

DSOs

Deep Sky Objects

Djorg

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NGC

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What are Deep Sky Objects?

They are “objects” that are relatively faint and distant. They are NOT individual stars, double stars or any object in our solar system.

THEY ARE...



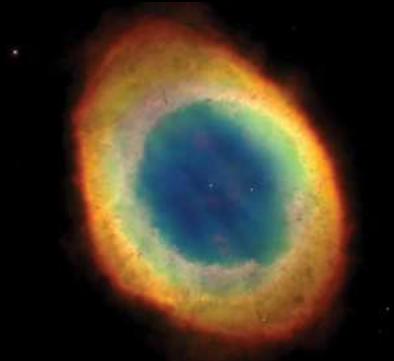
Clusters of Stars
Pleiades, **M45**



Globular Clusters
Hercules Globular Cluster, **M13**



Nebulae
Orion Nebula, **M42**



Planetary Nebulae
Ring Nebula, **M57**



Galaxies
Andromeda Galaxy, **M31**



Supernova Explosions
Crab Nebula, **M1**

Charles Messier

Father of Deep Sky Objects

Charles Messier
1730-1817
Observational Astronomer
Paris, France



Charles Messier was the very first astronomer to compile/publish a catalogue of Deep Sky Objects by directly observing many of the objects for the first time and using short lists of objects observed by others.

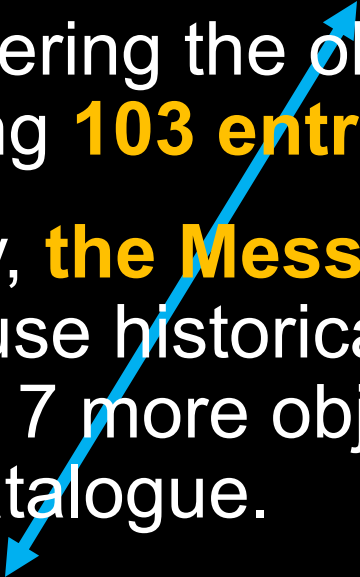
“You are going to hear a lot of people say that Messier created the catalogue so others would avoid confusing the objects with comets.”

THIS IS NOT TRUE!

What's so special about Messier's Catalogue?

1. It was the **very first of its kind**.
2. Represents the **biggest & brightest objects** in the northern hemisphere — the cream of the crop, the favorites (this is what happens when you are the first on the scene).
3. It has at least **one example of every** type of **Deep Sky Object**.
4. All objects can be **seen with a 3-inch diameter telescope** — beginning amateur's delight.

Messier's Catalogues⁺

1. From **1771 to 1781**, he published **3 catalogues**, numbering the objects and adding to each, totaling **103 entries** in the final publication.
 2. Today, **the Messier catalogue has 110 objects** because historical notes indicated that he had found 7 more objects but never included them in his catalogue.
 3. In 1781, **William Herschel** receive a copy of Messier's catalogue and got inspired. He **published a catalogued of 1,000 DSOs by 1785** and 2,500 by 1802.
- 

DATE des OBSERVATIONS.	Numeros des Nébuleuses	ASCENSION DROITE.		DÉCLINAISON.	Diamètre en degrés & min.
		En Temps.	En Degrés.		
		H. M. S.	D. M. S.	D. M. S.	
1758. Sept. 12	1.	5. 20. 2	80. 0. 33	21. 45. 27 B	
1760. Sept. 11	2.	21. 21. 8	320. 17. 0	1. 47. 0 A	0. 4
1764. Mai. 3	3.	13. 31. 25	202. 51. 19	29. 32. 57 B	0. 3
	8	4. 16. 9. 8	242. 16. 56	25. 55. 40 A	0. 2 $\frac{1}{2}$
	23	5. 15. 6. 36	226. 39. 4	2. 57. 16 B	0. 3

Détails des Nébuleuses & des amas d'Étoiles.

Les positions sont rapportées ci-contre.

