

## Stellafane: Visual Observing Olympics – 2016 “The Hidden Gems of Stellafane”

The Deep sky objects listed are among the brightest Non-Messier objects that are visible from the 2016 Stellafane Convention in Vermont. They have been divided into roughly equal proportions of Galaxies, Globular Clusters, Open Clusters and Planetary Nebulae. All objects should be visible in 4 inch and above telescopes under a sky with fairly good seeing and transparency.....L. Mitchell

*“When we are chafed and fretted by small cares, a look at the stars will show us the littleness of our own interests.”*  
Maria Mitchell

**NGC5846** – This is an Elliptical Galaxy located in Virgo and is the brightest galaxy in a chain of four with an apparent magnitude of 10.0v making it visible in almost any telescope. Its distance is about 80 million light years from the Earth. Large telescopes reveal the presence of nine separate knots threading the inner rim, which are gas clouds compressed by recent passages of shock waves. A companion galaxy, NGC5846A, is a compact Elliptical and appears as a 13.5 magnitude stellar object 40” from the center on the southern portion of NGC5846s halo. The compact size of the small elliptical halo is the results of ram-pressure stripping as it plummets supersonically at 300 miles per second into the core of NGC5846. NGC5846A has a 1,850 light year long tail which contains 105 Solar Masses of gas. The time needed for AGB

stars to produce this gas is ~5.5 million years. NGC5846 was discovered by William Herschel on Feb. 24, 1786.

**NGC5907** – This edge-on spiral galaxy is located approximately 50 million light years from Earth and is also known as the “Knife Edge” or “Splinter” Galaxy. Visually it appears as a very thin high surface brightness streak, notable for not having a central bulge which is typical of most spiral type galaxies. It is also unusual for having a very low metallicity with few detectable giant stars, and is apparently composed predominantly of dwarf stars. Subtle warps in the outer regions of the disk hint at a past encounter with another object. In 2006 large telescopes discovered an extended tidal stream which surrounds the galaxy, suggesting gravitational perturbations induced by the another object. This structure has probably survived for several billion years, and the arcing structures form tenuous loops extending more than 150,000 light-years from NGC5907. The streams likely represent the ghostly trail of a dwarf galaxy that left debris along the orbit of the smaller satellite galaxy that was gradually torn apart and eventually merged with NGC 5907 over four billion years ago. Another way to create a tidal stream is with a major merger event when two galaxies of approximately equal size interact gravitationally and eventually merge together into one bigger galaxy. This can eject a stream of stars that looks quite a bit like this as well. At present we do not know if this tidal stream was caused by a small or a large galaxy.

**NGC5897** – Discovered by William Herschel in 1784 with his 18-inch f/13 telescope, this small globular cluster is one of the few deep sky objects of note in the constellation Libra. It is approximately 40,000 light years distant with a diameter of over 170 light years. Its metallicity is just over 1% that of the Sun meaning it is extremely ancient. With a visual magnitude of 8.4 this is a fairly bright and fine object of telescopes of all sizes.

**NGC6210** – Also known as “the Turtle”, this planetary nebula has a very high surface brightness and is located about 6,500 light years away in the constellation of Hercules. The entire nebula measures 1.6 light-years across while the inner shell is about 0.5 light-years in diameter. The central star likely ejected its outer layers in several periods, reshaping the nebula created by the fast stellar winds several times. NGC6210 is moving away from us at 14 kilometers per second. HST images of this object show jets of hot gas streaming through holes in the older, outer shell of gas. It is somewhat unusual to see color in planetaries in amateur telescopes, but NGC6210 has such a high surface brightness that its round disk often visually shows a bluish color due to ionized Oxygen when observing this object.

**NGC6229** – A compact Globular Cluster of high surface brightness, and one of the most remote outer halo Globular Clusters, located about 100,000 light years away in Hercules. It was discovered by William Herschel on May 12, 1787 who mistakenly thought this was a planetary nebula from his visual impression. In 1819 it was taken for a comet, and it was only revealed as a “very crowded cluster” in the mid 19<sup>th</sup> century. Perhaps the reason for its resolving difficulties lies in viewing this object at its relatively large distance. A total of 64 Blue Straggler stars have been found in this globular.

