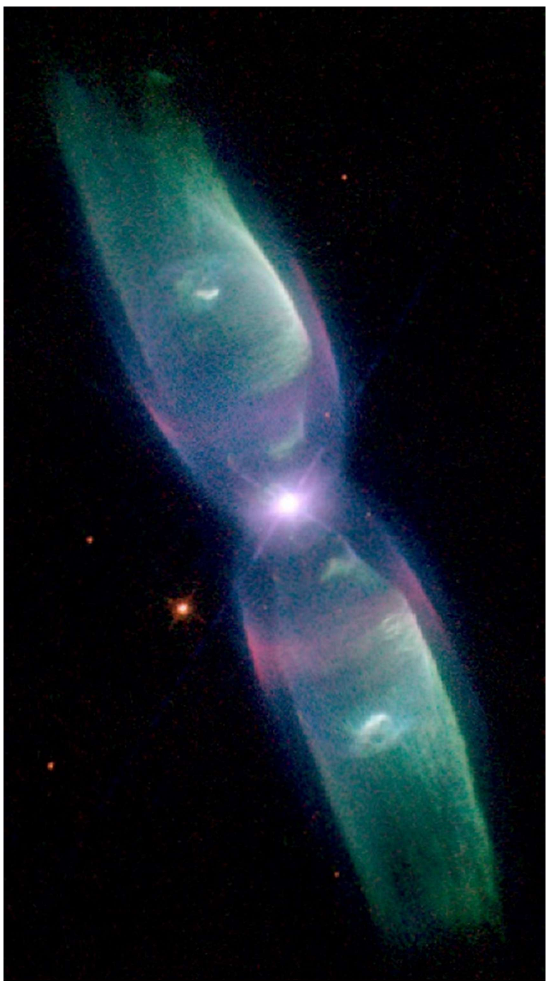
The "binary hypothesis" was, at first, fiercely resisted. Not only was it revolutionary, there was a serious problem. While 80% of PNe were non-spherical, fewer than 20% of them had been shown to have binary central stars.

Yet the physics was elegant. Models based on binary star interactions could easily reproduce the structures we observe in planetary nebulae. All of the PNe with known binary central stars exhibit the types of structures predicted by the binary hypothesis. More importantly, in all cases where both are known, the structures indicative of binary interaction lie perpendicular to the orbital plane of the binary; a 100% correlation that has just one chance in a million of happening by chance.

Further theorizing led to a far greater understanding of several phenomena that are now seen to be related to PNe. Symbiotic stars are a type of binary star system that usually contain a white dwarf with a companion red giant. The cool giant star loses material via Roche lobe overflow or through its stellar wind, which flows onto the hot compact star, usually via an accretion disk. They exhibit a "composite spectra" that shows characteristics of the red giant and the white dwarf in a sort of symbiotic relationship, hence the name. The progenitors of some novae are certainly related as are the cosmologically important Ia supernovae. A binary interaction as the progenitor of PNe leads scientists to the realization that all of these objects are so similar as to blur the distinctions almost to the point of irrelevancy.

The latest work involves what is termed Common Envelope Evolution (CEE) and Grazing Envelope Evolution (GEE) and their propensity to create and sustain bi-polar and multi-polar jets. In these systems, two stars of varying mass and evolutional stage, spiral inward until the smaller star ends up orbiting within the atmosphere of the larger star (or some extended part of that atmosphere) without actually merging. Eventually, the envelope of one or both is expelled in opposing, jet-driven outflows manifesting in the aspherical shapes that we see in most PNe. This has convinced the community that binary interactions are a necessary part of the shaping of non-spherical nebulae. Some researchers even insist that such a binary interaction is required for all visible planetary nebulae, but many still believe that spherical PNe can be created by single stars.

But what about that paucity of actual binary central stars? Recently, we have seen a number of surveys that employ methodologies like radial velocity monitoring, infrared excesses, photometric variability and space-based photometry that indicate that the 20% binary fraction is likely a gross under-estimate. The binary fraction may actually be closer to 100% when both post common envelope mergers and extremely wide separations are included. Even with many open questions remaining, it has become absolutely clear that central star binarity plays a crucial role in the formation and shaping of planetary nebulae. It remains to be seen as to whether or not that will apply to all planetary nebulae or if single stars like our sun can form a visible nebula.



