## GSSP 2025 Observing Program Settle your beef with the Milky Way

by Akarsh Simha, with guidance from Steve Gottlieb

Yes, the milky way is the "Zone of Avoidance" and hides all the cool galaxies behind it. That's what I thought for years, until I discovered some of the joys of observing objects in the milky way.

1 Cart

The theme of the program is to observe the stages of stellar evolution in the Milky Way and also outside. This program is based on the same theme as my article in the October 2024 issue of Sky & Telescope, which was targeted at the fall/winter sky. This is a single observing program which offers something for every experience level and every aperture class.

**Note:** My guesstimates of aperture class and difficulty are probably very far from reality in many cases, especially given my lack of recent observing experience with smaller telescopes, please use them as a very rough guideline. Also there are always very talented and otherwise experienced observers who are capable of eking out faint stuff even in small telescopes. The guesstimate can sometimes assume a determined observer and sometimes not. There are also many objects on the list that I have not observed myself – some which I have little interest in trying, and others which I plan to observe at GSSP or in the future!

Finally, there are no pins, no certificates; there is no reason to complete the list (I haven't done it myself and may not) and it should not take away from the rest of the star party. Perhaps a tangible goal is to observe at least one object from these classes: Dark Nebula, Bok Globule, OB Association, Emission Nebula, Old Open Cluster, Stars/Stellar Remnants, Planetary Nebulae, Supernova Remnants

If you are printing this program, consider skipping this page to reduce waste The cow-art for this program was generated using ChatGPT

Object	RA	Dec	Constellation	Common Name	Туре	Guesstimated Aperture	Guesstimated Difficulty
Molecular Cloud	Ś						
Rho Onh	16.07.35	-23-26-20	Onh	Rho Ophiuchi Clouds	Edge of a Giant	3"+, try NVD on EN narts	Hard
Barnard 72	17:23:39	-23:41:42	Oph	Snake	Dark Nebula	4"+	Hard
Barnard 86	18:02:58	-27:52:05	Sgr	Inkspot	Dark Nebula	3"+	Easy
<u>Pillars of</u> Creation	18:18:53	-13:50:43	Ser		Dark Nebula	14"+ or NVD	Medium
Barnard 142/143	19:40:13	+10:51:36	Aql	Bamard's "E"	Dark Nebula	3"+	Medium
Barnard 168	21:53:18	+47:16:00	Суд	Dark Cigar	Dark Nebula	3"+	Easy
Bok Globules							
<u>Bok globule in</u> NGC 281	00:52:25	+56:33:54	Cas	Pacman Nebula	Bok Globule	?	?
vdBH 73	16:47:10	-41:16:30	Sco	Dark Tower	Cowmetary Globule	?	?
Barnard 68	17:22:38	-23:49:33	Oph		Bok Globule	ċ	Ś
<u>Bok globules in</u> <u>M8</u>	18:03:37	-24:23:12	Sgr		Bok Globule	?	?
Young Stellar O	bjects						
PDS 144N	15:49:15	-26:00:52	Sco		Protoplanetary Disk	20"+	Medium

Note: Featured objects with finder charts / observing notes have been underlined

## Observing Program Ordered by Stage of Stellar Evolution

Object	RA	Dec	Constellation	Common Name	Туре	Guesstimated Aperture	Guesstimated Difficulty
<u>SVS2</u>	18:29:56	+01:14:46	Ser	Serpens Red Object	YSO	16"+	Very Hard
Parsamian 21	19:29:00	+09:38:42	Aql		YSO (FUor)	12"+	Medium
<u>IRAS</u> 23077+6707	23:09:43	+67:23:38	Сер	Dracula's Chivito	Protoplanetary Disk	20"+	Medium
<b>OB</b> Association	S						
<u>NGC 206</u>	00:40:33	+40:44:21	And		OB Assoc	10"+	Medium
Sco OB2	N/A	N/A	Sco/Lup	Scorpius and Lupus	OB Assoc	Naked Eye	Easy
R CrA cluster	19:01:54	-36:57:11	CrA	Cowronet Cluster	OB Assoc	ċ	Ś
IC 4996	20:16:32	+37:38:56	Cyg		Part of OB Assoc	?	Easy
M 29	20:23:46	+38:29:13	Суд		Part of OB Assoc	3"+	Easy
Hodge Complex and NGC 6946							
	∠U.∪ <del>4</del> .∪ I		Cap				
Emission Nebu	2						
<u>M 8</u>	18:03:37	-24:23:12	Sgr	Lagoon Nebula	EN + Clus	Naked Eye	Easy
<u>M 16</u>	18:18:45	-13:47:31	Ser	Eagle Nebula	EN + Clus	2"+	Medium
M 17	18:20:46	-16:10:18	Sgr	Swan Nebula	EN + Clus	Naked Eye	Easy
IC 1308	19:45:05	-14:43:17	Sgr	Hubble X	EN / SFR	12"+, or try NVD	Easy/Medium
Sh2-155	22:57:05	+62:38:09	Сер	Caldwell Cave Neb	EN	12"+ or NVD	Medium
Ancient Open C	lusters						
NGC 188	00:47:11	+85:14:38	Сер		Old OC	8"+	Medium
NGC 6791	19:20:53	+37:46:40	Lyr		Old OC	8"+	Medium?

