STARSCAPES

IMAGES OF THE DEEP SKY

BY GREG PARKER

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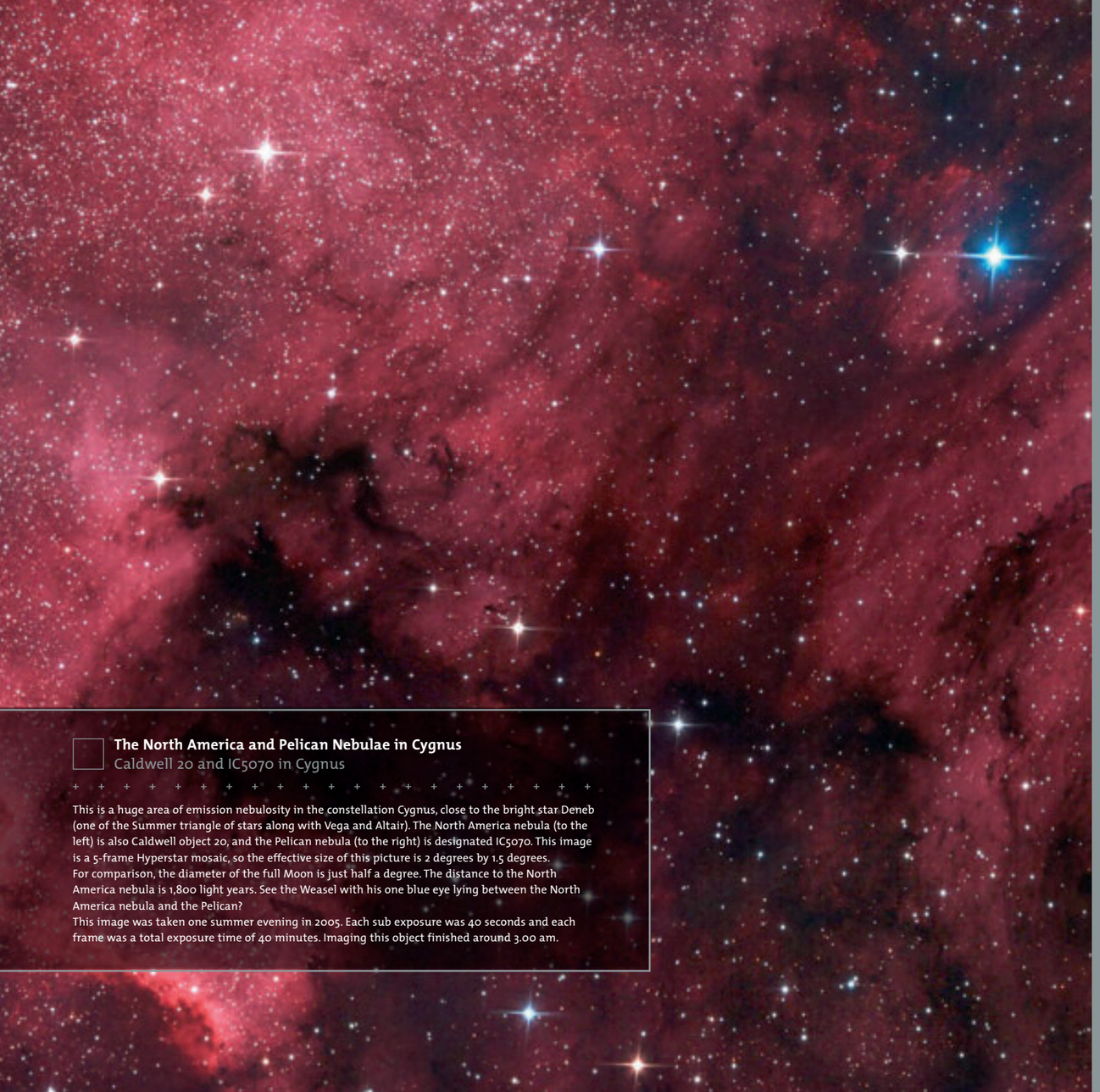

The North America and Pelican Nebulae in Cygnus
Caldwell 20 and IC5070 in Cygnus

This is a huge area of emission nebulosity in the constellation Cygnus, close to the bright star Deneb (one of the Summer triangle of stars along with Vega and Altair). The North America nebula (to the left) is also Caldwell object 20, and the Pelican nebula (to the right) is designated IC5070. This image is a 5-frame Hyperstar mosaic, so the effective size of this picture is 2 degrees by 1.5 degrees.
For comparison, the diameter of the full Moon is just half a degree. The distance to the North America nebula is 1,800 light years. See the Weasel with his one blue eye lying between the North America nebula and the Pelican?
This image was taken one summer evening in 2005. Each sub exposure was 40 seconds and each frame was a total exposure time of 40 minutes. Imaging this object finished around 3.00 am.

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All the deep-sky images in this exhibition have been acquired during the past year from a garden Observatory in Brockenhurst, the New Forest, Hampshire, using readily available amateur equipment.

The Starscapes collection is an Internet collaboration with Noel Carboni, Florida, USA, who processed many of the images in the exhibition using his suite of PhotoShop Actions. An illustrated book containing these and other deep-sky images is being published by Springer and will be available later this year.

Professor Greg Parker

In Starscapes you will see seven different types of object, which are listed according to four different classification schemes.

+ + Messier Catalogue + +

Starting with the classification schemes we have the 'M' objects, or Messier catalogue objects. Messier was a French amateur comet hunter active in the 1700s, who made a list of 'annoying' celestial objects that could possibly be mistaken for comets! As these 'vermin of this skies', as he referred to them, did not change their relative positions in the night sky they were clearly not comets, and thus to be ignored. Many of these objects are however very beautiful deep-sky objects worthy of our imaging time. Messier object 45, the 45th entry in Messier's catalogue is the Pleiades open star cluster, M45 (see pages 12 - 13).

+ + Caldwell Catalogue + +

A second catalogue, the Caldwell catalogue, is a much more recent listing, and contains many objects that the author thought worthy of observation (or imaging) which were not contained in the Messier catalogue. In fact the author of the Caldwell catalogue is none other than our own Patrick Moore, whose full name is Patrick Caldwell-Moore, but he dropped 'Moore' to avoid a conflict with the 'Messier' or M objects.

The most northerly objects in the Caldwell catalogue have the smallest Caldwell number, so Caldwell 1, the open star cluster NGC188 (see page 16) lies at a declination of over 85 degrees, only 4 degrees from Polaris.

+ + New General Catalogue (NGC) + +

John Dreyer published the New General Catalogue (NGC) of Nebulae and Clusters of Stars in 1888. This is a huge list of objects with many contributions from Sir William and Sir John Herschel from their observations in the mid-1800s from both hemispheres. NGC2300 in Starscapes is a large elliptical galaxy in the constellation Cepheus (see page 10).

