Comet Tales: The Mythology and Science of Comets (And How to Observe Them)

(LM sketch– Comet Hale-Bopp, 1997 - naked-eye)

Introduction:

Comets,,,,,, when I hear that phrase, I think of a type of Solar System object that's always challenging, but also interesting and fun to observe or image.

They also bring to mind their descriptions: Ephemeral ghosts, luminescent fuzzy stars with tails, unpredictable transient phenomena up in the night sky, delighting amateur astronomers using just their eyes, binoculars, or any type of telescope. They run from large, bright, easily located, showing great detail to small and faint, challenging to find. Leftover remnants, giving up secrets of the formation of our Solar System.

So today, I would like to bring these ethereal objects 'down to Earth' by discussing the ancient beliefs behind them, what they truly are both historical and modern, and how to go about observing them.
Hopefully, when we are done, some of the mystery around these objects will have been lifted, and you will find Comets as interesting to hunt as I do.

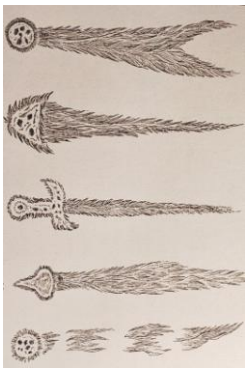
Discussion outline:

- **Mythology:**
- **Science:**
  - *Historical*
  - *Modern*
- **How to Observe Them:**
- **When will the next Comet be Visible?**
- **Conclusion**

Mythology:

Comets have fascinated humanity since before recorded history. From ancient texts in China going back 4,000 years, to Babylonian cuneiform records to more recent writings of the classical Greeks and Romans, it is known that comet appearances have been noticed and recorded by people for millennia. Comet symbols can be found in ancient Egyptian artwork, rock carvings in the American Southwest, and on Aztec buildings in central Mexico.
But without the scientific understanding of what they are, ancient people often turned to myth and legend to explain them.

Only in the past few centuries have Comets been seriously studied as astronomical objects. Before modern times, comets were often considered to be bad omens, an ethereal weapon or message from the gods foretelling disaster, impending doom, and death to King and country. A bright comet in the sky was a sign that the Day of Judgment was at hand. That comet-related disasters would soon occur such as earthquakes, famine, floods, hail storms, drought, poor harvests, epidemics, and war. People in medieval times thought that comets were evil stars, and were so in fear of comets that they would wear charms to protect themselves from the evils that comets would bring. (the word 'disaster comes from '*dis*' meaning evil, and '*aster*', meaning star).
In his book 'Theatrum Cometrium', published in 1668, Polish Theologian Stanislaus Lubeinski, the author states: "Never had there been a disaster without a comet or a comet without a disaster."
Even in relatively recent modern times, the fear of toxic gases in the 1910 return of Halley's Comet caused panicked buying of gas masks and quack "anti-comet pills" and "anti-comet umbrellas" by the public.



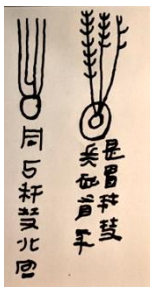
Why were ancient people so afraid of comets? Our ancestors closely followed the slow cycles of the sky as their lives depended on it to tell them when to plant crops and when to harvest them, or when it was safe to sail the sea. The stars and planets, Sun and Moon moved thru the sky in an orderly, predictable fashion. Comets didn't!

Comets would chaotically appear suddenly, some with large diffuse tails that to the overly imaginative looked like a giant dagger or sword shaped object hanging over their heads, ready to fall on them. The people felt they must have done something wrong to so displease the gods, so comets gave them a sense of impending doom.

Some of the beliefs and the historical impact of comets include:
Comets and meteors were of great importance to the Aztecs of central Mexico. Meteors were viewed as arrows of stellar gods. The arrows could hit people and were feared when walking at night. Comets were viewed as smoking stars and as bad omens, announcing the death of a ruler. A bright comet seen by the last Aztec ruler – Montezuma was said to foretell his downfall to the Spanish conquerors.

In North America around the Great Lakes region, the native Chippewa's creation myth involves a comet called "*Genondahwayanung*", (Long Tailed Heavenly Climbing Star) that flew low over the Earth, and as it went over, its long, wide tail burned-up all the land and creatures. Only the people who the Great Spirit told to take reeds to breathe thru and hide in a swamp survived the scorching heat from the comet. Thereafter, any appearances of bright comets were regarded as a serious matter requiring the attention of the tribal medicine men.

Ancient Chinese considered comets as disastrous omens, and were seen as an imbalance in nature of yin and yang that could bring on war. So as to be forewarned, Chinese emperors employed astrologers specifically to watch for comets. One emperor, Ruizong of Tang, in 712 AD actually abdicated his throne after the appearance of a comet. Chinese records of "Broom Stars" (hui-sing) as comets were called, go all the way back to 1059 BC, with the comet of 240 BC being the earliest confirmed record of Halley's Comet.



Australian Aboriginals believed that comets, which they called "star with trails", had great significance and meaning. These events were often recorded in oral tradition, but some comet inspired art has been found in rock carvings near Sydney. The appearance of a bright comet often triggered great dread among aboriginals and were associated with omens of sickness and death. Some tribes saw comets as evil spirits that drank the rain-clouds causing drought on the land below. Others thought they were spears of a celestial being named *Wurluru* who lived in the sky and would occasionally threw spears across the heavens. To drive away the comet, medicine men would throw magical stones at the comet until it faded from view.

The Greeks and Romans believed that the appearance of comets were omens from the gods. They were signs foretelling that something had happened or was about to happen, (usually something bad). In Homer's "*the Iliad*", the Greek hero Achilles said of comets: "*their flaming hair shakes down disease, pestilence, and war*".
The arrival of a comet could herald the birth of a great figure, or more likely his death or defeat in war, and conquest of a country.