- | N. ^o
des
Nébul. | |
|----------------------------------|---|
| 1. | Nébuleuse au dessus de la corne méridionale du Taureau, ne contient aucune étoile; c'est une lumière blancheâtre, alongée en forme de la lumière d'une bougie, découverte en observant la Comète de 1758. Voyez la Carte de cette Comète, <i>Mém. Acad. année 1759, page 188</i> ; observée par le Docteur Bévis vers 1731. Elle est rapportée sur l' <i>Atlas céleste</i> anglois. |
| 2. | Nébuleuse sans étoile dans la tête du Verseau, le centre en est brillant, & la lumière qui l'environne est ronde; elle ressemble à la belle Nébuleuse qui se trouve entre la tête & l'arc du Sagittaire, elle se voit très-bien avec une lunette de deux pieds, placée sur le parallèle de α du Verseau. M. Messier a rapporté cette nébuleuse sur la Carte de la route de la Comète observée en 1759. <i>Mém. Acad. année 1760, page 464</i> . M. Maraldi avoit vu cette nébuleuse en 1746, en observant la Comète qui parut cette année. |
| 3. | Nébuleuse découverte entre le Bouvier & un des Chiens de Chasse d'Hévélius, elle ne contient aucune étoile, le centre en est brillant & sa lumière se perd insensiblement, elle est ronde; par un beau ciel on peut la voir avec une lunette d'un pied: elle sera rapportée sur la Carte de la Comète observée en 1779. <i>Mémoires de l'Académie de la même année. Revue le 29 Mars 1781</i> , toujours très-belle. |
| 4. | Amas d'étoiles très-petites; avec une foible lunette on le voit sous la forme d'une nébuleuse; cet amas d'étoiles est placé près d' <i>Antarès</i> & sur son parallèle. Observé par M. de la Caille, & rapporté dans son Catalogue. Revu le 30 Janvier & le 22 Mars 1781. |
| 5. | Belle Nébuleuse découverte entre la Balance & le Serpent, près de l'étoile du Serpent, de sixième grandeur, la cinquième suivant le Catalogue de Flamsteed: elle ne contient aucune étoile; elle est ronde, & on la voit |

CATALOGUE
DES NÉBULEUSES
ET
DES AMAS D'ÉTOILES,

Que l'on découvre parmi les Étoiles fixes,
sur l'horizon de Paris.

Observées à l'Observatoire de la Marine,
avec différens instrumens.

Par M. MESSIER.

PLUSIEURS Astronomes ont travaillé à la recherche des Étoiles nébuleuses, comme Hévélius, Huygens, Derham, Halley, Chéseaux, l'Abbé de la Caille, & en dernier lieu M. le Gentil: d'autres Astronomes en ont découvert par hasard, soit en travaillant à la détermination du lieu des Étoiles pour en former des Catalogues, soit en observant le cours des Comètes: plusieurs de ces Astronomes n'ont fait que les indiquer dans les constellations où elles se trouvoient, sans en donner les positions exactes & une description détaillée.

16 Février
1771.

J'ai entrepris cet ouvrage en 1764, soit en observant celles qui étoient déjà connues, soit en en recherchant d'autres qui avoient échappé aux Astronomes depuis l'invention des lunettes: ce travail qui a été long & pénible me met en état de donner aujourd'hui à l'Académie un catalogue plus complet, plus précis & plus détaillé des Étoiles nébuleuses, ouvrage qui manquoit peut-être à l'Astronomie.

La Comète de 1758, le 28 Août, étoit entre les cornes du Taureau, je découvris au-dessus de la Corne méridionale, & à peu de distance de l'Étoile ζ de cette constellation, une lumière

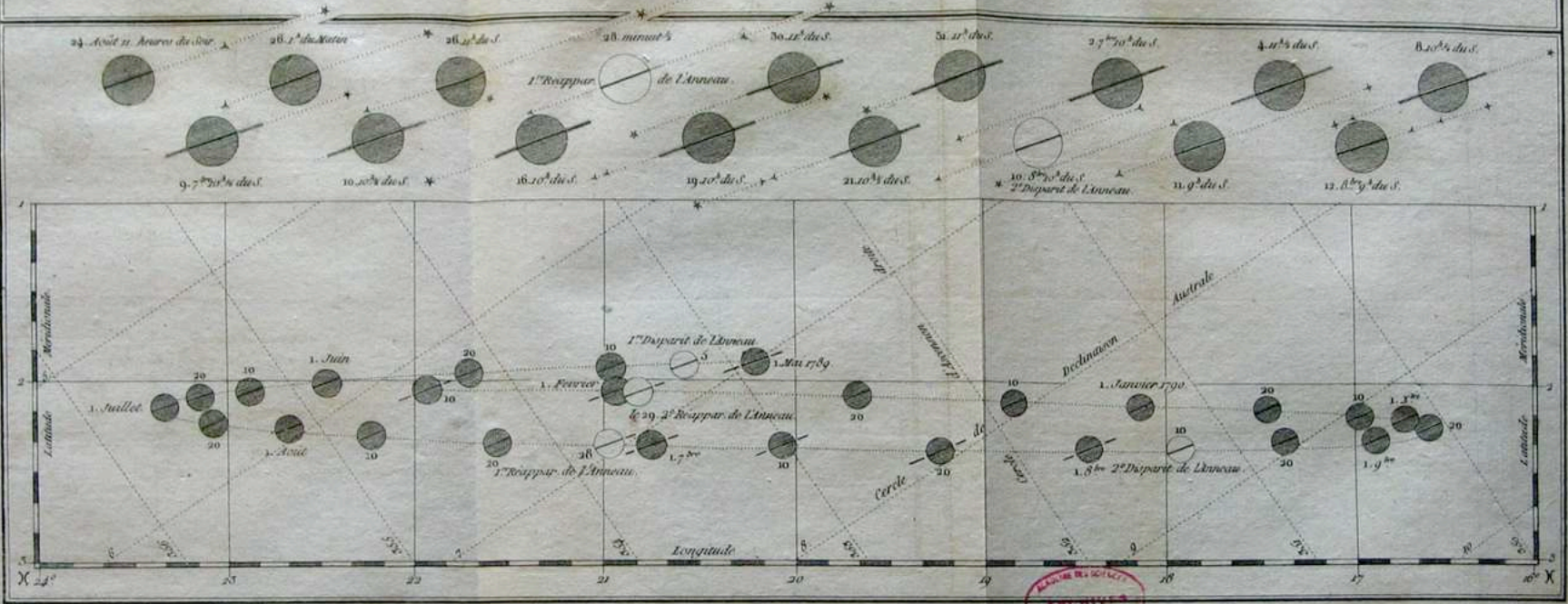
Several astronomers have searched for nebular stars, including Hévélius, Huygens, Derham, Halley, Chéseaux, Father De la Caille and, finally, Mr. le Gentil; other astronomers have discovered some by chance, either while working on establishing the location of stars for cataloguing purposes, or while observing comets; several of these astronomers only indicated the constellations where they were located, without giving their exact position or a detailed description.