Object	RA	Dec	Constellation	Common Name	Туре	Guesstimated Aperture	Guesstimated Difficulty
Sundry Stars							
gam And	02:03:53	+42:19:47	And	Almach	Double Star	4"+	Easy
Antares	16:29:24	-26:25:55	Sco		Red Giant	Naked Eye	Easy
V AqI	19:04:24	-05:41:05	AqI		Carbon Star		Easy
NGC 6888	20:12:07	+38:21:18	Суд	Crescent Nebula	WR Shell	8"+	Medium
				Herschel's Garnet	,		
mu Cep	21:43:30	+58:46:48	Сер	Star	Red Supergiant	Naked Eye	Easy
Pre-planetary N	lebulae						
PN M 2-9	17:05:37	-10:08:32	Oph	Minkowski's Butterfly	PPN	16"+	Hard
PN M 1-92	19:36:18	+29:32:49	Суд	Minkowski's Footprint	PPN	16"+	Medium
CRL 2688	21:02:18	+36:41:36	Суд	Cygnus Egg	PPN	16"+	Medium
<b>Planetary Nebu</b>	la						
NGC 40	00:13:01	+72:31:19	Сер	Bow Tie Neb	PN	8"+	Medium
IC 3568	12:33:06	+82:33:50	Cam	Lemon Slice Neb	PN	8"+	Medium
NGC 6905	20:22:22	+20:06:16	Del	Blue Flash Neb	PN	8"+	Medium
NGC 7662	23:25:53	+42:32:05	And	Blue Snowball	PN	4"+	Easy
White Dwarfs a	nd Supernova						
<u>V462 Lup</u>	15:08:03	-40:08:30	Lup	Nova Lupi 2025	Nova!	Binoculars	Easy
SN 2025ngs	15:35:17	+30:51:56	CrB		Typell SuperNova	15"+	Medium
M 57 Central							
Star	18:53:35	+33:01:44	Lyr		WD	18"+	Hard
HD 340611	20:34:21	+25:03:49	Vul		WD	8"+	Medium

Object	RA	Dec	Constellation	Common Name	Туре	Guesstimated Aperture	Guesstimated Difficulty
Large Planetary	<b>v</b> Nebulae						
HFG 1	03:03:47	+64:54:35	Cas		Large PN	6"+	Very Hard
Abell PN 74	21:16:52	+24:08:51	Vul		Large PN	8"+	Very Hard
<u>Jones 1</u>	23:35:53	+30:28:06	Peg		Large PN	10"+	Medium
Supernova Ren	nnants						
<u>Sh2-91</u>	19:35:35	+29:36:00	Суд	phi Cygni nebula	SNR	16"+ or NVD	Hard
NGC 6960	20:45:37	+30:42:29	Суд	Veil Nebula: Witch's Broom	SNR	8"+ or NVD	Medium
				Veil Nebula:			
<u>Simeis 3-188</u>	20:48:32	+31:31:38	Суд	Fleming's Triangle	SNR	12"+ or NVD	Medium
NGC 6974	20:51:04	+31:49:41	Суд	Veil Nebula	SNR	12"+ or NVD	Medium
<u>Simeis 3-210</u>	20:53:07	+29:39	Суд	Veil Nebula	SNR	16"+ or NVD	Hard
				Veil Nebula:			
<u>CTB 1</u>	23:59:13	+62:26:12	Cas		SNR	? Try NVD	Very Hard

# <u>Useful external articles to study / download / print for offline access on the field</u>

Eagle Nebula and Pillars of Creation: Sky & Telescope, August 2025 issue, article by Howard Banich H. Banich Lagoon Nebula: Sky & Telescope, July 2012, "Going Deep" by Alan Whitman; August 2020, "Swimmin' in the Lagoon" by

Sh2-91: https://adventuresindeepspace.com/sh2091.htm CTB 1: https://adventuresindeepspace.com/ultimate.htm and https://adventuresindeepspace.com/ctb1.htm Steve Gottlieb, https://adventuresindeepspace.com/barnard.htm White Dwarfs: https://drive.google.com/file/d/1r9HWME4ymIMh7SPDJGPBXwnJhMcGYLOf/view by Scott N. Harrington Barnard's Galaxy and Hubble X: Sky & Telescope, August 2023, "Going Deep" by Dave Tosteson, Observing Report by Veil Nebula: Sky & Telescope, September 2021, "The Five Veils of the Cygnus Loop" by Howard Banich; NGC 6946 and Hodge Complex: Sky & Telescope, July 2013, "Going Deep" by Steve Gottlieb Dracula's Chivito: https://adventuresindeepspace.com/Draculas\_Chivito.html by Steve Gottlieb Pre-planetary nebulae M 1-92, M 2-9 and Cygnus Egg: Sky & Telescope, June 2021, "Going Deep" by Steve Gottlieb Rho Ophiuchi and many other objects on the list: Sky & Telescope, July 2014, "Going Deep" by Alan Whitman htt<u>ps://adventuresindeepspace.com/Dissecting%20the%20Veil%20Nebula.html</u> by Steve Gottlieb

Supernova Remnants: https://adventuresindeepspace.com/SNR\_Challenge.html by Jay Eads

Large Planetary Nebula: <u>https://www.reinervogel.net/LargePN/LargePN\_e.html</u> by Reiner Voge

Lecture notes on star formation: <u>https://sites.ualberta.ca/~pogosyan/teaching/ASTRO\_122/lect15/lecture15.html</u>