For example, in Rome, soon after Julius Caesar was killed in the Senate that spring of 44 BC, a comet appeared in the skies during the funerary games held for Caesar that became so bright it was visible during the daytime. Caesar's adopted son Octavian, (soon to be the Emperor Augustus), persuaded the roman citizens that the comet's appearance was a portent of his father's deification by the gods. Once he was made emperor, Augustus had new silver coins made celebrating the comet and the deification of his father. It helped in ruling the Roman Empire to remind the people that you were the son of a god.

In another example, the Roman historians in their writing mention celestial "comet stars" occurring as among the portents witnessed after the death of the Egyptian queen Cleopatra and Egypt being fully conquered by Rome.

Comets also played a prominent role in English history. During 1066 AD, a bright comet that was seen in England was considered as a bad omen for Saxon King Harold II, and later that year he died at the Battle of Hastings, defeated by William the Conqueror during the Norman invasion. The comet, (now known as Halley's Comet), is represented as a terrifying omen on the Bayeux Tapestry and described as a star appearing to be four times the size of Venus, trailing long flaming hair, and shining brighter than the 1st Quarter Moon.

Halley's Comet is associated with a number of other historical impacts. In the year 66 AD, the comet's return was described by Jewish historians of the time as the "Sword of God", and was associated with the destruction of Jerusalem by the Romans. Another return of Halley's Comet was in 451 AD and was brightly seen at the Battle of Chalons, where Attila the Hun was finally defeated. In 684 AD, the comet was seen during an outbreak of the plague and was blamed as the cause of the sickness. And in 1456 AD, the comet was see just after the fall of Constantinople to the Turks, and was so feared that Pope Calixtrus III offered special prayers for deliverance "from the Devil, the Turk, and the Comet".

In addition to comets being blamed for crop failures, they also were thought to impact farm animals causing birth defects or death. There are several reports in Europe during bright comets in 1665 and 1680 that hens eggs were discolored by the comets passing and some hens in Warsaw and Rome had laid eggs of unusual size with flaming swords or stars on the shells. No one would eat or cook with these eggs. Around the same time, there were claims that a sneezing sickness in the cats of Westphalia was caused by an overhead comet. And some livestock were born with too many legs or heads.

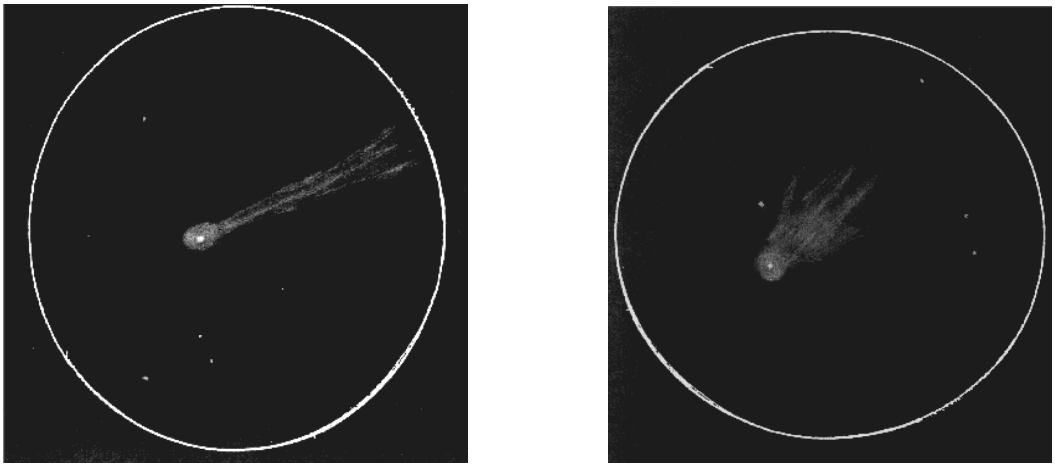
Science:

Historical:

Comets have been observed and recorded since ancient times by many cultures. Ancient philosopher's ideas as to what comets were fell into two main camps. Some ancient Greek philosopher's such as Anaxagoras believed comets to be celestial bodies, created by the conjunctions of planets, while others thought that they were meteorological in nature and occurred high in the atmosphere. The Greek philosopher Aristotle propounded the idea that comets were not the same as planets, which as heavenly bodies were pure and unchanging, but instead were phenomena of the Earth's upper atmosphere, and were hot, dry exhalations or pockets of gas gathered together that occasionally would burst into flame. Aristotle's 'view' of comets would unfortunately hold sway in Greek, Roman, and then Western European thought for nearly two thousand years, holding back the study of comets until the mid 1500's.

The first modern attempt to understand comets came in 1577 with the appearance of a bright comet visible over Europe. Astronomer Tycho Brahe, using parallax and taking very precise measurements of the comets path, calculated the distance to this comet proving that comets were located far out in space, much more distant than the Moon, and not within the Earth's atmosphere or in orbit around the Earth.

A pivotal point in our understanding of comets and their orbits came in 1705 when English astronomer Edmond Halley, using the recently formulated laws of gravity and motion by Isaac Newton, along with twenty years of researching thru old records and manuscripts, calculated that a bright comet last seen in 1682 had the same elliptical orbital characteristics as several other prior comets and determined that all the comet appearances every 76 years were from the same comet making multiple returns in its orbit. Halley went on to calculate its future orbit and predicted the comet's return in 1759. After the comet returned as predicted, it became known as "Halley's Comet".

