

Our messy galaxy

Explore the southern Milky Way's dark clouds

Dusty webs sprawling across the galaxy's richest star fields make for must-see observing.

by Craig Crossen; photos by Gerald Rhemann

Our Milky Way Galaxy is a dirty place. So much soot and dust occupies interstellar space that we see less than 20 percent of the light from the brilliant Perseus Double Cluster (NGC 869 and NGC 884). But for all dust takes away, it also helps create some of the finest cosmic vistas. In fact, we usually take note of them only when they lie between us and a star-rich patch of the galaxy.

Microscopic grains of carbon (ordinary soot), ice (water), silicates (sand), and even some metals (notably iron from certain types of supernovae) compose interstellar dust. The dust gathers in clumps and clouds. The thickest clouds shield their interiors from starlight, which makes them cool enough that space's ever-present hydrogen gas

can exist in its molecular form. That's why astronomers call the densest of these regions molecular clouds.

The northern Milky Way's most famous dust feature is the Great Rift that runs through Cygnus, Vulpecula, Aquila, and Serpens. This is actually a chain of dust clouds. Its northeast end, near Deneb, lies about 2,300 light-years away, but the clouds in southern Serpens approach much closer to us.

Glories of the Southern Crown

Less sprawling, but just as photogenic, is a chain of small molecular clouds (SMCs) that stretches along the Milky Way between Scorpius and Crux. The clouds lie a few hundred light-years away and now produce clusters of modest-mass stars. The Rho (ρ) Ophiuchi cloud com-

plex is one of the most frequently imaged. The star lies 3° north of Antares and is some 700 light-years away from Earth.

Nearby, but less well known, is a compact, 1° -long cloud named **Bernes 157**. It's the heart of the Corona Australis Dark Cloud Complex about 420 light-years away, which makes the clumpy, ragged Bernes SMC about 8 light-years long. At its thickest, the cloud's dust squelches light from newborn stars by 35 magnitudes. These baby stars can be mapped only in the infrared by sensing dust their light has warmed.

The blue nebulosities around these stars are reflection nebulae, where dust preferentially scatters blue light. One of these, NGC 6729, includes some pink flourishes. They mark where emission from ionized hydrogen gas supplements the reflected starlight.

Why so little pink in photographs of Bernes 157? The cloud produces stars of spectral type B1 or cooler. Stars this cool don't emit much ultraviolet light energetic enough for ionizing hydrogen atoms. Hotter O-type stars, which ionize hydrogen for scores of light-years around them, create the diffuse glow of all of the sky's great emission nebulae.

Globules in the Chamaeleon

Our next stop is a group of SMCs about 520 light-years away toward the small southern constellation of Chamaeleon. The **Chamaeleon Cloud Complex**, located on the extreme southern edge of the Milky Way near Crux, is similar to the Corona Australis Complex, but much clumpier.

Craig Crossen and Gerald Rhemann co-wrote *Sky Vistas: Astronomy for Binoculars and Richest-Field Telescopes* (Springer-Verlag, 2004).



NGC 5367 in Centaurus is a reflection nebula on a comet-shaped cloud called CG 12.

The hottest stars produced in the Chamaeleon Cloud are type B1, so we see mostly blue reflection nebulae. In photographs, a few pink areas glow where energetic starlight manages to make hydrogen gas fluoresce.

Several cloudlets look particularly dark. These are Bok globules, spherical clouds between about 0.3 and 7 light-years across. The smallest ones will dissipate before they can condense into stars. Medium-size globules can produce a single Sun-like star, and larger globules may form multiple-star systems. Astronomers estimate 100,000 of these mini-clouds populate our galaxy.

Fringed in dust and gas

The clumps of dust thin quickly as we look even slightly out of the Milky Way's plane. For an example, consider a patch of faint emission nebulosity in the southern constellation of Apus.

This is not a star-forming region, just a gauze of gas and dust. The material is so thin that three external galaxies shine through it. IC 4633 is conspicuous on the edge of the emission glow. In the midst of the nebular haze lies the bright sliver of a distant edge-on spiral or lenticular system. Across the nebula from IC 4633 resides a third galaxy — just a smudge, because it's farther away than the others.

