

These thick clumps of gas and dust make excellent targets for astro-imagers.

Astrophotographers tend to be drawn to the biggest and most colorful objects in the night sky. Emission nebulae, star clusters, and nearby galaxies quickly attract the attention of both novice and seasoned imagers. But there's another, more subtle type of object that can add variety to your growing deep-sky portfolio: dark nebulae.

Most dark nebulae are visible in three of the four seasons, with a break during spring when the Milky Way clings to the horizon. From mid-northern latitudes, the best time of year to image these turbid regions is when the Milky Way rides high in the summer, fall, and winter skies.

Dark nebulae are massive interstellar clouds of dust and gas that permeate the Milky Way. Unlike their luminous

emission- and reflection-nebulae cousins, many of the finest dark nebulae stand out as starless voids in the rich star fields of the Milky Way, though some are found above or below the galactic plane. Others appear as dark features in front of bright emission and reflection clouds. Here are some of the more interesting dusty targets you can target from mid-northern latitudes.

### Fall and Winter Classics

Several large, fascinating dark nebulae lie in Cepheus and are well placed in the autumn and early winter. Let's start about  $4\frac{1}{2}^\circ$  northeast of Alfirm, Beta ( $\beta$ ) Cephei, with **LDN 1235**, sometimes called the Dark Shark. The most opaque part of

▼ **THE DARK SHARK** The same dust that obscures starlight can also reflect it. Light from the Milky Way illuminates the brownish dust in LDN 1235, though the blue reflection nebulae vdB 149 (top) and vdB 150 (lower left) add a different hue (and fins) to the sharky composition.

# Capturing Stellar

# "VOIDS"

vdB 149

LDN 1235

vdB 150

the cloud makes up the shark's "snout" roughly  $10''$  north-east of 6th magnitude HD 211300, the shark's "eye." The predator's body appears in long exposures as brownish dust trailing off to the west. Adding to the shark's anatomy are two reflection nebulae, vdB 149 and vdB 150, which some interpret as representing the dorsal and pectoral fins, respectively. This collection of objects fits cozily in a  $3\frac{1}{2}^\circ$  field with a little room to spare for creative framing.

Another interesting bit of dust lies  $1\frac{1}{2}^\circ$  south-southeast of Eta ( $\eta$ ) Cephei: **B150**, often referred to as the Seahorse Nebula. Brownish dust throughout the field surrounds the denser material that produces the  $1^\circ$  seahorse shape aligned roughly east-west and terminating at 8.5-magnitude HD 198300. A wide-field telescope and camera combination producing at least a  $1\frac{1}{2}^\circ$  field is necessary to frame this target.

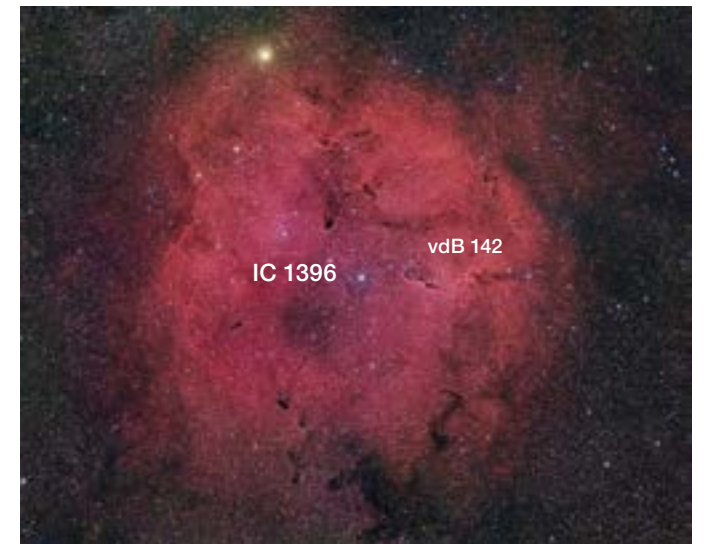
Returning to Alfirm, aim  $3\frac{1}{8}^\circ$  southwest for **NGC 7023**, the Iris Nebula. This complex structure contains reflection, emission, and dark nebulae each having its own designation. Just  $6'$  northeast of the reflection component is the prominent dust of **LDN 1174**, while  $\frac{1}{2}^\circ$  to the south is a group consisting of **LDN 1173**, **LDN 1172**, and **LDN 1170**. These are just a few of the many dusty structures revealed in long exposures of this region (more can be found in the August issue, p. 18).

