July 10th Suggested Observing list

M 6: Butterfly Cluster (Lawrence Johnson and Kathy Ortega, Adam Block, NOAO/AURA/NSF)

M 7, NGC 6475 - Ptolemy's Cluster (Allan Cook, Adam Block, NOAO/AURA/NSF)

M 23, NGC 6494 (Robert Gendler)

M 8, NGC 6523, NGC 6530 - Lagoon Nebula and Cluster (Jim Misti)

M 16, NGC 6611 - Eagle Nebula, Star Queen Nebula (Jim Misti)

M17: NGC 6618 - Omega Nebula, Swan Nebula (Jim Misti)

M70, NGC 668 (NOAO/AURA/NSF)

M11, NGC 6705 - Wild Duck Cluster (Jim Misti)

M57, NGC 6720 - Ring Nebula (Adam Block, /NOAO/AURA/NSF)

M27, NGC 6853 - Dumbbell Nebula

M73, NGC 6994

M15, NGC 7078 (Jim Misti)

M2, NGC 7089 (Jim Misti)

M 30, NGC 7099, (Jim Misti)

Notes on NOAO/AURA/NSF:

July 10th Suggested Observing list[1,2]

By Bill Lockman

As stated in Ref. 1, this list is taken from Astronomy Magazine (August, 2021). The first 6 objects have been observed at previous star parties and are hyperlinked accordingly. Descriptions of the remaining 13 objects are taken from Ref. 2. When available, the authors' names are listed in parentheses.

M 13: Great cluster in Hercules

M 10

M 12

M 92

M 20: Trifid Nebula

M 22

M 6: Butterfly Cluster (Lawrence Johnson and Kathy Ortega, Adam Block, NOAO/AURA/NSF)

Messier 6 is an open cluster of stars in Scorpius, known as the Butterfly Cluster, from the vague resemblance of its shape to that of a butterfly.

Historial Observation

Robert Burnham, Jr. speculated that had M 6 was seen with the naked eye by Ptolemy in the 2nd century A.D., and included by Ptolemy in his mention of its apparent neighbor M 7. However, the first certain observer of M 6 was Giovanni Batista Hodierna, sometime prior to 1654. Hodierna's records were not discovered before the 1980s; thus, Philippe Loys de Chéseaux independently rediscovered M 6 in 1745-46; Nicholas Louis de Lacaille included it in his catalog of 1751-52 as Lac III.12, and Charles Messier eventually included it in his catalog in 1764.

Visual Appearance

Burnham described M 6 as a "charming group whose arrangement suggests the outline of a butterfly with open wings." The Butterfly Cluster contains 80 stars spread over a 54 arc-minute area, with its brighter members concentrated in a 30' x 15' rectangle. The irregular parallel lines of stars that form the long side of the rectangle are the butterfly's wings, and its antennae are a small but conspicuous V of 10th and 11th magnitude stars southeast of the cluster's center.

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[1] Target list is from Vol. 49 Issue 8 of Astronomy Magazine, "SEE SUMMER'S BEST Messier objects," by Michael E. Bakich.

[2] Dialog is from SkySafari 6 Pro with the authors names listed in parentheses

M 6 is seen against a darker background than M 7, so it appears somewhat brighter. The total visual magnitude of M 6 is about 4.2. Of all Messier objects, M 6 is situated at the closest angular distance to the Galactic Center.

Physical Properties

Estimates of the Butterfly Cluster's distance have varied over the years, with modern values around 1,600 light years. At this distance, the 25' apparent diameter of the cluster's main portion gives it spatial dimensions of some 12 light years. M 6 has an absolute magnitude of -5.0 (a luminosity of 8,300 suns), and an average density estimated at 0.6 stars per cubic parsec. The age of M 6 has been estimated at 50 to 100 million years.

The brightest star in this cluster is the semiregular variable star beta Scorpii, an orange supergiant of spectral type K0-K3 Ib whose apparent magnitude varies between 5.5 and 7. The cluster's hottest stars are blue main sequence stars of spectral type B4-B5. The contrast between the orange giant and the bright blue stars is obvious in color photos of the cluster.