I started this book in 1764, by observing those which were already known as well as researching others that had eluded astronomers since the telescope was invented; this long and tedious work allows me today to submit to the Académie a more comprehensive, more precise and more detailed catalogue of nebular stars, a reference work that may have been lacking in the field of astronomy.

Messier became famous as a comet hunter but he was MUCH more than that, he was the **Leading Observational Astronomer in Europe during the mid 1700s!**

- **Member of 17 science academies throughout Europe.**
- **Had over 100 astronomical observations published in various scientific circulars covering the gamut of astronomy. Only 30% pertained to comets.**

CARTE qui représente les Observations qui ont été faites sur les Anneaux de SATURNE et des Satellites ou Etoiles qui se sont trouvés dans la direction de l'Anneau.
Le second Cadre représente la Route apparente tracée de cette Planète depuis le 5^e Mai 1789, jusqu'au 10^e Février 1790. Pendant le quel temps sont arrivés les quatre Observations intéressantes des Disparitions et Réapparitions des Anneaux de Saturne.
Ces Conspiration de Saturne sont rapportées comme la Lunette les représentent. Renversés.



Gravé par F. L. Vermeil, d'après le Dessin de M. Bouguer.

Mémoires de l'Académie des Sciences



Sir William Herschel 1738 – 1822

Leading observational astronomer
of his time, late 1700s

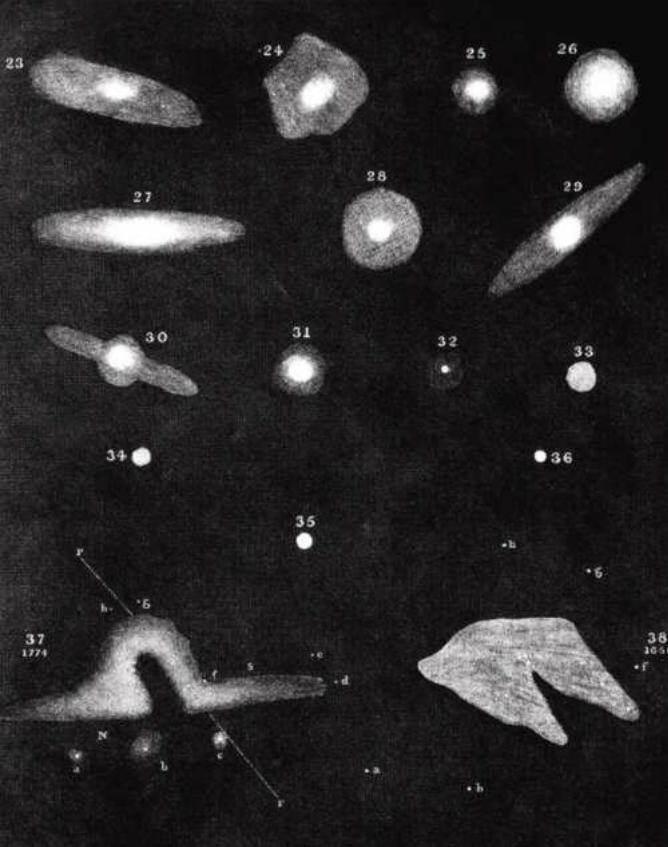
- Berkshire, England

Major Accomplishments

1. Discovered Uranus in 1781
2. Discovered infrared radiation in 1800
3. Observed/Catalogued 2500 DSOs
4. Observed many Double Stars
5. Discovered Solar System moons
6. Built/Used/Sold many
Newtonian Reflector Telescopes
200+ by 1795



Favorite 6.2-inch
metal mirror
reflector



William Herschel & DSOs with Caroline's help

1. Messier's last catalogue 1781
2. Herschel given a copy of Messier's catalogue in December 1781
3. 1785 • FIRST set of 1000 DSOs catalogued*
4. 1788 • SECOND set of 1000
5. 1802 • 500 more

Where did the Herschel 400 list of DSOs come from?

