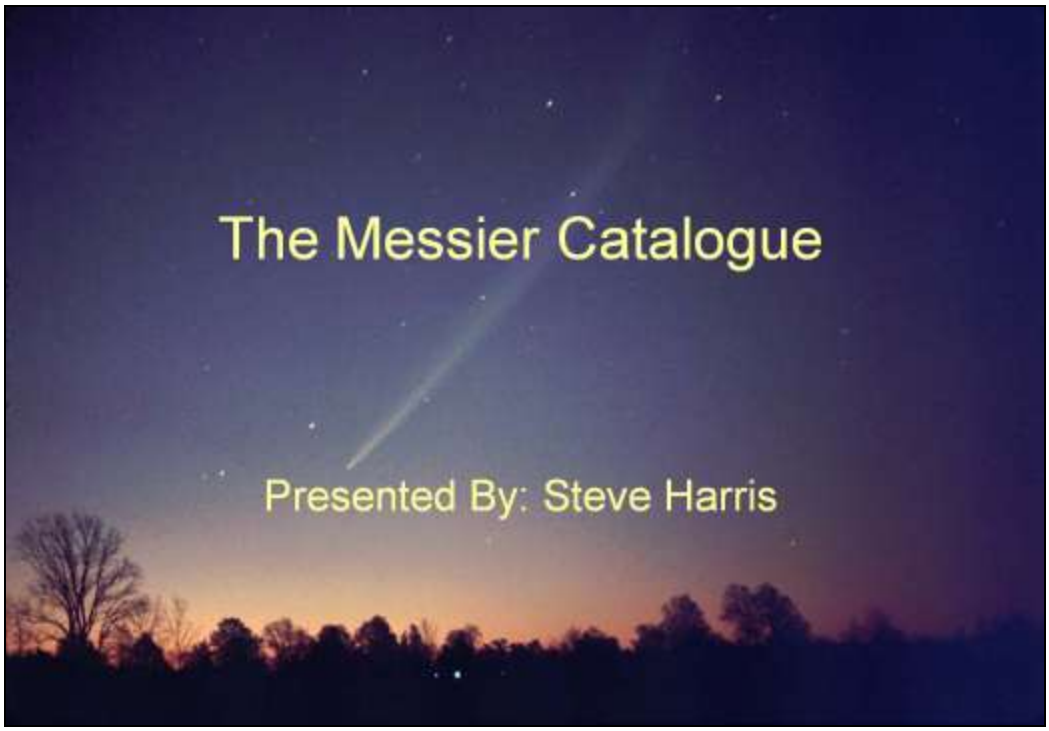
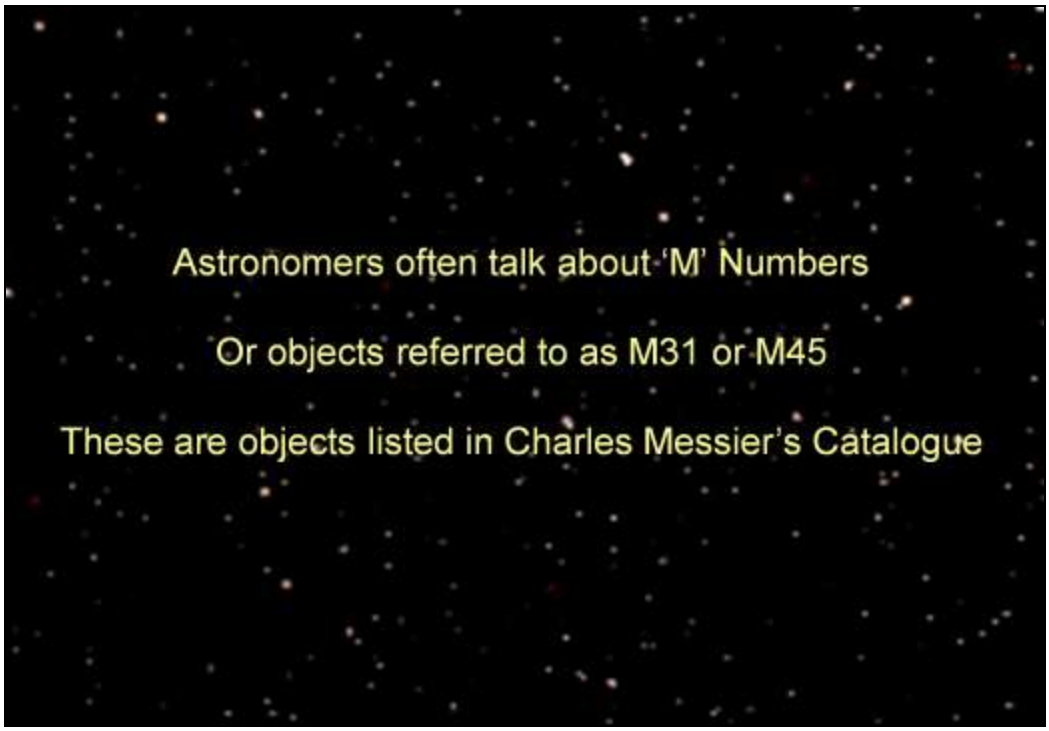
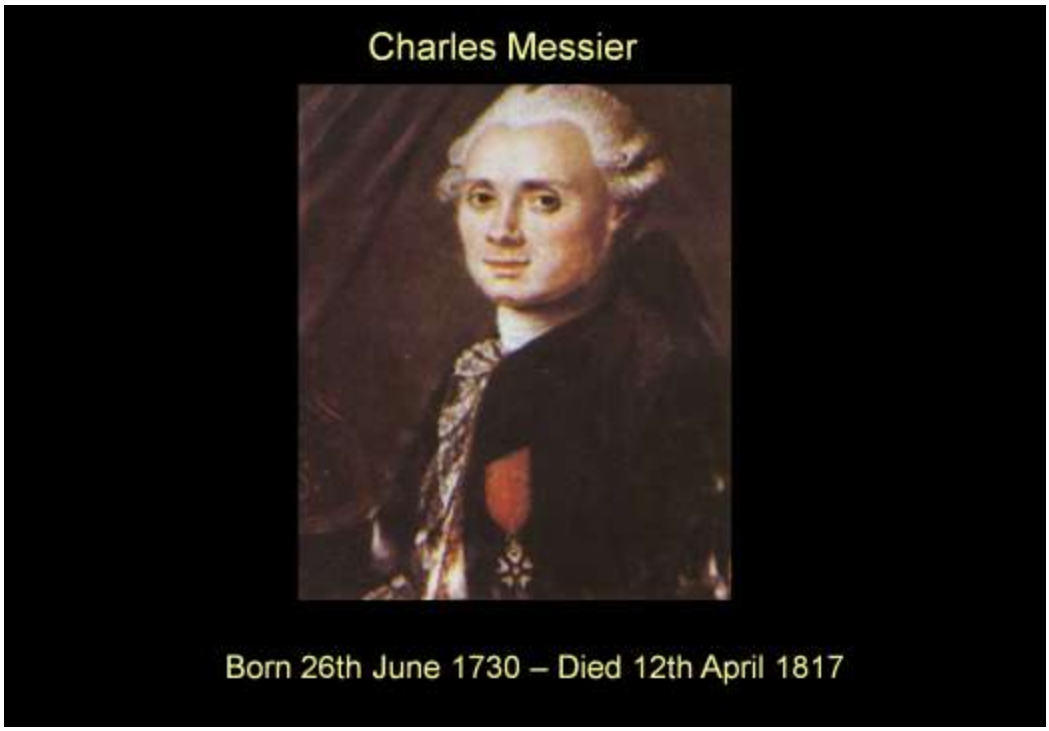
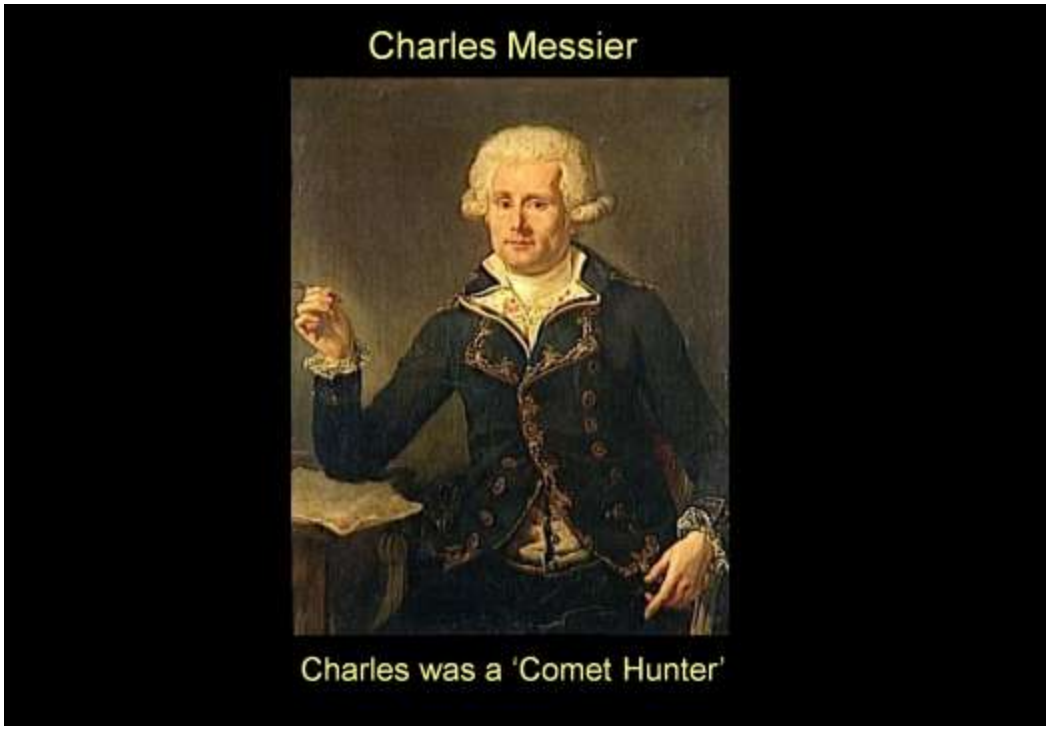


This presentation was given to the Newbury Astronomical Society Beginners Section on Wednesday 20th March 2019.