M 7, NGC 6475 - Ptolemy's Cluster (Allan Cook, Adam Block, NOAO/AURA/NSF)

Also designated NGC 6475, M 7 is a large and brilliant open cluster in Scorpius, easily detected with the naked eye.

This splendid cluster was known to Ptolemy, who mentioned it about 130 AD and described it as the "little cloud following the stinger of Scorpius." His description may also include M6, but this is uncertain.

M 7 was observed by Giovanni Battista Hodierna before 1654, who counted 30 stars. Edmond Halley listed it as No. 29 in his catalog of southern stars of 1678, and Nicholas Louis de Lacaille added it to his catalog of southern objects as Lac II.14. Charles Messier included it as the seventh object in his catalog in 1764.

Messier 7 is a huge open cluster, plainly visible to the naked eye as a concentrated patch in the Milky Way. Telescopic observations reveal about 80 stars within a field of view of 1.3° across. The cluster's brighter stars are near the cluster's center, with jagged star chains running generally east to west.

The cluster's estimated distance is 800-1000 light years, a little more than half as far as M 6. At this distance, it has an actual diameter of 18-25 light years. Its absolute magnitude is a rather modest -3.7, a luminosity of 2,500 suns, and it is approaching us at 14 km/sec.

Modern sources agree on M 7's integrated apparent magnitude at 3.3. Its brightest star is a magnitude 5.6 yellow giant of spectral type G8; its hottest main sequence star is of spectral type B6. The age of the cluster is estimated at 220 million years.

M 23, NGC 6494 (Robert Gendler)

The open cluster Messier 23 is a glorious sight for small telescopes and binoculars, located in the rich star fields of the Sagittarius Milky Way.

This stunning 7th-magnitude cluster, discovered by Charles Messier in June 1764, fills an area the size of the full Moon. Messier 23 contains 150 stars in an area 27' across; the brightest is of magnitude 9.21. A magnitude 6.5 foreground star is quite prominent, about 18' northwest of the cluster's center. Star chains curve around the periphery like gems around the cornice of a crown. The cluster is narrower east to west on its north than on its south, where its full width approaches one degree.

Messier 23 lies 2,100 light years away, and has a diameter of approximately 20 light-years. It has an absolute magnitude of -4.7, and a luminosity of 6,300 suns. The hottest stars in M 23 are of spectral type B9, making the cluster 300 million years old.

M 8, NGC 6523, NGC 6530 - Lagoon Nebula and Cluster (Jim Misti)

The Lagoon Nebula is one of the finest star-forming regions in the sky, and is faintly visible to the naked eye. It is a giant glowing cloud of interstellar gas, divided by a dark lane of dust, containing a cluster of young stars (NGC 6530) that have formed from it.

Discovery and History

The earliest observations of this object were made by Giovanni Battista Hodierna before 1654. He classified it as "nebulosa" of intermediate brightness. It was independently noted as a "nebula" by John Flamsteed around 1680. The object was again seen by Philippe Loys de Chéseaux in 1746, who could resolve some stars and consequently classified it as a cluster. One year later, in 1747, it was observed by Guillaume Le Gentil, who found the nebula along with the cluster. Abbe Nicholas Louis de la Caille cataloged it in his 1751-52 compilation.

When Charles Messier cataloged this object in 1764, he primarily described the cluster, and mentioned the nebula separately as surrounding the star 9 Sagittarii. Although most sources identify only the nebula as "Messier 8", it is clear from Messier's description that he found both the nebula and the cluster.

William Herschel assigned separate catalog numbers to two parts of, the Lagoon Nebula: H V.9 (GC 4363, NGC 6526) and H V.13 (GC 4368, NGC 6533), which are described in the NGC as "large and faint nebulae". John Herschel eventually cataloged the open cluster NGC 6530 separately as h 3725 (GC 4366); he has M 8 as h 3723 (GC 4361, NGC 6523).

Amateur Observation

At magnitude 6, the Lagoon Nebula is faintly visible to the naked eye under good conditions. It is one of only two star-forming regions visible to the naked eye from mid-northern latitudes (the other is M 42 in Orion).