+ + Index Catalogue (IC) + +

The Index Catalogue (IC) has a number of additional objects supplementing the NGC catalogue. Published in two volumes in 1895 and 1908, most of the objects in the IC catalogue were found through the new medium of photography. Object IC443 in Starscapes is the Jellyfish nebula (see page 15), a very faint supernova remnant in the constellation of Gemini, the twins.

The different objects you will see in Starscapes come under three main headings: galaxies, star clusters, and nebulae.

+ + Galaxies + +

These are 'Island Universes' comprising millions to billions of stars in a structure like our own Milky Way. Although there are many different categories of galaxy, in general they are of the spiral type like M31 the Great Andromeda galaxy (see page 6), or of the elliptical type like NGC2300 in Cepheus (see page 10). There are also some strangely shaped galaxies, usually caused by gravitational interaction with another close-by galaxy, and these strange-shaped galaxies are often designated as Arp galaxies after Halton Arp who first listed them. NGC2276 in Starscapes is a strangely shaped galaxy, probably caused by an encounter with the nearby NGC2300 (see page 10). NGC2276 is also known as Arp25.

+ + Star Clusters + +

With star clusters, or groupings of stars in the hundreds to thousands regime, we have two distinct classes, open clusters and globular clusters. Probably the most famous open cluster of stars is M45, the Pleiades, and a winter favourite (see pages 12 - 13). The most amazing globular cluster in the Northern hemisphere is certainly M13 (see page 6), the Great Globular Cluster in Hercules with its huge concentration of half a million stars.

+ + Nebulae + +

Nebulae also include many different types. Some are great glowing regions of ionised gas, rather like huge neon signs in space, except the glowing gas is usually Hydrogen rather than Neon. The bright red glowing gas regions you will see in Starscapes are ionised Hydrogen atoms emitting red light at 656.3nm, also called Hydrogen-alpha. The North America and Pelican nebulae in Cygnus are examples of these **emission** nebulae (see page 2).

Bright blue **reflection** nebulae are caused by dust particles scattering short wavelength (blue) light from a nearby star much more efficiently than longer wavelength (red) light. The eerie-looking M78 in Orion is a fine example of a reflection nebula (see page 7).

Some nebulae are not 'lit up' by a nearby star, so the gas in these regions simply acts as an absorber of light giving rise to **dark** nebulae. Perhaps the most famous of all dark nebulae is the Horsehead nebula in the constellation of Orion (cover image). Take a close look at the Horsehead panoramic image in Starscapes and you will see emission, reflection, and dark nebulae all in close proximity to one another.

Finally there are a class of objects known as **planetary nebulae.** These are the remains of supernova events and typical examples are the tiny planetary NGC2438 seen in the M46 open cluster image (see page 9), and the much larger Dumbbell Nebula, M27 (see page 10).

As you look at the Starscapes images note the different types of nebulae, galaxy and star cluster that you see. Note the very bright reflection nebulae that surround the Pleiades in the M45 image, something not visible to the naked eye, or even with the aided eye!

Professor Greg Parker

Galactic Soup I
Abell 1656

This is a two-frame Hyperstar mosaic of a very famous and well-known region in the constellation Coma Berenices (Berenices' Hair). Sitting below the handle of the plough (Ursa Major) is this glittering region full of galaxies. In the above image everything that is not obviously a star (all the orange/brown 'faint fuzzies') are galaxies. This is definitely one of the densest regions in the sky for galaxies. Look at the two large elliptical galaxies towards the centre of this image – the giant elliptical galaxy on the left is NGC4889, 300 million light years distant and 240,000 light years across (about two and a half times the size of our own Milky Way). The elliptical galaxy on the right is NGC4874. The two-frames were made up from 83 subs per frame at 30 seconds exposure per sub.

01 The Great Globular Cluster in Hercules
Messier 13

This is rated as the finest globular cluster in the Northern Hemisphere, and it certainly makes a stunning sight in any reasonably sized telescope. I can clearly recall the awe I felt when I saw this object for the very first time, and I still feel the same way every time I look at it! This immense globular cluster lies in the constellation Hercules at a distance of 23,400 light years and contains close to half a million stars. This is yet another naked eye object, where good viewing conditions will reveal a faintly glowing ball of light. Note the bright galaxy towards the top left of the image: NGC6207. This image is a single Hyperstar frame using 10 and 30 second sub exposures with a total exposure time of approximately one hour.

02 The Core Region of the Great Andromeda Galaxy
Messier 31

This is the central region only of the huge spiral galaxy M31 that lies in the constellation Andromeda. Although the field of view of the Hyperstar is large at 1 degree by 0.75 degrees, it is nowhere near large enough to encompass the whole of M31! This image concentrates on the core region alone, and the dark dust lanes circling the very bright core region can be clearly seen. M31 lies at a distance of 2.3 million light years, and as it can be seen (as a fuzzy glowing region) with the naked eye, it is one of the most distant objects that we can see with the unaided eye. This image is a single Hyperstar frame comprising a massive 311 sub exposures at 15 seconds exposure per sub.

03 The Cocoon Nebula
Caldwell 19

The Cocoon nebula (Caldwell 19) in Cygnus is an emission nebula whose beauty is enhanced by the surrounding dark nebulosity, and the fact that the whole object sits in the Milky Way, so it is surrounded by a very high density of stars. The distance to this nebula is 3,300 light years, and the nebulosity is about one-sixth of a degree in diameter. This is a single Hyperstar frame consisting of 159 sub exposures at 55 seconds per exposure giving a total exposure time of nearly two and a half hours.


