Chapter Two



Vast Explosive Remnants

Puppis
Vela

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This chapter focuses on a part of the Milky Way that appears to have been ripped apart visually! A jagged dark-lane referred to as the Rift seems to split the Milky Way just west of the False Cross.

In the 1950s Australian astronomer Colin S. Gum began a photographic survey of the southern Milky Way in black and white using a hydrogen alpha filter at Mt. Stromlo Observatory. Amongst his many discoveries the most famous was the one that still bears his name, the Gum Nebula.

The Gum Nebula turned out to be just the first of several supernova remnants (SNRs) in this region that Colin Gum discovered in this fashion. The now equally famous Vela SNR sits in the background but steals the show with its intricate detail. The Gum Catalogue of objects contains many of his discoveries.

This area of star death still has enough star birth activity going on to balance the feel of it all. The emission nebulae and young clusters are the beneficiaries of all the heavy elements created in the supernova explosions of the past that we see spreading out into the interstellar medium, creating the beautiful shockwaves and filaments seen in the images within this chapter.

Due to the high levels of both H-alpha and OIII, these objects all respond well to narrowband imaging or hybridizing RGB with narrowband data.

Gum Nebula — Gum 12

Constellation	Vela/Puppis
RA	08 h 04 min 03 s
Dec	−40° 02′ 29″

The Gum Nebula refers to the largest single entity available photographically in the entire sky. It could be argued that the Milky Way fits that bill, but there is nowhere on Earth that it is possible to get the entire Milky Way into a field of view at any one time.

Covering an area of 35° × 25° a standard wide angle lensed DSLR will readily reveal the faint oval nature of the Gum Nebula as it extends on both sides of the galactic plane. The Gum Nebula is believed to be the supernova remnant (SNR) of a spectacular explosion that occurred 2.6 million years ago! It is so vast that we are only 450 light years away from its front edge but over 1,500 light years from its back edge.

Imaging

Due to its immense size, this object can only be captured in its entirety using a camera lens. The nebulosity actually stretches nearly as far as Canopus, the bright star at the top of Fig. 2.1. This image was taken with an 18 mm lens orientated perpendicular to the plane of the Milky Way. Due to its low surface brightness, and the fact that much of it is in the plane of the Milky Way it is actually quite difficult to prevent the faint nebulosity from being obscured by the galactic star fields. This is where a monochrome CCD camera is useful. If a sufficient number of H-alpha subs are taken (which suppress the intensity of the star light) and these are blended into the red channel of short exposure RGB subs then the nebulosity can be made to really stand out from the Milky Way.



Fig. 2.1 Gum Nebula (south-west is up).

Technical Information – Fig. 2.1

Camera Lens:	Canon 18–55 mm at 18 mm
F-stop:	f/4.5
Camera:	QSI 683wsg Mono
Exposures:	6 × 3 min R 6 × 3 min G 6 × 3 min B 15 × 15 min H-alpha (blended with the red) (All unbinned)
Field Size:	50° × 40°

Gum 15 — RCW 32

Constellation	Vela
RA	8 h 44 min 54 s
Dec	–41° 17′ 11″

Gum 15 is a fine object in a moderate sized telescope. An ultra high contrast (UHC) filter brings out the dark-lane and the slightly irregular outline of an otherwise circular appearance.

Fig. 2.2 reveals the dark-lane well along with the bright, shockwave feature left of center, and there is a sense that this is another Triffid Nebula in the making. The sparse open cluster Cr 197 makes up most of the stars in the northern half of the nebula.

Imaging

Without the Gum or RCW catalogue available the above RA and Dec coordinates can be used to locate this object. Alternatively, aim for the open cluster NGC 2671 and slowly move the camera a few fields north. Due to its small size, Gum 15 is only really suited to a medium to long focal length telescope. This image was taken at 2,010 mm and would have benefited from a larger field of view. It is bright enough to be a good target for DSLR and OSC, although it would still require extensive exposure.

With a wider field, Gum 15 can be imaged along with the much larger Gum 14 (RCW 27) and the reflection nebula NGC 2626 which lie to the north-west. Alternatively, it could be imaged with Gum 17 and the open cluster NGC 2671 to the south-east.



Fig. 2.2 Gum 15 (north is left).