The Lagoon is a spectacular object in small telescopes, nearly as impressive as M 42. Even binoculars show an oval wisp of light split, into distinct sections by an irregular dark lane (the "Lagoon"). M 8 has apparent dimensions of 90' x 40', and covers three times the area of the full Moon. The nebula's faint extension to the East has its own IC number: IC 4678. The open cluster NGC 6530, centered in the eastern wing of the nebula, contains thirty members in a 10' area.

Like most nebulae, the Lagoon appears gray to the eye peering through binoculars or a telescope, since human vision has poor color sensitivity at low light levels. But M 8 is a magnificent object for the amateur astro-photographer, appearing pink in long-exposure color photos. M 8 is situated in a very conspicuous Milky Way field near the Trifid Nebula M 20 and the open star cluster, M 21. This region, and the rich star field and faint nebulae surrounding it, is a favorite of astro-imagers.

The brightest parts of the Lagoon Nebula contain a feature known as the "Hourglass Nebula", discovered and named by John Herschel. This is in a region where vivid star formation is taking place, and its bright emission is caused by heavy excitation from very hot, young stars.

The nebula also contains a number of dark globules which represent collapsing clouds of proto-stellar material. The most prominent of these dark patches were catalogued by E. E. Barnard: B 88, a comet-shaped globule extended North-to-South in the nebula's eastern half; B 89, a smaller dark nebula near the cluster NGC 6530; and B 296, a long, narrow black patch at the nebula's south edge.

Properties and Cluster

The Lagoon Nebula lies in the heart of the galaxy's Sagittarius-Carina spiral arm, but its distance is a bit uncertain. Estimates range from 4,800 to 6,500 light years, with 5,200 quoted by many sources. A 2006 study found a distance of 4,100 light years, which would make its true size about 110 x 50 light years. The nebula probably has a depth comparable to its linear dimensions. The dark "Bok" globules of collapsing proto-stellar material have diameters of about 10,000 AU.

The western half of M 8 is primarily illuminated by the magnitude 5.97 star 9 Sagittarii, an extremely hot O5 star which radiates 44 times more high-energy ultraviolet than visual light. At visual wavelengths, 9 Sagittarii is 23,000 times brighter than our Sun! The illuminator of the "Hourglass" feature is the hot star Herschel 36 (magnitide 9.5, spectral class O7). In 2006, four Herbig-Haro objects were detected within the Hourglass, providing the first direct evidence of active star formation by accretion within it.

The hot O-type stars of the young open cluster NGC 6530 are fluorescing the eastern part of the nebula. As their light shows little reddening by interstellar matter, this cluster is probably situated just in front of the Lagoon Nebula. Its brightest star is a hot, mag 6.9 class O5 star, with an age around 2 million years. The cluster also contains one extremely hot, peculiar star of spectral type Of, with spectral lines of ionized Helium and Nitrogen.

M 16, NGC 6611 - Eagle Nebula, Star Queen Nebula (Jim Misti)

Messier 16 is a conspicuous region of active star formation, appearing in the constellation Serpens Cauda. This giant cloud of interstellar gas and dust is commonly known as the Eagle Nebula, and has already created a cluster of young stars. The nebula is also referred to the Star Queen Nebula and as IC 4703; the cluster is NGC 6611.

Discovery and Observation

The cluster was discovered by Philippe Loys de Cheseaux in 1745-1746, who made no mention of the nebula. Charles Messier independently rediscovered the cluster in 1764, and described its stars as "enmeshed in a faint glow", suggesting that he discovered the nebula as well.

The Herschels apparently did not perceive the nebula, so their catalogs (and consequently the NGC) only describe the cluster. The nebula was probably first photographed by E.E. Barnard in 1895, or by Isaac Roberts in 1897. From Roberts's finding, the nebula was added to the second Index Catalog in 1908 as IC 4703, "with cluster M 16 involved".

M 16 is found rather easily, close to Serpens Cauda's borders with Scutum and Sagittarius. Starting from Altair (α Aquilae), follow δ and λ Aquila to Gamma Scuti; M 16 is about 2-1/2° west of this star. The Omega Nebula (M 17) is 2° SW of γ Scutum.