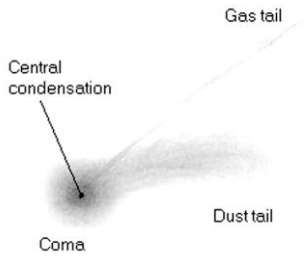


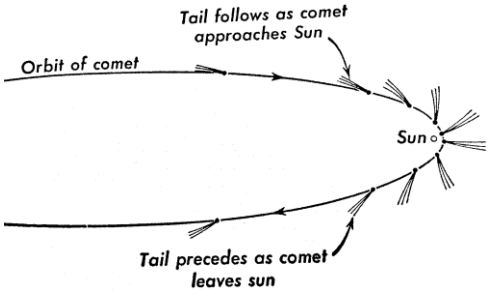
(LM sketch– Comet Halley, 1986 – 10" f5.6 reflector)

Since the confirmation of the periodicity of Halley's Comet, other historical periodic comets have been discovered through the use of telescopic observations and researching of archives, and their orbits mathematically calculated. The second comet found to have a periodic orbit observed in the past was "Encke's Comet" in 1821, just in time for a successfully predicted return in 1822. By 1900, seventeen comets had been observed through more than one return and recognized as being periodic comets. Currently, there are over 300 comets having been identified as being past historically observed periodic comets. (As of July 2019, based on modern spacecraft and automated surveys, there have now been over 6,619 known comets discovered, and constantly increasing every year. Even this is only a tiny fraction of the estimated potential of one trillion comet-like bodies in the Oort cloud reservoir of the outer Solar System)

Modern:

Thanks to modern science, we now know today that a comet is a small, icy member of our solar system, that when their orbits take them close to the Sun, warms up and releases gases and dust from the comet's core or "nucleus". This produces the visible head of the comet, called a "coma" and sometimes also a "tail" of gas & dust that extends from the comet.

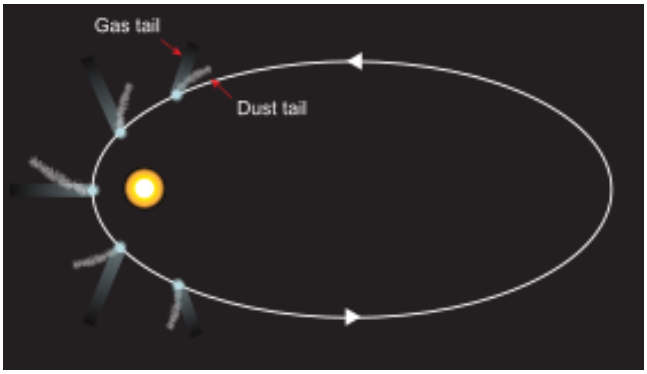




A comet's nucleus generally runs in size from several thousand feet to several hundred miles in diameter, and is made-up of a collection of ice, dust, rocky material, and frozen gases such as carbon dioxide, carbon monoxide and hydrogen cyanide under a surface crust several feet thick. (Known as a "dirty snowball" , or if they have a higher dust content -"icy dirtballs", and have also been suggested to being like "deep fried ice-cream")
Modern research indicates that large comets with a diameter of 30 miles and greater could contain liquid water at their cores. Because comet nuclei are not solid objects, they generally do not have enough gravity mass to become spherical, so many are irregular shaped. It been theorized that much of the water in the Earth' oceans may have come from comet impacts bombarding the young Earth around 4 billion years ago.
With the detection of organic molecules and amino acids in comets, scientists have also speculated that comets may have brought the precursors or building-blocks of life to the Earth. Even in modern times, comets can still potentially hit the Earth. After years of research, it has been mostly determined that the June 1908 'explosion' over the dense forest of the Tunguska region in Siberia that was felt for hundreds of miles and heard half-way around the world was due to a small comet disintegrating in the Earth's atmosphere above Tunguska.

As the comet nears the Sun to within 3 to 4 AU's, (Astronomical Unit – 1AU = about 93 million miles, the distance of the Earth's orbit from the Sun) , depending on what elements the ice is made of, uneven heating will sublimate the ice directly into gas that will erupt from the comets surface like a geyser, carrying away with it additional ice, dust, and pebbles. These streams of gas and dust can cause the nucleus to spin, and even split apart. This material will enclose the nucleus in a bright "coma", (or cloud), upwards to 100,000 miles or larger in diameter. The force exerted by the Sun's radiation pressure and solar wind causes the coma to take on an oval shape.

As a comet approaches the inner Solar System, the increased pressure from the solar wind coming from the Sun will blow the material in the coma outward away from the comet forming a dust, and sometimes a separate gas tail, both point away from the Sun that may extend through space for many millions of miles. The dust tail, being made of heavier materials will follow the comet's curved orbit, while the gas or ion tail being much lighter will point directly away from the Sun in the direction the magnetic field lines of the solar wind is heading.



As the comet approaches the Sun, increasing outgassing causes the coma to expand, and the intense radiation of the sunlight ionizes the gases in the coma. Interactions with strong solar winds passing thru the ionized coma can cause "bow shocks" (similar to that of a ship's bow wave in water), to form within the coma in front of the nucleus.