Technical Information – Fig. 2.2

Telescope:	10″ Vixen VMC260L with 0.67× focal reducer
Focal Length:	2,010 mm
F-ratio:	f/7.7
Camera:	QSI 583wsg Mono
Exposures:	10 × 10 min L
	8 × 5 min R
	8 × 5 min G
	8 × 5 min B
	(All unbinned)
Field Size:	46′ × 36′

Gum 20 — RCW 36

Constellation	Vela
RA	8 h 59 min 21 s
Dec	–43° 44′ 10″

Gum 20 is a curious star forming nebula with brilliant young stars deeply embedded amongst the dark and light nebulosity. Despite its appearance in photographs it is still a very dim object even in large telescopes.

Imaging

When trying to frame Gum 20 look out for the four brighter patches (reminiscent of the Cat's Paw Nebula, Fig. 6.9) and bring them to the center of the field. Without the catalogues and with an inaccurate mount it might be difficult to locate this object. Moving from the star Lambda Velorum is an option. There is actually a substantial amount of extremely faint nebulosity surrounding Gum 20 that might be captured with very long exposure time. However, a more pleasing appearance is achieved without capturing this nebulosity or by reducing its prominence during processing.

A much larger field will capture Gum 20 along with the Spiral Flame Nebula (Fig. 2.11).



Fig. 2.3 Gum 20.

Technical Information – Fig. 2.3

Telescope:	7″ Intes-Micro Mak-Cass with 0.67× focal reducer
Focal Length:	1,206 mm
F-ratio:	f/6.7
Camera:	QSI 583wsg Mono
Exposures:	10 × 10 min L
	7 × 5 min R
	7 × 5 min G
	7 × 5 min B
	(All unbinned)
Field Size:	35′ × 26′

Vela Supernova Remnant

Constellation	Vela
RA	8 h 59 min 47.2 s
Dec	–47° 31′ 57″

The Vela SNR is a large, somewhat enticing object for large aperture telescope users and astroimagers alike. In area the Vela SNR covers thirty square degrees. This size makes it one of the largest single objects that an observer can view through a telescope. In saying that, it takes a large aperture telescope with an O-III filter on a dark, transparent night to see this complex at its best.

When you have seen the whole of the Vela SNR through a telescope you get the feeling of travelling along a road or highway, such is the vast size of this much extended object. The names of some of the features therefore reflect these engineering similarities. Crossing a 'bridge' here, taking the short-cut along the 'bypass,' a wrong turn up to a dead end on the 'spur' or climbing to the 'crest', a journey along this oxygen-filled road is one never to be forgotten.

The supernova explosion that has left us with these amazing features occurred between 11,000 and 12,300 years ago at a distance of 800 light years.

Imaging

The Vela SNR is an astroimager's paradise. There are countless different areas to image of all field sizes.

Using a camera lens enables you to capture the entire object in one field. Fig. 2.4 was taken using an 80 mm camera lens. In it you can see most of the Vela SNR in the foreground, with its filaments of green and blue shock waves, superimposed upon the background Gum SNR – two colossal explosions in one small field of view!

When it comes to imaging at prime focus the world really is your oyster. The various parts of the Vela SNR suit the whole range of cameras, telescopes and imaging techniques. Parts of it are very bright so will show up well with OSC and DSLR. For the fainter wispy bits a monochrome CCD will gather the data much faster and probably result in a richer field.

While LRGB will yield great results the Vela SNR is a real treat for narrowband imaging. The use of an H-alpha filter really helps to pick up the fainter wisps but when used in conjunction with an OIII filter the effect is magical. The shockwaves from the explosion contain a lot of OIII so the mix of H-alpha and OIII produces a great criss-crossing effect of green, red and blue. Both LRGB and narrowband have been used in the images in this chapter.