Blue Stragglers are bluer, brighter and younger and more massive stars than normal cluster stars are. Possible explanations involve evolution of binary systems and collisions and mergers between single and binary stars.

**NGC6293** – A Globular Cluster discovered by the American astronomer Lewis A. Swift on 08 July 1885. It is located at a distance of 28,700 light years away from the Earth in Ophiuchus and is considered an inner old halo Cluster and like many similar objects, it has a low chemical abundance. NGC6293 is only 5,000 light years from the Galactic center and is the second most metal poor globular cluster within 10,000 light years of the center. Color-magnitude diagrams show well defined Blue Horizontal-branch populations consistent with the low metallicities and old ages and this low metallicity indicates a formation time only a few hundred million years after the formation of the Milky Way Galaxy. It is only 4,000 light years from the Galactic plane and therefore suffers from interstellar reddening. The center of NGC6293 is extremely dense and there are indications it has undergone a core collapse of material mass in the past. 22 Blue Stragglers have been found in this cluster's central region, another indication of density. Interestingly however it appears there is no age gradient in the inner part of our Galaxy and it seems that Globular Cluster formation must have been triggered almost everywhere and at about the same time, within 0.5 billion years, in our Galaxy.

**NGC6316** – A Globular Cluster discovered by William Herschel on May 24 1784. It is located at a distance of 35,900 light years from the Earth and unlike most metal deficient Globulars, it is a fairly metal rich object. At least seven long period Cepheid Variable Stars have been found within the cluster and four RR Lyrae variables are seen. The short period of these RR Lyrae stars indicates that this cluster is a normal but metal-rich globular cluster. RR Lyrae stars are periodic variable stars found in Globular Clusters and used as standard candles to measure distances. They are pulsating horizontal branch stars of spectral class A or F and with a mass about half that of the Sun's. They are thought to have previously shed mass and consequently, they were once stars with slightly less mass than the Sun, around 0.8 Solar Masses. About 90% of all variables known in globular clusters are RR Lyrae stars. Metal rich Globular Clusters ( $[Fe/H] > -0.8$ ), with their extremely cool red giant branches (RGBs) and horizontal branches (HBs), are expected to harbor large numbers of Population II Cepheid's or Long Period Variables (LPVs) on the AGB branch and few or no RR Lyrae stars on the Horizontal branch.

**NGC6520 and Barnard 86** – NGC6520 is a very bright open star cluster and its neighbor, Barnard 86, is a dark Nebula, appearing as a drop of ink on the sky background. This pair is set against millions of glowing stars located in the center and brightest region of the Milky Way, which emphasizes the blackness of B86. The star cluster contains many hot stars that glow a bright-blue-hot color, an indication of their youth, which is only about 150 million years. Both the star cluster and its dusty neighbor are thought to lie at a distance of only 6,000 light years from the Earth. Barnard 86 is a small dark nebula that is known as a Bok Globule, and it was discovered by Edward Emerson Barnard who described it as a "drop of ink on the luminous sky". It is thought to have formed from the remnants of a molecular cloud that collapsed to form the nearby star cluster. Many dark nebulae are known to have new stars forming in their centers but it is not clear if this is still happening inside B86.

**NGC6543** – A bright Planetary Nebula in Draco, also called the "Cat's Eye Nebula" was discovered by William Herschel on Feb. 15, 1786. It was the first PN whose spectrum was investigated and this was conducted by the English amateur astronomer William Huggins who found that Planetary Nebulae were gaseous in nature and not stellar objects. It is located about 3,300 light years from the Earth, near the North Galactic Pole and has a combined magnitude of 8.1. Deep images reveal an extended Outer halo of about 5 arcmin across which is the remnant of the star in its red giant phase. The bright nebula has a temperature of between 7,000 and 9,000 K with densities averaging about 5,000 particles per cubic centimeter. Its Outer Halo has a higher temperature around 15,000 K but of a much lower density. The fast stellar wind is expanding outward at about 1,200 miles/sec. and spectroscopic analysis shows the current rate of mass loss averages  $3.2 \times 10^{-7}$  solar masses per year, equivalent to 20 trillion tons per second. The central star has a surface temperature of about 80,000 K (our sun is 5,780 K) and is 1,000 times as luminous as the Sun, yet its diameter is about 0.65 that of the Sun. It is calculated to be over one Solar mass, down from an initial 5 Solar masses. Observations of NGC 6543 at far infrared wavelengths (about 60  $\mu\text{m}$ ) reveal the presence of stellar dust at low temperatures, around 85K, believed to have formed during the last phases of the progenitor star's life. It absorbs light from the central star and re-radiates it at IR wavelengths. In 2001, observations at X-ray wavelengths revealed the presence of extremely hot gas within NGC 6543 with a temperature of 1.7 million degrees K. It is thought that the very hot gas results from the violent interaction of a fast stellar wind with material previously ejected which has hollowed out the inner bubble of the nebula. A star with a temperature of about 100,000 K would not be expected to emit strongly in hard X-rays, and so their