### Observing List ordered by Transit Time (RA)

Object	RA	Dec	Constellation
IC 3568	12:33:06	+82:33:50	Cam
V462 Lup	15:08:03	-40:08:30	Lup
Scorpius and Lupus	N/A	N/A	Sco/Lup
SN 2025ngs	15:35:17	+30:51:56	CrB
PDS 144N	15:49:15	-26:00:52	Sco
Rho Oph	16:25:35	-23:26:49	Oph
Antares	16:29:24	-26:25:55	Sco
vdBH 73	16:47:10	-41:16:30	Sco
PN M 2-9	17:05:37	-10:08:32	Oph
Barnard 68	17:22:38	-23:49:33	Oph
Barnard 72	17:23:39	-23:41:42	Oph
Barnard 86	18:02:58	-27:52:05	Sgr
Bok globules in M8	18:03:37	-24:23:12	Sgr
M 8	18:03:37	-24:23:12	Sgr
M 16	18:18:45	-13:47:31	Ser
Pillars of Creation	18:18:53	-13:50:43	Ser
M 17	18:20:46	-16:10:18	Sgr
SVS2	18:29:56	+01:14:46	Ser
M 57 Central Star	18:53:35	+33:01:44	Lyr
R CrA cluster	19:01:54	-36:57:11	CrA
V Aql	19:04:24	-05:41:05	Aql
NGC 6791	19:20:53	+37:46:40	Lyr
Parsamian 21	19:29:00	+09:38:42	Aql
Sh2-91	19:35:35	+29:36:00	Cyg
PN M 1-92	19:36:18	+29:32:49	Суд
Barnard 142/143	19:40:13	+10:51:36	Aql
IC 1308	19:45:05	-14:43:17	Sgr
NGC 6888	20:12:07	+38:21:18	Суд
IC 4996	20:16:32	+37:38:56	Суд
NGC 6905	20:22:22	+20:06:16	Del

Object	RA	Dec	Constellation
M 29	20:23:46	+38:29:13	Суд
HD 340611	20:34:21	+25:03:49	Vul
Hodge Complex	20:34:31	+60:08:17	Сер
NGC 6960	20:45:37	+30:42:29	Суд
Simeis 3-188	20:48:32	+31:31:38	Суд
NGC 6974	20:51:04	+31:49:41	Суд
Simeis 3-210	20:53:07	+29:39	Суд
NGC 6992	20:56:19	+31:44:35	Суд
CRL 2688	21:02:18	+36:41:36	Суд
Abell PN 74	21:16:52	+24:08:51	Vul
mu Cep	21:43:30	+58:46:48	Сер
Barnard 168	21:53:18	+47:16:00	Суд
Sh2-155	22:57:05	+62:38:09	Сер
IRAS 23077+6707	23:09:43	+67:23:38	Сер
NGC 7662	23:25:53	+42:32:05	And
Jones 1	23:35:53	+30:28:06	Peg
CTB 1	23:59:13	+62:26:12	Cas
NGC 40	00:13:01	+72:31:19	Сер
NGC 206	00:40:33	+40:44:21	And
NGC 188	00:47:11	+85:14:38	Сер
Bok globules in NGC281	00:52:25	+56:33:54	Cas
gam And	02:03:53	+42:19:47	And
HFG 1	03:03:47	+64:54:35	Cas

### Notes and finder charts for selected objects

Please note that this section has not been thoroughly reviewed / peer-reviewed due to paucity of time. Any mistakes are mine and I would be grateful to be informed of them if found!



Rho Ophiuchi Region, and Scorpius/Lupus (Sco OB2 association)

Finder Chart of rho Ophiuchi region, based on a DSS2 image

Star formation begins in molecular clouds, such as the one whose edge forms the rho Ophiuchi region. An illustration commonly found in astronomy textbooks shows how generations of stars form from a molecular cloud, with each generation of stars disturbing the cloud to generate the next generation of stars. This phenomenon is called "Triggered Star Formation":



Image from <a href="https://sites.ualberta.ca/~pogosyan/teaching/ASTRO\_122/lect15/lecture15.html">https://sites.ualberta.ca/~pogosyan/teaching/ASTRO\_122/lect15/lecture15.html</a>

According to <u>this presentation</u>, the rho Ophiuchi region is the presently active edge of a molecular cloud where star formation is happening. The molecular clouds are generally cold and dark and block light (dark nebula), but when the stars form in these clouds, the nebula is either ionized by the ultraviolet radiation from the stars causing it to glow (emission nebulae), or reflects the light of the star (reflection nebula). The many colors of the rho Ophiuchi clouds are caused by emission (pink from ionized hydrogen, like <u>Sh2-9</u>), or reflection of star light (blue from most stars, orange around the red giant Antares)

This cover slide of the presentation linked above tells a fascinating story connecting rho Ophiuchi to the constellations of Scorpius, Lupus and Centaurus:



The bright blue stars at the head of Scorpius and parts of Lupus and Centaurus are part of an OB-association called Sco OB2. These are the stars believed to have been formed in the molecular cloud whose edge is now in the rho Ophiuchi region. These bright blue stars of spectral type O and B are typically the early formers in a star-forming cloud, and the ultraviolet light and strong stellar winds from these very luminous stars evaporate the molecular cloud around them, "biting the very hand that fed them". That's why you don't see much nebulosity around the previous generations of stars, but there is nebulosity in the rho Ophiuchi region. It is this evaporation that sends disturbances through the rest of the cloud triggering the next generation of star formation, and that is the scene we are observing.

Lupus and Upper Centaurus being the previous generation of star formation, appears more spread-out than the head of Scorpius: the random relative velocities of the stars cause OB Associations to "spread out" over time as a general rule.

So the job of observing Sco OB2 is simply to look at the constellations with the naked eye and admire the astrophysical history we are seeing! The view is even more dramatic when at southern latitudes, so that Crux is also visible – that region of the sky is just so much richer in bright stars, marking three generations of sequentially triggered star formation.

Visually, the clouds of rho Ophiuchi are difficult objects to observe. My hunch from physics is that a night-vision device with H-alpha filter will only help on Sh2-9 as it is an emission nebula, but it is certainly worth exploring.

I have picked up various parts of the rho Ophiuchi nebula on occasion with both binoculars and telescopes. Wide-field binoculars delivering maximal exit pupil (5-7mm) would be my best recommendation, but a telescope fitted with a wide-field eyepiece operating close to maximum exit pupil should also work. Avoid nebula filters as they do not help on reflection nebulae. Scan the field carefully for subtle changes in background brightness, these are due to the nebulosity.

It is not clear to me if the three globular clusters in the region, namely M 80, M 4, NGC 6144, have any relation to the cloud. My suspicion is no – they are simply in the same line-of-sight. M 4 is ostensibly the nearest globular cluster to the earth and will appear as a beautiful, resolved, loose cluster of stars in a larger telescope.