Please Welcome Our New Members

We don't have any but whenever we have them let's welcome them with an elbow bump.

NASA Night Sky Notes

April 2020

This article is distributed by NASA Night Sky Network

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.org to find local clubs, events, and more!

Hubble at 30: Three Decades of Cosmic Discovery

David Prosper

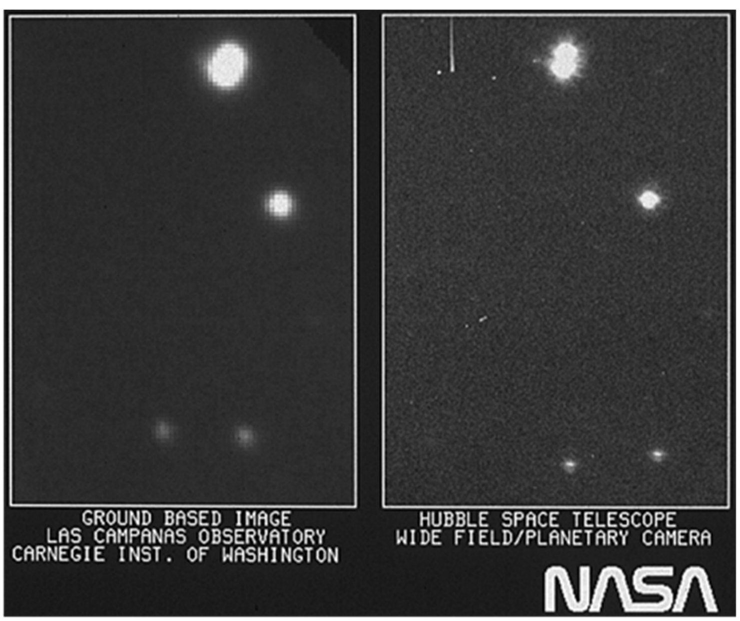
The **Hubble Space Telescope** celebrates its 30th birthday in orbit around Earth this month! It's hard to believe how much this telescope has changed the face of astronomy in just three decades. It had a rough start -- an 8-foot mirror just slightly out of focus in the most famous case of spherical aberration of all time. But subsequent repairs and upgrades by space shuttle astronauts made Hubble a symbol of the ingenuity of human spaceflight and one of the most important scientific instruments ever created. Beginning as a twinkle in the eye of the late Nancy Grace Roman, the Hubble Space Telescope's work over the past thirty years changed the way we view the universe, and more is yet to come!

We've all seen the amazing images created by Hubble and its team of scientists, but have you seen Hubble yourself? You actually can! Hubble's orbit – around 330 miles overhead -- is close enough to Earth that you can see it at night. The best times are within an hour after sunset or before sunrise, when its solar panels are angled best to reflect the light of the Sun back down to Earth. You can't see the structure of the telescope, but you can identify it as a bright star-like point, moving silently across the night sky. It's not as bright as the Space Station, which is much larger and whose orbit is closer to Earth (about 220 miles), but it's still very noticeable as a single steady dot of light, speeding across the sky. Hubble's orbit brings it directly overhead for observers located near tropical latitudes; observers further north and south can see it closer to the horizon. You can find sighting opportunities using satellite tracking apps for your smartphone or tablet, and dedicated satellite tracking websites. These resources can also help you identify other satellites that you may see passing overhead during your stargazing sessions.

NASA has a dedicated site for Hubble's 30th's anniversary at bit.ly/NASAHubble30. The Night Sky Network's "Why Do We Put Telescopes in Space?" activity can help you and your audiences discover why we launch telescopes into orbit, high above the interference of Earth's atmosphere, at bit.ly/TelescopesInSpace. Amateur astronomers may especially enjoy Hubble's images of the beautiful objects found in both the Caldwell and Messier catalogs, at bit.ly/HubbleCaldwell and bit.ly/HubbleMessier. As we celebrate Hubble's legacy, we look forward to the future, as there is another telescope ramping up that promises to further revolutionize our understanding of the early universe: the James Webb Space Telescope!