It was a subset of Herschel's catalogue chosen by a Florida astronomy club in 1980 that is used as a second list of objects for DSO observers.

*Using 12-inch & 18.7-inch diameter metal mirror reflectors

J. L. E. Dreyer

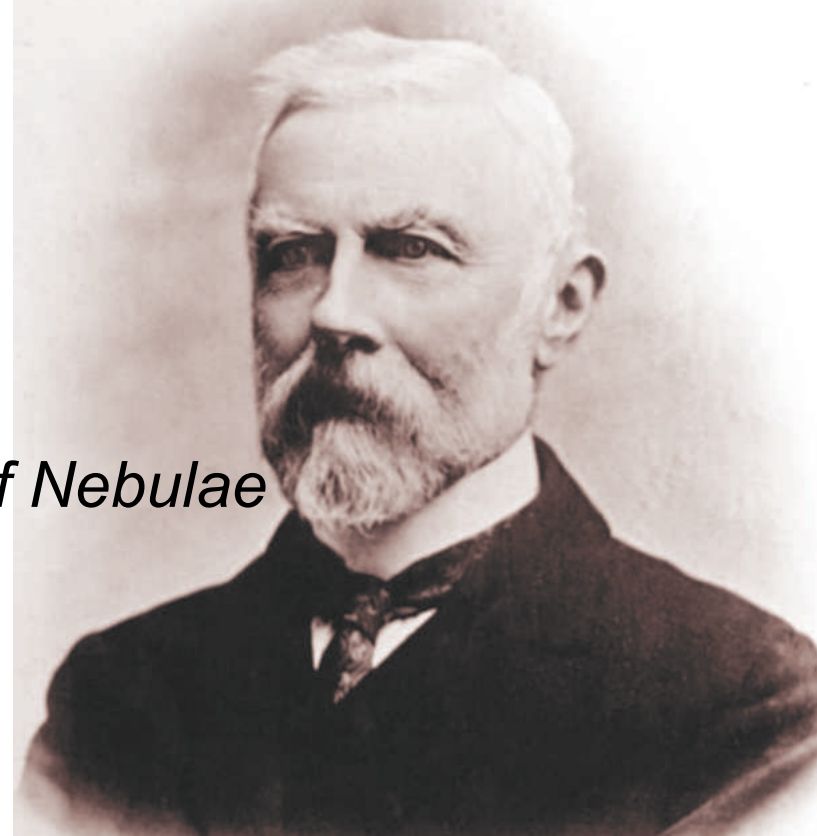
1852 – 1926

*Best known as the **Compiler** of*

1. *The New General Catalogue of Nebulae and Clusters of Stars (**NGC**)*
2. *The Index Catalogue (**IC**)*

Timeline

1. Age 22 in 1874, moved from Denmark to Ireland and worked at Birr Castle assisting with the 6-foot Leviathan.
2. Assistant at Dunsink observatory for a few years.
3. Became the director in 1881 of the Armagh Observatory 30 miles southwest of Belfast where he spent most of his career.
4. In his later years he wrote on Tycho in Latin and a history book on planetary systems from Thales to Kepler.



Dreyer as the compiler

1. John Herschel (William's son) published the *General Catalogue of Nebulae and Clusters* in 1864 listing around 5,000 objects (He added 1,700 to his father's work).
2. Dreyer added a supplement of 1,000 objects to John Herschel's catalogue.
3. Dreyer had intentions of adding another supplement to John Herschel's catalogue but was urged by the Royal Astronomical Society to create a new catalogue.
4. Dreyer's *The New General Catalogue of Nebulae and Clusters of Stars* (NGC) was published in 1888 listing 7,840 objects.
5. Dreyer's published two *Index Catalogues* (IC), the first in 1895 and the second in 1908 totaling 5386 objects.
6. His catalogues list over 13,000 DSOs and are used extensively today by professionals/ amateurs!