Before moving on from Cepheus, I can't resist slewing slightly more than  $1^\circ$  southwest from 4th-magnitude Mu ( $\mu$ ) Cephei, the Garnet Star. That's where the large, faint emission nebula **IC 1396** resides. This sprawling object covers a  $2^\circ$ -wide, roughly circular patch of sky and is riddled with thick clumps of dark nebulosity. The best known is **vdB 142**, the Elephant's Trunk Nebula, located just west of the center of IC 1396. The Elephant's Trunk also contains a small, bluish reflection component, which landed it on van den Bergh's catalog of reflection nebulae. The entire IC 1396 complex is an excellent target for large and small telescopes alike; small, wide-field instruments with a  $2\frac{1}{2}^\circ$  field of view will frame the entire nebula, while large telescopes are better suited for close-ups of vdB 142 and other nearby silhouetted knots of dust.

Skipping southeast over to Orion, you'll find some of the best-known dark nebulae of the winter Milky Way. Orion houses such a treasure trove of glittering deep-sky objects that perhaps the darker features have escaped your notice.

The most striking of these for imagers is **B33**, the famous Horsehead Nebula, located  $\frac{1}{2}^\circ$  south-southeast of Alnitak, the easternmost star of Orion's Belt. This distinct pillar of cosmic dust billows in front of the glowing nebulosity of IC 404. Just  $15'$  east-northeast of Alnitak lies **NGC 2024**, the Flame Nebula, with its back-illuminated dust lanes giving the appearance of a match that's just been struck. Both NGC 2024 and B33 comfortably fit within the same  $1^\circ$  field. These two objects are among the most frequently imaged dark nebulae in the winter sky (see page 25).

Found  $2\frac{1}{2}^\circ$  northeast of Alnitak are the dark tendrils winding through reflection nebula **M78**. Aside from its network of opaque dust, I've always found M78 interesting



▲ **KNOTS AND TRUNKS** Top: The large emission nebula IC 1396 in Cepheus hosts several dark components. Particularly interesting for imagers with large scopes is vdB 142, seen at right, which also contains a small, bluish reflection nebula.

▲ **EXOTIC FLOWER** Above: Composition is important when attempting to include as much of the dust surrounding the Iris Nebula (NGC 7023) as possible in the frame. Orient the long axis of your camera north to south and place the bright reflection nebulosity towards the top of the frame in order to include dark nebulae LDN 1173, 1172, and 1170.



◀ **A BIT OF EVERYTHING** The combination of emission, reflection, and dark nebulosity in M78 makes it challenging to image but rewarding when you pull it off successfully.

because it contains structures of so many different colors and brightnesses. But these attributes make it a challenging target to process.

Moving east-northeast about 12° to Monoceros you'll come to **NGC 2237**, **NGC 2238**, and **NGC 2239**, which together make the Rosette Nebula, a large emission nebula complex roughly 1½° in diameter (see image on page 27). Standing out in stark contrast along its north and west sections are a meandering series of dark knots of dust. The most prominent of these appears as a jagged, three-vane structure almost due north. Each of these dark clumps of dust is slowly evaporating due to hot stellar winds emanating from the young stars of open cluster NGC 2244 in the center of the nebula. The Rosette looks great when photographed through most any telescope — imagers with wide-field instruments can frame the entire complex, while those using large scopes can focus their attention on the complex strands of dust.