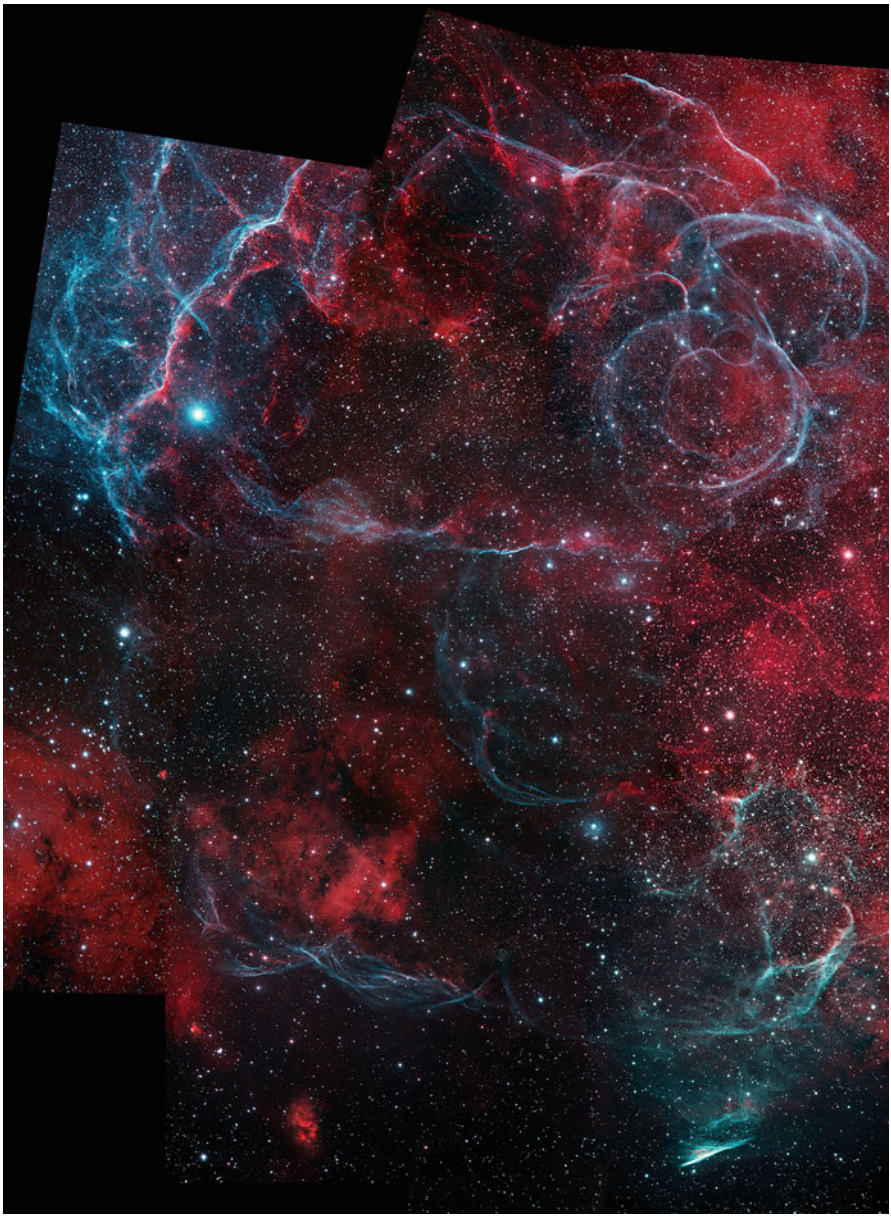


Fig. 2.4 Vela Supernova Remnant (north is left).