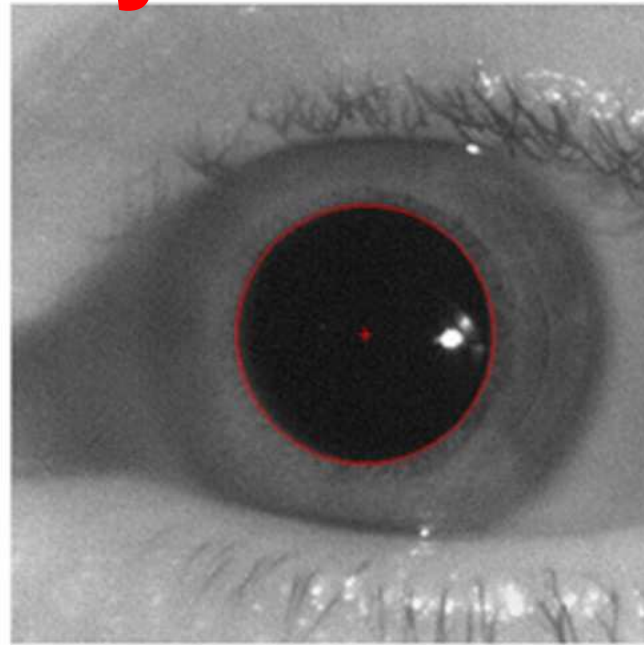
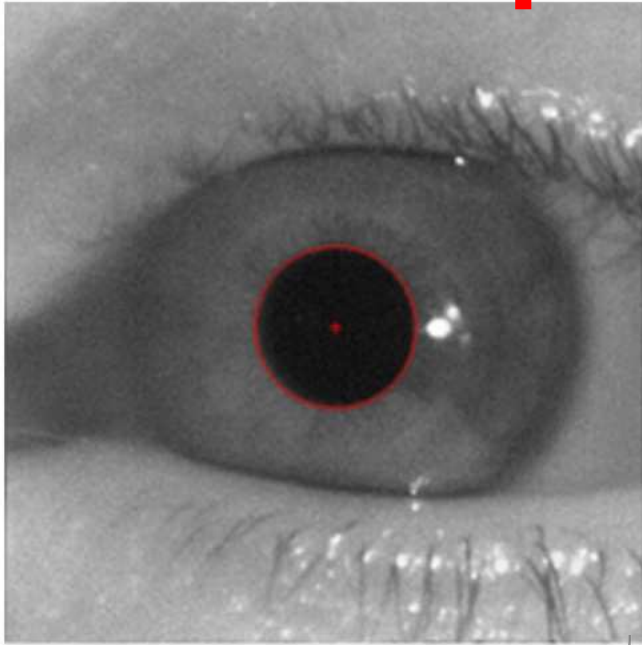


General considerations/tips for

Visually Observing DSOs

1. You **need relatively dark skies**. Big city skies won't do. Some people have to leave their cities to observe any DSOs. But, give your skies a try to test its limits.
2. **Need to avoid nights when the Moon is Full or bright**—this whitewashes the sky and makes it difficult, if not impossible to see DSOs.
3. Your **eyes must be dark adapted**. It takes a good 10 minutes to get them initially dark adapted and more minutes for a deeper dark adaptation. **Use a red-light flashlight to read** charts and atlases to keep them that way—see above topic.
4. Need to **avoid nearby bright or glaring lights** because this interferes with dark adapted eyes. Don't stare into car headlights.
5. Sometimes, you **may need to use averted vision** with your observing eye to glimpse fainter DSOs—see separate topic.
6. DSOs can be **observed easier in larger diameter telescopes**, so the bigger the scope, the brighter DSOs will appear, and bigger scopes will allow you to see fainter ones, too.
7. Useful **magnification is from 50x to 150x** but start with the 50x to 75x range.

Dark Adaped Eyes



Light



Dark

**Red-Light
Flashlight**

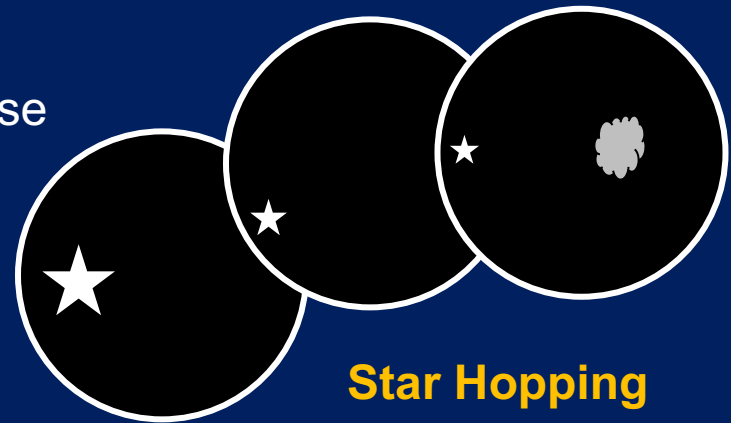
\$17 to \$23



Locating DSOs

3 Ways

- 1. Manually.** You become familiar with the constellations and use a star chart or atlas to point/aim your telescope at the spot in the sky where the DSO is located. You will most likely have to move the scope about to bump into the object.
- 2. Star Hopping.** You use a *detailed* Celestial Atlas and hop from a relatively bright star or easy object, field-of-view by field-of-view, until you get to your object of interest. Slow and tedious but it works!
- 3. GOTO telescope mount.** Just choose an object from the hand controller and press a few more buttons for the scope to move to and follow the object.