Open cluster NGC 6193 contains two fiercely hot O-type stars that erode and illuminate the surrounding nebula, NGC 6188. Their energy brightens the rim of the molecular cloud that formed the cluster and is sweeping it away. The cluster lies 4,300 light-years away.



The Chamaeleon Cloud Complex contains dust that reflects the blue light of nearby B-type stars. Nebula IC 2631 (left) is the brightest example. The clouds lie 520 light-years away.



NGC 6193



An unnamed Bok globule's matter (top) flows away from O stars in the nearby open cluster NGC 6231 (bottom right) in Scorpius. Intense radiation and strong outflows from these exceedingly hot stars can clear out a molecular cloud in less than half a million years. NGC 6231 is 6,200 light-years away.

Another example occurs northeast of the rich, but distant, open cluster Melotte 66 in Puppis. However, a feature known as **Cometary Globule 4** (CG4) shows this area of interstellar matter is considerably dustier than that in Apus.

Cometary globules are isolated, relatively small clouds of gas and dust within the Milky Way. CG4 lies about 1,300 light-years away and contains enough material to make several Sun-sized stars. CG4 sports two extensions that resemble

the pincers of a claw. Seemingly within their reach is a faint edge-on galaxy.

The fact that a galaxy is visible at all tells how thin and localized the dust here is. Indeed, Puppis is the Milky Way's least dusty region. Along certain lines of sight, dust dims stars 20,000 light-years away by just 3 magnitudes.

Somehow, gas and dust rise hundreds of light-years out of the galaxy's plane. Astronomers find their subtle infrared and ultraviolet glow even near the galac-



Comet-shaped cloud CG4 in Puppis is illuminated and sculpted by stars in open cluster Melotte 66. Thanks to pincer-like projections at the cloud's large end, CG4 seems to be trying to grasp a faint background galaxy. The cloud is 1,300 light-years away.