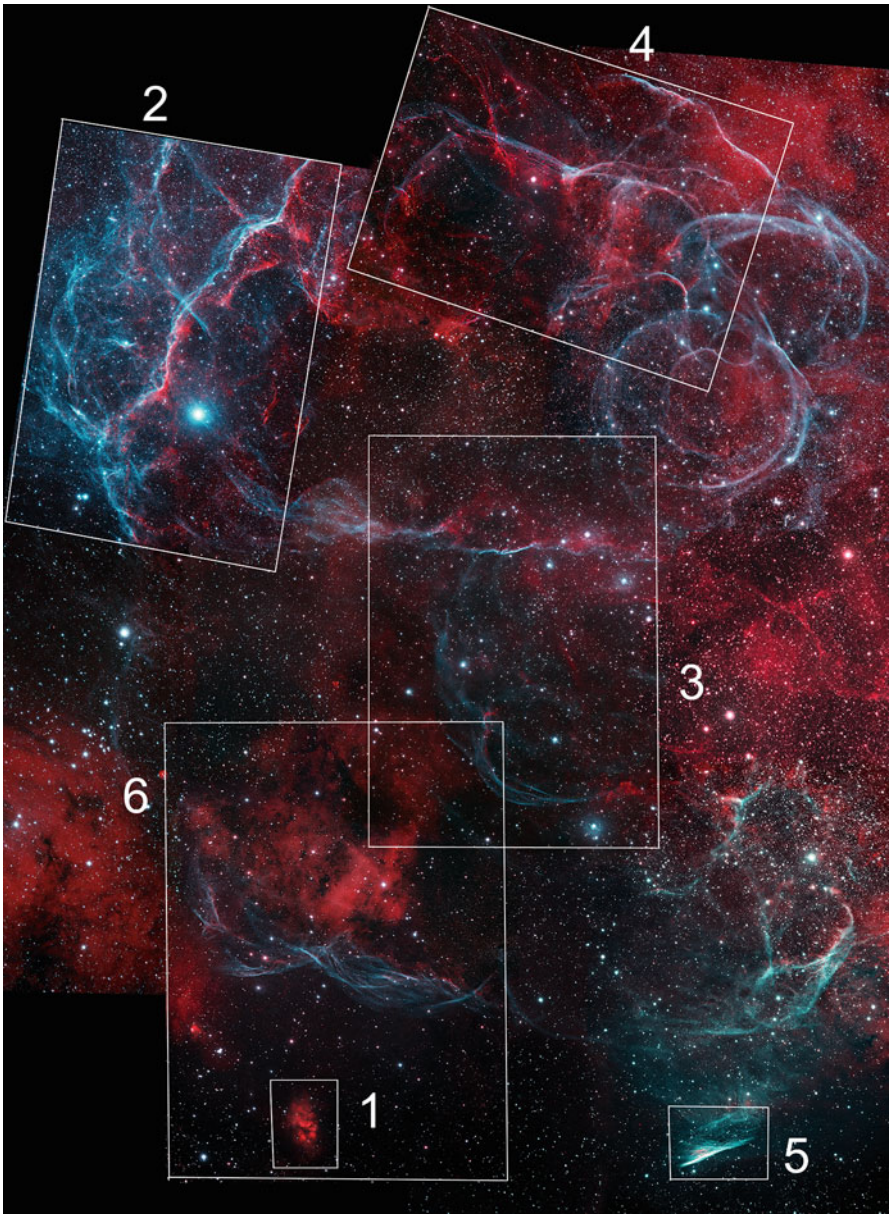


Fig. 2.5 Vela SNR reference chart.

Technical Information – Figs. 2.4 and 2.5

Camera Lens:	Canon 80 mm
F-stop:	f4.5
Camera:	QSI 683wsg Mono
Exposures:	6 × 3 min R 6 × 3 min G 6 × 3 min B 15 × 15 min H-alpha (blended with the red) 15 × 15 min OIII (blended with green and blue) (All unbinned)
Field Size:	6.4° × 4.9°

Vela SNR Reference Chart

There follows in this chapter a selection of fields from the Vela SNR. There are few specific catalogue numbers associated with the Vela SNR so you may have to rely on RA and Dec coordinates and a reliable star atlas/planetarium to find your way around. Fig. 2.5 shows where some of the fields in this chapter are in relation to each other. However, a lot of fun can be had choosing and composing your own unique fields that fit the particular telescope and camera that you have.

1. Gum 20 (Fig. 2.3)
2. Crest and the Bridge (Fig. 2.6)
3. Twin Crescents and the Bypass (Fig. 2.7)
4. Highway and the Spur (Fig. 2.8)
5. Pencil Nebula (Fig. 2.9)
6. Spiral Flame Nebula (Fig. 2.11)

Crest and the Bridge

Constellation	Vela
RA	8 h 37 min 38.6 s
Dec	−42° 59′ 20.8″

The Crest comes from the region around the fourth magnitude star e Velorum. Apart from the Pencil Nebula, (Fig. 2.9), this is the brightest section of the Vela SNR. In images with north at the top the highway appears to have reached a crest before turning north and then west to trail away in a plume-like spur. Back along the highway (top right corner in the image) we find a bright bifurcated section reminiscent of the symbol for a bridge in civil engineering drawings with a short spur line running underneath the bridge.