Star Hopping

Identifying DSOs

Recognizing DSOs. It does take some orientation/practice/experience to recognize the various DSOs, but not a lot. So, when you first start, the question is, “What exactly should I be looking for?” Observing the Messier objects is a good training ground for learning what DSOs look like because the NGC objects are usually smaller and fainter.

Unfortunately, none of the DSOs will look like the beautiful color photos that you see. Unfortunately, most DSOs, especially nebulae and galaxies, lack color, so they look whitish and often resemble smudges. With larger telescopes, some of the objects, like globular clusters look absolutely beautiful in the eyepiece. It does take astrophotography to bring out all the detail and colors.

The Pretty & Reality



M81/82, NGC 3031/3034



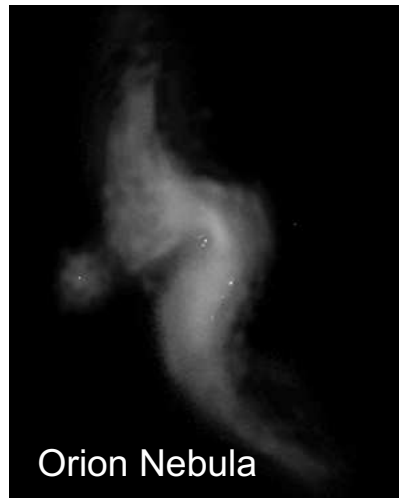
M42, NGC 1976



M17, NGC 6618



**Bode's Galaxy
Cigar Galaxy**



Orion Nebula



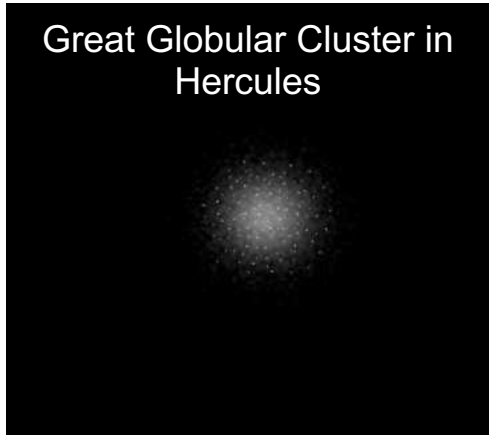
**Omega or Swan
Nebula**

The Pretty & Reality



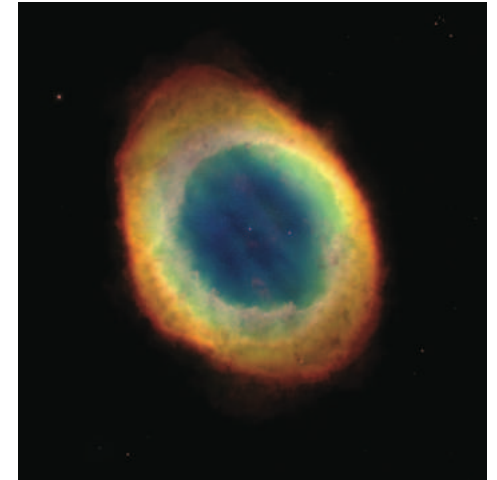
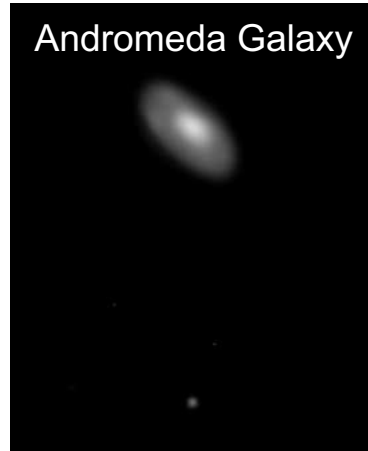
M13, NGC 6205