Comets usually have highly elliptical orbits, with a wide range of orbital periods ranging from a few years (Short-period: 3 to 60 years) on upwards to centuries or even longer (Long-period: >100 to 1,000's years).
Short-period comets originate in the Kuiper Belt, a circumstellar disc in the outer Solar System, beyond the orbit of Neptune that extends to about 50 AU out from the Sun. The Kuiper Belt is estimated to be about 200 times more massive than the Asteroid Belt between Mars and Jupiter, and consists mainly of small bodies or remnants from when the Solar System formed, composed largely of frozen ices such as methane, ammonia and water.
It was the recent discovery of a number of large ice worlds such as Haumea and Makemake in the Kuiper Belt that led to Pluto being reclassified as a dwarf-planet. Astronomers estimate there are over 100,000 Kuiper Belt Objects (KBO's) with diameters greater than 50 miles. Long-period comets originate in the Oort Cloud, a vast spherical cloud of an estimated trillion icy bodies extending from outside the Kuiper belt to around one light-year.
It is thought that the gravitational nudge of nearby passing stars occasionally sends an icy member of the Oort Cloud inwards as a long-period comet. A few comets have what are called hyperbolic orbits (trajectories) with so steep of an angle that they make only one pass thru the inner Solar System before being slingshot around the Sun with enough speed to escape its gravitational pull and exits the entire Solar System into deep-space.

But not all short or long-period elliptical orbit comets make it safely thru the Solar System during a return.
Close encounters with the gravity of the larger planets can alter the orbit of a comet, either ejecting it from the Solar System, or causing it to break apart, or impact another planet. In 1994, comet Shoemaker–Levy first broke apart into a string of smaller comets which then all crashed spectacularly into the planet Jupiter. The impact was visible as large smudges on the planet even in small amateur astronomer's telescopes.

Other comets, known as "Sun-Grazers" pass too close to the Sun, and the heat and solar wind causes them to break-up or completely evaporate. (both predicted bright Comets Atlas and Swan in the spring of 2020 fizzled-out).
Eventually, over the course of many returns through the inner Solar System, a comet will eventually lose all of its internal gasses and ice and becomes a small inert object or rubble pile similar to an asteroid.

Whether a comets break-apart, or from just the more gradual decay over multiple returns, the comet's resulting debris field can sometimes result in spectacular meteor showers when the Earth later crosses the comet's orbital path. An example is the annual Perseid Meteor shower every mid-august that has been traced back to the debris from periodic comet Swift-Tuttle. Halley's Comet is tied to the annual Orionids Meteor shower in October.

In its 1986 return, Halley's Comet became the first comet to be observed and visited by an armada of five spacecraft from Europe, the Soviet Union, and Japan, (with the European Space Agency's Giotto probe and the Soviet Union's *Vega 1* and *Vega 2* flying through the comet coma, photographing the nucleus, and observing jets of evaporating material). The United States efforts were stymied by budget cuts and the Challenger Shuttle disaster, but several spacecraft (Pioneer 7, Pioneer Venus, and the International Cometary Explorer) launched on other missions were able to make scientifically useful observations of Halley's Comet. Additionally, there was a world-wide coordinated observational effort between amateur/professional Earth based astronomers to visually and photography observe the comet. Unfortunately for us, the 1986 return of Halley's Comet was the historically least favorable appearance on record for the past 2,000 years. During 1986, the comet and the Earth were on opposite sides of the Sun from each other, giving us the worst possible viewing angle for Earth based observers.
Additionally, the comets brightest period for the northern hemisphere was in late March and early April with the comet visible only for brief periods at sunset close to the horizon. And finally, increased light pollution from across the globe prevented many people living in developed urban areas from even being able to see the comet, if the weather allowed it.

Halley was last observed in 2003 by the Very Large Array Telescope at Paranal, Chile. But, in just a few short years away, in December 2023, Halley's Comet is calculated to have reached the farthest point in its orbit from Sun, and will begin the long fall back into the inner Solar System. The Comet's next return is in July of 2061, where it will be better positioned, both orbital and seasonal, for observation, as this time it will be on the same side of the Sun as Earth, and fairly close, and it is expected to bright with a magnitude of around −1. Of course, who knows what light pollution will be like by then?

Since 1986, in addition to Comet Halley, 7 other comets have been visited by spacecraft. These were the Comets Borrelly, Giacobini–Zinner, Hartley 2, Grigg–Skjellerup, Tempel 1 (Deep Impact – first landing via impact), Wild 2 (Stardust – first sample return mission), and recently Comet Churyumov–Gerasimenko (Rosetta - with its soft lander Philae).

How to Observe Them:

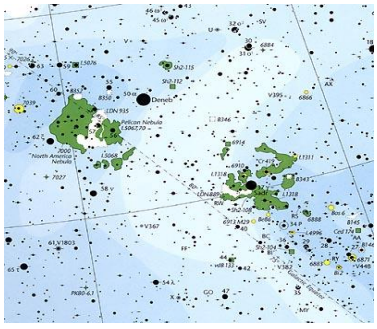
So, what do we look for when observing a comet?
During its passage thru the inner Solar System around the Sun, a comet can display many interesting and dynamic features, including hood-shells, jets, and fountains in the nucleus, and streamers, kinks, and knots in the tail.

But not all these details will necessarily be visible when you observe, as these features can vary from night to night, and sometimes movement and changes in structure can be seen over a single evening.
But knowing beforehand what to look will help you to recognize and identify these features.

Before you begin your comet hunting, good preparation beforehand is very important, as you can waste a lot of time looking in the wrong place for a faint comet. Using a laptop or cell phone planetarium program prepare a wide field finder chart of the comet (or find and download charts from the internet.) Planetarium software can be used to zoom in/out on the fly as needed.