With an overall visual magnitude of 6.4, and an apparent diameter of 7', the Eagle Nebula's star cluster is best seen with low power telescopes. The brightest star in the cluster has an apparent magnitude of +8.24, easily visible with good binoculars. A 4" scope reveals about 20 stars in an uneven background of fainter stars and nebulosity; three nebulous concentrations can be glimpsed under good conditions. Under very good conditions, suggestions of dark obscuring matter can be seen to the north of the cluster.

In an 8" telescope at low power, M 16 is an impressive object. The nebula extends much farther out, to a diameter of over 30'. It is filled with dark regions and globules, including a peculiar dark column and a luminous rim around the cluster. The outlines of the nebula are sometimes said to look like a three-leaf clover.

The Eagle nebula is best seen on photographs, but larger apertures and O-III filters may help to trace some detail visually. More dark pillars, also known as "elephant trunks", can be seen in large amateur instruments (12" and larger aperture).

Properties and Evolution

The Eagle Nebula lies some 7,000 light years away in the Sagittarius-Carina spiral arM of our galaxy - the next arm inward from us. At this distance, the cluster's angular diameter corresponds to a linear size of about 15 light years. The nebula extends much farther out, to dimensions of about 70 x 55 light years. M 16 might form one giant complex with M 17, the Omega Nebula, to the south in Sagittarius.

M 16's stellar swarm is only about 5.5 million years old, with its hottest, youngest stars of spectral type O6. Excited by high-energy ultraviolet radiation from these massive stars, this great cloud of interstellar gas glows by fluorescence.

Images made in 1995 by the Hubble Space Telescope greatly improved our understanding of the star formation process taking place inside the nebula. One of these images, a famous photograph known as the "Pillars of Creation", depicts a large region of star formation whose small dark areas are believed to be protostars. At the end of each pillar, the intense ultraviolet light of newborn stars is vaporizing some of the hydrogen gas, and shaping structures called "EGGs" (Evaporating Gaseous Globules).

In 2007, scientists using the Spitzer Space Telescope discovered evidence that the Pillars were actually destroyed by a supernova explosion about 6,000 years ago. But the light showing their destruction, and the new shape of the nebula, will not reach the Earth for another millennium.

M17: NGC 6618 - Omega Nebula, Swan Nebula (Jim Misti)

Messier 17 in Sagittarius is one of the brightest diffuse nebulae in the sky. Commonly known as the Omega, Swan, Horseshoe, or (especially in the southern hemisphere) Lobster nebula, M 17 is just visible to the naked eye under very favorable conditions.

Discovery and Observation

M 17 was first noticed by Philippe Loys de Cheseaux in the spring of 1746, and rediscovered independently by Charles Messier in June of the same year. De Cheseaux's discovery did not become widely known, so Messier cataloged it as M 17 in 1764.

M 17 is located in the rich star fields of the Milky Way in Sagittarius. It can be found easily, along with its apparent neighbor, M 16, the Eagle Nebula. Starting from Altair (α Aquila), follow δ Aquila and λ Aquila to γ Scutum; M 17 is just over 2° SW of this star, and M 16 lies 2° NW. With a visual magnitude of 6.0, M 17 is visible to the naked eye from low latitudes under good observing conditions.

In a small telescope, M 17 rivals the Orion Nebula (M 42) in splendor. The core of the nebula is a checkmark, the bar of which extends 12' ESE-WNW. The check projects SSW from the WNW end of the bar. Fainter nebulosity loops west from the check, enclosing a dark mass popularly called the Fish's Mouth. The involved cluster is poorly concentrated, its stars spread over a 25' area.

The overall color of the Omega Nebula is reddish, due to light emitted from the hot hydrogen gas excited by the stars that have just formed within it. However, the nebula's brightest region is actually white, apparently the result of light emission from the hottest gas, mixed with reflections of bright starlight from dust. The nebula contains a large amount of dark obscuring material, which has been heated by the hidden young stars, and shines brightly in the infra-red.