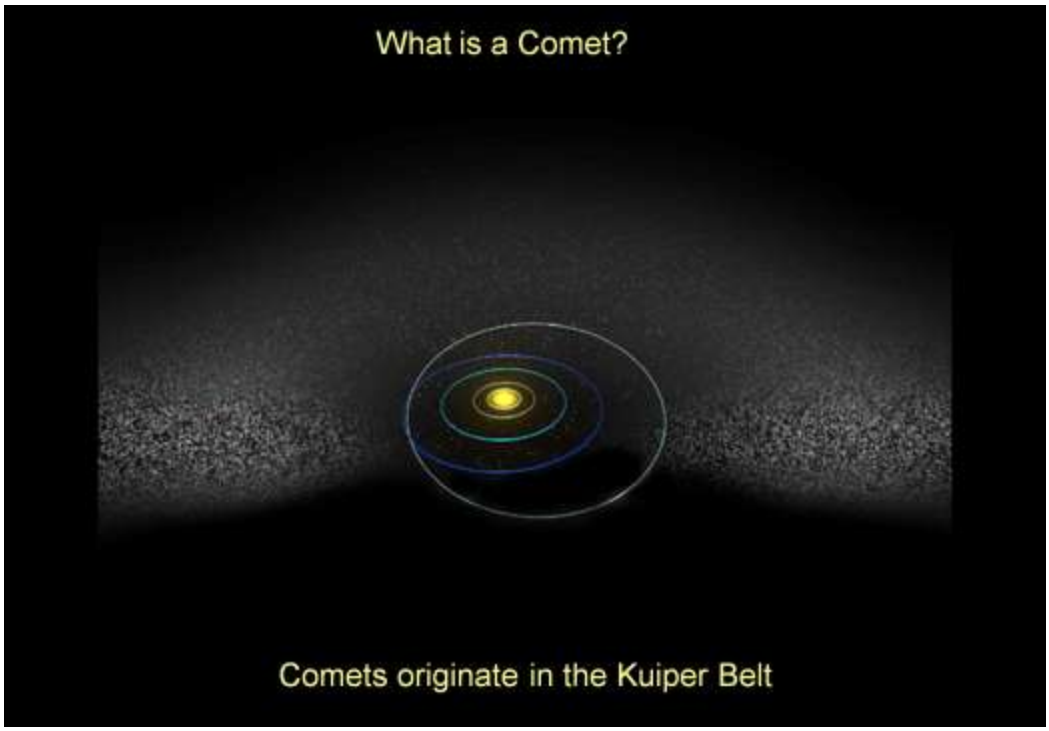

Astronomers often talk about 'M' Numbers
Or objects referred to as M31 or M45
These are objects listed in Charles Messier's Catalogue



The ‘M’ is short for Messier and refers to in an object from the Messier Catalogue of ‘fuzzy’ objects. Charles Messier was a French comet hunter who spent much of his life searching for and studying new comets.

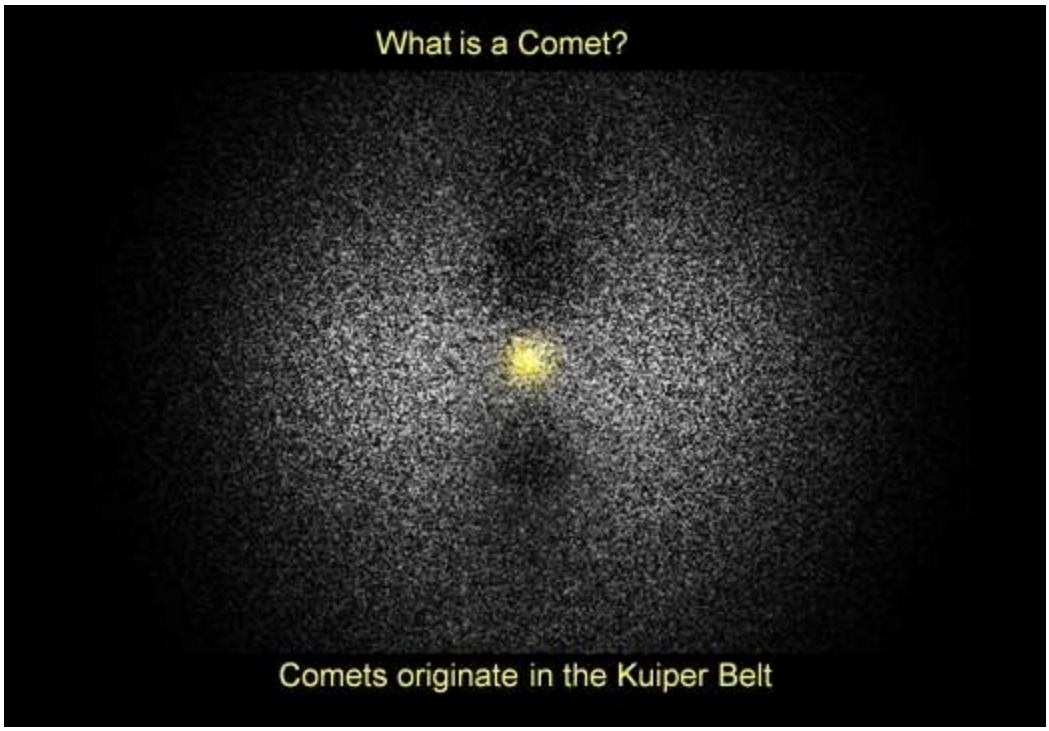


While scanning the night sky for new comets, Messier kept finding 'fuzzy' objects that were not stars, looked like comets but did not appear to move like comets. To avoid confusion Messier made a list of these 'fuzzy' objects so he could avoid them when he was searching for new comets.



Astronomers tend to divide space into two areas the first is our own space in the immediate area surrounding our star that we call ‘the Sun’. This local area stretches out about two light years from the Sun to the edge the extent of the gravitational influence of the Sun.

Beyond the orbits of the main planets in our Solar System is a vast torus (doughnut shape) of icy minor planets called the Kuiper Belt. There are millions of objects ranging in size from the size of Pluto (Pluto’s orbit is shown as the outer and largest orbit) and down to a few metres across. These are the source of the comets that sometimes sweep in to visit our Sun.

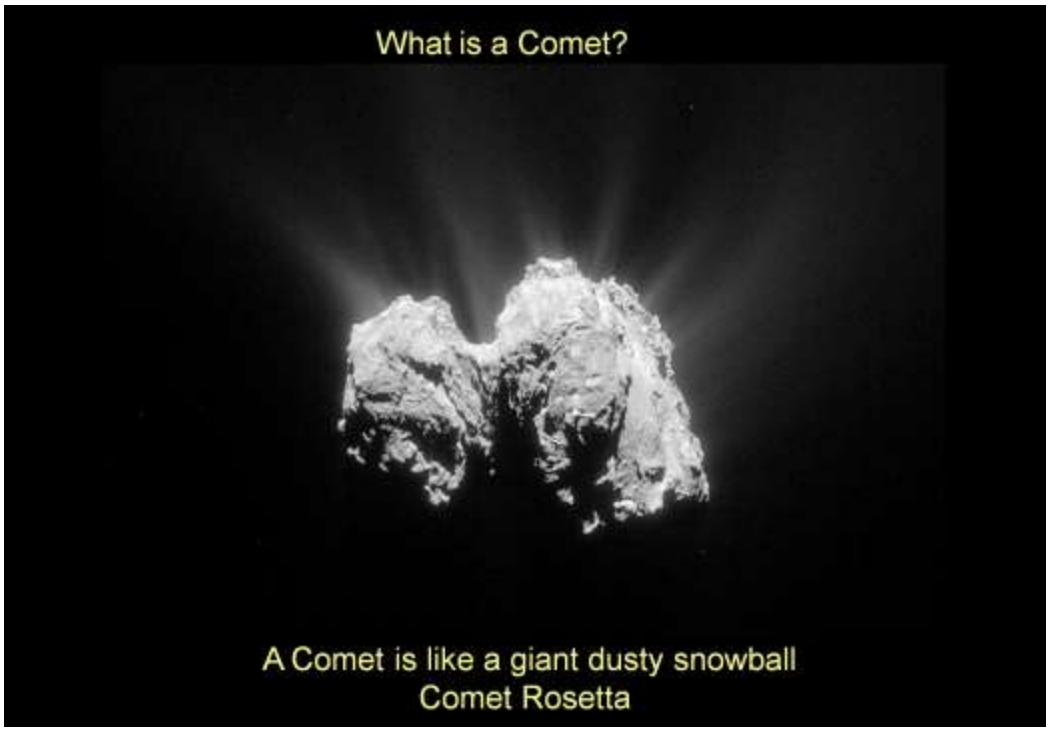


Beyond the Kuiper Belt there is believed to be an enormous halo of very remote icy objects of various sizes. These objects have not yet been detected and are only just held in orbit by the Sun. This halo is called the Oort Cloud and is thought to extend out to about two light years from the Sun. This is about half the distance to our nearest stellar neighbour, the star Alpha Centauri which is about four light years from our Sun.

At this distance it is thought to be possible that the remotest Oort Cloud type objects may be exchanged between our Solar System and any similar objects that may be held by the Alpha Centauri System.

Beyond this outer limit of our Sun's gravitational influence is the rest of the Universe stretching out into infinity.

We call the space beyond our Solar System 'Deep Space' and any objects residing in Deep Space are known as 'Deep Space Objects'.