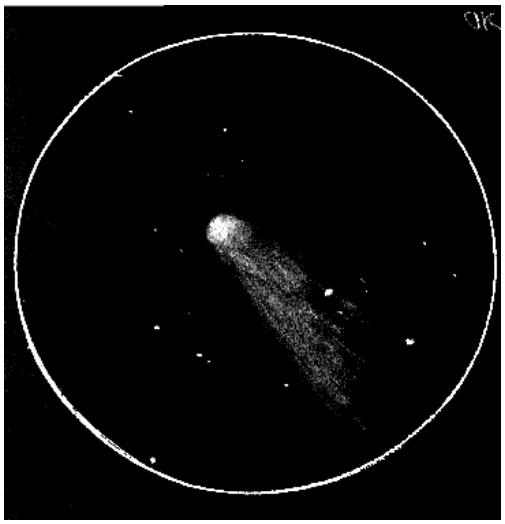
It is always worth the effort to find and travel to the best observing site location available that is readily accessible and has minimal light pollution. An open field with clear sightlines (no trees or buildings) in the direction of the sky where the comet will be is most desirable as comets generally tend to be low on the horizon.
If possible, plan your observing attempt when there is no bright Moon above the horizon, as it will wash-out most of the faint comet making it harder to see or image.

In addition to a chart showing the comets path thru the constellations and a suitable observing location, all the equipment you need to begin comet observing are your binoculars, such as a pair of handheld 7x50 or 10x50, (and larger tripod mounted 20x80 and 25x100 if you have them), or a telescope from small spotting refractors to large dobsonian reflectors with a range of eyepieces that covers low to medium to high magnifications (30mm, 16mm, 8mm, and a barlow). Additionally, if you want a visual record of your observation, you'll need a sketchpad, pencil, and red flashlight. If you wish to capture a photo, you'll need a camera, tripod, and perhaps a mount that tracks. Finally, bring along a good portable chair for taking breaks from standing.

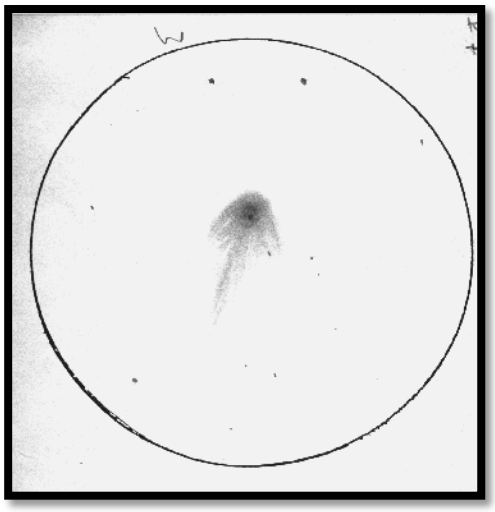


Upon arriving at your observing location, setup your equipment and allow your eyes to dark-adapt for 20 minutes before starting your comet search. Enjoy the view of the night-sky around you. Only use your red flashlight if needed, to consult your star chart or other notes. Begin searching the sky in the general location of the comet.

So once you've located the glow of the comet with your naked-eyes or binoculars and admired the view, examine the comets diffuse coma for any bright visible details. In general, look for a star-like nucleus and specifically for bright outer hoods-shells or bow waves within the coma at the head of the comet. Within the tail, (if any), look for structure along with bright sections of the tail streaming away from the coma.



(LM sketch– Comet Bradfield, 1987 – 13" f4.5 reflector)



(LM sketch– Comet Swift-Tuttle, 1992 – 8" f4.5 reflector)

Then switch to your telescope starting with a low power eyepiece and examine the comets diffuse coma for any bright visible details that the binoculars may have missed. Take your time and look for more intricate details hidden within the coma that may not be visible at a first glance.
Specifically, try to estimate how condensed the coma is. Use the below scale in your visual description of the coma.

0 = Diffuse coma of uniform brightness
1 = Diffuse coma with slight brightening towards center
2 = Diffuse coma with definite brightening towards center
3 = Centre of coma much brighter than edges, though still diffuse
4 = Diffuse condensation at centre of coma
5 = Condensation appears as a diffuse spot at centre of coma – described as moderately condensed.
6 = Condensation appears as a bright diffuse spot at centre of coma
7 = Condensation appears like a star that cannot be focused – described as strongly condensed
8 = Coma virtually invisible
9 = Stellar or disk like in appearance.

Through the telescope, you may see activity within the coma such as "Jets", which can appear as a single ray or a fan of arcing rays projecting away from the central condensation either as straight lines or curved arc towards the Sun. If jets are suspected, switch to higher magnification to confirm. Long jets will show a gradual curve away from the Sun back towards the tail. Another feature to look for is "Fountains". They are diffuse features extending several degrees in angle pointing sunward and are more common than jets. Sometimes the material ejected from jets and fountains can form a series of parabolic "Hoods" or "Shells" often seen concentrically around the central condensation. Finally, look for a bright 'Spine', which is a sharp, narrow streak leading from the central coma condensation back into the tail.

The Comet's tail is generally the most distinctive feature of a comet. There are two types of tails, "Dust" and "Gas" "Dust" Tails are the most common and obviously bright type of tail for visual observers. They are made up of dust particles that reflect sunlight and curve away from the coma. Being made of heavier materials, the dust tail will flow away from behind the coma following the comet's orbital path. Dust tails can vary from faint to almost non-

existent, to very bright depending on how active and dusty a comet is, its distance from the Sun at close approach, and its angle between the Earth and the Sun. Tails often appear as an off-white pastel color, or have a yellowish tinge from the reflected sunlight.

The “Gas” (sometimes called the ion or plasma) Tail being much lighter density than the dust; will point straight out from the coma, directly away from the Sun in the direction the solar wind is heading. Gas tails always display as an electric blue color. Observing gas tails requires a very transparent dark sky and are seldom seen with the naked eye so are best observed visually through binoculars or a telescope.