### **Object types:**

IC 4604, IC 4603, IC 4605 are reflection nebulae IC 4592 = Blue Horsehead Nebula is also a reflection nebula The nebulosity around Antares is a reflection nebula as well Sh2-91 is an emission nebula Sh2-1 seems to be a reflection nebula (image is clipped, it extends further west) M 4, M 80 and NGC 6144 are globular clusters

### Steve Gottlieb's Notes:

**IC 4604:** 17.5" (6/30/00): this northern section of the Rho Ophiuchi nebula surrounds three bright stars including mag 5 Rho Ophiuchi (a close double at 3" separation) and two mag 7 stars 2.5' N and WSW. The glow appears most evident around the bright star. The dusty surrounding field (Barnard 42) is nearly empty of stars.

**IC 4603:** 17.5" (6/30/00): this is a large, circular glow surrounding a 4' pair of mag 8/10 stars and part of the Rho Ophiuchi complex (2° north of Antares). The nebulosity extends roughly 8'-10' in diameter. The setting is quite eerie as the 50' field is nearly devoid of all stars - just two other faint stars. The field has a dull gray appearance as if it was weakly luminous.

**IC 4605:** 17.5" (6/30/00): this section of the Rho Ophiuchi reflection nebula appears as a faint halo surrounding 5th magnitude 22 Scorpii. A mag 7 companion lies 3.6' SW. As with other sections of the nebula, the surrounding field is strangely devoid of stars and the background has a grayish sheen as if it is feebly glowing. Barnard 44 is a huge dark lane that extends roughly 6° ENE.

**NGC 6144:** 8" (6/5/81): faint, small. A mag 12 star is at the SW end but no other resolution. Located 40' NW of Antares.

17.5" (6/6/86): about 20 stars mag 12-14 resolved at 286x. The brightest mag 12 star is at the west edge. Located 37' NW of Antares. This globular is about 30,000 light years away or 5 times the distance of nearby M4.

**M 80**: 8" (7/5/83): a few faint stars resolved at moderate to high power at edges, very grainy, difficult to resolve.

18" (7/24/06): at 325x appears bright, fairly large, round, pretty symmetrical appearance, contains a blazing 1.5' core in a 5' to 6' halo. At 435x the halo and the periphery of the core are well resolved into roughly 100 stars and additional extremely faint stars pop in and out of visibility. The core itself is overlayed with a number of faint stars. Beautiful view at 565x as the

cluster nearly fills the 7' field with 100-150 stars from edge to edge and the core region is well resolved. The cluster appears asymmetric with the halo more extensive to the west (core offset to the east). Mag 8.5 HD 146457 is at the NE edgeo of the halo.

**M 4**: 8" (7/3/80): at 100x-125x; superb resolution of mag 11-13 stars. A brighter bar of stars extends N-S in the core. Somewhat straggling halo with some star-poor area. 18" (7/12/07): at 225x, the remarkable 10' central region is bounded by a nearly complete ring of stars with a prominent string (bar) of brighter stars oriented SSW-NNE nearly bisecting the central region. The center of this ridge of stars is intersected by a dense, elongated ring of stars with major axis E-W, with the majority of the stars to the east of the bar. A wide, brighter pair of stars (10.8/10.9 at 17") to the SE of the bar has an orange tint. Sprays of stars appear to emanate from the bar in all directions with a beautiful arc of stars curving along the entire north side of the core. The outer halo is relatively sparse but includes a number of brighter stars and appears to extend 15'-18' in diameter.



My notes on IC 4592 (Blue Horsehead) made with 25x100 binoculars:

Barnard 72 and Barnard 68



Annotated DSS2 Image, north is up

**Barnard 72**: Known as "The Snake" is a difficult-to-observe dark nebula. It is also featured on the RASC Deep Sky Challenge program

**Barnard 68**: Is a "Bok Globule", a small, dense cloud of dust and molecules. This is where star formation begins. These are regions in a molecular cloud that are denser. The smaller regions inside the Bok globule that have higher-than-average density will start collapsing under gravity to form protostars.

You can also try exploring the other dark nebulae in this region. See Alan Whitman's "Going Deep" article in the 2014 July issue of Sky & Telescope for a larger finder chart and notes on this region.

The coordinates of the star HIP 85154 are: 17h 24m 04s, -23° 50' 40"

A large patch of low-contrast dack hebulosity that snales around near a bright star. A higher contrast die nebula hies the thickest kmost on

Above is my observation with 25×100 binoculars. The "other dk. Neb." mentioned is Barnard 68

The Inkspot (Barnard 86)

This is one of the best-known and most beautiful dark nebulae.



The above is an image by Adam Block / KPNO (Creative Commons license) that I have annotated to show open cluster NGC 6520, right next to which lies the Inkspot (Barnard 86) dark nebula.

As a bonus object, not far outside the field of the image in the direction marked lies globular cluster Djorgovski 2, which was discovered by S. George Djorgovski of Caltech in 1986.



Finder Chart for Djorgovski 2 made from POSS I Blue imagery. Orientation is arbitrary.

Djorgovski 2 is easy to find by panning west of the Inkspot and it lies in the center of a Hercules-like keystone of stars. The glow is subtle in smaller telescopes, whereas bigger telescopes may resolve stars. Coordinates for Djorgovski 2 are 18h 01m 49s, -27° 49' 35". In the SIMBAD database, Djorgovski 2 is cataloged as "CI Djorg 2"

A low power eyepiece can show all three objects in one go: NGC 6520, Barnard 86 and Djorgovski 2.

Further reading: Object of the Week Post by Paul Alsing

### **Pillars of Creation**

The Pillars of Creation are a dark star-forming region in the Eagle Nebula (M 16). The region is a dark nebula inside which there are many young stars forming. The radiation from these young stars is slowly causing the pillars to evaporate. In the pillars, evaporating gas shields dense regions of dust and gas which become protostars. Such systems are called "Evaporating Gas Globules".