Imaging

This field is fairly easy to find due to the presence of the bright star e Velorum (SAO 220204). The short tube refractor (446 mm) was used here in order to capture both the Crest and the Bridge. A longer focal length could be used if you wanted to just capture one or the other but the two combined make an impressive pair. The presence of e Velorum can cause some trouble here as many of the filaments are very faint in comparison. So you might have to cut back on the exposure lengths to prevent saturation. To increase the intensity of the green/blue filaments a series of OIII subs can be taken and combined with the green and blue channel.

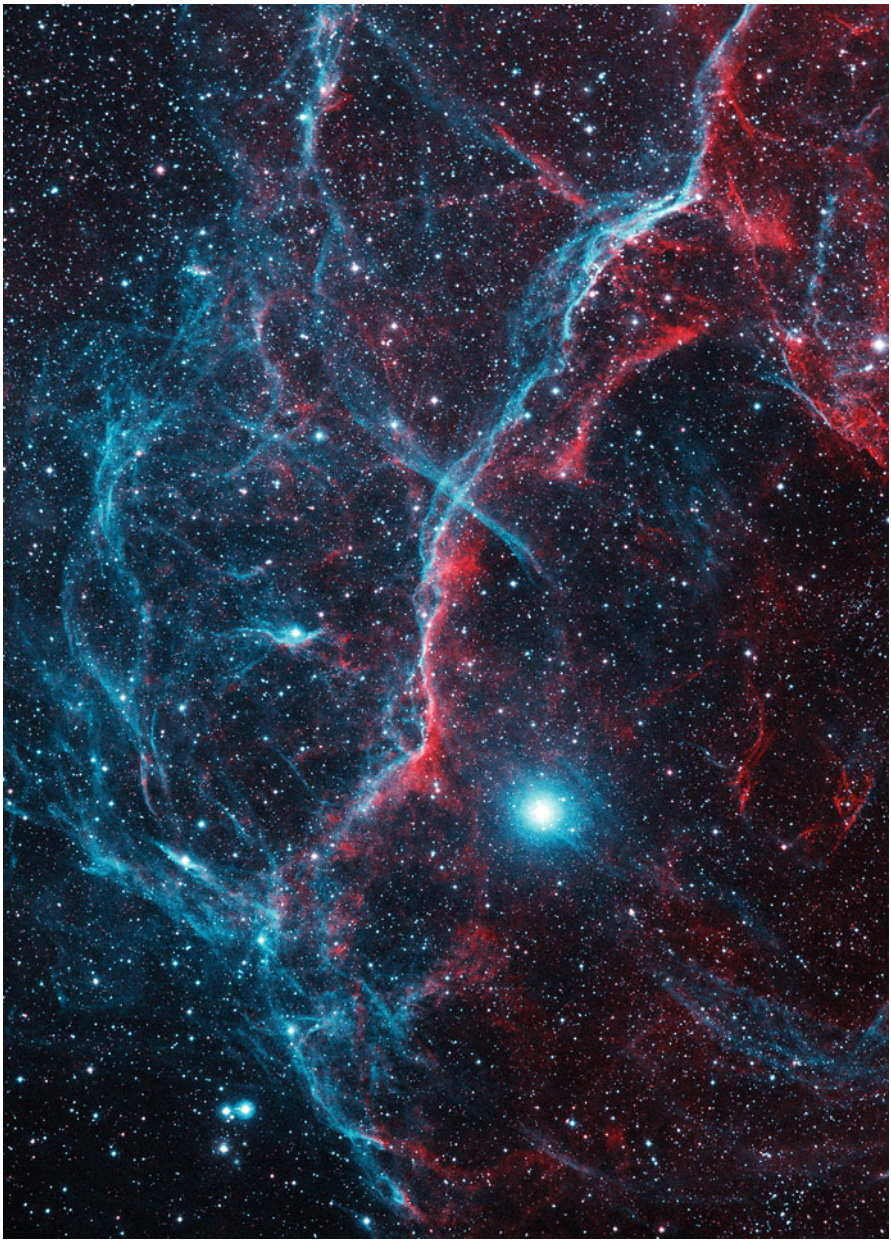


Fig. 2.6 Crest and the bridge (north is left).