(LM sketch– Comet Hale-Bopp, 1997 – 80mm f3 refractor)

(LM image– Comet Giacobini-Zinner, 2018 – 8” f6.3 ACT)

Comet tails are usually uniform in brightness and structure however very active comets may exhibit what is known as ‘synchronic bands’. These are bright sections of bands within the dust tail that are caused by periodic outbursts of active jets of dust from the rotating nucleus.
Tails can also be very dynamic structures and can change dramatically in a short period of time often displaying intricate detailed features such as “Kinks”, “Knots”, “Streamers”, and “Disconnections”.
Kinks are twists in the tail material that can be seen to move downwind through the tail over a period of several hours. Knots are dark patches of thicker material (gas or dust) moving downwind through the tail.
Streamers are bright but delicate thin lines, like gossamer, that radiate from the coma running straight down the tail. They can be numerous, very long and be seen superimposed on the dust tail. Disconnection Events, These are very rare to see and are caused by a change in direction of the solar wind, which temporarily severs the tail from the coma. Comet tails, like weather vanes, point in the direction that the solar wind takes them.

(LM sketch– Comet Hale-Bopp, 1997 – 80mm f3 refractor)

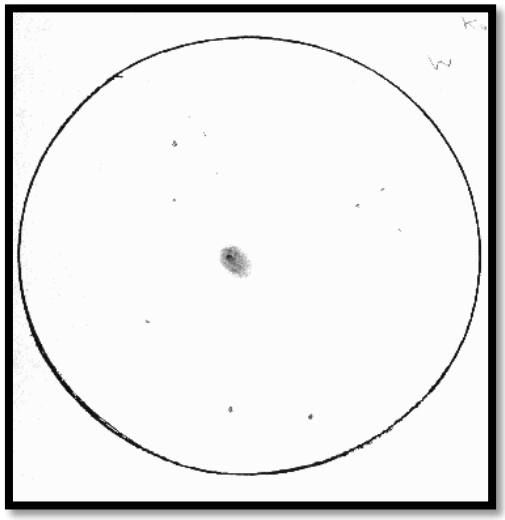
Once done with your low-power scan, then replace the low-power eyepiece with one yielding a higher power and again re-examine the comet. This will allow you to see any fine details in subtle features that may be visible in the comet's coma in and around the nucleus. Also follow the tail leading away from the coma and look for finer details along its length.

If the comet is naked-eye and has a tail, try to determine its length. Comet tail lengths are defined in degrees of arc. For a basic sky measure technique that can be used on naked eye comets, extend your arm and hand in front of you toward the comet. You can then make a rough estimate by:

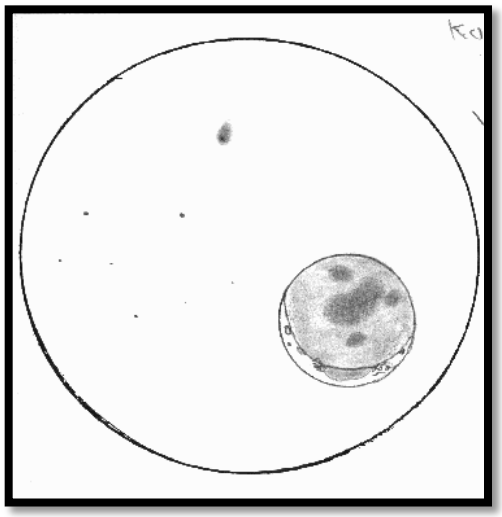
1) Tip of your little finger is about 1 degree in length.
2) Tip of your thumb is about 2 degrees long.
3) Three fingers together is about 5 degrees of length.
4) A closed fist covers about 10 degrees.
5) Your thumb and little finger on the same hand extended will cover about 20 degrees.

If using binoculars or telescope and you have a printed star atlas, you can more precisely plot the comets position and tail length using the stars on the chart. Be careful not to take too long doing this, as some comets can show rapid movement among the background stars.

Try documenting your observation by making a sketch of the comet. Drawings are a good way of training the eye to see more detail and also provide a lasting record of what you saw. It's also a good way to later share the view with family and friends. Don't forget to include information such as equipment used, and the date and time.
If you have the photographic equipment, you may also want to try and capture an image of the comet. The camera will need to expose for several seconds in order to capture the faint comet details, so you will need to use a camera tripod to hold you camera and a timed shutter release to minimize vibrations. If you are using a lens of 50mm or less, you can generally get by with a 30 second or less exposure without the stars showing trails from the Earth's rotation. Anything longer will require a polar aligned mount that will track the stars.
Many recent cell phones come with a camera 'night-mode' feature, so it never hurts to try experimenting using them for a quick comet photo.



(LM sketch– Comet Liller, 1988 – 8" f4.5 reflector)



(LM sketch– Comet Okazaki-Levy-Rudenko, 1989 – 80mm f3 refractor)

When will the Next Comet be Visible?

Generally, while up to a dozen comets may return over the course of a year, usually only one of those will become bright enough to be visible to the naked eye. Most are faint and unspectacular, requiring binoculars, telescopes, cameras, and dark country skies to be observable.

On average, a major comet arrives about every decade and becomes bright enough to be noticed by the casual observer. Particularly bright examples are called "great comets". Great comets arrive on average every 20 to 30 years. Since the year 2000, there has been one great comet, Comet McNaught in 2007, (brightest comet in over 40 years), and two major comets - Comet Lovejoy in 2011, and Comet Neowise in 2020.
But, both Comets McNaught and Lovejoy were only visible in the Southern Hemisphere. The last great comets for us here in North America was Comet Hyakutake in 1996, followed a year later by Comet Hale-Bopp in 1997.