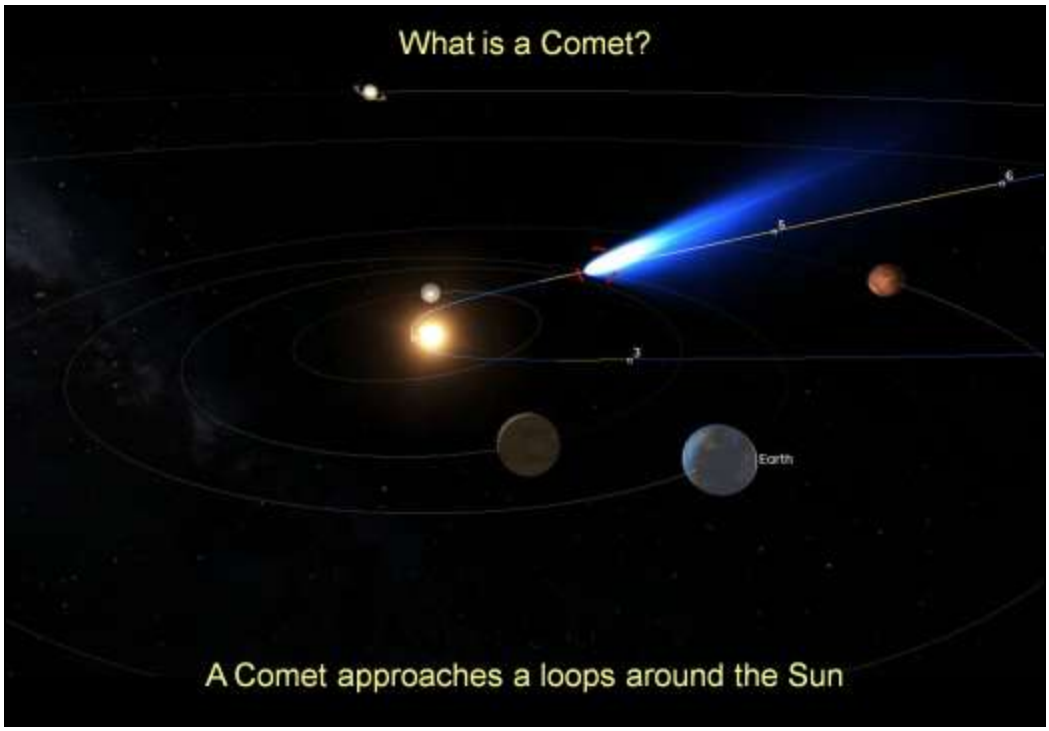


As the Sun burst into life, 4.3 billion years ago, it produced enormous amounts of radiation, largely in the form of Ultraviolet light. This radiation was so intense it blasted any gas and volatile materials away from the centre of the planetary forming disc around the Sun.

The inner proto-planets were stripped of most their early atmospheres and any water was boiled away and then pushed to the outer regions of the disc by the intense radiation (Solar Wind).

In the cold of the outer disc the gases froze and began to accumulate to form the lumps of ice of the Kuiper Belt and Oort Cloud.

A comet is a lump of loosely coalesced ice, mainly comprised of water ice and Carbon Dioxide (CO^2) ice as the second largest constituent. It will also have traces of many other frozen gases and dust particles from the nebula (cloud of gas and dust) in which the Sun formed. When a comet is in the outer reaches of the Solar System it does not have a tail and resembles our much closer neighbours the Asteroids.



During the period from 4.1 to 3.8 billion years ago millions of these lumps of ice returned to bombard the centre of the Solar System in what is called the 'Late Heavy Bombardment' (LHB). This 'storm' of comets may have brought the water back to the planets in collisions with the planets and given Earth its Oceans.

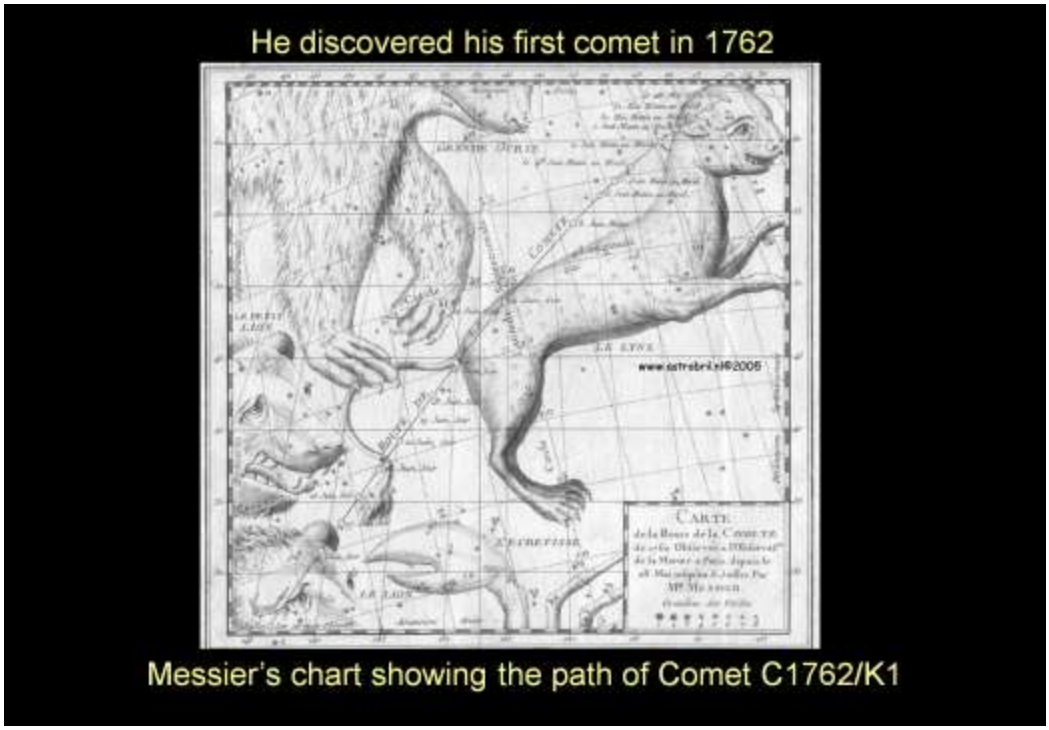
The Late Heavy Bombardment finished about 3.8 million years ago but we still have occasional visits by comets. These are a tiny fraction of the activity that occurred during the LHB. It is likely that there are still close encounters and even collisions of the Dwarf Planets in the Oort Cloud and the Kuiper Belt. Any close encounters are likely to disturb the fragile orbits of these icy bodies. The effect of the gravity of the Sun is extremely week at these vast distances. Just a tiny change to the path of one of the objects could send it hurtling out of our Solar system or put it on a course towards the Sun and its planets. These journeys in towards the Sun may take many thousands or even millions of years.

Messier became interested in astronomy when he saw Comet C/1743 X1 and the Annular Solar Eclipse of 1744

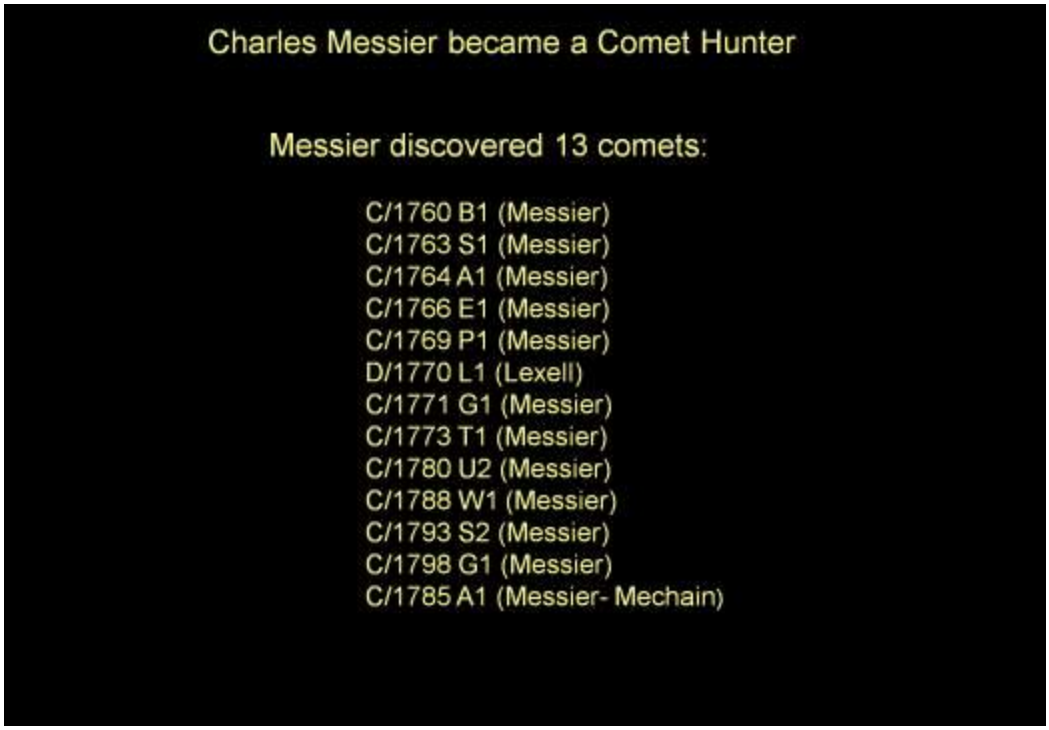
The six tails of Comet C/1743 X1, the Great Comet were seen extending above the horizon before sunrise on 9th March 1744

As the comet nucleus approaches the Sun the frozen gases begin to sublime (melt directly into gas) and form a cloud around the nucleus called the 'Coma'. Between the orbits of Jupiter and Mars is the point when the Carbon Dioxide (CO^2) on the surface begins to sublime. As the comet moves inside the orbit of Mars there is enough heat from the Sun to 'sublime' the water ice (turn it directly into water vapour) and add it to the coma.