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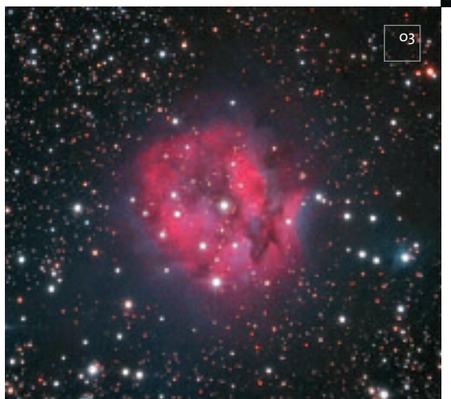
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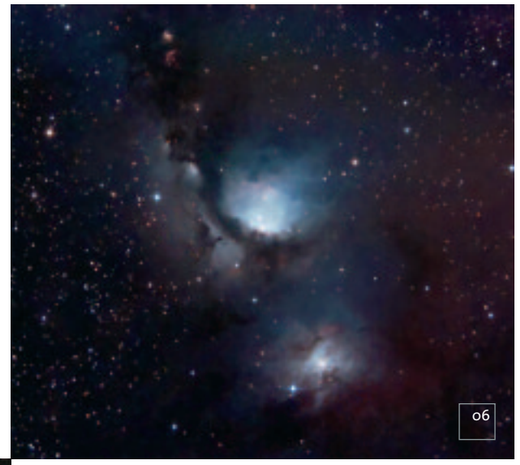
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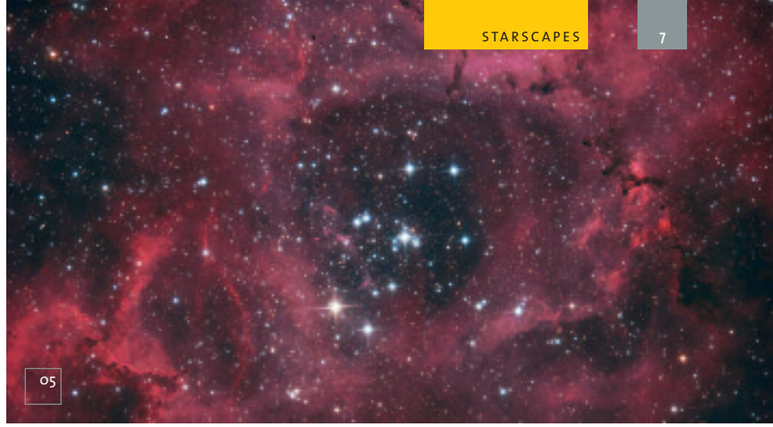
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04 The Whirlpool Galaxy
Messier 51

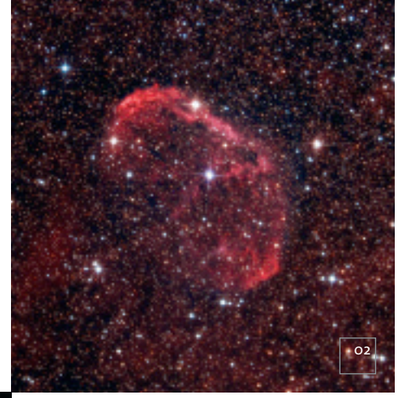
This beautiful pair of interacting galaxies in the constellation Canes Venatici (close to the Plough) comprises M51, the large face-on spiral galaxy, and NGC5195, the lower and smaller galaxy of the pair. M51 is one of the finest examples of a face-on spiral galaxy and lies at a distance of about 15 million light years. The faint galaxy towards the top left of the image is IC4263 shining at a magnitude of 15.20; M51 itself is a magnitude 8.4 object. For each change in magnitude there is a change of 2.5 in apparent brightness. This is a single Hyperstar frame comprising a huge number of sub exposures (205), with an exposure time of 30 seconds per sub, giving a total exposure time of over one and a half hours.

05 The Rosette Nebula in Monoceros
Caldwell 49 & NGC2244 (Caldwell 50)

The Rosette nebula in Monoceros is a huge emission nebula with a nice open cluster, NGC2244, at its centre. You can see many dark regions in this nebula known as 'Bok globules'. The Rosette nebula is a massive 1-degree by 1.33 degrees in size, with a full Moon only coming in at half a degree in diameter! The Rosette lies at a distance of 4,900 light years, over three times further away than the Great Nebula in Orion, and yet the Rosette is of a similar apparent size in the sky. This of course means that in fact the Rosette nebula is considerably larger than the Orion nebula, spanning something like 115 light years. This is a single Hyperstar frame of the central core region of the Rosette and is made up from 84 sub exposures of 60 seconds per sub.

06 Into the Cauldron
Messier 78

I find it strange that this beautiful, awe-inspiring, region of space doesn't have its own name but is only known by its Messier (78) and NGC (2068) numbers. M78 is a reflection nebula surrounded by a large region of dark nebulosity. An associated nebula to the northeast is NGC 2071. M78 lies in the constellation Orion at a distance of 1,630 light years. This is a single Hyperstar frame comprising 114 sub exposures of 60 seconds per sub.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01 The Monkey-Head Nebula
NGC2175

This rather faint emission nebula in Orion has been printed upside-down (north is downwards in this image) so that the 'Monkey Head' can be more clearly seen. Often mistakenly called NGC2174 (which is a smaller nebulosity within the Monkey Head), this is a region of strong H-alpha emission, and its size is an almost perfect match for the field-of-view of the Hyperstar lens. This is a single Hyperstar frame consisting of 157 sub exposures at 60 seconds per sub, giving a total exposure time of over two and a half hours, which was still not long enough to capture this very faint object.

02 The Crescent Nebula
NGC6888

The crescent nebula (NGC6888, Caldwell 27) lies at a distance of 4,700 light years in the constellation Cygnus. Why are there so many stars in this image? This is because it is not only a very long exposure, but also the Crescent lies in the star-rich Milky Way. This is an emission nebula where the material has been thrown out by the Wolf-Rayet star HD 192163 you can see within the nebulosity. This is a single frame Hyperstar image consisting of three hours RGB data and two hours of H-alpha. The RGB data used 90 second subs and the H-alpha data used 200 second subs.

03 The Pinwheel Galaxy in Ursa Major
Messier 101

Messier object number 101 is a fine face-on spiral galaxy in the constellation Ursa Major (the Plough). There is a faint galaxy towards the left of the image, NGC5477 shining at magnitude 14.3, whilst M101 is at a relatively bright magnitude 7.9. The bright star towards the top of the image is HIP68621 at magnitude 8.00. M101 lies at a distance of 17.5 million light years and is a relatively large half a degree in diameter, again making this a good-sized object for the Hyperstar lens. This is a single Hyperstar frame of 155 40-second sub exposures giving a total exposure time of over one and a half hours.

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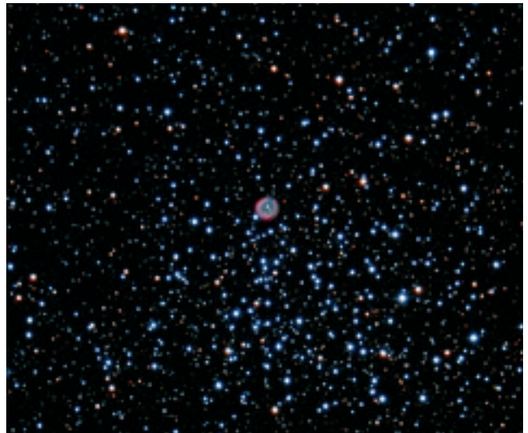
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04 The Open Cluster That Thinks It's a Globular
NGC7789

This incredibly rich open cluster is doing a really good act of impersonating a globular cluster (such as M13). This star cluster is in the constellation Cassiopeia. Star clusters are often good targets for CCD imaging when the Moon is up, thus preventing the imaging of faint objects like nebulae. As star clusters are intrinsically bright objects there is an added bonus that good images can be acquired in a relatively short time. NGC7789 lies approximately 6,000 light years from the Sun and is about 50 light years in diameter with around 200 stars between magnitude 10 and 12. This single Hyperstar frame is made up from 67 sub exposures with 30 seconds per sub, giving roughly a half-hour total imaging time.