Great Globular Cluster in
Hercules

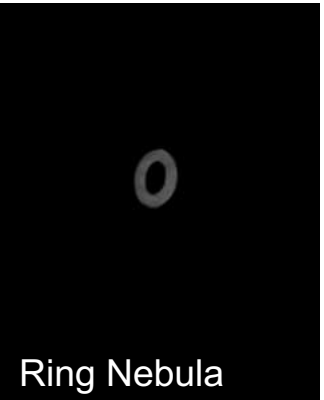


M31, NGC 224

Andromeda Galaxy



M57, NGC 6720



Ring Nebula

DSOs Observing Notes

1. Dark adapted eyes are really important in order to see DSO.
2. Forget observing DSOs when the Moon is near Full or even when the Moon is bright or in the area where DSOs reside.
3. If you are manually finding DSOs, after you point the scope, and move it about, you may not find the object, so point to the object again and move the scope about. On bad nights when you can't seem to find anything, give up and come back on another night.
4. Open Clusters look like a loose or tight group of stars having a roundish or irregular pattern. You can see color in some stars. Larger diameter telescopes make these clusters brighter. The number of stars may be a few dozen to a hundred or so, with different magnitudes and the size in the eyepiece could be big or small. The Pleiades and Beehive are very large and look best in binoculars at 8 to 10x.
5. There is something called the **Messier Marathon**. It is possible to see 109 out of the 110 Messier object in one night during a moonless night in March. If you get really lucky, you may see all 110!




Hotel Cluny

Plaque on his Birth House



Messier & Comets, plus

1. Messier would probably concede that his greatest passion was hunting and discovering comets. And, this gave him the gravitas to be accepted as a professional in the world of aristocrats and astronomy.
2. He discovered 20 comets, the first in 1758, the last in 1801. Discovering comets was a big deal back then. Very early, in 1758 when searching for comets, he came across M32 and M1, and thought it might be a good idea to list objects that could be confused with comets but that was just an initial thought.
3. In 1757, Delisle had him looking for the return of Comet Halley, which he found in January 21, 1759, second after Palitzsch in Germany, December 25/26, 1758.
4. Initially, Delisle did not announce Messier discovery of comets but this eventually changed after Messier observed/discovered 4 comets by 1760. His discovery of comets gave him standing as a “scientist.”
5. Messier was eventually elected into all of the European Science academies and it took a bit to be recognized by the French Academy of Science.
6. His friend/colleague Mechain who he met in 1774 discovered 8 comets.
7. Oh, only 30% of his 100 or so publications dealt with comets!

A photograph of a comet streaking across a starry night sky. The comet's head is bright and white, with a long, diffuse tail that transitions from white to blue and then to a faint purple. The background is a dense field of stars of various colors and sizes.

Comets: M32, Aug. 1758, M1 Sep. 1758,
Jan. 1759 Halley,

Jan. 1760 (2), 1763, 1764, 1766 (2) ...1801, 20th & last

Double Stars

Definition: A “single” star to the eye that becomes two distinct stars with sufficient magnification using binoculars or more likely, a telescope.

TYPES

- **Optical** just happen to be in the same line of sight and thus appear close together
- **Binary** revolve around each other—vast majority
- **Spectroscopic** identified by their spectrum (professional astronomers)

50 to 80% of all stars are binary stars(?) and most are spectroscopic.

DOUBLE STARS •• DOUBLE STARS

Double stars Facts

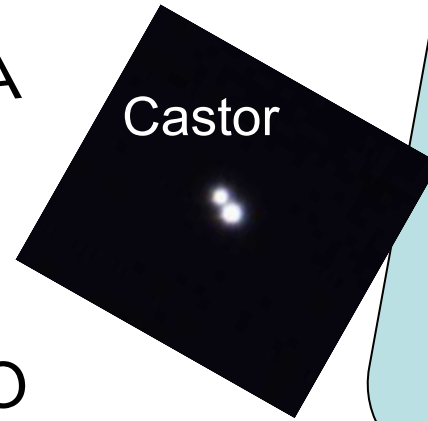
1. Observe even when the Moon is out
2. Two thousand plus for amateurs to explore
3. Some are colored, usually blue or goldish, unique patterns
4. Difference in magnitudes – generally more challenging
5. A few split with binoculars
6. Usually need magnifications from 50x to 300x
7. Can “separate” up to about 0.5 seconds of arc with a good steady sky—these are challenging & merged.
8. Can follow the revolution of a few
9. Many designations are unusual like, Δ , $\mathbf{O}\Sigma$, Σ , β and denote catalogues by specific astronomers
10. Spectrographic binaries are discerned by movement of black lines against spectrum as shown below



DOUBLE STARS •• DOUBLE STARS

POPULAR

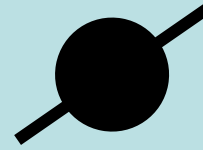
1. **Double-Double** in LYRA
2. **Albireo** in CYGNUS
3. **Castor** in GEMINI
4. **Mizar** in BIG DIPPER
5. **16 Draconis** in DRACO



Common **symbol**

on charts for
Double Stars

A line thru the star



Albireo

Mizar

Mizar B
Mizar A

Alcor

Double-Double

DOUBLE STARS •• DOUBLE STARS

Sigma (Σ) indicates the Wilhelm Struve (1793–1864) catalogue of 5,100 double stars.