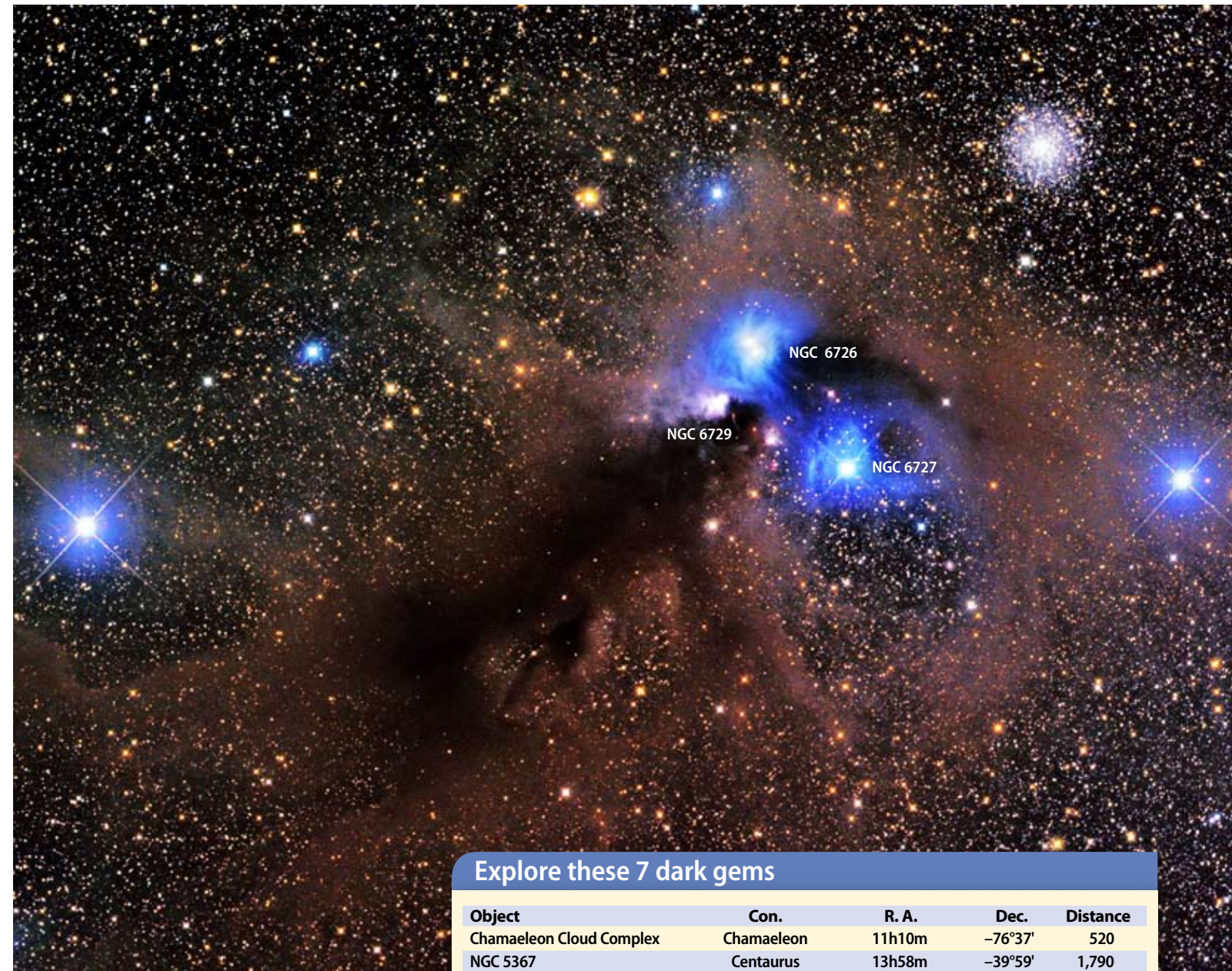


This patch of faint emission in the southern constellations of Apus and Octans is not part of a star-forming region. It's just a thin haze of gas and dust above the galaxy's plane. The cloud is so thin, three galaxies — including IC 4633, the brightest — shine through it.

tic poles. In those wavelengths, these high-latitude clouds reflect the galaxy's cumulative light.

Hot stuff in Ara

A nest of hot, young O stars can clear out a molecular cloud in less than half a million years. One beautiful example is open cluster **NGC 6193** and its associated nebula NGC 6188 in Ara. What remains of the original molecular cloud forms a dark shoreline-like edge on one side of the



Bernes 157 is the heart of the Corona Australis Dark Cloud Complex about 420 light-years away. Three reflection nebulae — NGCs 6726, 6727, and 6729 — flare in the cloud's northern end (right). NGC 6729 has a touch of pink, which indicates its star is setting some gas aglow.

cluster. Stellar winds and radiation crash into the cloud's edge, creating a thin, bright excitation zone — a rim nebula.

Scorpius O stars

In the southwest corner of Scorpius' tail lies **NGC 6231**, one of the most impressive clusters of O-type giants and supergiants known in the galaxy. NGC 6231 is only a couple of million years old, but it has already cleared gas and dust for scores of light-years around it. A comet-shaped

Explore these 7 dark gems

Object	Con.	R. A.	Dec.	Distance
Chamaeleon Cloud Complex	Chamaeleon	11h10m	-76°37'	520
NGC 5367	Centaurus	13h58m	-39°59'	1,790
NGC 6193	Ara	16h41m	-48°46'	4,300
NGC 6231	Scorpius	16h54m	-41°49'	6,200
Melotte 66/CG4	Puppis	7h27m	-47°44'	1,300
Faint emission around IC 4633	Octans	17h14m	-77°32'	—
Bernes 157	Corona Australis	19h02m	-36°53'	420

Con. = Constellation; R.A. = Right ascension (2000.0); Dec. = Declination (2000.0); Distance = light-years

dust cloud, a remnant of the massive one that birthed NGC 6231, shows how O-star winds and radiation erode Bok globules. The cluster is blowing gas and dust away from the cloud. Even in such a hostile environment, a globule far enough from the cluster can produce a new star before it completely disintegrates.

Calm winds in the Centaur

Not all comet-shaped clouds are true cometary globules. The cloud that hosts

reflection nebula **NGC 5367** in Centaurus is a good example. There are no O-type stars here, just the light of a B-type sun scattered by dust. With no rim nebula, we can conclude this cloud owes its shape to something other than the winds and radiation of hot stars.

Don't overlook some of the galaxy's darker views. The interplay of bright stars and dark molecular clouds is a pleasing sight — and it adds a seemingly 3-D perspective to your Milky Way tours. ☾