05 Methuselah
NGC6791

This faint-looking, very red, open cluster has the look of age about it, and old it is. NGC6791 in the constellation Lyra is perhaps the oldest open cluster in our Milky Way galaxy with an estimated age of 7 billion years! This single frame Hyperstar image consists of 54 sub exposures with 50 seconds exposure per sub, needing a little longer total exposure for a cluster than usual, as this one is rather faint. In the Starscapes exhibition I have 'paired up' NGC6791 with NGC7789; NGC6791 is on the left and NGC7789 is on the right.

06 Double Object – Open Cluster & Planetary Nebula
Messier 46

This is a very difficult object for me to image, as it is so low down on the horizon I have to catch it as it passes between two tall oak trees. But the wait is worth it, for open cluster Messier 46 holds a little gem, a tiny planetary nebula NGC2438 that you can see glowing towards the top of the cluster. M46 lies at a distance of 5,300 light years and is about a third of a degree in diameter. This single frame Hyperstar image is 31 sub exposures at 60 seconds per sub.

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01 The Dumbbell Nebula
Messier 27

Messier object 27 is the Dumbbell nebula in the constellation Vulpecula. M27 is a planetary nebula, the result of the final stages of stellar evolution with the 48,000-year-old white dwarf star at its centre. M27 is rather close to us at only 815 light years distance, and it measures 1.2 light years across. The several colours seen in this nebula are due to ionised Hydrogen, Nitrogen and Oxygen. This is a single Hyperstar frame with 100 sub exposures of 55 seconds per sub giving a total exposure time of just over an hour and a half.

02 A Very Peculiar Galaxy
NGC2276 & NGC2300

The strange-shaped galaxy towards the centre of this image (NGC2276) is an example of an Arp galaxy, a galaxy that has had a close gravitational encounter with another galaxy. In this case NGC2276 has had an interaction with the giant elliptical galaxy NGC2300 lying towards its lower left. In this region of space very close to the pole there are over half a dozen other small faint galaxies, can you spot them? I like imaging in this region, as it is very difficult for equatorially mounted scopes to image here as the CCD may strike the base of the telescope in a conventional system. As the Hyperstar is actually mounted on the front of the telescope I don't meet this restriction. This image is a single Hyperstar frame consisting of 151 sub exposures of 30 seconds per sub.

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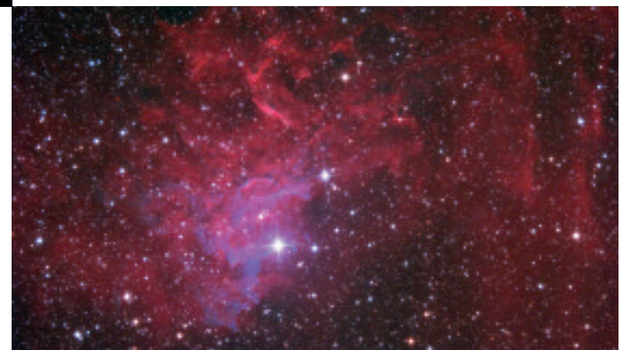
03 The Flaming Star Nebula
Caldwell 31

The beautiful Flaming Star nebula (Caldwell 31, IC405) lies at a distance of 1,600 light years in the constellation Auriga. This image shows the bright red emission nebulosity together with bright blue reflection nebulosity. Towards the right is a fainter vertical bar of emission nebulosity that continues quite a distance below the field of view. There is a strange story behind AE Aurigae, the very bright star in this image that is lighting up the nebula. Apparently this star was thrown out of the Trapezium (core) region of the Great Nebula in Orion some 2.5 million years ago, so AE Aurigae is just 'passing through' IC405, and perhaps in another 20,000 years time the Flaming Star nebula will 'go out' as AE Aurigae continues on its journey through space. This single frame Hyperstar image consists of 86 sub exposures of 70 seconds per sub.



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04 The Perseus Double-Cluster
Caldwell 14

NGC869 & NGC894 are a magnificent pair of open clusters in the constellation Perseus. Also known as Caldwell 14, the 14th entry in Patrick Moore's list, the Double Cluster in Perseus is one of the most amazing sights in a pair of low power binoculars. This image does no justice to the view in even very modest optical instruments – 'diamonds in black velvet' is the term most often used for these celestial gems. These two open clusters cover a lot of space, and once again this image is a mosaic comprised of 5 Hyperstar frames. These objects do not form part of the Messier catalogue, so he must have considered them most un-comet like! The Double Cluster lies at a distance of 7,300 light years. This 5-frame Hyperstar mosaic of the Perseus sword-arm region consists of 80 sub exposures of 30 seconds for each individual frame. The whole image therefore took over three hours to capture.

05 A Catherine-Wheel in Cepheus
Caldwell 12

Caldwell 12 (NGC6946) is a prettily coloured mixed barred-spiral galaxy in the constellation Cepheus. Although it has pretty colours, it looks a little on the small side, and maybe a bit unexciting, but NGC6946 is a veritable breeding-ground for supernova explosions! There have been recorded supernovae in NGC6946 in 1917, 1939, 1948, 1968, 1969, 1980 and 2004. So, if you are a supernova hunter, there is no doubt that NGC6946 should be on your patrol list. Caldwell 12 lies at a distance of 18 million light years. This image is composed from 106 sub exposures of 40 seconds each.

06 A Double-Object in Cepheus
NGC6946 & NGC6939

When I took the initial image of galaxy NGC6946 and had the object nicely set up in the field of view, I had no idea that just outside the frame sat a nice little open cluster, NGC6939, which would allow a nice 2-frame composition. This is a 2-frame Hyperstar composition of galaxy NGC6946 and open cluster NGC6939 with a total exposure time of approximately two hours.

06

The Pleiades
Messier 45

This famous open cluster of stars is M45 – The Pleiades, or seven sisters, or Subaru, or Soraya (Persia), or Mataariki (Maori). The Vikings called the Pleiades 'Freya's Hens', and it has many other names around the world! The Pleiades lie in the constellation Taurus and are about 2 degrees in diameter (the full Moon is about half a degree in diameter). The Pleiades are the stars that form that well-known constellation of the winter skies that looks like a question mark. As you can see in this 4-frame Hyperstar mosaic, a beautiful blue reflection nebula that extends well beyond this star group surrounds the Pleiades. A reflection nebula is basically a dust region, and the dust is of such a size that it scatters short wavelength (blue) light very effectively. The Pleiades lie at a distance of only 407 light years, so in astronomical terms, they are pretty close to us. This is a 4-frame Hyperstar image where each frame is composed of around 70 sub exposures at 60 seconds per sub.