### Lazy Summer Nights

The summer Milky Way features some of the most majestic dark nebulae found in the sky. Most obvious is the massive complex of dust found in Ophiuchus, northwest of the galactic center. Here lies a sprawling collection of opaque dust and gas roughly 10° in circumference known collectively as the **Dark Horse Nebula**. The Dark Horse is most recognizable as a walking horse with its head bowed low if you present the image with east at the top. The horse doesn't have an official designation, but individual parts of it do. Its hind legs are made up of **B78**, also known as the Pipe Nebula (a large, 7°-wide nebula itself), and **B72**, the S-shaped Snake Nebula found within the horse's torso. You can record this entire collection of nebulae with a full-frame camera and lens of about 100-mm focal length, though smaller components like B78 require a field of at least 8° to adequately frame both the Pipe's stem and bowl. The Snake Nebula is framed best with about a 1° field of view.

Moving about 9° east into Sagittarius, we find M20, the Trifid Nebula. While we usually think of the Trifid as an emission and reflection nebula complex, it owes its nickname to dark nebula **B85**, appearing as a triad of dusty gashes dividing up the emission component. Messier 20 is a colorful target with many small-scale features that beckon imagers with large telescopes, but it also looks great in wide-field astrographs, particularly when framed to include its popular neighbor M8, the Lagoon Nebula, just 1½° south-southeast.

Following the Milky Way north into Aquila we come to another silhouetted molecular cloud with a familiar appearance. With a little imagination, the two dark nebulae **B142** and **B143** appear like an interstellar letter E. Use a field of at least 1.5° to frame it comfortably and be sure to orient your camera so that its long axis is directed north to south. Only 2° west-northwest is **LDN 673**, a fascinating dark nebula

consisting of wide, tentacle-like dark structures. This object can be a challenge to photograph due to 6th-magnitude HD 181383, which lies just 20' to the northwest. Careful framing is required to avoid reflections or scatter from the star that would detract from your composition.

### Northern Nebulae

I can't overstate the beauty of the dark structures found around the galactic center. However, there are plenty of great dark nebulae targets further north, around and within the Summer Triangle formed by the bright stars Vega, Deneb, and Altair.

Perhaps the most familiar lies about 2½° east-southeast of Deneb, in Cygnus. The prominent dust lane that separates **NGC 7000**, the North America Nebula, from **IC 5070** and **IC 5067**, the Pelican Nebula, doesn't have an official name, though it makes up the nebulous continent's Gulf of Mexico. Both the North America and Pelican nebulae neatly fit in a 4° field of view.

Another emission nebula subdivided by dark nebulae is **IC 1318**, sometimes called the Butterfly Nebula. The glowing wings of this celestial insect span the 2° directly east



▲ **HOST WITH THE MOST** The opaque lanes of Barnard 85 give M20, the Trifid Nebula, its memorable name.

## Fall-Winter Dark Nebulae

Object	Type	Size	RA	Dec.
LDN 1235	Dark	100' × 40'	22 <sup>h</sup> 15 <sup>m</sup>	+73° 25'
B150	Dark	60' × 3'	20 <sup>h</sup> 50.6 <sup>m</sup>	+60° 18'
NGC 7023	Reflection	18'	21 <sup>h</sup> 00.5 <sup>m</sup>	+68° 10'
LDN 1174	Dark	37'	21 <sup>h</sup> 02.6 <sup>m</sup>	+68° 12'
LDN 1173	Dark	5'	21 <sup>h</sup> 04.7 <sup>m</sup>	+67° 42'
LDN 1172	Dark	6.8'	21 <sup>h</sup> 02.7 <sup>m</sup>	+67° 42'
LDN 1170	Dark	32'	21 <sup>h</sup> 01.7 <sup>m</sup>	+67° 37'
IC 1396	Emission	2.8° × 2.3°	21 <sup>h</sup> 39.1 <sup>m</sup>	+57° 30'
vdB 142	Dark / Reflection	1'	21 <sup>h</sup> 37.1 <sup>m</sup>	+57° 29'
B33	Dark	6' × 4'	05 <sup>h</sup> 40.9 <sup>m</sup>	-02° 28'
NGC 2024	Dark / Reflection	30'	05 <sup>h</sup> 41.9 <sup>m</sup>	-01° 51'
M78	Emission / Reflection	7' × 6'	05 <sup>h</sup> 46.7 <sup>m</sup>	+00° 03'
NGC 2237-39	Emission	80' × 60'	06 <sup>h</sup> 32.3 <sup>m</sup>	+05° 03'

Angular sizes are from recent catalogs. Right ascension and declination are for equinox 2000.0.