Technical Information – Fig. 2.6

Telescope:	William Optics 90 mm Refractor with 0.8× flattener/reducer
Focal Length:	446 mm
F-ratio:	f/4.96
Camera:	QSI 583wsg Mono
Exposures:	20 × 10 min L
	10 × 10 min R
	10 × 10 min G
	10 × 10 min B
	5 × 15 min OIII (blended with the green and blue)
	(All unbinned)
Field Size:	2.1° × 1.7°

Twin Crescents and the Bypass

Constellation	Vela
RA	8 h 44 min 0.37 s
Dec	–44° 56′ 19″

This pair of beautiful crescent-shaped shockwaves lies apart from the road network to the west but is well worth the detour to visit. The sparse open cluster NGC 2659 can be seen just above centre in the photo. Above that again is the north–south running section of the Highway we call the Bypass. The Bypass connects the southern section to the Crest and e Velorum.

In large amateur telescopes with a narrowband filter, the south-eastern crescent stands out the most. The north-western crescent is more diffuse. The most discrete part of the Bypass can be seen in this picture.

Imaging

In order to capture both of the interwoven crescents in one frame it is necessary to use a fairly short focal length. An identical set-up was used in Fig. 2.7 as with Fig. 2.6. This field is slightly more difficult to find as the filaments are fairly faint and there are few bright obvious stars. For those with accurate GOTOs the provided coordinates will situate you in the right area. It is then simply a case of choosing the best field that suits your set-up. However, if your mount is not particularly accurate you might have to star hop from the star g Velorum (SAO 220540).



Fig. 2.7 Twin crescents and the bypass (north is left).

Technical Information – Fig. 2.7

Telescope:	William Optics 90 mm Refractor with 0.8× flattener/reducer
Focal Length:	446 mm
F-ratio:	f/4.96
Camera:	QSI 583wsg Mono
Exposures:	25 × 10 min L
	10 × 10 min R
	10 × 10 min G
	10 × 10 min B
	5 × 15 min OIII (blended with the green and blue)
	(All unbinned)
Field Size:	2.1° × 1.7°

Highway and the Spur

Constellation	Vela
RA	8 h 30 min 0.0 s
Dec	−44° 58′ 18″

Fig. 2.8 includes the field made famous by David Malin at the Anglo-Australian Observatory in the 1980s. The section of the Highway, next to SAO 219995 is one of the brightest visually and can be a good starting point for a grand tour of the Vela SNR itself. Further south (to the bottom in this image) we have the Fork, where the highway splits off to the incredibly thin Spur. The image shows the thread-like nature of the Spur very well. In the telescope with an OIII filter the discrete line of the Spur comes to an abrupt end.

Imaging

The Highway is the bright straight filaments in Fig. 2.8 running vertical so to do this field justice you really need to rotate your camera ninety degrees and image west-up. With a relatively accurate GOTO system this field is fairly easy to locate due to the presence of the star SAO 219995 right in the middle. However, if your mount is not as accurate you might have to star hop from e velorum to SAO 219995. This field is probably the best one to choose if you are using a DSLR or OSC camera. While not bright, the filaments should show up clearly in these cameras. With a monochrome CCD camera remember to take extra exposures of OIII to help accentuate the supernova shockwaves.



Fig. 2.8 Highway and the Spur.

Technical Information – Fig. 2.8

Telescope:	William Optics 90 mm Refractor with 0.8× flattener/reducer
Focal Length:	446 mm
F-ratio:	f/4.96
Camera:	QSI 583wsg Mono
Exposures:	25 × 10 min L
	10 × 10 min R
	10 × 10 min G
	10 × 10 min B
	5 × 15 min OIII (blended with the green and blue)
	(All unbinned)
Field Size:	2.1° × 1.7°

Pencil Nebula — NGC 2736

Constellation	Vela
RA	9 h 00 min 0.0 s
Dec	−45° 56′ 30″

Discovered by Sir John Herschel during the early nineteenth century in his time at the Cape of Good Hope, South Africa, NGC 2736 is actually the brightest piece of the Vela SNR. Moderate sized amateur telescopes will pick it up, but like all sections of this vast complex a combination of non-light polluted skies, large aperture and a narrowband filter is best suited to showing these delicate threads properly.

The Pencil Nebula marks the eastern extremity of the Vela SNR and lies in a sparse field between c Velorum and SAO 220664. Fig. 2.9 shows it to be more than just a straight line. The filamentary strands appear braided and about to twist ribbon-fashion like the Spiral Flame further north-west (Fig. 2.11).