presence is a mystery, however it may be due to a high temperature accretion disk within a binary star system. If the nebula has been expanding at a constant rate of 10 milli-arcseconds a year, then it would take  $1000 \pm 260$  years to reach a diameter of 20 arcseconds. This may be an upper limit to the age, because ejected material will be slowed when it encounters material ejected from the star at earlier stages of its evolution, and the interstellar medium.

**NGC6572** – A very bright 8.1 magnitude Planetary Nebula, located in Ophiuchus and discovered in 1825 by Friedrich George Wilhelm Von Struve. Visually at low power it will appear as a colored star but higher magnification will reveal its disk. It has a very high surface brightness and some observers report that NGC6572 looks blue while others think it is green. It has an integrated magnitude of 7.0p packed into a tiny 11" disk which is brighter than the famous Ring nebula. NGC 6572 only began to shed its gases a few thousand years ago, so it is a fairly young planetary nebula. As a result the material is still quite concentrated, which explains why it is abnormally bright. The envelope of gas is currently racing out into space at a speed of over 9 miles every second and as it becomes more diffuse, it will dim. Due to its high surface brightness it takes magnification well so power up those telescopes.

**NGC6638** – A fairly small high surface brightness Globular Cluster that is listed as a Bulge Object and discovered on June 5, 1834 by the Scottish astronomer James Dunlop. Compared to most Globular Clusters this is a metal-rich object, meaning it is younger than most of the approximately 150 known Milky Way Globulars. It contains 26 short period variables and 13 RR Lyrae c-type variable stars. It is 28,000 light years from the Sun but only 5.5 light years from the galactic center as it makes its way in its orbit around the Milky Way Galaxy.

**NGC6645** – A very nice visual object to look at, this open cluster shows a very distinct circlet of stars found near its center. It is 25,000 light years from the Sun and is a very unusual object. Open Clusters are usually composed of very young stars a few tens or hundreds of millions of years old, but the color-magnitude diagram position of NGC6645 indicates this cluster is presently moving between the main sequence and the Giant Branches of the H-R diagram, resulting in a whopping age of 9.7 Billion Years. A total of 72 members have been positively identified (with an additional 9 possible members), with masses ranging from 0.86 to 1.04 Solar Masses and a range of temperatures from 6600 K to 8100 K.

**NGC6712** – This Globular Cluster was probably discovered by Le Gentil on July 9, 1749 while investigating the Milky Way star cloud in Aquila. In 1866 William Huggins found it to have a continuous spectrum proving that it is composed of stars and was not a gaseous nebula. The cluster is 64 light years across and sparse at approximately 1 million stars, yet it is very concentrated and takes power well. A [study by the European Southern Observatory](#) concludes that NGC 6712 is only a pale remnant of a once much more massive cluster. It noted that none of NGC 6712's stars are less massive than our Sun, making it totally unlike any other Globular Cluster. Most likely, NGC 6712 is unique only because no other globular cluster comes as close to the Milky Way's center. It penetrates very deeply into the galactic bulge and ventures to within only 1,000 light years of the galactic center. The tidal force of the galaxy not only strips low-mass stars from the cluster, but it also stretches out the cluster stars like a comet's tail. While observing NGC 6712 also take a look at IC 1295, a planetary nebula that is only 25' to the southeast of 6712. It responds strongly to both OIII and UGC filters and together in a rich star field, these two objects provide a pleasing and interesting contrast.