Properties and Evolution

Distance estimates for M 17 range between 5,000 and 6,000 light years - a little less than its apparent neighbor, M 16. Physically, these two star forming regions are indeed close together, in the Sagittarius-Carina spiral arm of the Milky Way galaxy, and are perhaps part of the same giant complex of interstellar matter.

While the visible nebula is about 15 light-years across, the total gaseous cloud, including low-luminosity material, extends to at least 40 light-years. The total mass of the gas has been estimated at about 800 Suns: enough to form a conspicuous cluster, and a good deal more than the Orion Nebula (M 42).

Some 35 bright but obscured stars, each about six times hotter and 20 to 30 times more massive than the Sun, are embedded in the nebulosity. Unlike in many other emission nebulae, however,

these stars are not obvious in optical images, but hidden in the nebula. Star formation is either still active in this nebula, or ceased very recently.

The radiation from these stars erodes the dense cloud of cold gas within which they were formed, exposing dense pockets of gas that may contain other stars in the birthing process. Because these dense pockets are more resistant to the radiation onslaught than is the surrounding cloud, they appear as sculptures in the walls of the cloud, or as isolated islands in a sea of glowing gas. The pressure on the tips of the waves may trigger new star formation within them.

M70, NGC 668 (NOAO/AURA/NSF)

Messier 70 is a globular cluster in Sagittarius, and one of the fainter and less conspicuous globulars in Messier's catalog.

Charles Messier discovered this globular in August, 1780, and described it as a "nebula without star." William Herschel was the first to resolve it into stars, and described it as "a miniature of M 3."

Due to its southern declination, M 70 is difficult to observe from the mid-northern latitudes where Messier discovered it. M 70 is the smallest and faintest of the three Messier globular clusters distributed along the base of the Teapot asterism, located about 2° northeast of M 69.

M 70 appears at visual magnitude 7.9, and about 8' in angular diameter. Its halo shows a fair number of stars against a granular background. The halo's edges are irregular; some of its brighter stars lie along short chains, the most conspicuous leading northeast away from the cluster. The globular's core is small and concentrated.

M 70 is at a distance of 29,300 light years from Earth, close to the Galactic Center, and is roughly 68 light years in linear diameter. Its absolute magnitude is -7.3, a luminosity of 70,000 Suns, and less than average for a globular cluster. This is roughly the same size and luminosity as M 69, its neighbor in space.

The core of M 70 is extremely dense, and has undergone a collapse sometime in its history, similar to other Milky Way globulars including M 15, M 30, and possibly M 62. Only two variable stars are known within M 70. It is receding from us rapidly, at about 200 km/sec.

M11, NGC 6705 - Wild Duck Cluster (Jim Misti)

The Wild Duck Cluster in Scutum, is one of the richest and most compact open clusters in the sky.

M 11 was discovered by the German astronomer Gottfried Kirch in 1681, and first resolved into stars by William Derham around 1733. Charles Messier included it in his catalog in 1764. The Wild Duck cluster's common name comes from Admiral Smyth, who noted that its fan-shaped appearance resembles "a flight of wild ducks."

The Wild Duck Cluster is 14' in diameter, about 1/3 the size of the full moon. With a total magnitude of 6.3, it is visible in binoculars. With an 8-inch telescope at low power, it is a

remarkable object. M 11 contains an estimated 2900 stars, about 500 of which are brighter than magnitude 14. The cluster's stars are distributed in a network of knots and clumps, mixed with some meandering dark lanes. The two most conspicuous of these wind from the cluster's center to its northern and western edges. Although difficult to discern among the profusion of stars, careful scrutiny shows the east-pointing V of the brighter cluster stars.

The Wild Duck Cluster is one of the richest and most compact open clusters. Messier 11 is so rich that it resembles the looser globular clusters, but it is in fact an intermediate-age open cluster, 250 million years old. It is extremely luminous for a somewhat evolved open cluster, with an absolute magnitude of -6.9, a luminosity of 48,000 suns. It is about 6,000 light years away, and receding at 22 km/sec.

M57, NGC 6720 - Ring Nebula (Adam Block, /NOAO/AURA/NSF)

The Ring Nebula is a showpiece in the northern hemisphere summer sky, and often regarded as the prototype of all planetary nebulae. These objects are the remains of sunlike stars which have blown away their outer envelopes, leaving planet-sized white dwarfs at their centers.