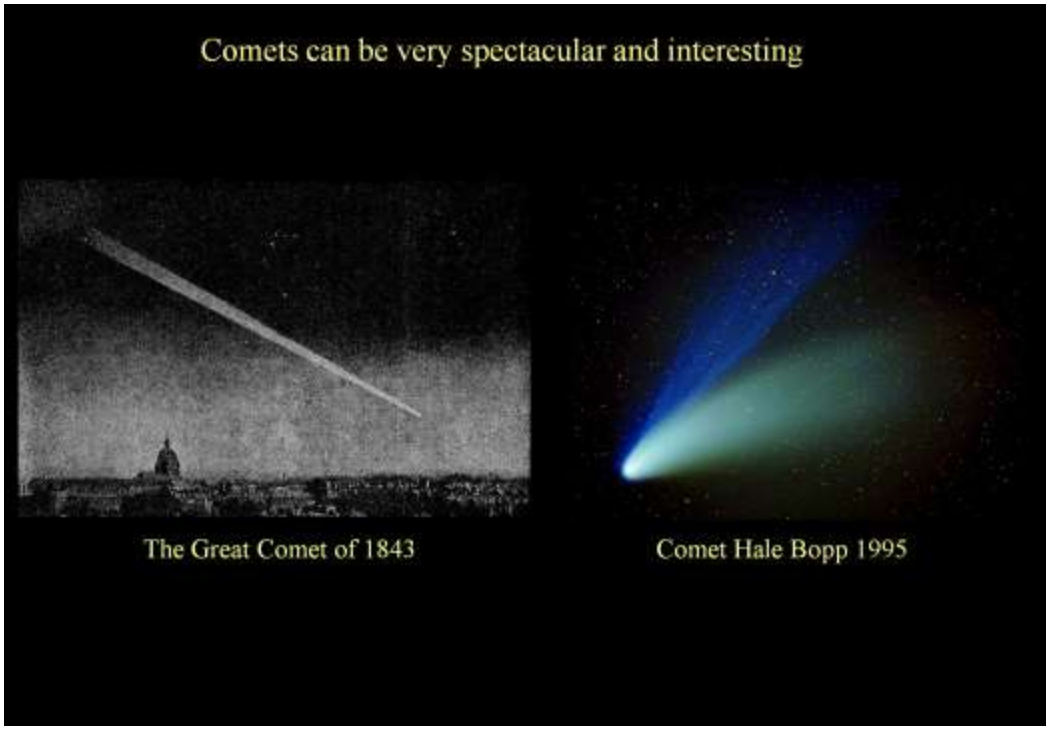
The coma of a comet is extremely tenuous but may be very large, often over 100,000 kilometres in diameter. The coma is heated as the comet moves ever closer to the Sun and the radiation from the Sun begins to drive the gas away and form a gaseous tail or tails. Tail will always be driven away from the Sun and always point away from the Sun regardless of the direction the comet is travelling (towards or away from the Sun).



Messier recorded the path of objects that he classified as comets on the very elaborate star charts of his time. The cart above shows the path of Comet C1762/K1 as it moved across the sky from the lower left to upper right. He annotated the path of the comet marked on the chart above as: “ROUTE DE LA COMETE”. Messier’s name appears in the notation box at the lower right as M^R Messier.



Messier made a list of these new comets he had discovered.

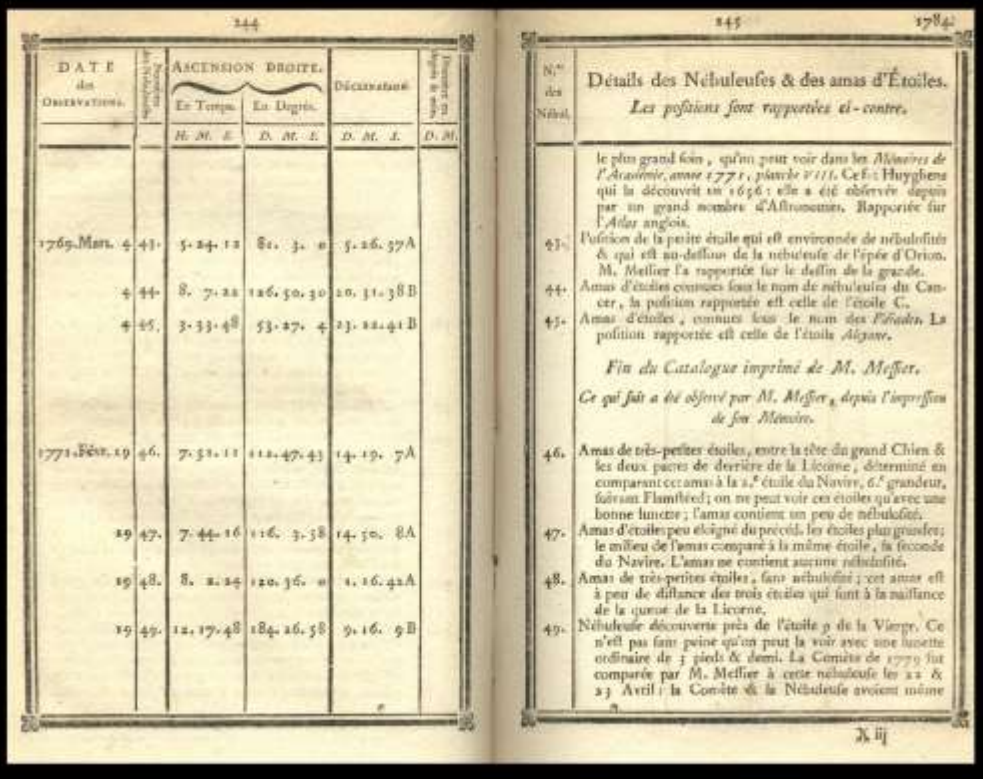


The Great Comet of 1843 is considered to be the brightest and most spectacular comet in our recorded history.

Hal Bopp 1995 is the most spectacular of the most recent comets.

The object above is listed as M01 and is the fist object recorded in Charles Messier's Catalogue.

There are 110 objects in Charles Messier's Catalogue



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DATE des Observations.	Nouveau Style.	Ascension Droite. En Temps. H. M. S.	Ascension Droite. En Degrés. D. M. S.	Déclinaison. D. M. S.	Déclinaison Boréale ou Australe. D. M.
1769. Mars. 4	43.	5. 24. 12	81. 3. 0	5. 26. 57 A	
4	44.	8. 7. 22	126. 50. 30	20. 31. 38 B	
4	45.	3. 33. 48	53. 27. 4	23. 22. 41 B	
1771. Févr. 19	46.	7. 32. 11	112. 47. 43	14. 19. 7 A	
19	47.	7. 44. 16	116. 3. 58	14. 30. 8 A	
19	48.	8. 2. 24	120. 36. 0	1. 16. 42 A	
19	49.	12. 17. 48	184. 26. 58	9. 16. 9 B	

245 1784.

N.° des Nébul.

Détails des Nébuleuses & des amas d'Étoiles.

Les positions sont rapportées ci-contre.

le plus grand soin, qu'on peut voir dans les *Mémoires de l'Académie, année 1771, planche VIII.* Cet Anneau découvert par Huyghens qui la découvrit en 1656: elle a été observée depuis par un grand nombre d'Astronomes. Rapportée sur l'*Atlas* anglois.

43. Position de la petite étoile qui est environnée de nébulosités & qui est au-dessous de la nébuleuse de l'épée d'Orion. M. Messier l'a rapportée sur le dessin de la grande.

44. Amas d'étoiles connues sous le nom de nébuleuses du Cancer, la position rapportée est celle de l'étoile C.

45. Amas d'étoiles, connues sous le nom des *Pléiades*. La position rapportée est celle de l'étoile *Alcyone*.

Fin du Catalogue imprimé de M. Messier.

Ce qui suit a été observé par M. Messier, depuis l'impression de son Mémoire.

46. Amas de très-petites étoiles, entre la tête du grand Chien & les deux pattes de derrière de la Licorne, déterminé en comparant cet amas à la 2.e étoile du Navire, 6.e grandeur, suivant Flamsteed; on ne peut voir ces étoiles qu'avec une bonne lunette; l'amas contient un peu de nébulosité.

47. Amas d'étoiles peu éloigné du précédent, les étoiles plus grandes; le milieu de l'amas comparé à la même étoile, la seconde du Navire. L'amas ne contient aucune nébulosité.