**NGC6755** – This is an open cluster in the constellation Aquila located against a very rich Milky Way background of dense stars. NGC6755 is about 4,700 light years distant and visually is a bright group (mag. 7.5) of about 50 stars ranging in magnitude from 10 to 14.0 with an apparent diameter of 14.0 arc mins. Located about half a degree to the northeast is another open cluster, NGC6756 which is smaller and fainter (mag. 10.6) than NGC6755 and located a slightly more distant 4,900 light years away. Together these two objects give the appearance of a Double Cluster in a telescope field.

**NGC6781** – A bright and beautiful Planetary Nebula located in Aquila. The nebula has a V-magnitude of 11.4 and a size of 2 light years (1.8 arc-minutes) and distance estimates vary from 1,200 to 3,000 light years. Compared to the Ring Nebula it is relatively large and faint, yet not so faint that it isn't visible in small telescopes. The rim is brighter along the southern side and overall it appears as an oval with a slightly darker center. Within NGC 6781, shells of gas are blown off from the faint, but very hot magnitude 14.9 – 17.8 central star's surface and expand out into space. These shells shine under ultraviolet radiation from the progenitor star which has a luminosity 385 times that of the Sun. When a star reaches this stage of evolution, it has burned its available hydrogen and helium and when a sun-like star's helium is gone, the core collapses into a white dwarf star. The remains of the star will eventually cool into oblivion after the ejected gas has dispersed into space. We are actually looking down the throat of a slightly tilted hour-glass nebula of expanding gas.

**NGC6811** – An Open Cluster in Cygnus with an angular size half that of the full Moon and composed of about 1000 stars of roughly the same magnitude. It has been called “The Hole in the Cluster” because of its dark center seemingly absent of

stars. NGC6811 lies far away from the Galactic Plane like so many other Open Clusters, and is approximately  $3,600 \pm 300$

light years distant and 14 – 20 light years across. It has a total luminosity of 2,100 Suns and is approximately  $1.00 \pm 0.17$

Billion years old. Originally it probably contained about 6,000 stars but gravitational interactions and stellar evolution have since reduced the number what we see today. The spectral types of most of its stars range from mid-F to early-K, with surface temperatures relatively similar to the Sun's. The rest of the stars are larger and hotter and include A2-types, several O-types, and more than 100 B-types. Sixteen stars have been observed to vary in brightness. Its Trumpler classification is IIIr meaning it is “a rich cluster with equally bright stars with no noticeable central concentration”. The stars do have an unusual distribution with an apparent ring surrounding a hole in the center. The cluster has recently been the subject of study by the Kepler mission, with the aim of characterizing its stars' rotation rate, age, and distance to help in the hunt for exoplanets. Two planets – Kepler 66b and Kepler 67b – orbit sun like stars in the cluster having been discovered by the space-born Kepler telescope using the transit method. Both planets are smaller than Neptune and are both the first sub-Jupiter planets and the first transiting planets discovered orbiting stars within an open cluster. This finding suggests that the frequency of planets in clusters is similar to that in stars not belonging to clusters or associations and planets can form and survive in environments more crowded and violent than the one of our own isolated Sun. Visually NGC6811 is a pleasing object for amateur astronomers even if the brightest members are only 10<sup>th</sup> magnitude. It appears as a hazy patch in 10x binoculars. Through a telescope it is often described as a “smoke ring of stars”.