▲ **TWISTED TENDRILS** Left: Dark nebula LDN 673 in Aquila appears as a complex tangle of blackness spanning roughly ½°. Right: Barnard 142 and 143 together make up Barnard's E, though inky B142 is denser and more prominent against the background star field.



of 2nd-magnitude Sadr, Gamma ( $\gamma$ ) Cygni, and is, in my opinion, one of the prettiest fields in the summer sky.

### Imaging Strategies

Dark nebulae are, well, dark. Often they appear either slightly brighter or fainter than the background sky. They are invariably low-contrast and require careful post-processing to reveal their subtleties. Apart from those that appear in front of emission nebulae, these opaque objects are best imaged with one-shot-color cameras or monochrome detectors equipped with LRGB filters. They respond well to modern light-pollution filters, as well as the exotic multi-bandpass filters designed for DSLRs. When using a light-pollution filter, be sure to compensate for the filter's reduced light transmission by increasing your exposure time. Dark nebulae in front of emission regions are also excellent targets for those imaging through narrowband filters.

Since dark nebulae are set against dense Milky Way star fields, the appearance of the individual stars has a major impact on the overall aesthetics of your image. Try to retain as much star color as possible during processing. My approach is similar to that for star clusters (*S&T*: July 2021, p. 35).

Any time the Milky Way is visible in your sky, you won't have to look far to find a dark nebula that suits your specific imaging setup. They come in all sizes and help reveal the three-dimensionality of our home galaxy. Best of all, many can be captured in a few hours with a one-shot-color camera, allowing you to take advantage of those brief breaks in the clouds. So what are you waiting for? Come on over to the dark side.

■ Contributing Editor **RON BRECHER** often targets nebulae, star clusters, and galaxies from his backyard observatory in Guelph, Ontario, Canada.

### Summer Dark Nebulae

Object	Type	Size/Sep	RA	Dec.
Dark Horse Nebula	Dark	10° × 10°	17 <sup>h</sup> 21.0 <sup>m</sup>	-21° 07'
B78	Dark	7°	17 <sup>h</sup> 30.0 <sup>m</sup>	-26° 00'
B72	Dark	10'	17 <sup>h</sup> 23.0 <sup>m</sup>	-23° 32'
B85 (M20)	Emission / Dark	28'	18 <sup>h</sup> 02.6 <sup>m</sup>	-23° 02'
B142	Dark	60' × 30'	19 <sup>h</sup> 40.7 <sup>m</sup>	+10° 30'
B143	Dark	50' × 39'	19 <sup>h</sup> 41.5 <sup>m</sup>	+11° 00'
LDN 673	Dark	50' × 15'	19 <sup>h</sup> 20.9 <sup>m</sup>	+11° 16'
NGC 7000	Emission	2.0° × 1.7°	20 <sup>h</sup> 58.8 <sup>m</sup>	+44° 20'
IC 5067/70	Emission	80' × 70'	20 <sup>h</sup> 47.8 <sup>m</sup>	+44° 22'
IC 1318	Emission	50' × 30'	20 <sup>h</sup> 21.0 <sup>m</sup>	+39° 54'

Angular sizes are from recent catalogs. Right ascension and declination are for equinox 2000.0.



▲ **BUTTERFLY WINGS** *Top*: Emission nebula IC 1318 (left) is divided by a thick dust lane into two fairly symmetrical “wings”.

▲ **DARK GULF** *Above*: The dark nebula between NGC 7000, the North America Nebula (left), and NGC 5067/5070, the Pelican Nebula (right), helps to give both objects their namesake shapes.