Discover more about the history and future of Hubble and space telescopes at nasa.gov.

Image Credit: NASA



Hubble's "first light" image. Even with the not-yet-corrected imperfections in its mirror, its images were generally sharper compared to photos taken by ground-based telescopes at the time. Image Credit: NASA

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And Now a special section of HAC Nightfall, the planetary distancing edition

rebuilding my observatory, aka, How I learned to love steel

BY Gary Sedun

I've had a wooden observatory with a steel roof now for a few years.

It's 30' by 16' and houses my 20"imaging scope and 25" visual scope. Here it is with the roof rolled off:

All was fine until this happened:

A careless worker started a grass fire half a mile from my house and thankfully the wind was blowing away from the house up here in the Dragoon Mountain Ranch, just east of St. David. In total, 3,500 acres were burned but amazingly no one was hurt, and no houses were destroyed. Last year, lightning hit two spots next to Mark Orvek's house and the ensuing flames got to within 10 feet of his observatory. Yikes, time to start thinking about what would happen to my observatory in a fire! It's not too hard to figure out; the walls would burn, and the metal roof would fall onto the scopes. Ouch.

Time to do something about this risk. Thankfully a neighbor was tearing down a barn and gave me all the metal - enough beams and metal roofing to completely replace the wooden walls in my observatory.

Here is the metal roof being supported and the walls being replaced:

Here's the steel framework all done. It's 15" taller than the original structure. I didn't realize my scopes would stick up past the walls when I built the original structure. These large scope tubes act like sails even in the lightest winds. I should get better images from now on since the scopes are now shielded from the wind. All I had to buy were the main steel rails that the roof rolls on:

Here are the former roofing panels now being used for wall panels:

The rails are painted white, so they don't rust over the summer. Everything will be painted next fall when I return. The inside will be black, and the outside color has yet to be determined.

Here are the two scopes parked for the summer, the 20":

and the 25":

I am truly am blessed to have these scopes, which I purchased at an estate sale in pieces. I finally have them working, most days. Now I can sleep soundly and not worry about any grass fires. In fact, it's built so stoutly that's where I'd head to if a tornado showed up here

One Small Patch of Sky

Alex Woronow, 2020

Sometimes a special image contains features and objects that makes it stand-out from the otherwise “remarkable” images we more frequently encounter. I’d like to describe one image that goes beyond remarkable because of its content, at least in my opinion.

The image of interest today centers on NGC 3576, which Wikipedia describes as, ”...a minor nebula in the Sagittarius arm of our galaxy...”, and says not much more. But there is more. The image in Fig 1 reveals an obvious contorted and dynamic cloud complexity. And if we read an ESO description of NGC 3576, we discover that this nebula hosts a wealth of star-birth activity. Furthermore, the neighborhood around NGC 3576 has another object of even greater scientific interest, NGC 3603, as well as an object of lesser interest, but some beauty, NGC 3590.