Discovery and History

The Ring Nebula was discovered by the French Astronomer Antoine Darquier de Pellepoix in January, 1779. He described it as "a dull nebula, but perfectly outlined; as large as Jupiter and looks like a fading planet." Only a few days later, Charles Messier independently found the same nebula while searching for comets, and entered it as the 57th object in his catalogue. Messier, and later William Herschel, speculated that the nebula was formed by multiple faint stars that they were unable to resolve.

William Herschel, who discovered the planet Uranus, found other nebulous objects resembling M 57 (and his newly discovered planet), and introduced the term "Planetary Nebulae" for them. Yet, oddly, Herschel did not count their most prominent representative among them. He instead considered M 57 to be a peculiar object, a "curiosity of the heavens", and described it as "a perforated nebula, or ring of stars"; this was the first mention of its ring shape. Herschel also identified some of the superimposed stars, and correctly assumed that "none [of them] seems to belong to it."

M27, NGC 6853 - Dumbbell Nebula

The Dumbbell Nebula is the first planetary nebula ever discovered, and perhaps the finest in the sky. It is easily seen in binoculars, and a popular observing target for amateur telescopes.

Discovery and Observation

Charles Messier discovered this object in 1764, and described it as an oval nebula without stars. William Herschel invented the name "Planetary Nebula" for this class of objects around 1784, because he found them to resemble his newly discovered planet, Uranus. The name "Dumbbell" goes back to William's son John Herschel, who compared M 27 to a "double-headed shot".

This planetary nebula is certainly the most impressive object of its kind in the sky. But at visual magnitude 7.4, it only the second brightest. While the Helix Nebula in Aquarius (NGC 7293) is slightly brighter, at magnitude 7.3, it a much lower surface brightness because of its larger size.

The two bright triangular lobes that give rise to the Dumbbell's name extend north and south to an overall length of 8' x 6'. A faint halo extends out to over 15', half the apparent diameter of the Moon. Several stars are superimposed on the nebula, the most conspicuous in the center of the northern lobe.

Like many nearby planetary nebulae, the Dumbbell contains knots. Its central region is marked by a pattern of dark and bright cusped knots and their associated dark tails. The knots vary in appearance from symmetric objects with tails to rather irregular tail-less objects.

The central star of M 27, just visible at magnitude 13.5, is surrounded by a slightly darker area. It has a faint (magnitude 17) yellow companion 6.5" away. About 2 degrees to the west of M 27 is an inconspicuous open cluster, NGC 6830, which contains about 20 - 30 widely scattered stars; this cluster is about 5500 light years distant.

Properties and Evolution

As with most planetary nebulae, the distance to M 27 is not very well known. Existing estimates range from 490 to 3500 light years. Adopting a value of 1200 light years, the nebula's intrinsic luminosity is about 100 times the Sun's. Its central star has about 1/3 of the Sun's luminosity, and its companion is nearly 100 times fainter.

As with all planetary nebulae, M 27's central white dwarf is the collapsed core of a formerly sunlike star which, after exhausting its hydrogen fuel, become a red giant and ejected its outer layers. The expanding gas shell is excited by high-energy radiation from the central white dwarf star, forming the visible nebula. The star is so much fainter than the nebula because it emits mainly in the non-visible part of the spectrum.

The central white dwarf of M 27 contains an estimated 60% of the Sun's mass. It is about 5% of the Sun's diameter, making it the largest white dwarf known. With a surface temperature of 85,000 K, this blue-white star has a spectral type of O7. The high-energy ultraviolet radiation from its extremely hot surface is absorbed by the nebula's gas, and re-emitted as visible light. Most of this light is emitted at only one wavelength, 500.7 nm, which corresponds to the greenish spectral line of doubly-ionized oxygen.

We happen to see M 27 approximately from its equatorial plane - similar to our view of another, fainter Messier planetary nebula, M 76 in Perseus, also called the "Little Dumbbell". Viewed from its poles, M 27 would probably appear ring-shaped, like M 57, the Ring Nebula in Lyra. The knots in the Dumbbell Nebula have bright cusps which are local photoionization fronts, similar to those in the Helix and Eskimo Nebulae.