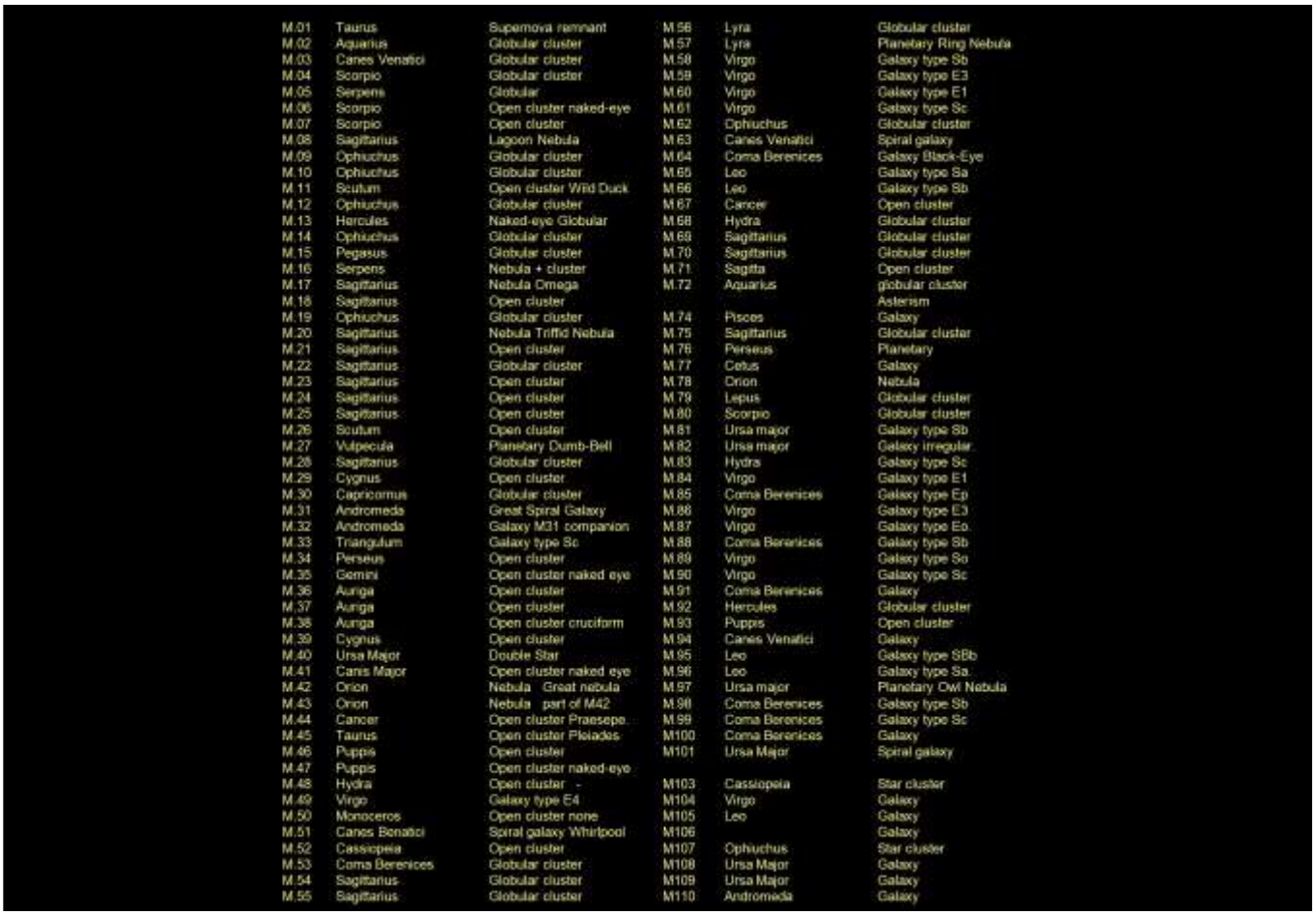
48. Amas de très-petites étoiles, sans nébulosité; cet amas est à peu de distance des trois étoiles qui sont à la naissance de la queue de la Licorne.

49. Nébuleuse découverte près de l'étoile ρ de la Vierge. Ce n'est pas sans peine qu'on peut la voir avec une lunette ordinaire de 3 pieds & demi. La Comète de 1779 fut comparée par M. Messier à cette nébuleuse les 22 & 23 Avril; la Comète & la Nébuleuse avoient même

X iij

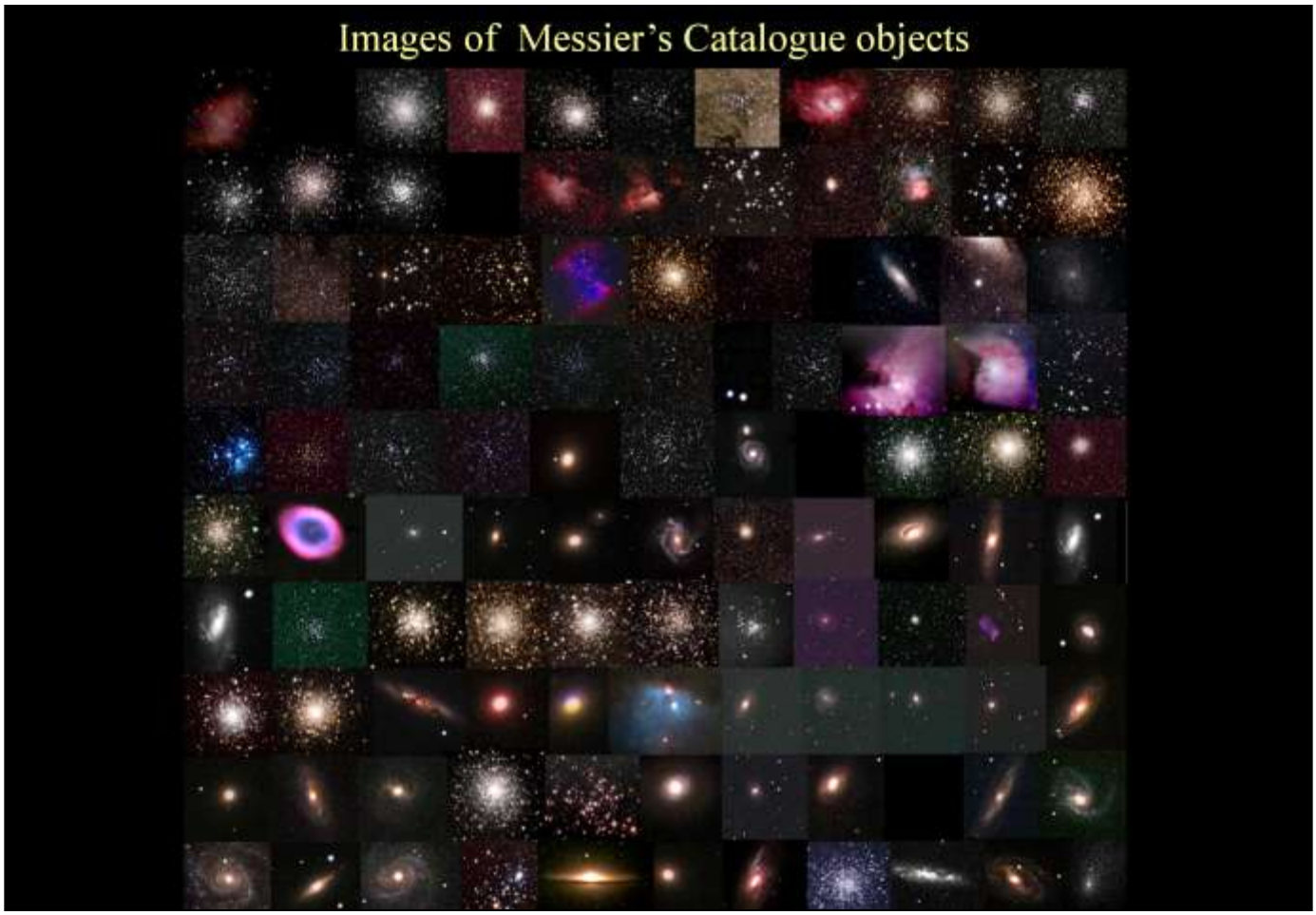
To avoid confusion Messier recorded and made a list of these 'fuzzy' objects, that were not Comets. He did this so he could avoid them when he was searching for new comets. The illustration above shows Charles Messier's 1784 edition of his Catalogue of objects that he had identified as 'looking like a comet but not a comet'. In the first column on the right hand page he lists the deep sky objects we now known as: M43. M44, M45,M46, M47, M46 and M49.

So What are the objects in Messier Catalogue?