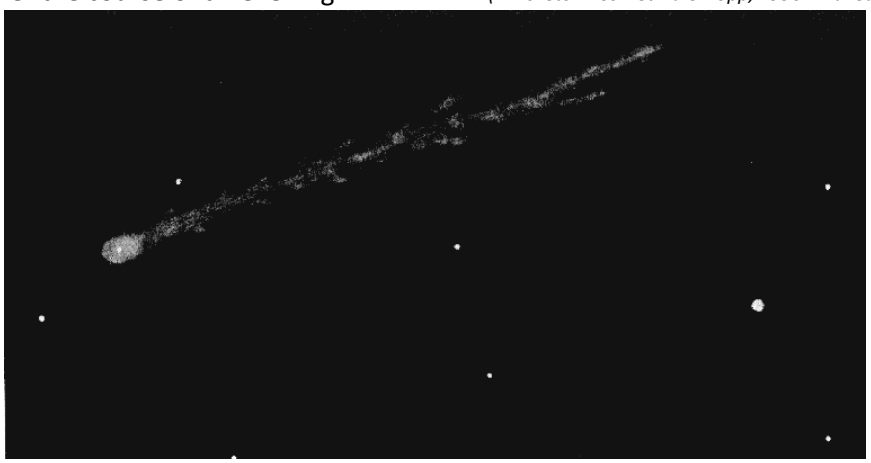
Here's a list of the last 10 "Great Comets from the last 160 years:

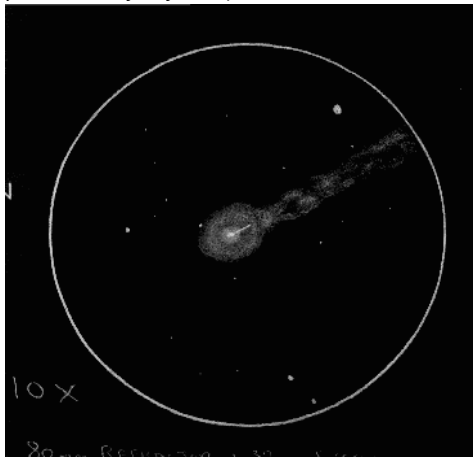
COMET	Earth distance at brightest (AU)	Perihelion distance (AU)	Absolute magnitude	Brightest magnitude	Tail length (°)
C/1858 L1 Donati	0.54	0.57	+3.3	+1.0	50
C/1882 R1 Great September Comet	0.98	0.008	+0.8	–17.0	20
C/1910 A1 Daylight Comet	1.12	0.129	+5.0	–5.0	50
C/1956 R1 Arend-Roland	0.66	0.316	+5.4	+1.0	25
C/1965 S1 Ikeya-Seki	1.02	0.008	+6.2	–10.0	60
C/1969 Y1 Bennett	0.80	0.538	+4.5	0.0	25
C/1975 V1 West	0.86	0.197	+5	–3.0	30
C/1996 B2 Hyakutake	0.10	0.230	+7.3	–0.8	>80
C/1995 O1 Hale-Bopp	1.31	0.914	0.0	–0.7	25
C/2006 P1 McNaught	0.81	0.171	+9.5	+5.5	35

https://www.skyatnightmagazine.com/space-science/greatest-comets-of-recent-times/

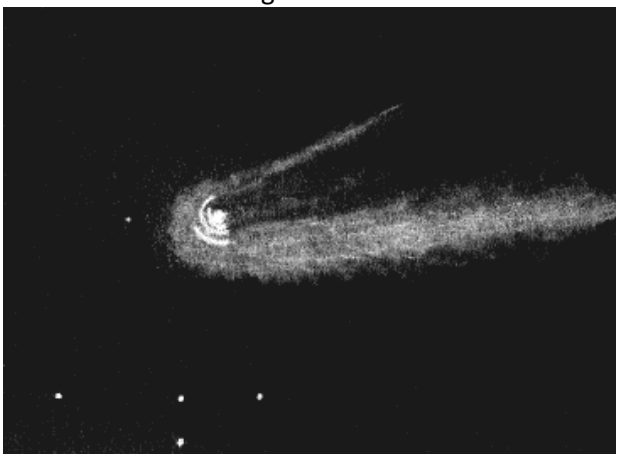
Statistically, in the northern hemisphere, we're about due for a great comet!
But for now, we'll have to get by on the memories of our last two great comets and one major comet:

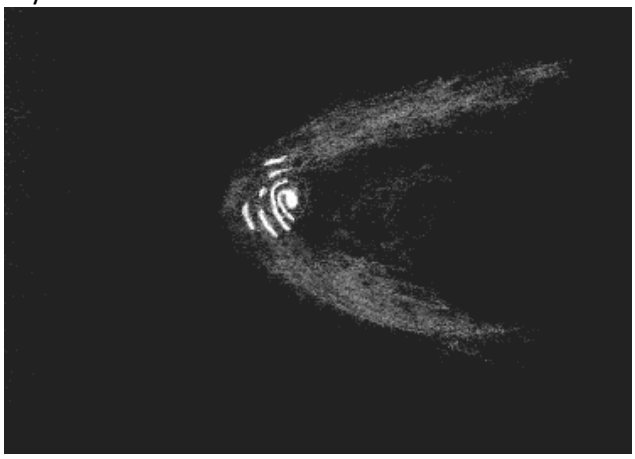
The first great comet was Comet Hyakutake in the spring of 1996, which displayed an extremely long tail of ghostly pale light that extended over half the night sky. The beautiful unexpected splendor of Comet Hyakutake was a treat for the naked-eye, especially in a dark country sky. Telescopically observing Comet Hyakutake's bright coma using high magnifications observers were able to see dynamic displays of Sunward jets and a tailward spine that changed over the course of an evening. *(LM sketch– Comet Hale-Bopp, 1996 – naked-eye and 80mm f3 refractor)*





The next great comet was bright Comet Hale-Bopp, arriving a year later in 1997, and remained visible for months before and after its return. Observers using small telescopes were able to see great details in the comets coma, including jets ejecting dust and gas from the nucleus, and multiple parabolic hoods or shells surrounding the inner coma. Both the dust and gas tails were visible to the naked-eye.