**NGC6826** – A Planetary Nebula located in Cygnus and commonly referred to as the “Blinking Planetary”. The brightness of the central star overwhelms the eye when viewed directly, causing the surrounding nebula to seemingly disappear. It also can be viewed well using averted vision which causes it to “blink” in and out of view as the observer's eye wanders. A distinctive feature of this nebula are two bright patches on either side, which are known as Fast Low-Ionization Emission Regions or more commonly FLIERS. They appear to be relatively young and moving outwards at supersonic speeds and are possibly the initial ejection from the central regions of the dying star. They remain however something of a mystery as it appears from their shapes that they are stationary objects, and that material ejected from the star flows past them scraping gas from their surfaces. The formation of FLIERS cannot be easily explained by any models of stellar evolution. The FLIERS are composed of ionized Nitrogen while the rest of the halo is seen due to twice ionized Oxygen. NGC6826 is estimated to be 3,600 light years away and the nebula itself is between 0.4 and 0.5 light years across and expanding at a relatively low (compared to other PN) 7 miles per second. However NGC6826 is one of the few nebulae that is surrounded by a relatively bright Outer Halo 65” in diameter which is about five times the size of the halo normally seen in planetaries. This Outer Halo is over 2 light years across and is the result of earlier episodes of stellar mass loss illuminated by ultraviolet radiation from the star leaking into it. The central star has a visual magnitude of 10.7 and its temperature is about 47,000 Kelvin which is relatively cool for the central stars of planetaries. Its luminosity is 1,300 that of the Sun while its mass is only 0.55 that of the Sun. The star is still in the act of heating and when it reaches 100,000 K it will begin to cool and fade to nothing, the ultimate fate of common lower-mass white dwarfs.

**NGC6822** – Commonly known as Barnard's galaxy, it was discovered by Edward Emerson Barnard in 1884 with a six-inch refractor. It is a Barred Irregular type galaxy located approximately 1.6 million light years away in Sagittarius and is a member of the Local Group of Galaxies making it one of the closer galaxies to the Milky Way. It is similar in structure and composition to the Small Magellanic Cloud and is only about 7,000 light years in diameter. In 1925 Edwin Hubble discovered 15 variable stars, 11 of which were Cepheid's, and his detection of the Cepheid variable stars was a milestone in astronomy as he used the Cepheid Period Luminosity Relationship to determine distances in the universe. This was the first system beyond the Magellanic Clouds to have its distance somewhat accurately determined and he determined the distance to be 700,000 light years, about half the true distance. Hubble in 1925 wrote: “NGC 6822 is fairly conspicuous in

*a short 4-inch finder...but is barely discernible at the primary focus of the 100-inch".* The dwarf irregular galaxy is filled with young blue stars and HII regions and it consists of a "bright" central bar embedded in a broad oval halo of lower

surface brightness, and the halo is much larger than most published dimensions, measuring at least  $\sim 15'$  by  $10'$ . Though

it has a fairly low surface brightness, NGC 6822 is one of the easiest galaxies to resolve with over one hundred stars having magnitudes in the range of 13.5 to 16.5, well within range of larger amateur telescopes. Barnard's Galaxy is a "binocular object" and a fairly easy one at that. Small, short focal length "rich-field" telescopes are often the instrument of choice for general study of the galaxy. The central bar of the galaxy is easy to observe.

**NGC6939** – An Open Cluster in Cepheus located 1.5 degrees southwest of the star  $\eta$  Cephei and near the galaxy NGC

6946 just 40 arcminutes southeast of NGC 6939. Both can be picked up in the same low-power field. NGC6939 is a small cluster whose two main stars shine at tenth magnitude near the northern and southern edge, while the central components are from 12th magnitude. Its distance is estimated at about 3,860 light years from Earth and it falls within the Orion Arm of the Milky Way which is a very rich region of molecular clouds. Its distance from the center of the Milky Way is estimated to be about 3,200 light years and its age is probably between 1.0 and 1.3 Billion years, which makes it rather old, though not among the oldest, of known Open Clusters. Some of its stellar components have been identified as double stars and a few are variable stars. A 10 x 50 binocular is enough to see the cluster, but with a telescope of 4 inches of aperture the cluster is largely resolved.

**NGC6934** – This is a Globular Cluster found in the constellation Delphinus and it is about 50,000 light years away and is estimated to be some 10 Billion years old. NGC 6934 is home to some of the most distant stars still to be part of our Galactic system. It was discovered by William Herschel on Sept. 24, 1785. Globular clusters are large balls of (typically) a few hundred thousand ancient stars that exist on the edges of galaxies. Gravitationally bound to the galaxy these spherical groupings are much older than the stars of the galactic disk. In fact, measurements of globular cluster ages define the age of the Universe (it must be older than the stars in it!) and accurate cluster distance determinations provide a rung on the astronomical distance ladder. NGC6934 is a popular target for amateur astronomers as it can be observed with relatively small telescopes. Broadcaster Patrick Moore included this cluster in his "Caldwell catalogue" of celestial objects that amateur astronomers look out for.