Like its distance, the Dumbbell Nebula's age is also uncertain. By one estimate, the bright portion of the nebula is expanding at a rate of 6.8" per century, leading to an age of 3,000 to 4,000 years. By another, the expansion rate is no more than 2.3" per century, giving an upper

age limit of about 15,000 years. Spectroscopic observations indicate that the nebula has an expansion velocity of 31 km/sec. With a physical radius of about 1 light year, the kinematic age of the planetary nebula is approximately 9,800 years.

M73, NGC 6994

Messier 73, also known as NGC 6994, is an asterism of four stars in Aquarius. An asterism is composed of physically unconnected stars that appear close together in the sky. M 73 is one of the best-known asterisms in the sky, and has been carefully studied.

M 73 was discovered by Charles Messier in 1780; he originally described it as a "cluster of four stars with some nebulosity". Subsequent observations by John Herschel failed to reveal any nebulosity, and Herschel noted that the designation of M 73 as a cluster was questionable. Nonetheless, Herschel included M 73 in his General Catalogue of clusters, nebulae, and galaxies; and John Dreyer included M 73 as NGC 6994 when he compiled the New General Catalogue.

This "Y"-shaped group of stars is easily visible in a 4-inch telescope. It is best found from the globular cluster M 72, which is almost exactly 1.5° to the west. Three of M 73's stars are of 10th to 11th magnitude (A: 10.5, B: 10.5, and C: 11.0), the fourth (D: 12.0) is notably fainter. Although modern telescopes reveal no nebulosity around the group, this is clearly the object Messier described.

M 73 was once treated as a sparsely-populated open cluster, which consists of stars that are physically related. The question of whether the stars in M 73 are an asterism or an open cluster has generated some debate.

In 2000, astronomers published an analysis of the colors and luminosities of the stars in and around M 73. They concluded that the four bright central stars, and some others nearby, exhibited a color-luminosity relation typical of open clusters. However, the same year, another group of astronomers published exactly contradictory results.

Adding to the controversy, other astronomers calculated that the chance alignment of the four bright stars seen in M 73 was highly unlikely, so M 73 probably was a sparse open cluster.

The controversy was resolved in 2002, when high resolution spectra showed that M 73's stars were at very different distances from Earth, and moving in different directions. Therefore, the current conclusion is that the stars in M 73 are only an asterism - and that Messier's description of the nebulosity around theM was simply a mistake.

M15, NGC 7078 (Jim Misti)

Messier 15 is a globular cluster in the constellation Pegasus. This bright globular was discovered by Jean-Dominique Maraldi in September of 1746, and included in Charles Messier's catalog in 1764.

With a total visual magnitude of 6.2, Messier 15 is among the more conspicuous of these great stellar swarms. It can be seen as a fuzzy star with binoculars or a small telescope. Instruments of at least 6 inches' aperture will start to reveal individual stars, the brightest of which are

magnitude 12.6. This cluster is a fine, bright globular with a blazing core that thins rapidly from the center. Many arms and chains radiate from the core, out to a diameter of 18'.

Messier 15 lies approximately 33,600 light years from Earth and has a diameter of about 175 light years. Its tidal radius, beyond which member stars would escape because of the Milky Way's gravity is a bit larger: 210 light years. M 15 has an absolute magnitude of -9.2, which translates to a luminosity of 360,000 Suns. M 15 is estimated to be 13.2 billion years old, making it one of the oldest known globular clusters.

Messier 15 is one of the most densely packed globular clusters known in the Milky Way galaxy. The half-mass radius of M 15 is about 10 light years - half the mass of this cluster is concentrated in a sphere of that radius. M 15's core has undergone a contraction known as core collapse, which may indicate a black hole.

M 15 is the first globular cluster in which a planetary nebula, Pease 1, was identified, in 1928. To this date, Pease 1 is still one of only four planetary nebulae known in a globular cluster. Messier 15 contains over one hundred variable stars. It also contains at least 8 pulsars, including one double neutron star system.