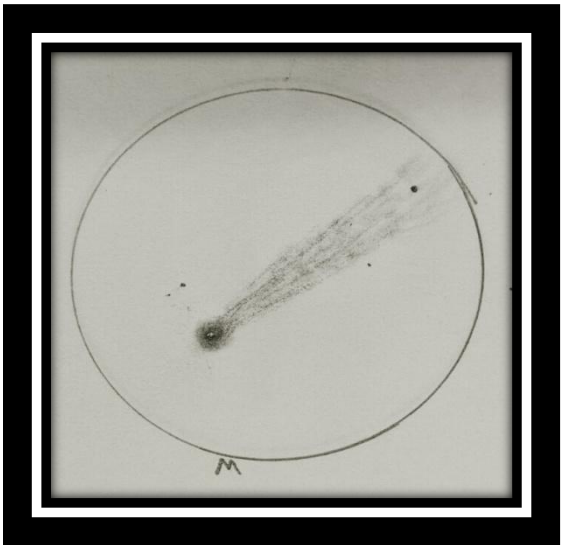




(LM sketch– Comet Hale-Bopp, 1997 – 8" f4.5 reflector and 8" f10 SCT)

The summer of 2020 brought Comet Neowise, a major comet in the northern hemisphere.
The comet was just barely visible to the naked-eye, low in the NW sky, with a bright star-like nucleus surrounded by a bright coma. Observers were able to trace the comet tail for several 10's of degrees. A tailward spine and hints of streamers were visible in the tail. The view greatly benefited from a dark-sky and no nearby streetlights.

(LM image -25mm lens f5.6)



(LM sketch– Comet Neowise, 12020 – 10" f4.5 reflector and image - 8" f6.3 SCT)

Predicting whether a comet will become a great comet, or even visible to the naked-eye is notoriously difficult, as many factors may cause a comet's brightness to depart drastically from predictions. Over the years there have been a number of predictions that have fizzled out. (one spectacularly overhyped comet by the news media was Comet Kouhoutek in 1974, which disappointed everyone by turning out to be a dim comet).
In order for a comet to have a chance of becoming a "Great Comet", it has to have a large, active nucleus, pass close enough to the Sun that solar radiation generates a large volume of gas and dust, (but not too close as to break-apart or evaporate), and have an orbital path that brings the comet to the same side of the Sun as the Earth so as not to be obscured by the Sun as seen from Earth when the comet is at its brightest, and it should have a higher dust content (an "icy dirtball") that will create a large, brightly visible, extended tail.

Comet expectations for 2021:
There are over a dozen comets predicted to return during 2021. Unfortunately, most won't get brighter than 9th magnitude with the exception of Comet Leonard that could possibly reach naked-eye visibility in December. Unless a new comet is discovered in the next few months, here's the best:

Comet D'Arrest - should brightened to about 9th magnitude in the evening sky as it passes closest to Earth on August 2nd in Ophiuchus. It should continue to be visible in the evening sky into the fall.

Comet Churyumov-Gerasimenko (Rosetta mission comet) - with closest approach on November 12th, peak brightness of around 9th magnitude occurs in late November as the comet cruises in the evening sky thru Gemini.

Comet Leonard - in mid-December could become as bright as magnitude 4, and could become a naked-eye object as it rapidly crosses thru Sagittarius low in the southwestern sky at dusk.

Conclusion:

Today I've introduced you to a special class of Solar System bodies.
We learned a little bit about the historical and modern science behind comets, their place in our mythology, and how to observe their internal features. In some ways, the more we learn about comets, the more their mysterious beauty deepens. Hopefully this little presentation has given you a taste of what comet observation is all about, and inspired you to search-out and explore these very rewarding celestial objects.

So I encourage everyone, the next time there's a comet cruising thru the inner Solar System, to get out and try your hand at finding and observing the ghostly diffuse tails of these elusive celestial objects, the Comets!

Thank you.
Larry McHenry

Credits:

Books:

"*A Complete Manual of Amateur Astronomy*", by P. Clay Sherrod, 1981.
"*The First Stargazers*", by James Cornell, 1981.
"*Introduction to Comets*" by John Brandt and Robert Chapman, 1982
"*The Atlas of the Solar System*", by Patrick Moore & Garry Hunt , 1983.
"International Halley Watch Amateurs Observers Manual", by Stephen Edberg, 1983.
"*Comets*", by Martyn Hamer, 1984.
"*Astronomy with a Small Telescope*", by James Muirden, 1985.
"*The Arrival of Halley's Comet*", by Paul Doherty, 1985.
"*Halley's Comet!*", by Francis Reddy, 1985.
"*Comets*", by David C Knight, 1986.
"*Beyond the Blue Horizon*", by E.C. Krupp, 1991.
"*Comets: A Chronological History of Observation, Science, Myth, and Folklore*", by Donald Yeomans, 1991.
"*Earth & Sky – Visions of the Cosmos in Native American Folklore*", by Ray Williamson & Claire Farrer , 1992.
"*Comets, Popular Culture, and the Birth of Modern Cosmology*" by Sara Genuth, 1997
"*Comets in Australian Aboriginal Astronomy*", by Duane W. Hamacher and Ray P. Norris, 2011.

Magazines:

Sky & Telescope
Astronomy
National Geographic

Internet:

Google, Wikipedia & Wikimedia