The pillars are themselves pretty difficult to observe visually, and aperture really helps. Fellow observers and I have detected all three pillars in my 18-inch. The large dark pillar is the easiest to see, followed by the small dark pillar, and finally the brighter pillar. My 28-inch shows a drastic boost in the visibility of the pillars. A narrow-band nebula filter like an OIII, H-Beta, or UHC filter will help tremendously.



POSS I Blue image with annotations showing the pillars, north is up (colors not inverted)

The coordinates for the center of the middle pillar are 18h 18m 52s, -13° 50' 43"

### NGC 281 (Pac-Man Nebula) and a Bok Globule in it

NGC 281 is the well-known Pac-Man Nebula in Cassiopeia. It is not a trivial visual target, but I have definitely detected it in my large binoculars (25×100) from a dark sky without filters. Night vision devices should make it extremely easy to observe.

Unfortunately, it isn't exactly well-placed during GSSP but it can be observed in the early hours just before dawn astronomical twilight.



DSS2 Blue image of Pac-Man Nebula annotated with features (north up)

A bright star anchors the open cluster IC 1590. South of that is a dark rift, which can be rather subtle visually, which represents the mouth of the Pac-Man character. The Bok globule of interest lies due almost east of the open cluster IC 1590 as marked. Bok globules are regions of high density and low temperatures in a molecular cloud, which have both cold molecular gas and dust. These are the sites of star formation within the cloud. Note the small Crux-like

asterism on the eastern edge of the globule which can be used to find it. The coordinates for the Bok globule are 00:53:09 +56:38:42

There is a beautiful HST image of the globule <u>here</u> which is oriented west-up.

### Lagoon Nebula and its Bok Globules

I have not researched the Lagoon Nebula much at all, and I recommend instead the following references:

- 1. https://skyandtelescope.org/observing/wallow-a-while-in-the-lagoon-nebula/
- 2. Sky & Telescope, August 2020, "Swimmin' in the Lagoon" by Howard Banich, pp. 20–25
- 3. Sky & Telescope, July 2012, "Going Deep" by Alan Whitman, pp. 61–62
- 4. "Visual Mysteries of the Universe" Volume 3 by Larry Mitchell, pp. 11–15

For your convenience, below is a reproduction of the finder chart provided on Reference 1:



Image from Sky & Telescope, article here, Gábor Toth

The aim here is to see the dark nebula, Barnard 88, Barnard 89, Barnard 296 ("The Dragon"), Dab 1, Dab 2, many of which (all?) are Bok globules

### **PDS 144N**

Reference:

https://www.deepskyforum.com/showthread.php?1781-Object-of-the-Week-June-23st-2024-%2 5E2%2580%2593-Protoplanetary-disk-PDS-144N

Scott N. Harrington wrote about this fascinating object on the Deep Sky Forum last June. The star-like object is actually the light from the protoplanetary disk around a young stellar object. These are the disks of gas and dust that eventually form planets around the star, so we're essentially looking at something that is similar to the early stages of the formation of our own solar system.

We brought it up in Steve Gottlieb's 24-inch scope during the last GSSP (2024). Unfortunately, it appears just like a star in our telescopes. Even Jimi Lowrey's 48-inch, it still appeared stellar; perhaps there is hope on a night of better seeing.



What we are looking for is essentially the northern (well, north-eastern) component of a tight 5.35"-wide double star. It is also the fainter component. The tight double itself bears the designation PDS 144 = IRAS 15462-2551 and has coordinates 15h 49m 15.4s, -26° 00' 52.45". The challenge is to split the double and isolate the fainter north-eastern component.

Scott writes on the Deep Sky Forum, "But while searching for PDS 144N might hardly seem worth it since it's a faint point of light in the eyepiece, one must keep in mind that you are seeing the first confirmed Herbig Ae-Herbig Ae binary with one displaying a disk that can be spatially resolved and studied in professional telescopes. Plus, the two stars are among a small set of Herbig Ae stars known to drive jets associated with parsec-scale chains of HH knots. Incredible! I never thought I'd be able to see a protoplanetary disk with an intermediate-mass YSO being obscured at its center with my own eyes."

### Serpens Red Object (SVS2)

References:

- <u>"Visual Mysteries of the Universe" Volume 3</u> by Larry Mitchell, pp. 47–51
- <u>Steve Gottlieb's post on the DeepSkyForum</u>



Finder chart made from DSS2 image, north is up

This is a very red reflection nebula illuminated by pre-main sequence star HD 170634. It is a 9.9mag star of spectral type M0. Young stars of low mass or intermediate mass are generally found enshrouded in cocoons of dust from the molecular cloud that they collapsed from. These generally turn into reflection nebulae after the star emerges, and this is one such example. The more famous examples like Hubble's Variable Nebula and Hind's Variable Nebula are not exactly well-placed during GSSP.

Visually, the Serpens Red Object is extremely challenging to view, because of the red color that our rod cells are virtually insensitive to. With my 18-inch, I did manage to see it at Texas Star Party 2014, and my notes read "At the edge of visibility. Another reflection nebula is nearby." The "other" reflection nebula I refer to, which appears much brighter, is vdB 123.

Below are Steve Gottlieb's notes copied from DeepSkyForum. I'm guessing Steve was using his 24-inch.

"This unusual Red Reflection Nebula was seen at 175x, knowing the exact position. It appeared extremely faint, small, round, ~15"-20" diameter. Using averted vision the glow popped ~20% of time, and was only seen for brief glimpses, though confirmed with certainty. Visually, there wasn't much to see, but it was still exciting to pick up such an obscure object."

Larry Mitchell writes in his book: "Visually, this object is very dependent upon sky conditions, and it is probably reserved for larger telescopes, 20-inches and above."