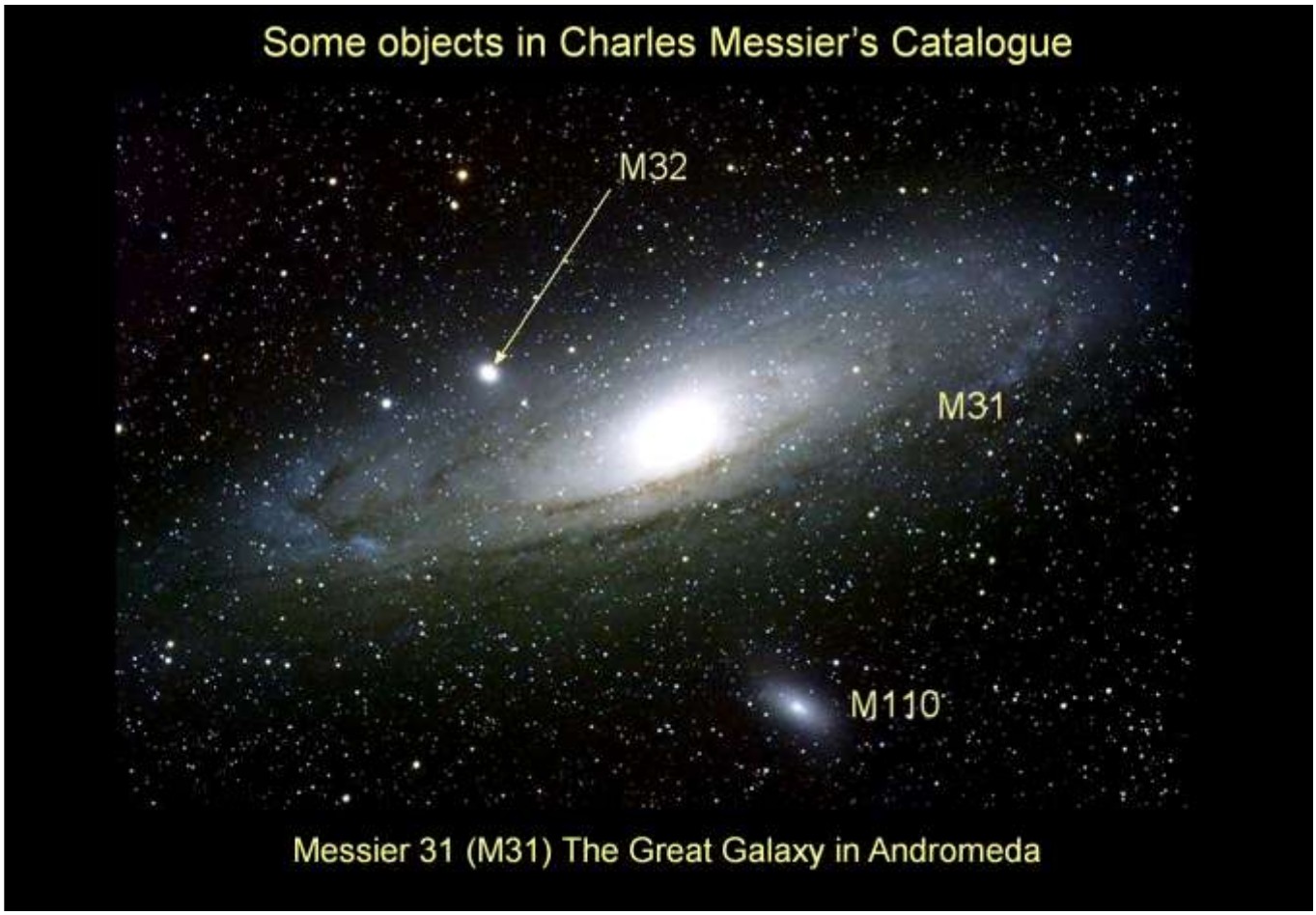


M.01	Taurus	Supernova remnant	M.56	Lyra	Globular cluster
M.02	Aquarius	Globular cluster	M.57	Lyra	Planetary Ring Nebula
M.03	Canes Venatici	Globular cluster	M.58	Virgo	Galaxy type Sb
M.04	Scorpio	Globular cluster	M.59	Virgo	Galaxy type E3
M.05	Serpens	Globular	M.60	Virgo	Galaxy type E1
M.06	Scorpio	Open cluster naked-eye	M.61	Virgo	Galaxy type Sc
M.07	Scorpio	Open cluster	M.62	Ophiuchus	Globular cluster
M.08	Sagittarius	Lagoon Nebula	M.63	Canes Venatici	Spiral galaxy
M.09	Ophiuchus	Globular cluster	M.64	Coma Berenices	Galaxy Black-Eye
M.10	Ophiuchus	Globular cluster	M.65	Leo	Galaxy type Sa
M.11	Scutum	Open cluster Wild Duck	M.66	Leo	Galaxy type Sb
M.12	Ophiuchus	Globular cluster	M.67	Cancer	Open cluster
M.13	Hercules	Naked-eye Globular	M.68	Hydra	Globular cluster
M.14	Ophiuchus	Globular cluster	M.69	Sagittarius	Globular cluster
M.15	Pegasus	Globular cluster	M.70	Sagittarius	Globular cluster
M.16	Serpens	Nebula + cluster	M.71	Sagitta	Open cluster
M.17	Sagittarius	Nebula Omega	M.72	Aquarius	globular cluster
M.18	Sagittarius	Open cluster			Asterism
M.19	Ophiuchus	Globular cluster	M.74	Pisces	Galaxy
M.20	Sagittarius	Nebula Triffid Nebula	M.75	Sagittarius	Globular cluster
M.21	Sagittarius	Open cluster	M.76	Perseus	Planetary
M.22	Sagittarius	Globular cluster	M.77	Cetus	Galaxy
M.23	Sagittarius	Open cluster	M.78	Orion	Nebula
M.24	Sagittarius	Open cluster	M.79	Lepus	Globular cluster
M.25	Sagittarius	Open cluster	M.80	Scorpio	Globular cluster
M.26	Scutum	Open cluster	M.81	Ursa major	Galaxy type Sb
M.27	Vulpecula	Planetary Dumb-Bell	M.82	Ursa major	Galaxy irregular
M.28	Sagittarius	Globular cluster	M.83	Hydra	Galaxy type Sc
M.29	Cygnus	Open cluster	M.84	Virgo	Galaxy type E1
M.30	Capricornus	Globular cluster	M.85	Coma Berenices	Galaxy type Ep
M.31	Andromeda	Great Spiral Galaxy	M.86	Virgo	Galaxy type E3
M.32	Andromeda	Galaxy M31 companion	M.87	Virgo	Galaxy type Eo.
M.33	Triangulum	Galaxy type Sc	M.88	Coma Berenices	Galaxy type Sb
M.34	Perseus	Open cluster	M.89	Virgo	Galaxy type So
M.35	Gemini	Open cluster naked eye	M.90	Virgo	Galaxy type Sc
M.36	Auriga	Open cluster	M.91	Coma Berenices	Galaxy
M.37	Auriga	Open cluster	M.92	Hercules	Globular cluster
M.38	Auriga	Open cluster cruciform	M.93	Puppis	Open cluster
M.39	Cygnus	Open cluster	M.94	Canes Venatici	Galaxy
M.40	Ursa Major	Double Star	M.95	Leo	Galaxy type SBb
M.41	Canis Major	Open cluster naked eye	M.96	Leo	Galaxy type Sa.
M.42	Orion	Nebula Great nebula	M.97	Ursa major	Planetary Owl Nebula
M.43	Orion	Nebula part of M42	M.98	Coma Berenices	Galaxy type Sb
M.44	Cancer	Open cluster Praesepe	M.99	Coma Berenices	Galaxy type Sc
M.45	Taurus	Open cluster Pleiades	M100	Coma Berenices	Galaxy
M.46	Puppis	Open cluster	M101	Ursa Major	Spiral galaxy
M.47	Puppis	Open cluster naked-eye			
M.48	Hydra	Open cluster -	M103	Cassiopeia	Star cluster
M.49	Virgo	Galaxy type E4	M104	Virgo	Galaxy
M.50	Monoceros	Open cluster none	M105	Leo	Galaxy
M.51	Canes Benatici	Spiral galaxy Whirlpool	M106		Galaxy
M.52	Cassiopeia	Open cluster	M107	Ophiuchus	Star cluster
M.53	Coma Berenices	Globular cluster	M108	Ursa Major	Galaxy
M.54	Sagittarius	Globular cluster	M109	Ursa Major	Galaxy
M.55	Sagittarius	Globular cluster	M110	Andromeda	Galaxy

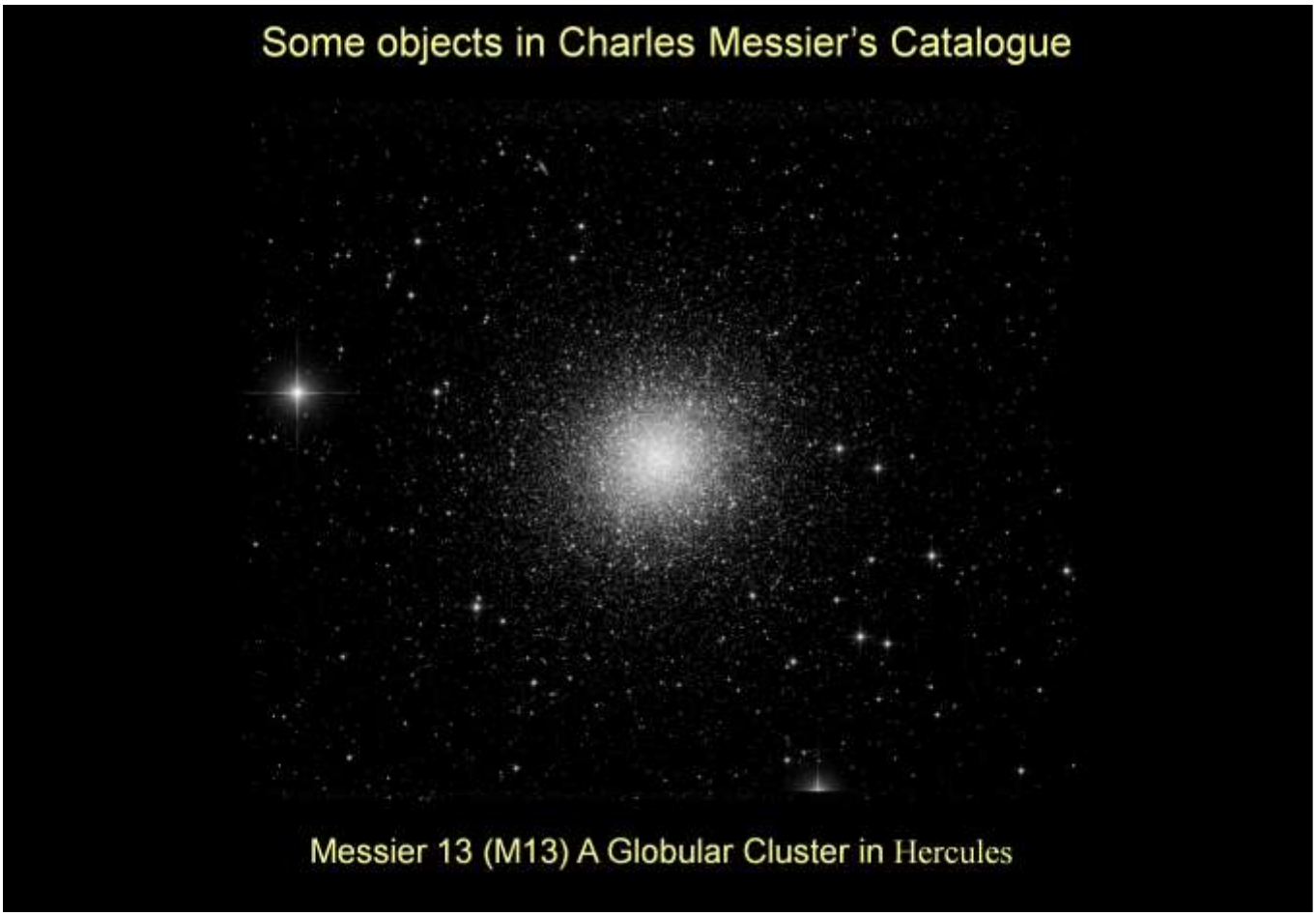
The list shows the ‘Messier Deep Sky Objects’ in numerical order in two columns listing: (M number) (Constellation in which it is located) and (the Type of Object).