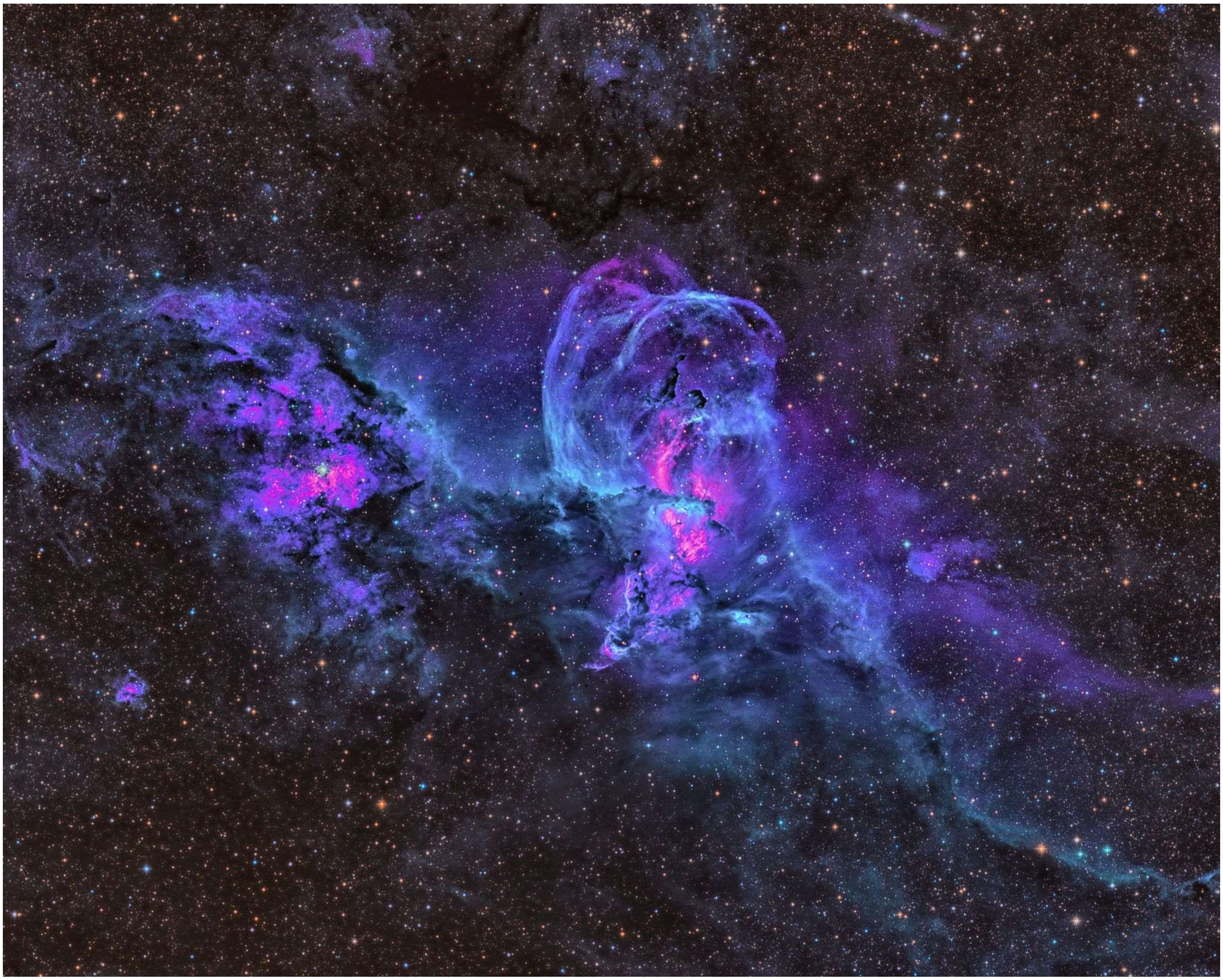

Fig 1. NGC 3576 and nearby objects. The loops and red core, in the center of the image, comprise the greater NGC 3576 nebula. This image is about 1.2 degrees in width and is a narrowband (SHO) false-color image. However, the stars have been rendered in their true colors.

Image processed by A. Woronow. Additional acquisition details and higher resolution images available at https://www.astrobin.com/py7jwt/

Returning to NGC 3576, it hosts several active “star-burst” regions--regions where star-birth is rampant. *(Star birth can be a chain-reaction event. One star forms. When it ignites, strong stellar winds drive the gas and dust outward where impact pre-existing clouds and compress them…leading to the condensation and spawning of yet more stars. And so, it goes.)* NGC 3576 lies about 9,000 light-years from us and spans about 100 light-years. The ESO description speaks of intense stellar winds “shredding” the nebula. An enlarged view of the central, star-forming region shows just that (Fig 2 left). Also, the loops at the top of that image arise from the outflowing, intense stellar winds and UV radiation emanating from the newly born stars, which push the gases and dust away, eventually forming hollowed-out bubble.