### Parsamian 21

References:

- <u>"Visual Mysteries of the Universe" Volume 3</u> by Larry Mitchell, pp. 126–130
- <u>DeepSkyForum OOTW post</u> by Akarsh Simha

Parsamian 21 is a nebulosity illuminated by an eruptive variable star of type "FU Orionis". These stars comprise an accretion disk around a young star, and it is believed that whenever the accretion rate increases, the newly accreted material getting heated up by the star causes the system to brighten drastically.

The nebulosity Parsamian 21 appears rather "cometary". It is theorized that a bipolar outflow from the young star excavates a cavity in the surrounding material, and the material is illuminated by the star like a reflection nebula. We see the light scattered from the walls of the cavity as the cometary nebula.



Model for Parsamian 21 from Agnes Kospal's dissertation

Visually, it was not too difficult in my 18-inch telescope. I logged, "Beautiful! Quite bright. Elongation easily detected."

### Dracula's Chivito (IRAS 23077+6707)

References:

- DeepSkyForum thread on Dracula's Chivito
- Adventures in Deep Space article by Steve Gottlieb

The true nature of this object was only discovered last year, so it's definitely worth a look! Although cataloged as an infrared source by the IRAS, it turns out that this object is a protoplanetary disk! And we can actually see it as an extended object!!

Ciprian Berghea from the US Naval Observatory serendipitously found the disk on PanSTARRS images in 2016, and the discovery is reported in <u>this 2024 paper</u>.



Image of Dracula's Chivito



Wider FOV finder chart from DSS2 images, north is up. The object forms a nice isosceles triangle with two stars In terms of visual observation, Jimi Lowrey reports with his 48-inch: "At 1040x I was able to see that it was elongated. I was also surprised as to the high surface brightness of the main disk. I could also see the nebula going near the star on the left. I only caught the dark lane twice and can not count it as a positive."

But owners of "normal" telescopes need not despair. Scott Harrington reports that it was visible in his 16-inch, where "it looked like a 14.2-magnitude star."

I took a look at Dracula's Chivito with my 28-inch f/4.1 in late 2024, wherein it looked distinctly non-stellar and nebulous. I was using a 4.5mm Morpheus which delivered about 650x magnification.

It appeared like an elongated fuzzy spot with an elongation at between -15° or -30° position angle east of north, i.e. NNW-SSE. On about three occasions, I may have sensed a "split" in that same direction of its elongation, as though it was a tight double star, but it was so weak I can't be sure—I can't make sense of what this could possibly be, if at all real. A faint star was seen to about 90° PA, i.e. due east. One other observer on the field also confirmed its diffuse nature looking through my scope. Hand-tracking at 67° declination was not bad even at this high power. I wish I had carried my 3.5mm Pentax so I could try higher power.

### NGC 206 in Andromeda Galaxy

NGC 206 is a large association of stars in the Andromeda Galaxy. Our friendly neighborhood spiral, M 31, is decently placed just around astronomical twilight in the pre-dawn sky during GSSP.

NGC 206 appears as a subtle brightening on the south-western side of M 31. Below is a DSS2 image of M 31 and satellite galaxies M 32 and M 110 showing the location of NGC 206. North is to the right (not up!).



When you use a chart like this, remember the visual size of M 31's core is going to be a lot smaller than the image. It may be more robust to try to use the isosceles triangle it forms with M 32 and M 110, or some other such way of finding out where to look.

OB Associations like NGC 206 are loose "clusters" of O- and B-type stars that are formed from a molecular cloud. Generally these bright, luminous stars are the first to form from a cloud. A more detailed discussion can be found under the "Rho Ophiuchi Cloud" heading above. In this case, we are not seeing an OB Association within the Milky Way, but one in the Andromeda Galaxy, 2.2 million light years away!

As a further challenge, some amateur astronomers have taken to isolating individual stars within NGC 206, see <u>Scott Harrington's article on the subject</u>.



DSS2 image of NGC 206, north is up

Above is another close-up image of NGC 206 which you can use a finder chart, take note of the two stars nearby. Do not expect it to appear bursting resolved into stars like it does on the POSS II image plates! I only see a subtle brighter region in the disk of M 31 at low power, and have not really studied it much beyond.

Finally, here are Steve Gottlieb's notes on the object:

8" (12/6/80): very faint, moderately large, elongated N-S, low surface brightness patch near the SW end of M31.

17.5" (8/18/93): fairly faint, fairly large, elongated 5:2 N-S, 4.0'x1.6', low and uneven surface brightness. A few very faint stars are just visible over surface including a brighter star at the south tip. Located 40' SW of the core of M31. This is the huge star cloud at the SW end of M31.

### Hodge Complex and SSC in NGC 6946

NGC 6946, the Fireworks Galaxy, is a pretty low-surface brightness galaxy that is a challenge object for small telescopes. In larger telescopes like my 18-inch, the challenge was in tracing its faint spiral arms and finding the structures within them.

Steve Gottlieb has written an article in Sky & Telescope's July 2013 issue titled "Unraveling NGC 6946" in which he include a finder chart (page 61) with numerous knots and regions of interest marked. What is marked as #2 there is our target here. Quoting Gottlieb's notes on the object from the article:

"A 20" pair of 13th-magnitude stars lies 2.4' southwest of the nucleus. Just 1.5' northwest of this pair I picked up a soft, 15" knot (labeled 2) that could easily be missed. Studies reveal that this small-seeming patch is actually a huge stellar and gas complex spanning 2,000 light-years and containing more than a dozen tightly packed clusters, including a million-solar-mass SSC. At an age of only 10–15 million years, this supercluster is thought to be an early evolutionary stage in the formation of a classical globular star cluster."

I first noted the knot (known as the Hodge Complex) in my 18-inch at Okie-Tex Star Party 2015. However, I did not then resolve the million-solar-mass Super Star Cluster that Gottlieb talks about above.