The chart above shows images of the 'Messier Deep Sky Objects' in numerical order left to right / top to bottom.



The modern image above shows Messier 31 (M31) known as the Great Galaxy in Andromeda. It is our nearest neighbouring Giant Spiral Galaxy and is very similar to our own Milky Way Galaxy which hosts our Sun amongst its 200 billion stellar residents. It also shows two satellite galaxies of M31 listed as M32 and M110 in Messier Catalogue.

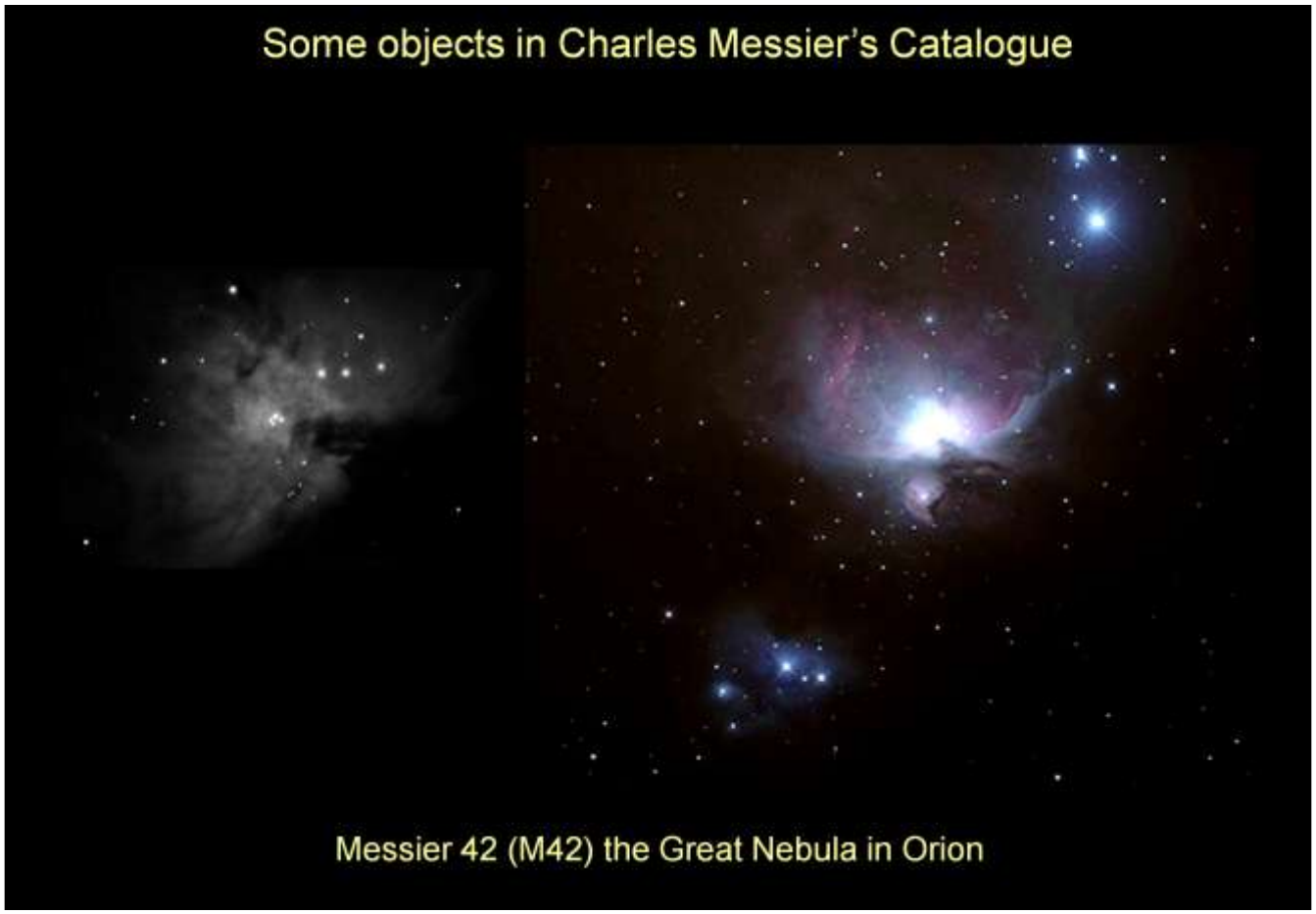


Globular Clusters are spherical clusters of stars that appear as a tight spherical ball of between about ten thousand and a million stars. These clusters are found in spiral galaxies but are not situated in the main disc of the spiral arms. They form a halo above and below the main disc of the galaxy orbiting around the central nucleus and even passing through the arms.

Messier 13 (M13) in Hercules is the brightest example in our sky but there is a bigger and brighter one visible from the Southern Hemisphere.

Globular clusters are comprised of very old stars with some appearing to be even older than the galaxy they are found in.

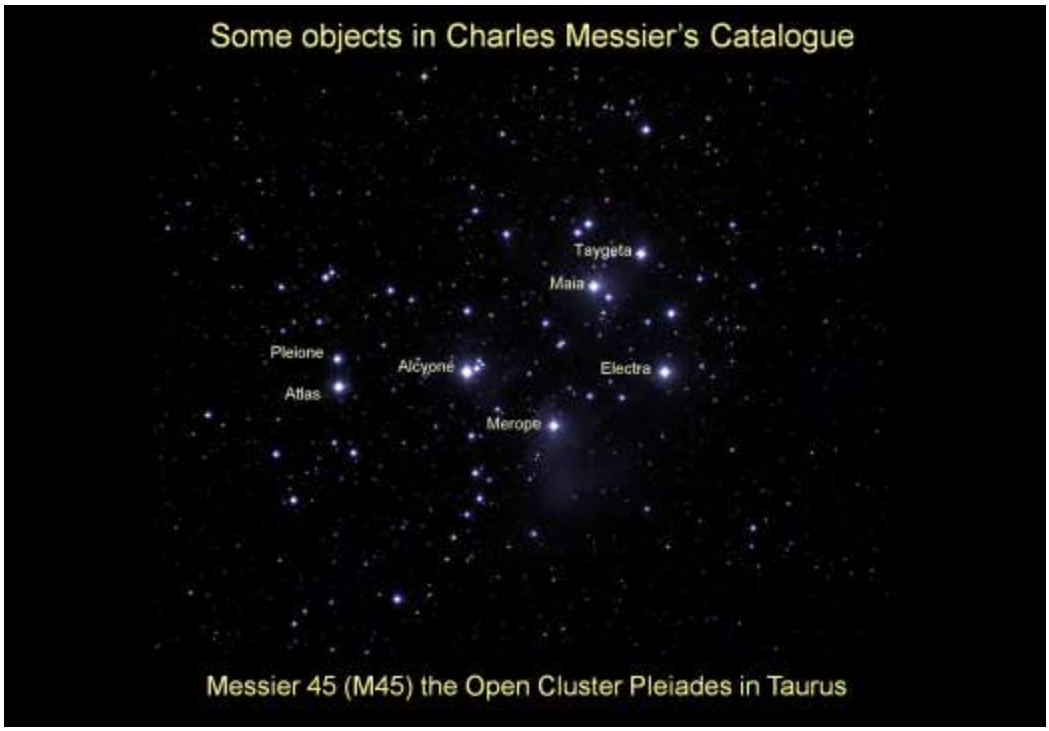
There are about 100 in our galaxy and about 200 have been found in the Andromeda Galaxy M31.



Nebulae (plural, the singular is Nebula) are huge clouds of gas and dust most commonly found in the arms of spiral galaxies. Most of the gas in these clouds is Hydrogen but there are also traces of other elements. There are two main types of nebula these are called Reflection Nebulae and Emission Nebulae. As the names suggest they either reflect light from neighbouring stars or emit light from the gas within them. In the picture of M42, light from the stars is being reflected off the nebulosity around the stars. The excited Hydrogen gas in the nebula is also emitting its own light.

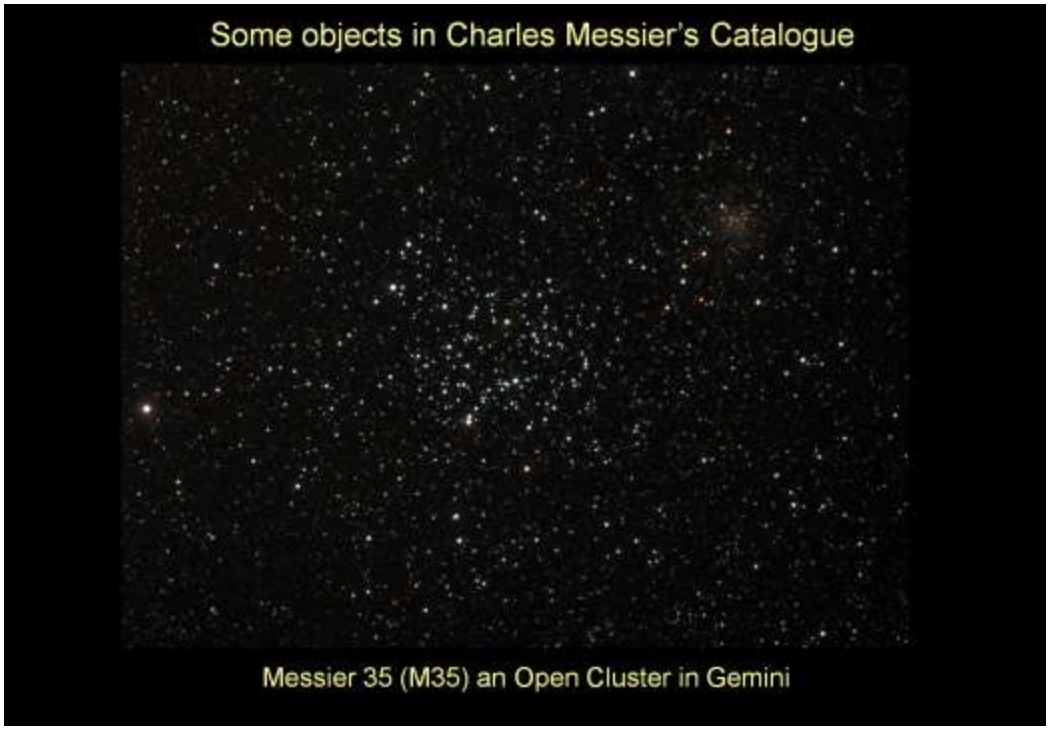
Light is emitted by the gas in the cloud when it has been hit by the radiation from the four large powerful and very active stars called the Trapezium. The left image shows the Trapezium superimposed on M42. Photons of mainly ultraviolet radiation from the stars of the Trapezium are absorbed by the atoms of the nebula.