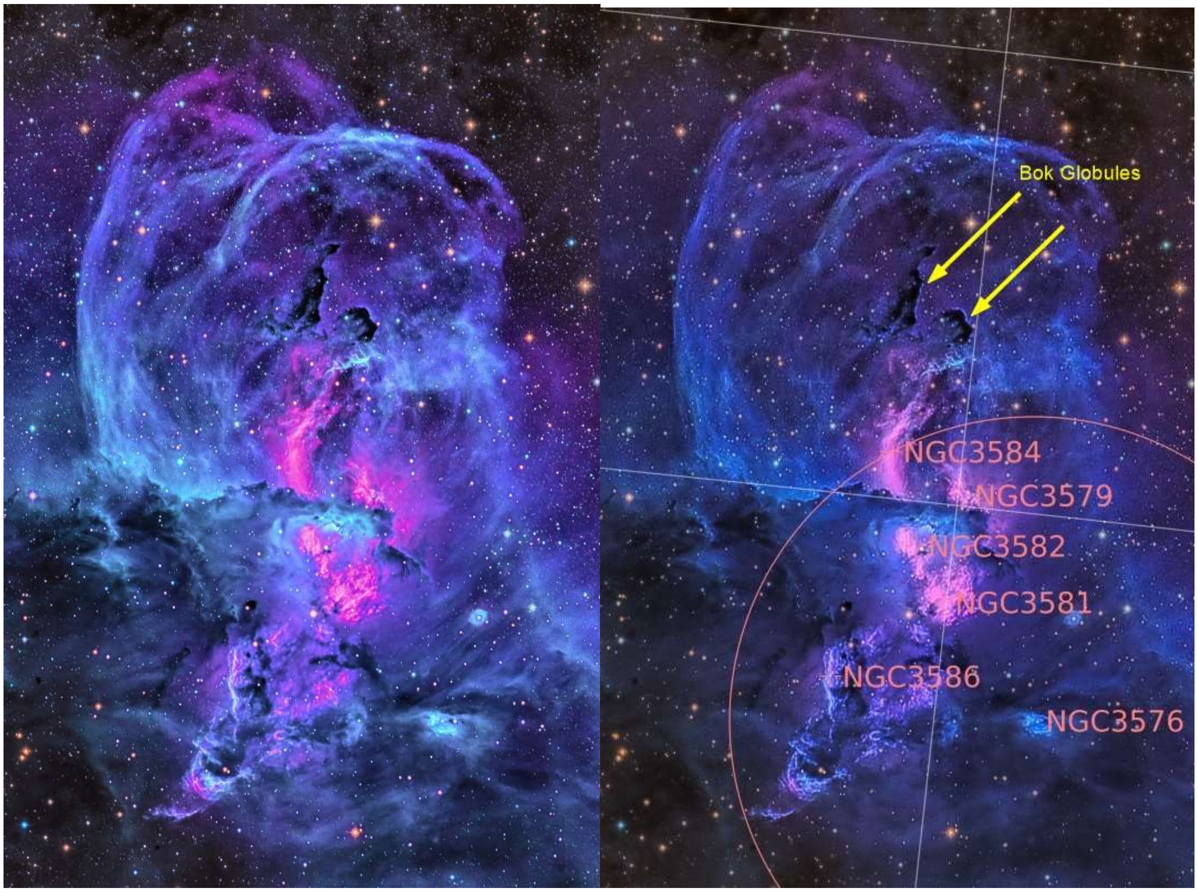

Fig 2. NGC 3576, in an enlarged view, showing “shredding” of the cloud by the violent stellar winds and UV radiation emanating from the young stars embedded in the nebula. Bubbles of gas driven outward by winds and radiation from the young stars become manifest as the loops at the top of the image. The annotated image (right) shows several of the star-forming regions, denoted as NGC objects. (NGC 3576 applies to the circle, or entire region.)