Imaging

The Pencil Nebula is a different kettle of fish from the previous three images. It is only 20′ × 3′ so requires a much longer focal length to do it justice. It is also a low contrast object so will require a fairly long exposure time to be effective. It emits very strongly in OIII hence the level of green in the image. It should be fairly easy to find as it has a designated catalogue number.

A wider field, of about 2° × 1° will enable you to capture both the Pencil Nebula and another area of filaments, which is only 1° away to the south-west.



Fig. 2.9 Pencil Nebula (north is right).

Technical Information – Fig. 2.9

Telescope:	10″ Vixen VMC260L with 0.67× focal reducer
Focal Length:	2,010 mm
F-ratio:	f/7.7
Camera:	QSI 583wsg Mono
Exposures:	7 × 20 min H-alpha
	7 × 20 min OIII
	5 × 15 min H-beta
	(All unbinned)
Field Size:	27′ × 19′

Gum 22–23 — RCW 38

Constellation	Vela
RA	8 h 59 min 47.2 s
Dec	−47° 31′ 57″

Gum 22 and 23 are a slightly brighter group of nebulous patches in the telescope. The camera reveals them much better as a bright group on the edge of a large, homogenous red nebula. This too is a star-forming area with young stars deeply embedded in the nebulosity.

Fig. 2.10 shows parts of the Vela SNR quite obvious against the background of the much further away Gum SNR. The green shockwaves are from the Vela SNR and are amongst the furthest from the site of the original explosion.

Imaging

Gum 22 and 23 are actually just the part of this image towards the top left. There are therefore many different possibilities for framing these objects. Using a longer focal length will produce a pleasing result. However, in this image a much larger field of view was chosen in order to capture some of the shockwaves from the Vela SNR. It is unlikely that an OSC or DSLR will pick these shockwaves up so if using such a camera it may pay just to concentrate on Gum 22 and 23 rather than aiming for such a wide field. This image was taken using narrowband filters and this has helped to bring out the shockwaves which are rich in OIII.



Fig. 2.10 Gum 22 and 23.

Technical Information – Fig. 2.10

Telescope:	William Optics 90 mm Refractor with 0.8× flattener/reducer
Focal Length:	446 mm
F-ratio:	f/4.96
Camera:	QHY9 Mono
Exposures:	9 × 20 min H-alpha
	7 × 20 min OIII
	5 × 10 min H-beta
	(All unbinned)
Field Size:	2.1° × 1.6°

Spiral Flame Nebula

Constellation	Vela
RA	8 h 54 min 21.0 s
Dec	−43° 50′ 43″

The last section of the amazing Vela SNR is the Spiral Flame Nebula. Fig. 2.11 reveals the helixial nature of this delicate, twisting series of filaments. The Spiral Flame is not bright and therefore is a challenge for the visual observer. Large aperture reflectors (upwards of 17.5″) with narrow band filters and ideal conditions are required to get the best from this object.

The Spiral Flame Nebula finishes off the largest discernable object available to any visual telescopes. In an area covering 8.7° × 5.4° we have examined a variety of forms brought about by a catastrophic event approximately 11,000 years ago from our own backyard!

Imaging

The Spiral Flame Nebula can be a challenge to frame satisfactorily. The most prominent part of Fig. 2.11 is actually Gum 20 (Fig. 2.3), the separate nebula towards the bottom of the image. Once this is in the field of view it is a matter of exposing until the faint wisps of filaments appear and then centering the object as desired. The turquoise flame actually carries on further south for a few more minutes so another pleasing orientation is to rotate the camera 90° to capture the full length of the flame. Capturing some OIII subs will help to bring out the flame when processing exposures.



Fig. 2.11 Spiral Flame Nebula (north is left).

Technical Information – Fig. 2.11

Telescope:	TS Super Apo Refractor with 0.8× flattener/reducer
Focal Length:	380 mm
F-ratio:	f/4.8
Camera:	QSI 683wsg Mono
Exposures:	20 × 10 min L 10 × 10 min R 10 × 10 min G 10 × 10 min B 5 × 15 min OIII (blended with the green and blue) (All unbinned)
Field Size:	2.5° × 2°

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