**NGC6946** – Also known as the "Fireworks" Galaxy it is an intermediate spiral galaxy located about 18 million light years away in the constellations of Cepheus and Cygnus. Discovered by William Herschel on September 9, 1788 it is highly obscured by interstellar matter of the Milky Way and located very close to the plane of the galaxy. This has led to conflicting estimates of the distance from 10 million all the way to 22 million light years. The diameter of the galaxy is approximately 40,000 light-years or just about a third of the size of the Milky Way and from our vantage point we see the galaxy face-on. In the last 100 years nine supernovae have been discovered inside NGC6946, making it the most prolific known galaxy for this type of event. For comparison the Milky Way galaxy with twice the number of stars as NGC6946 averages only one supernova event per century. From the core outward, the galaxy's colors change from the yellowish light of old stars in the center to young blue star clusters and reddish star forming regions along the loose, fragmented spiral arms. NGC 6946 is also bright in infrared light and rich in gas and dust, exhibiting a high star birth and death rate which furnished the supernovae seen.

**NGC7009** – A Very bright Planetary Nebula located in Aquarius and known as the "Saturn Nebula". It was discovered by William Herschel on Sept. 7, 1782. The object overall has a visual magnitude of 8.0 and a radial velocity of 28 miles per second towards the Earth. The central portion measures  $25'' \times 17''$ , while the outer shell extends to  $41'' \times 35''$ . The central star is now a bright white dwarf star of 11.5 magnitude that has ejected its outer layers into space forming the nebula. The star's temperature is 55,000K with a brightness of about 20 Solar Luminosities. This strong ultraviolet

irradiation from the central star creates the characteristic fluorescent green tint of the nebula via the radiation of doubly ionized oxygen. The central star seems faint to us only because of its distance and because the vast majority of its radiation comes out as energetic ultraviolet light. It is still heating at a constant luminosity but will eventually cool down and dim, fading from view. The Saturn Nebula is a complex planetary nebula and contains many morphological and kinematic sub-systems in three dimensions. It includes a halo, jet-like streams, multiple shells, Ansa ("handles" or FLIERS) which give the object its name, and small-scale filaments and knots. The Ansa are expanding non-radially from the central star and are clouds of low-density gas, joined to the tips of the cavity by jets of material. The distance to NGC7009 is not well known and estimates vary from 2,000 – 5,200 light years. If at 2,000 light years the nebula is  $\frac{3}{4}$  of a light year long,

**NGC7331** – This is a Spiral Galaxy located about 50 million light years away in Pegasus and is one of the brighter Galaxies not included in Charles Messier's 18<sup>th</sup> century catalog, being visible in binoculars. It was discovered by William Herschel in 1784 and is the brightest member of a group of Galaxies which is sometimes referred to as the "*Dear Lick Group*." It is similar in size and structure of the Milky Way Galaxy and has been referred to as our Twin Galaxy in the past. Recent discoveries have cast doubt on this similarity however. In most Spiral Galaxies, the central bulge typically rotates along with the disk in the same direction, but the bulge in NGC7331 is rotating in the opposite direction to the rest of the disk. The current bulge may have formed from infalling material, however if it has been there since the formation of the galaxy then it would be difficult to explain how such a situation arose. NGC7331 is rich in HII regions, similar to the Orion Nebula in our Galaxy, so star formation is active in the spiral arms. Larger amateur telescopes reveal the presence of nearby smaller galaxies which are roughly ten times farther away and not interacting with NGC7331. Nearby 1.5 degrees to the SW is the first compact group of Galaxies discovered, known as Stephan's Quintet, visible in large amateur telescopes. The largest member of the quintet NGC7320 is actually a companion of NGC7331, while the other fainter quintet members are part of the fainter group nearer NGC7331 and also located ten times distant.