Reference as in Fig 1

All those bright nebulae in Fig 2, called-out by NGC tags, are HII regions ionized by the radiation and shock-wave-generated winds arising from young massive stars. Wolf-Rayet, O, and B stars likely dominate the star nurseries in these objects. Such stars are massive. For instance, the Wolf-Rayet stars range up to 200 or more solar masses and have short lives and violent, super-novae deaths, which further contribute to the sculpting of the nebular gases.

Fig 2 also shows two Bok Globules: dark, dense dust and gas nebulae not yet producing young stars, but usually harboring very early indications of star-formation, including warm spots and Herbig-Haro objects. The globules commonly have small total masses (e.g. 10 solar masses) and often show indications of ongoing in-fall of material associated with proto-star formation. The stars that eventually form from the material of the globules often occur as double- or multi-star systems.

Another feature in this image, NGC 3590, is a “colorful” open cluster. It just catches the edge of Fig 1, at the center top. NGC 3590 lies somewhat closer to us than NGC 3576, at about 7,500 light-years. Astronomers speculate that the member stars were born together in space and at about the same time.

NGC 3603 sits at the farther end of the distance scale as well as the “scientific interest” scale (Fig 3). Geographically, it resides in a different arm of the Milky Way than we do. The sun is in the Sagittarius arm, and NGC 3603 is in the Carina arm (Fig 3, right), about 20,000 light-years away.