To absorb this additional energy an electron jumps from its normal orbit around the nucleus to a higher orbit. The atom will become unstable so the electron will quickly jump back to its original orbit. To enable this to happen, the atom must release the excess energy it has absorbed. It does this by radiating a flash of light photons. Light is always emitted at the same wavelength (colour) from an atom of a particular element. For example Hydrogen always emits a red light photon as can be seen above in the right (coloured) image of M42.

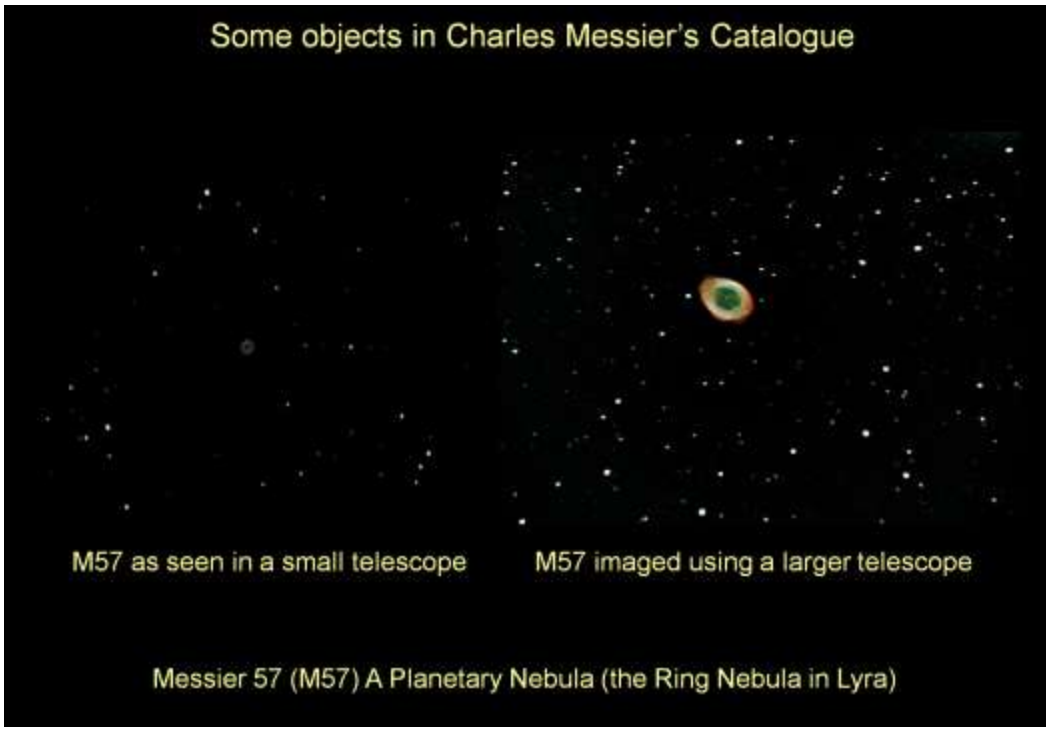


Open Star Clusters are groups of between a few tens to a few thousand stars that have formed together from a collapsing cloud of gas and dust called a Nebula. When stars form in a nebula they start their life as very active stars with a powerful wind of radiation blasting out into the surrounding space. This 'Solar Wind' eventually pushes the remaining gas and dust away to reveal a cluster of new stars. As millions of years pass the stars that formed the cluster, from the same nebula, gradually move further apart until the cluster is dispersed. Messier 45(M45) 'The Pleiades' (Seven Sisters) in Taurus is one of our closest and most beautiful open clusters. It is a relatively young cluster at about 100 million years old and contains approximately 1000 stars.

It is almost certain that our own star, the Sun, was formed in a nebula. It was also a member of an open cluster but over the past 4.3 billion years the stars have drifted so far apart that we cannot tell which stars were the Sun's siblings in the cluster.



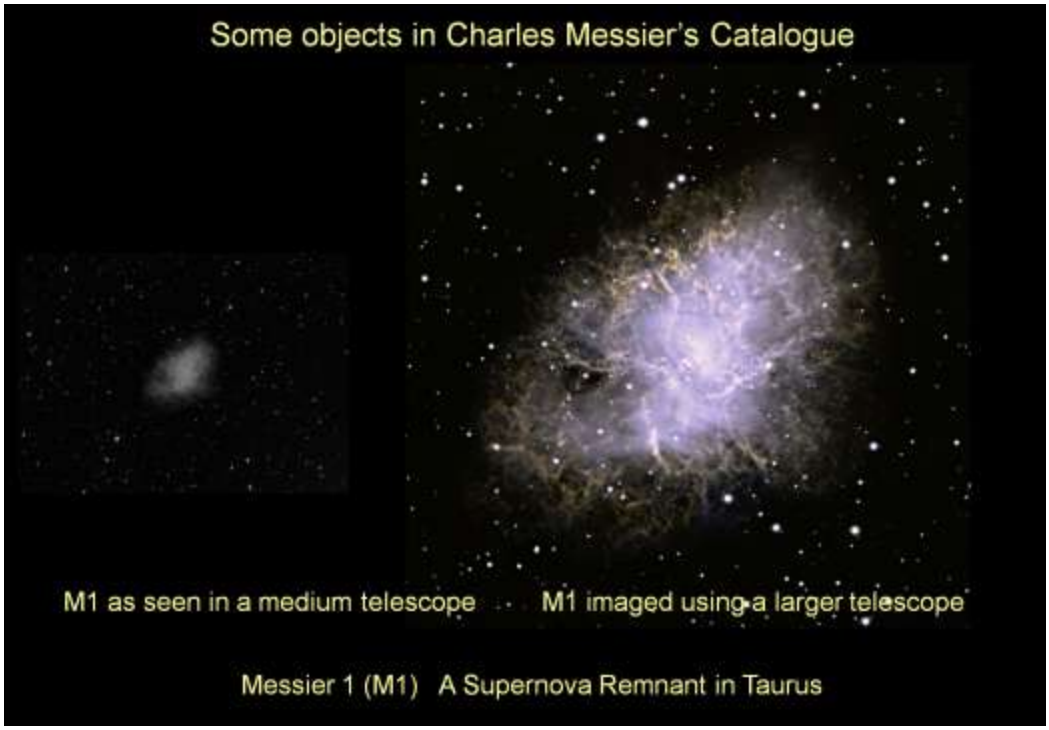
Messier 35 (M35) is a beautiful Open Cluster in the constellation of Gemini. It is just visible using binoculars but is best seen in a small to medium sized telescope. It is very beautiful and particularly interest as some stars in the centre of the cluster appear to form a linked string of star known as a 'Cascade' of stars. This is not a true formation and is just how they appear by coincidence and we as humans are very good at seeing patterns and shapes in things.



A Planetary Nebula is the remains of a star of about the same size as our Sun and nothing to do with planets at all. These object simply appeared similar to planet in the relatively primitive telescopes available in the 18th century.

After about ten billion years the Hydrogen that has powered the star would have run out. The outer parts of the star then became inflated like a giant balloon. Eventually the outer parts of the star drifted off into space and formed a huge bubble. As the Hydrogen fuel eventually ran out, the dying star 'gently' collapsed under the force of its own gravity to form a small but very dense 'White Dwarf Star'. As we look through the bubble we see more material through the edge so it appears more like a ring. Messier 57 (M57), known as the Ring Nebula in Lyra, is the most famous.

Many planetary nebulae look like a smoke ring but others may have very beautiful and intricate shapes. It is quite common for some planetary nebulae to have two lobes and look like an hourglass or a butterfly. M27 in the constellation of Vulpecula is one of the closest and largest of this type of planetary nebula and can be seen using a good pair of binoculars.



One particular type of dying star called a Super Nova produces a different fuzzy patch. This is created when a giant star of between about 5 to 50 times the mass of our Sun reaches the end of its existence. The star becomes very unstable until it eventually explodes and completely destroys itself.

The super nova remnant known as the Crab Nebula, in Taurus, is the first in Messier's list and s therefore designated as M1. It exploded about 7 thousand years ago but was seen by Chinese astronomers in the year 1054 AD. Its light had taken 5 thousand years to reach Earth . It appeared very bright in the sky in fact it was so bright it could be seen in daylight for about 3 months in 1054 AD.

With the passage of time over the course of thousands or millions of years the expansion of the gas and dust cloud blasted into space by the explosion dissipates. The filaments that can be seen in M1 will become long faint wisps spread across vast distances of space. The Veil Nebula in the constellation of Cygnus is one such ancient super nova remnant.

Observing Messier Objects

Some of the brighter Messier can be found using binoculars

Most require a small to medium telescope to see well

Fit a low power eyepiece into the telescope focuser (25mm)

Focus the eyepiece on a bright star

Use the finder to point the telescope at the required object

(The Messier object should be seen in a 50mm finder)

The object should be visible in the main telescope eyepiece

Study the object for a few minutes to get familiar with it

Carefully fit a higher power eyepiece (10mm)

Focus the eyepiece to view and enjoy observing the Object