**NGC7479** – This is a Barred Spiral Galaxy located about 105 million light years away in the constellation of Pegasus. It was discovered by William Herschel in 1784. NGC 7479 is also recognized as a Seyfert Galaxy undergoing starburst activity, not only in the nucleus and the outer arms, but also across the bar of the galaxy, where most of the stars were formed in the last 100 million years. Seyfert galaxies are also noted for harboring supermassive black holes of 100 – 1,000 million Solar Masses. The asymmetrical arms of the galaxy and the intense star formation activity are attributed to a merger event with a smaller galaxy 300M years ago. The tightly wound arms of the spiral galaxy create an inverted 'S', as they spin in an anticlockwise direction. However, at Radio Wavelengths, this galaxy, sometimes nicknamed the Propeller Galaxy, spins the opposite way, in a clockwise direction, with a jet of radiation that bends in the opposite direction to the stars and dust in the arms of the galaxy. Astronomers think that the radio jet in NGC 7479 was put into its bizarre backwards spin following a merger with another galaxy. Star formation is reignited by galactic collisions, and indeed NGC 7479 is undergoing starburst activity, with many bright, young stars visible in the spiral arms and disc. Two Supernovae, SN 1990U and SN 2009jf have been discovered in NGC7479. This beautiful galaxy is easily visible in moderate telescopes as an elongated fuzzy patch of light. The spiral arms and the bar can be seen in larger telescopes under dark conditions.

**NGC7626 and the Pegasus Cluster-** NGC7626 is an Elliptical Galaxy in the Constellation of Pegasus with an apparent magnitude of 11.2 and located 170 million light years distant. NGC 7626 contains a strong radio source, a core with two symmetric jets and radio lobes. The jet axis is parallel with the projected direction of motion of NGC 7626, and the southern leading jet is foreshortened as compared to the northern trailing one, possibly due to the additional ram pressure the forward jet encounters. NGC7626 and the nearby NGC7619 are the two dominant members of the Pegasus Galaxy Group or Pegasus 1 as it is sometimes called. The sharp edged appearance of the galaxies imply the two objects are falling towards one another in the plane of the sky. It is thought the Pegasus cluster is currently forming from the major merger of two subgroups of galaxies dominated by NGC7619 and NGC7626. Galaxy clusters such as Pegasus are

among the most distant objects that can be observed through ordinary amateur telescopes. Even fairly small telescopes can show the two brightest members of this cluster, the elliptical galaxies NGC 7619 and NGC 7626. With larger telescopes, some of the dimmer galaxies can be seen.

**NGC7662** – A bright Planetary nebula also known as the “Blue Snowball” or the “Snowball nebula” located in the constellation of Andromeda and discovered by William Herschel in 1784. As with all planetary nebulae this is the remnant of a red giant star that has ejected its outer gaseous shell leaving behind a hot dense white dwarf star that is variable with a magnitude range of 12 to 16. The star has a continuous spectrum and a computed temperature of about 75,000 K. It is estimated that 95% of all stars, including our Sun, will end their lives in the manner. Distances to Planetary nebula are very difficult to ascertain accurately but a fairly recent survey gave it a distance of 5,600 light years with a diameter of 0.8 light year or nearly 50,000 AU. A small telescope will reveal a star-like object with slight nebulosity and a 6 inch telescope will begin to reveal a slightly bluish color.

**NGC7789** – A beautiful large Open Cluster in Cassiopeia, discovered by Caroline Herschel in 1783. This cluster is also known as "The White Rose" Cluster or "Caroline's Rose" Cluster because when seen visually, the loops of stars and dark lanes look like the swirling pattern of rose petals as seen from above. It is about 8,000 light years away and about 1.6 Billion years old, which is relatively old for an Open Cluster. NGC7789 is over 50 light-years across and spans half a degree (the angular size of the Moon) in the sky. All the stars in the cluster were likely born at the same time, but the brighter and more massive ones have more rapidly exhausted the hydrogen fuel in their cores. These have evolved from Main Sequence stars like the Sun into many Red Giant Stars which are hinted at in large telescopes, appearing as a yellowish color. This Open Cluster is visible in binoculars and Walter Scott Houston wrote that “NGC7789 is one of those rare objects that is impressive in any size instrument.”