M 15 emits X-rays; two bright X-ray sources were resolved by the Chandra X-ray observatory. These provide further evidence of a black hole at the center of M 15.

M2, NGC 7089 (Jim Misti)

Messier 2 is a globular cluster in Aquarius, five degrees north of the star Beta Aquarii. It was discovered by Jean-Dominique Maraldi in 1746 and is one of the largest known globular clusters - the showpiece of the constellation!

Discovery and Observation

M 2 was discovered by the French astronomer Jean-Dominique Maraldi in 1746 while observing a comet with Jacques Cassini. Charles Messier rediscovered it in 1760, but described it as a "nebula without stars." William Herschel was the first to resolve individual stars in the cluster, in 1783.

With a visual magnitude of magnitude 6.5, Messier 2 is just visible to the naked eye under extremely good conditions. Binoculars or small telescopes will identify the cluster as non-stellar, while larger telescopes will resolve individual stars, of which the brightest are of magnitude 13.1.

Messier 2 is a large, bright globular cluster, well-compressed, with an intense core. The 6'-diameter core is symmetric, with a slight N-S elongation. There is a profusion of stars in the outer corona, and perhaps a hundred stars can be resolved across the disk against a background haze. Star chains meandering out from the core extend the halo's span to a diameter of 16'. Several dark lanes are visible, the most prominent located in the NE portion.

Physical Properties

M 2 is about 37,500 light years distant, and lies well beyond the Galactic Center It is about 175 light-years in diameter, and contains about 150,000 stars. It is one of the richer and more compact globular clusters, and is notably elliptical in shape. The dense central core has a diameter of only 3.7 light years. On the other hand, its tidal radius, beyond which member stars would escape due to gravitational forces from the Milky Way Galaxy, is 233 light years.

The age of M 2 has been estimated at about 13 billion years. M 2 is approaching us at 5.3 km/sec. It is moving on a highly eccentric (e=0.76) orbit, which carries it out to an enormous distance of 171,000 light-years from the galactic center, and 165,000 light-years above and below the Galactic plane.

M 30, NGC 7099, (Jim Misti)

Messier 30 (is a globular cluster in Capricornus. Discovered by Charles Messier in August of 1764, this globular was first resolved into stars by William Herschel in 1783.

Messier 30 is a bright (magnitude 7.2), well-resolved 12'-diameter disk of stellar points; it is a fine object for small telescopes. The cluster is distinctly elongated east to west; its brightest stars are about of visual magnitude 12.1. The star density increases dramatically near the center. The outer halo is filled with numerous star chains.

M 30 has a diameter of approximately 100 light years, and is about 26,000 light years away. The cluster contains at least 200,000 stars.

The core of M 30 exhibits an extremely dense stellar population, and has undergone a collapse similar to M 15, M 70, and possibly 20 other globulars in the Milky Way. Consequently, M 30's core is very small, less than a light year across. Its half-mass radius is 8.7 light years, about the distance from us to Sirius. On the other hand, its tidal radius is large: 139 light years. Beyond that distance, member stars would escape because of the Milky Way galaxy's gravitational forces.

Despite its compressed core, close encounters of M 30's member stars seem to have been rare. The cluster appears to contain only a few X-ray binary stars. These stellar systems are thought to form in close encounters that occur in the denser zones of globular clusters. A dwarf nova has occurred in M 30.

Notes on NOAO/AURA/NSF:

1. **NOAO:** The site for NOAO, the National Optical Astronomy Observatory, is no longer being actively maintained. On October 1, 2019 NOAO joined with Gemini Observatory and Vera Rubin Observatory (formerly LSST) operations to create a new organization, NSF's NOIRLab. The content of this site is being migrated to our new domain: noirlab.edu. The public site has been launched and is the main web portal for the public and media. Many links on this site may redirect you to the new site. For now, scientists and astronomers can still find information about Kitt Peak, CTIO, and CSDC on the old site (www.noao.edu).
2. **AURA:** Association of Universities for Research in Astronomy
3. **NSF:** The National Science Foundation's National Optical-Infrared Astronomy Research Laboratory (NOIRlab)