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01 The Iris Nebula
Caldwell 4

NGC7023, also called Caldwell 4, or the Iris nebula in Cepheus, is a beautiful reflection nebulosity. Its dimensions are given as only 10 by 8 minutes of arc, where 60 minutes of arc is one degree. But now look carefully at the image and notice that there is a huge clover-shaped dark nebula region surrounding the Iris itself, bringing out the colour, and greatly extending the boundaries of the nebula itself. Given that the distance to the Iris nebula is about 1,400 light years, this means the diameter of the dark nebulosity is something in the order of 4 light years, or basically the distance to the nearest star beyond our Sun! This single frame Hyperstar image comprises 160 sub exposures at 40 seconds per sub giving a total exposure time of just over one and three-quarter hours.

02 The Great Nebula in Orion
M42 & M43

This amazing region of emission nebulosity in the constellation of Orion is the Great Nebula. The large central region is M42, and the smaller circular region at the top with a notch taken out of it is M43. Together these are known as the Great Nebula in Orion, and I have a problem with this object. When Orion is high in the winter sky I rarely want to look at, or image anything else. Every time I return to this object there is something more to see, or something more to learn, and it has a great advantage over many other deep-sky objects in that it is very bright, and therefore very easy to image well. This nebula lies just below Orion's belt, and it is lit up by the Trapezium group of stars which you can just see in the brightest part of the nebula's core (near M43). Laying at a distance of 1,500 light years the Great Nebula in Orion measures a massive 1.5 degrees by 1 degree. Being over a degree in one dimension means that this image is a 2-frame Hyperstar mosaic. Each frame is composed of around 120 subs at 20 seconds per sub; each frame therefore represents about 40 minutes of total imaging time.

03 The Running-Man Nebula in Orion
NGC1973, NGC1975 & NGC1977

This region of rich nebulosity to the north of the Great Nebula in Orion is aptly named the Running Man nebula – can you see him? With three NGC designations, this region has nebulae and a very pretty open cluster that can be seen towards the top of the image. See how the whole region is surrounded by a dark nebula cutting out the background stars all around the edge of the image. This is a single Hyperstar frame with a total exposure time of approximately two hours using 55-second subs.

04 In the Region of the Thunderclouds
M43 & NGC1977

The turbulent 'thundercloud' region lying between M43 and the Running Man fascinates me. So, in order to see this area more clearly I took this very long total exposure of the region. This image is a single Hyperstar frame using 204 sub exposures at 50 seconds per sub, which represents a total exposure time of just less than three hours! See how extensive the dark nebulosity is in this image, blotting out all the stars in the perimeter regions away from the emission nebulae.

05 Multiple Galaxies in Perseus
Caldwell 30 & Stephan's Quintet

The large spiral galaxy towards the top of this image is Caldwell 30 (NGC7331) lying at a distance of 47 million light years in the constellation Pegasus. To the left of NGC7331 is a cluster of smaller galaxies called the Deer Lick group. Now move slightly to the right of NGC7331 and move towards the bottom of the frame, a group of 'faint fuzzies' can be seen. This is the famous 'Stephan's Quintet' group of galaxies, NGC7319/7318A/7318B/7320/7317. It is with wide-field images such as this where many objects can be accommodated in the one frame that the Hyperstar system really comes into its own. This single frame Hyperstar image is composed of 96 sub exposures at 45 seconds per sub giving a total exposure time of nearly one and a half hours.

06 The Jellyfish Nebula
IC443

This faint but large nebula is a supernova remnant in the constellation Gemini called the Jellyfish nebula (IC443). It is surprising that this image is quite so faint as this data represents over four hours of total exposure using 90-second sub exposures! It just goes to show how very faint some of these Deep-Sky objects really are. This is a single frame Hyperstar image and it shows just how big the Jellyfish nebula is as the 1 by three-quarters of a degree Hyperstar field of view is not sufficient to capture the whole object.

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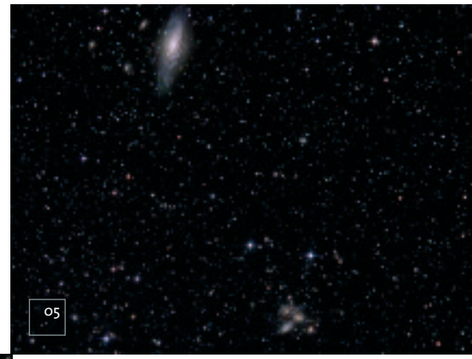

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01 **The Cave Nebula**
Caldwell 9

The Cave nebula in Cepheus (Caldwell 9, Sharpless 2-155) is a very faint emission nebula, with a large surrounding region of dark nebulosity. This region of nebulosity is rather large at 50 by 30 arc minutes (recall that 60 arc minutes equals 1 degree) and it makes this region a perfect match for the Hyperstar field of view. The Cave nebula lies at a distance of 2,800 light years and it shines (faintly) at a very weak magnitude 10. This image is a single Hyperstar frame of 161 sub exposures using 45 seconds per sub, giving a total exposure time of 2 hours. Even with such a long total exposure time it is clear that this image requires a lot more imaging time to get a nice smooth result.

02 **Caldwell 1**
NGC188

This open cluster has the honour of being the first object listed in the Caldwell catalogue – it is therefore the most northerly at a declination of 85 degrees 14.5 arc minutes. NGC188 lies at a distance of 4,800 light years and resides in the constellation Cepheus. It is also old – very old. At an estimated 5 billion years of age this open cluster is about 1 billion years older than M67 in Cancer, but is still 2 billion years younger than NGC6791 in Lyra, which is also in the Starscapes exhibition. This single Hyperstar frame was assembled from 169 sub exposures of 50 seconds exposure per sub, making a total exposure time of nearly two and a half hours. In Starscapes I have 'paired up' M37 and NGC188; M37 is on the left and NGC188 is on the right.

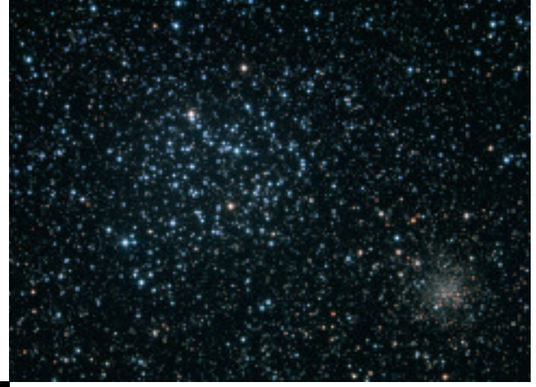
03 **Open Cluster in Auriga**
Messier 37

The pretty little open cluster M37 (NGC2099) lies at a distance of 4,400 light years in the constellation Auriga. I particularly like this cluster from my earlier observation days where the central orange-red star really stood out from the rest of the cluster. Auriga is home to open clusters M36, M37 and M38, but for me M37 is the prettiest. This single frame Hyperstar image consists of 61 sub exposures at 30 seconds per sub. In Starscapes I have paired up M37 and NGC188, M37 is on the left and NGC188 is on the right.