**NGC253** – Known as the Sculptor Galaxy, or the Silver Coin or Silver Dollar Galaxy, this is an intermediate spiral Galaxy in the constellation Sculptor. It is the brightest galaxy located in the center of the Sculptor group, one of the nearest groups of Galaxies to the Milky Way, and one of the intrinsically brightest galaxies in the vicinity of ours, only surpassed by the Andromeda Galaxy and the Sombrero Galaxy. Discovered by Caroline Herschel in 1783 during one of her comet sweeps, NGC253 is notable as a Starburst Galaxy, meaning it is currently undergoing a period of intense star formation. This starburst activity has created several super star clusters on NGC253’s center, discovered with the HST. These are massive structures, the largest is 140 million Solar Masses (age of 5.7 million yrs) and rich in Wolf Rayet massive stars, and heavily obscured by interstellar dust (another of 1.5 million and 2 others of 500,000 Solar Masses). The Galaxy is dominated by dust and dust lanes and patches of great complexity are scattered throughout the surface and spiral arms are somewhat difficult to trace. NGC253 is also a fairly strong Radio source and recent research suggests the presence of a supermassive black hole, with a mass estimated to be 5 million times that of our Sun, which is slightly heavier than Sagittarius A\*. Star formation is high in the NE of NGC253's disk, where a number of red supergiant stars can be found, and in its halo there are young stars as well as amounts of neutral hydrogen. This along with other peculiarities suggest that a gas-rich dwarf galaxy collided with it about 200 million years ago, disturbing its disk and starting the present starburst. This dwarf galaxy, NGC253-dw2 was recently discovered near NGC253 by the Subaru Telescope, and it may not survive the next time it plunges closer to its host as it could be shredded into oblivion.. As happens in other galaxies suffering strong star formation stellar winds of the massive stars produced in the starburst as well as their deaths as supernovae have blown out material to NGC 253's halo, in the form of a superwind that seems to be inhibiting star formation in the galaxy. Supernovae are generally associated with starburst galaxies but only one supernova has been detected within NGC253. Two techniques have been employed to measure the distance to NGC253. The Planetary Nebula Luminosity function gives a distance of 10.59 million light years while the Tip of the Red Branch Method gives a distance of 11.4 million light years. The diameter of NGC253 is 70,000 light years.

**NGC457** – This is the brightest Open Cluster in Cassiopeia and it is also known as the “Owl Cluster” or the “E.T. Cluster”. It was discovered by William Herschel in 1787. It lies over 7,900 light years away from the Sun and has an estimated young age of 21 million years which is typical of Open Clusters. At magnitude +6.4, it's just beyond naked-eye visibility but easily seen with binoculars, and is a beautiful sight through telescopes. The brightest star inside NGC 457 is Phi-1 Cassiopeiae ( $\phi$  Cas - mag. +5.0), but it is Not an actual member of the cluster, being a foreground star at approximately

4,000 light years and visible to the naked eye. Together with another Non-cluster star - seventh magnitude Phi-2 Cas or HD 7902 (HIP 6229) - they form the bright eyes of the Owl, greatly adding to the splendour of the view through backyard scopes. The cluster consists of a rich field of about 150 stars of magnitudes 12-15 and is one of the finest objects of its type in the northern sky.

**NGC654** – An Open Cluster in Cassiopeia, it was discovered by William Herschel in 1787. With an apparent magnitude of 6.5 it can be viewed in binoculars. The cluster has approximately 80 members which surrounds a 7<sup>th</sup> magnitude yellowish star, an F5Ia Supergiant and possibly a member of the group. Located at a distance of 7,800 light years it is a young cluster with an age of approximately 15 million years, but it can be as old as 40 million years with a time spread of

star formation of at least ~20 million years. A few very luminous stars are part of the cluster, including three Be stars, or

massive stars with an Emission Spectra. The central region of the cluster shows less reddening than the rest of the cluster. A possible reason is the fact that between the solar system and the cluster lie two dust layers, one at 650 and one more at 2,350 light years which block out part of the light from the cluster. NGC654 is thought to form part of the Cassiopeia OB8 Stellar Association that is located in the Perseus Arm of the Milky Way Galaxy.

**Larry Mitchell**