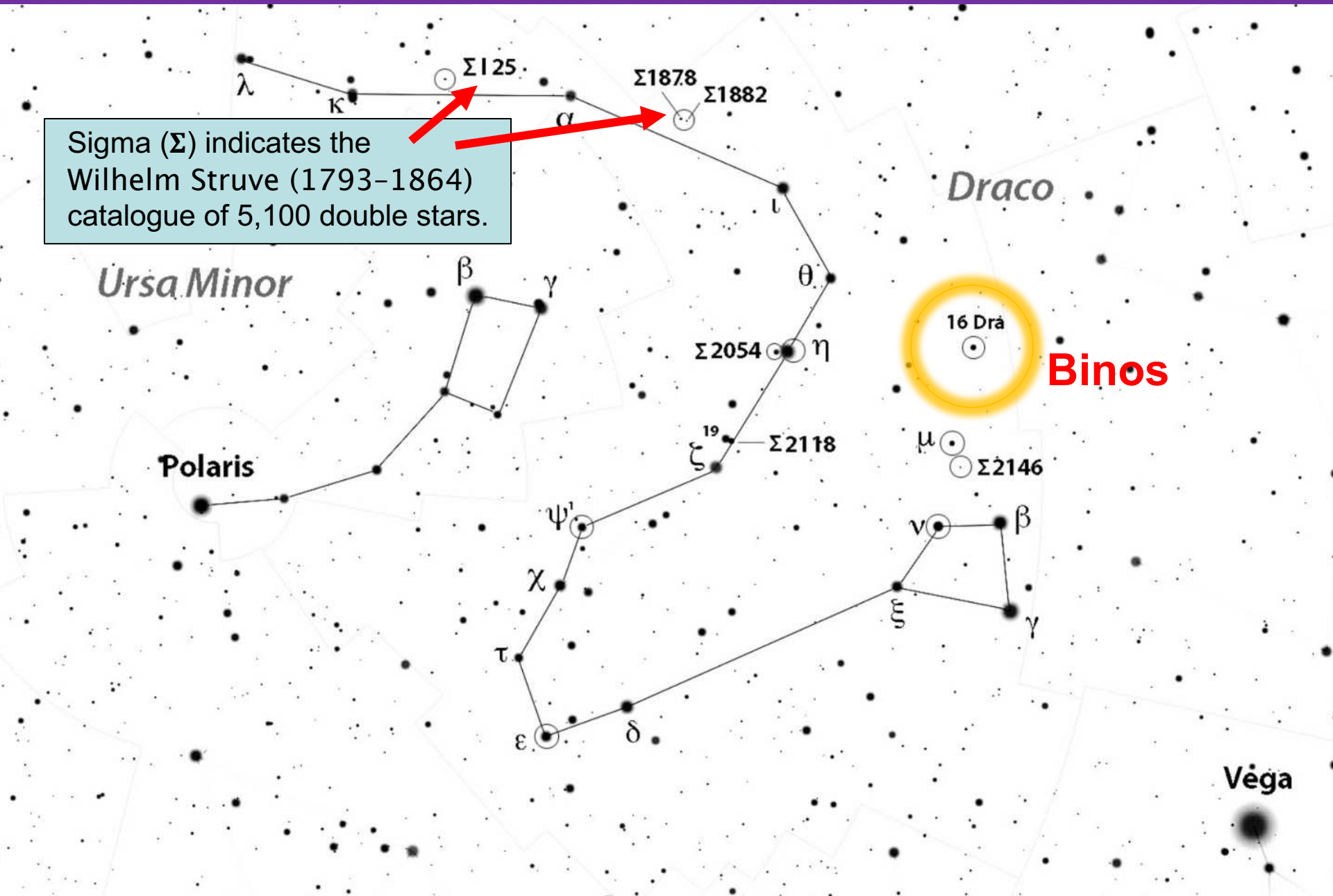
Ursa Minor

Polaris

Draco

Binos

Vega



Variable Stars

Some stars change in brightness. **Algol** in PERSEUS (fades from mag 2.1 to 3.4 for 2 hours with a period of 2.87 days) and **Mira** in CETUS (mag 2.5 to 11 over a year's time) are most famous but change their brightness for different reasons (*Extrinsic vs Intrinsic* respectively). Most stars vary in brightness because of a stage in their evolution (Intrinsic). A common type are Cepheid variables which have been used to measure the distances to other celestial objects.

There are amateur programs to watch and record changes in brightness of variable stars. The biggest is AAVSO—American Association of Variable Star Observers.

Thanks!