03

04 **The Leo Trio of Galaxies**
Galaxies NGC3628, M65 and M66

This is a famous galaxy grouping in the constellation Leo. In the UK 'galaxy season' is the springtime when the Leo/Virgo galaxies are in the best position for imaging. NGC3628 is an edge-on galaxy on the left of the image and you can see the dark dust lane running through its centre. Messier 65 (top right) is a spiral galaxy lying at a distance of 24 million light years, and M66 (bottom right) which has the appearance of mother of pearl is also a spiral galaxy lying 21.5 million light years away. This is a 2-frame Hyperstar mosaic with the left-hand side of the image composed of 74 sub exposures at 90 seconds per sub, and the right hand side 71 sub exposures again at 90 seconds per sub. The total imaging time for this picture was therefore just over three and a half hours.



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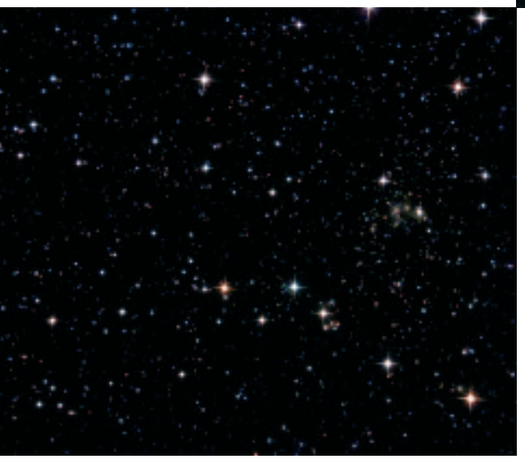


02

03

01 Double Object – Two Open Clusters in Gemini
Messier 35

Here's another image where the large field of view of the Hyperstar bags two objects in a single frame. In this image we see two open clusters in the constellation Gemini, M35 full of bright blue stars, and the much smaller NGC2158 full of old red stars. Although NGC2158 appears smaller in the image than M35, they are both roughly the same size, it's just that NGC2158 is six times further away than M35 which lies at a distance of 2,800 light years. This single frame Hyperstar image consists of 70 sub exposures with 45 seconds per sub.

02 1.5 Billion Light Years
Abell 2065

In this single frame Hyperstar image, look towards the right hand side about half way down. You will see a cluster of deep red/orange galaxies lying between two bright stars. You will see the galaxy cluster extends downwards towards a string of four bright stars. At first sight this image appears unremarkable, but this galaxy grouping is Abell 2065 in the constellation Corona Borealis, and it lies at a distance of 1.5 billion (thousand million) light years! This represents only 76 sub exposures with 55 seconds per sub, so a 1.5 billion light year distant object has been imaged with little over one hour's total exposure time.

03 Mother-of-Pearl Galaxy
Messier 106

This beautiful galaxy looks like it has been carved from mother of pearl. This is Messier 106 (NGC4258) a spiral galaxy in the constellation Canes Venatici. This galaxy lies at a distance of 22 million light years, and you can see three further galaxies to the right at the two o'clock position. This single frame Hyperstar image is composed of only 34 exposures of 55 seconds each representing only half and hour's imaging. Far too short to really do this jewel justice, and an object I will have to return to.

04 Galactic Soup II
Markarian's Chain

Another field that is very rich in galaxies of all sorts, this is the tail-end of Markarian's Chain (of galaxies) in the constellation Virgo. The two bright elliptical galaxies towards centre-right are in fact Messier objects, M84 and M86. The Messier galaxies lie at a distance of around 55 million light years. This is a single frame Hyperstar image using 72 subs at 40 seconds per sub. Noel Carboni spent over three hours processing time on this one to bring out the faint detail that is apparent in the spiral galaxies.

04

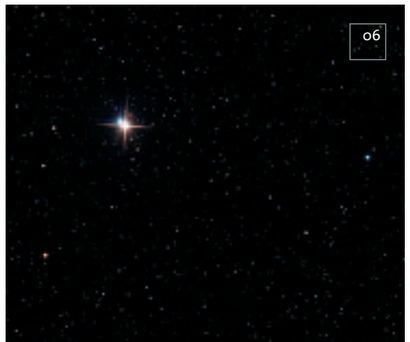
05 12.9 Billion Light Years
APM08279+5255

What's going on here then? At first sight this looks like the most boring image in the whole of the Exhibition and quite out of place with all the galaxies, nebulae, and bright stars. The star field is unremarkable, there's a few faint fuzzies (galaxies) in the background, and there's an arrow pointing towards a faint, very red, dim star. It's very red, for a good reason, and it's not a star. This is a quasar that goes under the very memorable label APM08279+5255 and it lies at a distance of 12.9 billion light years from the Earth! It's very red due to the enormous red shift it possesses at this distance. APM08279+5255 lies in the constellation Lynx. This single frame Hyperstar image contains 46 subs at an exposure time of 50 seconds per sub.

06 Stellar Jewels
Albireo

Possibly the most beautiful, and well-known double star in the Northern Hemisphere, this is Albireo in the tail of Cygnus (recall Deneb is at the head). Particularly nice as the colours are clearly very different, blue and orange, which makes a very striking contrast. This single frame Hyperstar image is composed of 76 sub exposures with 25 seconds exposure time per sub.

05



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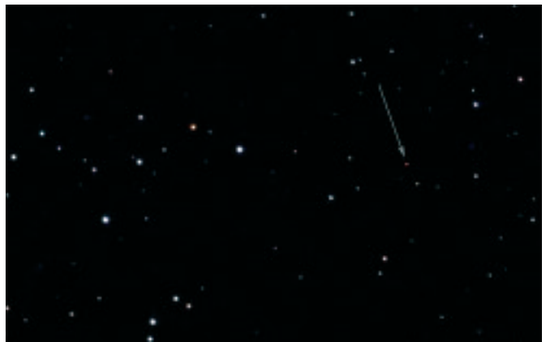