One recent study conjectures that the Hodge Complex is not a star-forming complex within NGC 6946, but may be a foreground dwarf galaxy.



Finder chart for the Hodge Complex and SSC made from DSS2 images, north is up



DSS2 Blue image zoomed-in on the Hodge Complex with the SSC appearing as a stellar point on the east, north is up

With my 28-inch, I observed the Hodge Complex during GSSP last year. The complex appeared as a bright knot WSW of the core and using 486x, I was able to distinctly see a stellar point superposed on the knot's southern end, indicating that I had isolated the super star cluster within the Hodge Complex. This was also suspected at lower power (162x) as a brightening towards the eastern side of the complex, but not fully isolated. I suspect it may be tractable even in smaller telescopes on a night of good seeing given its bright, stellar nature.

There is a lot more detail to be seen in NGC 6946, and I would encourage using the finder chart from Steve Gottlieb's aforementioned article to dig through the galaxy. In my 28-inch, in a cursory glance, the amount of structure in the galaxy was mind-boggling, revealing five spiral arms and lots of mottling and knots.

Barnard's Galaxy (NGC 6822), IC 1308, Hubble V and other objects

Barnard's Galaxy is a small irregular galaxy in the direction of Sagittarius, and part of the local group of galaxies. Its proximity allows us to peer into its structures and pick up several nebulae and a few globular clusters with amateur telescopes!



Finder chart of NGC 6822 made from DSS2 imagery, North is Up

IC 1308, also known as Hubble X, is the second brightest nebula in the galaxy. Hubble V is the brightest nebula.

Here are Steve Gottlieb's notes on Hubble X = IC 1308: 17.5" (5/10/91): HII region on the NE edge of NGC 6822. At 82x and OIII filter, appeared as a faint, very small but clearly nebulous round knot. Estimate mag 14. A mag 12 star lies 2' SE (very close double on the POSS). Not seen without a filter. Forms a pair with similar Hubble V just 3' W.

Tom Polakis reported it with a 13-inch, where he notes "blinks well with the O III filter and showed a round, uniform disk 15" across at 310x." He concurs that Hubble V appeared brighter than Hubble X, and noted some brightening in the center with his 13-inch.

Steve points out that these two knots are so high in surface brightness, that they may be seen even when the galaxy itself is invisible.

Hubble III, a much fainter nebula, was miscataloged in the Morphological Catalog of Galaxies as MCG -2-50-003.

Here are my notes with my 18" from the Warner Mountains:

**Hubble V**: A nebula with a strong response to DGM NPB filter. Forms a nice triangle with a pair of stars, almost isosceles. The nebula seems to have a star superposed. The nebula appears to fan out slightly to the northwest. Brightest nebula in NGC 6822.

**Hubble X** = IC 1308: Pretty obvious, slightly elongated piece of nebulosity. Responds to DGM NPB filter. Second easiest nebula in NGC 6822.

Hubble III: Faint and difficult, generally seen as a vague extension of the glow of Hubble I

**Hubble I**: A conspicuous sensation of "something present" that is faint but definite. A nearby star confirms the exact position of the glow against images. Intermittently "enlarges" in the direction of Hubble III.

As a bonus, try the globular clusters – Steve Gottlieb wrote about them in his list of extragalactic globulars on the Sky and Telescope website here: <u>https://skyandtelescope.org/sky-and-telescope-magazine/extragalactic-globular-clusters/</u>

I have only had success with "NGC 6822: SC 7" through my 18-inch. SC 6 did not yield to my 18-inch despite my attempts, especially due to the bright star flanking it. I may have attempted Hubble VII once but gave up quickly.

### Nova Lupi 2025

Thanks to Dan Smiley's post on TAC, I learned about the Nova in Lupus that is currently approaching naked-eye visibility! Due to its southern location, it should be caught right around transit just as it gets dark at 10:15–10:30 PM. It should culminate at an altitude of about 9° at GSSP.

Here is the reference article on Sky & Telescope's website: <u>https://skyandtelescope.org/astronomy-news/bright-nova-lights-up-lupus/</u>

For your convenience, I have pasted the finder chart by AAVSO and Bob King from the site above into this packet:



### The three pre-planetary nebulae (CRL 2688, M 1-92, M 2-9)

A pre-planetary nebula is a stage before the formation of a full planetary nebula, where the red giant's core hasn't heated up enough to ionize the surrounding ejecta, so the gas around it simply reflects the light of the star. This means narrow-band filters like OIII or UHC will not generally help on such nebulae. These nebulae are also called "protoplanetary nebulae", not to be confused with protoplanetary disks discussed earlier.

The three pre-planetary nebulae on this list are fairly tiny and need high power and preferably motorized tracking on the telescope to really study. Minkowski's Butterfly (M 2-9) is interesting in that it shows the two wing-shaped lobes pretty nicely. The Cygnus Egg Nebula shows strong response to a polarizing filter, which is interesting if you have one on hand.

For these three nebulae, I refer you to Steve Gottlieb's excellent article in the June 2021 issue of Sky & Telescope.