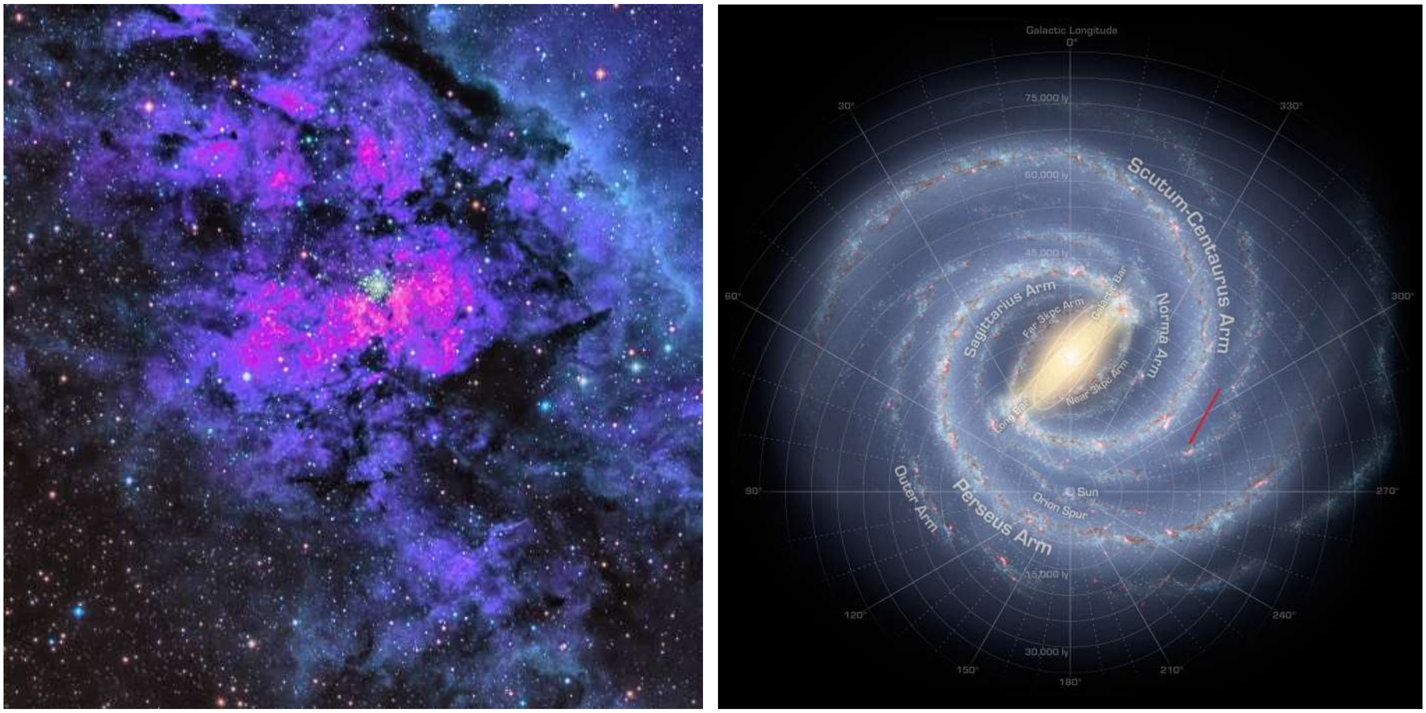

Fig 3. NGC 3603 (left image) lies in the Carina arm of our galaxy. In the Notional map of the Milky Way (right) the red arrow indicates the approximate location of the NGC 3603 with respect to the Sun. In Fig 1, NGC 3603 occurs about ¼ of the way in from the left edge of the image and about in the vertical center.

Right-hand image from https://www.nasa.gov/jpl/charting-the-milky-way-from-the-inside-out

John Hershel, on a trip to South Africa, discovered NGC 3603 in 1834. He speculated that it might be a globular cluster. It is not. The cluster of stars comprises the densest assemblage of stars known, and unlike the aged stars of globular clusters, these stars exude youth! Also, unlike globular clusters, usually hovering above the galaxy, this cluster lie well within the arms of the galaxy. Furthermore, the stars in NGC 3603 are embedded in the most massive gas, plasma and dust cloud known. Rather un-globular cluster like too!

The stars in NGC 3603 are very young, very massive, yet number in the thousands. What was once thought to be a single massive star at the center of the cluster actually consists of three massive Wolf-Rayet stars, and one of those is a binary star consisting of two Wolf-Rayet stars, together having a mass more than 200x that of the Sun. Along with these and other WR stars, the cluster also contains a considerable number of O and B—young, massive, luminous stars. In fact, two member stars, WR 442 and MTT 58, are among the most luminous stars known. Stolte, et al. (2004) argue that many of the cluster’s stars are remarkably young: between 0.3M and 1M years old.

The mere fact that one can observe this cluster raises a question. Generally, parental clouds of a star-nursery are largely obscured by their parental cloud. But this star-burst cluster stands out clearly. Why? The reason harkens back, once again, to the number, size, and youth of the cluster’s stars and the violent stellar winds and radiation they produce. Apparently, the winds and UV radiation have expelled the enveloping cloud to reveal the youthful stars themselves.

Additional features and processes in NGC 3603 and NGC 3576 remain topics of research and discovery. A richness of Herbig-Haro and Wolf-Rayet stars may help define the early processes of stellar evolution, and NGC 3603 is thought to harbor insights into the origins of processes in star-burst galaxies such as M 82.

Sometimes an innocent image contains a tale worth telling. I hope you agree that this was one of those times.

HAC Apr May Calendar of Events

SU	MO	TU	WE	TH	FR	SA
29	**30** **ALL APRIL AND MAY EVENTS ARE CANCELED**	**31**	**1 Apr** **3:21AM**	**2** Juno Opposition	**3**	**4**
5	**6**	**7** **7:35PM**	**8**	**9**	**10**	**11**
12	**13**	**14** **3:56 PM**	**15**	**16**	**17**	**18**
19	**20**	**21** Lyrid Meteors	**22** **7:26PM** Lyrid Meteors	**23** Lyrid Meteors	**24**	**25**
26	**27** Venus Greatest Brillancy	**28**	**29**	**30** **1:38 PM**	**1 May**	**2**
3	**4** Eta Aquarid Meteors	**5** Eta Aquarid Meteors	**6** Eta Aquarid Meteors	**7** **3:45 AM**	**8**	**9**
10	**11**	**12**	**13**	**14** **7:03 AM**	**15**	**16**
17	**18**	**19**	**20**	**21**	**22** **10:39 AM**	**23**
24	**25**	**26**	**27**	**28**	**29** **8:30 PM**	

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