01 Stellar Snowball
Messier 92

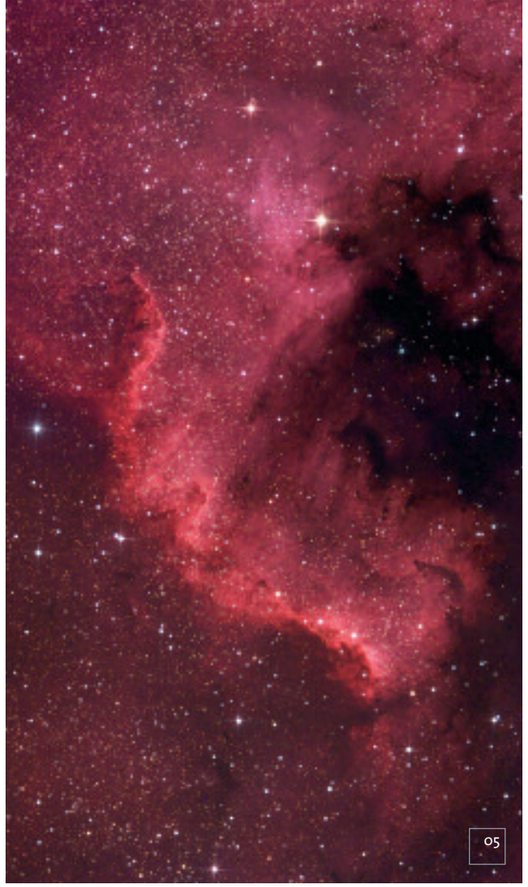
Another highly impressive globular cluster, and strangely enough this one is also in the constellation Hercules just like its very famous cousin M13 (also in this Exhibition). M92 doesn't get much press as it is overshadowed by M13 that lies close by. This is a shame as M92 is pretty spectacular in its own right and is only a little smaller in apparent diameter (14') than M13 (21'). M92 lies at a distance of around 25,400 light years from us. This single frame Hyperstar image is composed of 139 exposures with 30 seconds per exposure, so this image goes pretty deep. This is apparent if you look very carefully at the image, you will find several 'faint fuzzies' lying in the dark background.

02 Supermassive Black Hole
Messier 81

Messier 81 (Bode's Galaxy) is a beautiful spiral galaxy lying 4.5 million light years away in the constellation Ursa Major. The tiny immensely bright core is thought to contain a supermassive black-hole powerhouse. You may just see a very faint blue blob of light to the West of M81, this is Holmberg IX, an extremely faint galaxy, and a very good indicator that the image has gone very deep. This is a single frame Hyperstar image – but the total exposure time to create this image was very nearly six hours using both RGB and H-alpha filtered sub-exposures.

03 The Eye of the Bull
Aldeberan

Looking distinctly red to the naked eye on a winter evening, the bright star Aldeberan stands out clearly as the Bull's eye in the constellation Taurus. Aldeberan is an orange coloured giant star of magnitude 0.85 and is one of the 20 brightest stars in the sky. It lies at a distance of only 68 light years and is therefore relatively close to us. Aldeberan is from the Arabic for 'follower (of the Pleiades)'. This single frame Hyperstar image is composed of 20-second guided subs totalling approximately one hour.



04

04 The Head of the Swan
Deneb

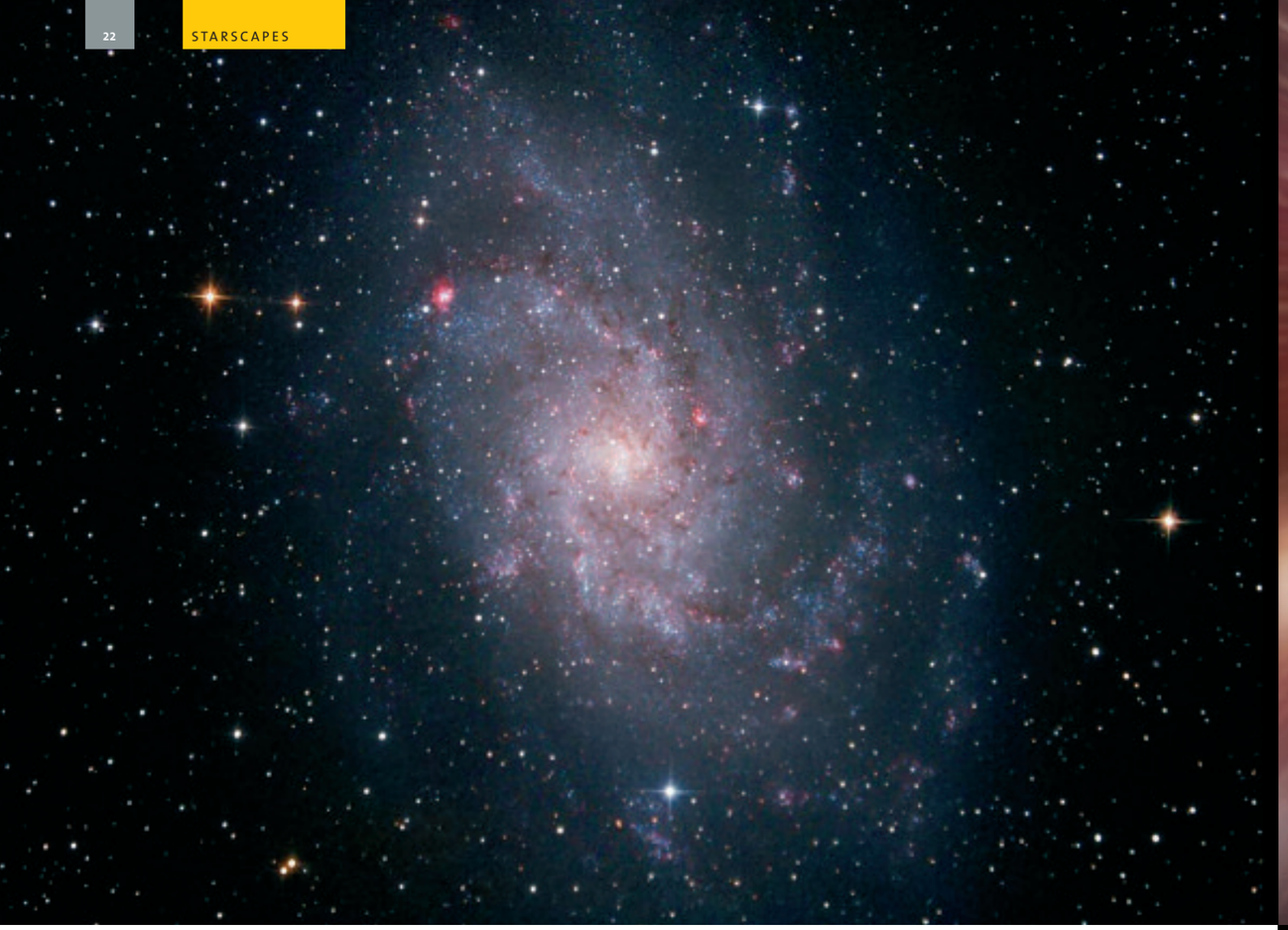
The brilliant star Deneb in the constellation Cygnus is one of the Summer Triangle of stars along with Altair and Vega. Deneb is a magnitude 1.25 star lying at a distance of 1,500 light years. This single frame Hyperstar image was taken in June 2006 and is composed of 73 subs with an exposure time of just 20 seconds per sub.