### Supernova SN2025ngs in NGC 5961

References:

- June 2025 Supernova Thread by Redbetter on CN
- ZTF: <u>https://lasair-ztf.lsst.ac.uk/objects/ZTF25aauvber/</u>
- TNS: <u>https://www.wis-tns.org/object/2025ngs</u>

This is a recently discovered Type II supernova. The estimated magnitude as of 16th June was 15.9, we can expect it to be fainter during GSSP. It lies 7" NE of the center of the galaxy. Below is a finder chart showing the position relative to the galaxy (marked with cross hairs)



Finder Chart for SN2025ngs, a Type II SN in NGC 5961

Large Planetary Nebulae

Planetary nebulae generally expand through the interstellar medium over time. Not only do they grow bigger, but there are changes to their light distribution and a separation of the OIII and H-beta emission due to the interaction with the interstellar medium. I refer you to the excellent article by Reiner Vogel on the subject:

https://www.reinervogel.net/LargePN/LargePN\_e.html

Reiner Vogel has also made a large planetary nebula observing guide which can be obtained here:

https://www.reinervogel.net/pdf/Large\_PN.pdf

### HFG 1

Below is a finder chart copied from Reiner's Observing Guide, which in turn I believe is an enhanced DSS2 image

### Heckathorn-Fesen-Gull 1 (HFG 1) in Cassiopeia



Here is a DeepSkyForum Object of the Week post on HFG 1 and Abell 6 which lies nearby as seen by us:

https://www.deepskyforum.com/showthread.php?1818-Object-of-the-Week-November-17-2024-Abell-PN-6-and-HFG1

Here are my notes on HFG 1 using my 18-inch at 67x:

OIII filter:

Estimated diameter of glow ~ 7' 50"

Glow seemed round, but lopsided towards the east. (I did not try looking for the "bow shock" like feature in the east). The rim was more prominent in the eastern half.

UHC filter:

Structure and diameter seems similar to OIII, but the brightness seems even more lop-sided towards the east.

It was not extremely faint, but by no means was it bright either.

As for Abell 6, I haven't had a successful observation with my 18-inch, but have seen it several times through a friend's 25-inch.

Abell 74

Once again, below is a finder chart from Reiner Vogel's guide:



With my 18-inch at 80x from excellent skies, I detected (this was my second attempt) an extremely faint glow. The glow, in the OIII filter, seemed lopsided north-east, asymmetric from the central star. Only a meager hint of a glow, if at all, was suspected on the other (southwestern) side. This may be because of the star-field on the southwest. One of the faintest objects I've ever seen!

Jones 1

Compared to the other two planetary nebulae I've listed, Jones 1 is bright and easy, but it still appears on many challenge lists including the RASC Deep Sky Challenge list. Below, again, is a screenshot from Reiner's guide



With my 18-inch at 67x, I logged: "Somewhat faint, but it was detectable without OIII after star-hopping to the region. Putting in an OIII filter made it obvious, showing a C-shape with more thickness at the edges."

Sh2-91, the "other" SNR in Cygnus

This is a toughie for sure, but more tractable than CTB 1 or Simeis 147. Here is a page on the subject on Adventures in Deep Space:

https://adventuresindeepspace.com/sh2091.htm



POSS II Red image of the phi Cygni fragment, north up

One "bright" filament of this SNR lies just south of the bright naked-eye star phi Cygni. It is tricky to isolate the faint tendril from the star-studded background, and a nebula filter is a must. The central coordinates for this filament are 19h 39m 11s, 29° 55' 46".

This filament actually continues further west, swooshing past Minkowski 1-92, but is very faint there. It later brightens up at around 19h 32m 51s, 29° 35' 19". Try that one if you succeed in seeing the phi Cygni fragment – I haven't tried this portion yet.

The Sh2-91 filament is part of a large supernova remnant that is extremely faint – see below. For now, let us be content with glimpsing this brightest segment.



The entirety of the Sh2-91 / Sh2-94 / Sh2-96 supernova remnant, image shared by Jay Eads on the <u>Supernova Remnant Challenge</u>

### Veil Nebula

Below is Howard Banich's **sketch (!!!)** which was featured in his Sky & Telescope article (September 2021 issue, "The Five Veils of the Cygnus Loop"), and can also be retrieved from his website <u>here</u>.



On the left, is the "eastern veil" and on the right is the "Witch's Broom" fragment near 52 Cygni

He also dissects the sketch and labels it on his website, I'm pasting screenshots for your convenience of offline access:

![](_page_38_Figure_0.jpeg)

![](_page_38_Figure_1.jpeg)

![](_page_38_Picture_2.jpeg)

Veil #3

![](_page_38_Picture_4.jpeg)

![](_page_38_Figure_5.jpeg)

Veil #1

![](_page_38_Figure_7.jpeg)

Veil #5

On his <u>DeepSkyForum OOTW post</u>, Howard writes a report of a binocular observation of the entire Cygnus Loop, which I have copied below:

Last week, two friends were out testing a new pair of 80 mm binoculars equipped with OIII filters, and reported that they too could see the entire Loop by following my drawing. This

suggests that many of us have been "missing the forest for the trees" by only looking at the individual segments with our larger telescopes.

### CTB 1

This elusive supernova remnant also bears the designation Abell 85, although it is not a planetary nebula.

See <u>https://adventuresindeepspace.com/ctb1.htm</u> It is also listed as an "Ultimate Challenge" by Rich Jakiel: <u>https://adventuresindeepspace.com/ultimate.htm</u> I tried to see it with my 18-inch, to no avail. You may have better luck.

Here's an OIII image to use as a finder chart:

![](_page_39_Picture_5.jpeg)

OIII exposure by M. Schirmer

![](_page_39_Picture_7.jpeg)

according to OIII exposures, the brightest sections are in the western and nort-west sections (very different from the H $\alpha$ /red plates)

The above finder charts come from Jay Eads' "Supernova Remnant Challenge": <u>https://adventuresindeepspace.com/SNR\_Challenge.html</u>

![](_page_40_Figure_1.jpeg)

Jay has posted some detailed star-hopping instructions as well as this helpful chart:

Akarsh Simha wishes to thank Steve Gottlieb and Scott Harrington for their inputs and corrections, Dan Smiley for pointing out the nova, Redbetter for his supernova threads on CloudyNights, Larry Mitchell for his wonderful three-volume series as well as Texas Star Party advanced lists (from where many objects have been drawn), Randy Pufahl and Rich Ozer for inspiration, and many other people of this community who have contributed in a myriad ways to my enjoyment of this hobby.