05 The Wall
NGC 7000

This is the Mexico region of the massive North America nebula (NGC7000, Caldwell 20), also popularly known as the Cygnus Wall. This huge HII region in Cygnus lies quite close to the bright star Deneb (above) and is at a distance of 1,800 light years from us. The image is a two-frame Hyperstar mosaic of the region with each frame being a total exposure time of one hour using 60-second subs.

06 Stellar Compass
Polaris

Another single bright star image, this time the one that shows the way home, the Pole Star or Polaris in the constellation Ursa Minor. Polaris is in fact a double star (the double is lost in the glare from Polaris in this image). This single frame Hyperstar image is composed of 30 subs with a very long exposure time of 120 seconds per sub. I was hoping to pick up a faint nebulosity in the area called an 'Integrated Flux Nebula' which is very faint and blue in colour. Unfortunately the nebulosity doesn't show up at all and needs far longer integration times even at f#1.85!



The Pinwheel Galaxy in Triangulum

Messier 33

Triangulum lies just below Andromeda, and contains a galaxy almost as impressive as M31, the Great galaxy in Andromeda. M33, the Triangulum galaxy, is too large for a single Hyperstar frame, so this image is a mosaic of two frames. You can clearly see lots of bright red HII regions (ionised hydrogen emitting light at 656.3nm in the red part of the spectrum) and these are also associated with star generating regions. Although it appears quite bright in this image, the surface brightness of this galaxy is very low making it a challenging target. M33 lies at a distance of 2.3 million light years (like the Andromeda galaxy) but it requires good conditions and very dark skies to see with the unaided eye. Each frame of this image was a total exposure time of about one hour using 65-second sub exposures.

Light has always been a defining factor in the life of Greg Parker, Professor of Photonics at the University of Southampton's School of Electronics and Computer Science.

It began with a young boy's love of the stars in the night sky and his father's photographic collection, many taken whilst he served in the First World War. This followed through to Greg's internationally acclaimed career in photonics and his own passion for capturing images of deep-sky objects.

His early career was spent studying and working in industry. On leaving school he joined the Harwell & Culham laboratories, also taking an HNC in applied physics at Oxford Polytechnic. Having gained a taste for study, he went to Sussex University to read maths, physics and astronomy, graduating with first class honours in 1978. He then joined the Philips Research Laboratories in Redhill and enrolled for a PhD at the University of Surrey.

Greg joined Southampton's Department of Electronics, as it was then, in 1987. He steadily climbed the ranks at Southampton, specialising in novel growth systems for Silicon compatible materials and Silicon-based optoelectronics, and was appointed Chair of Photonics in 2000.

Another dimension to Greg's career in light is his interest in photography, first sparked by his father. In 1985 Greg created the first portable high-power, high-speed flash unit with a 1/40,000 second duration for his older brother Alan. A design that, 20 years after development, remains virtually unchanged and is still in use by award-winning nature photographer Andy Harmer.

Greg's own photography necessitates a slightly longer exposure time; he needs two to three hours for his deep-sky imaging work. He readily admits it can be an addictive obsession but one he is keen to share, and use to inspire others. Although Greg has been stargazing for over 40 years and has his own mini dome observatory in his New Forest garden, he only started imaging the skies last year.

'CCD cameras with long exposure times have only been around for about ten years and it's only in the last five or six years you could get them at a reasonable price to do the job,' he says. 'I started imaging literally one year ago but the technology allows you to do it as long as you're au fait with computers.'

The camera downloads the data which Greg then processes digitally using Adobe Photoshop. This enables him to manipulate the picture and bring out the faint detail. The result is a galaxy of prints that bring the splendours of the cosmos to life.

'That's why it's a great one for me,' he says. 'It brings together optics, the stars, photography and the computational processing. It's got the lot in the one hobby.' And helps provides light relief to an academic career immersed in luminescence.

Rachel Albon

Blue Diamond

Vega

Vega, or Alpha Lyrae, shines like a beacon against a stellar background in the Lyra constellation. It is the fifth brightest star in the entire sky, and can be seen from almost anywhere in the summer sky as part of the Summer Triangle of very bright stars, including Deneb and Altair at the other vertices. Vega is only about 25 light-years from Earth, and is a relative youngster at only 500 million years of age. At twice the mass of our Sun, it is 50 times as luminous. Thus, an observer on a planet around Vega might perceive our sun as just another star in the background. And they might be looking this way right about now, as radio signals from Earth have been reaching Vega for the better part of a century. This image involved 103 exposures at 10 seconds with a Starlight Xpress SXV-H9C CCD camera on an 11" f/1.85 Hyperstar equipped Celestron C11. Even with only 10-second exposures, a small magnitude 14 galaxy, PGC62205, has been captured near the upper-left corner.

STARSCAPES

IMAGES OF THE DEEP SKY

By Greg Parker

Looking back billions of years in time and thousands of light years in space, these images of the deep sky are truly awe-inspiring.

All the images in this exhibition were captured over the last year, by Professor Greg Parker, from his garden observatory in the New Forest. They illustrate the splendours of the cosmos, but also its variety: from the longevity of Lyra at 7 billion years, to the splendour of the Great Nebula in Orion, the breathtaking beauty of the Triangulum galaxy, the sheer power of the North America and Pelican Nebulae in Cygnus, and the mystery of the Thunderclouds Region.

The Starscapes images are fully illustrated in this catalogue, accompanied by personal notes and reflections from Greg Parker.

A Panorama of the Horsehead Nebula Region in Orion
Barnard 33

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This is perhaps the most photographed region of space – and rightly so! There is so much going on in this image, a book could be written on this one photograph itself. This is of course the very famous Horsehead Nebula (Barnard 33), a dark nebula in the constellation Orion. To get your orientation, the very bright star to the left of the image is Alnitak, the leftmost star in the belt of Orion.

What can we see in this image? Well just about every classification of nebula for a start. We have the dark nebula region of the Horsehead itself, the bright red curtain of emission nebulosity behind the Horsehead (IC434), a bright reflection nebula (NGC2023) at the base and to the left of the Horsehead, and finally a most incredible emission nebula, the Flame Nebula (NGC2024) at the centre left of the image. What a totally amazing region of space this is! I must admit, when I first saw a photograph of this region I got pretty upset that someone had created some sort of artistic licence over to the left (the Flame nebula) – I didn't realise that this incredible emission nebula was actually for real.

This image is a 3-frame Hyperstar mosaic with each frame a total of 1-hour exposure using 55-second sub exposures. This image is my personal favourite in the whole exhibition.

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Electronics & Computer Science
University of Southampton

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