

The Magic of Comet Hunting

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Abstract

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Hung be the heavens with black, yield day to night!

Comets, importing change of times and states,

Brandish your crystal tresses in the sky. (1.1.2-3)

—William Shakespeare, I Henry VI

In the opening lines of one of William Shakespeare's earliest plays, the great amateur astronomer, as I like to call him, wrote about the majesty of comets. When he wrote that comets import change of times and states, he had something else in mind other than a comet literally plowing into Earth, with devastation so great as to destroy most of life here. Usually no larger than a village, a comet moves about the Sun, slowly and faintly when it is far away, then more quickly and becoming more active and luminous as it closes in from a place beyond Jupiter — plummeting past the orbits of Mars and the Earth.

Those of us who saw spectacular comets in 1996, 1997, 2007, and hopefully this year, will not soon forget those almost fearsome sights in the heavens. In March 1996, Comet Hyakutake, the first of two prominent comets that year, sported a filmy tail that stretched across the entire sky. The sight was remarkable, even in our time when we supposedly understand what a comet is and how it orbits the Sun.



Comet Hyakutake (Copyright Doug Zubenel)

Superstition and History

Past cultures, dating back to biblical times, were terrified by comet appearances so baffling that those who viewed them kept detailed records of their paths across the sky. "A comet appeared in the heavens like a twisting serpent," wrote the Byzantine historian Nicetus Choniates in 1182, "now writhing and coiling back upon itself; now it would terrify people with its gaping mouth; as if lusting for human blood, it seemed about to slake its thirst."¹ As late as 1528, the pioneering French surgeon Ambroise Pare² wrote of a comet: "So horrible was it, so terrible, so great a fright did it engender in the populace, that some died of fear; others fell sick... this comet was the color of blood; at its extremity we saw the shape of an arm holding a great sword as if about to strike us down. At the end of the blade there were three stars. On either side of the rays of this comet were seen great numbers of axes, knives, bloody swords, amongst which were a great number of hideous human faces, with beards and hair all awry...."

Now we keep records for different reasons. We want to learn about comets, and their orbits, and most especially we want to track those comets that could someday pose a threat to our home planet.

A Personal Retrospective

I have kept records of every observing session I have undertaken since the late 1950s, including notes on every one of the almost two hundred comets I have greeted during my lifetime so far. Of all the comets I have seen, the brightest was Comet Hyakutake. On its best night it straddled the entire sky, its head positioned not far from the North star. Once my eyes were adapted to the darkness I could trace its diaphanous tail stretching all the way to the constellation of Corvus deep in the southern part of the sky.

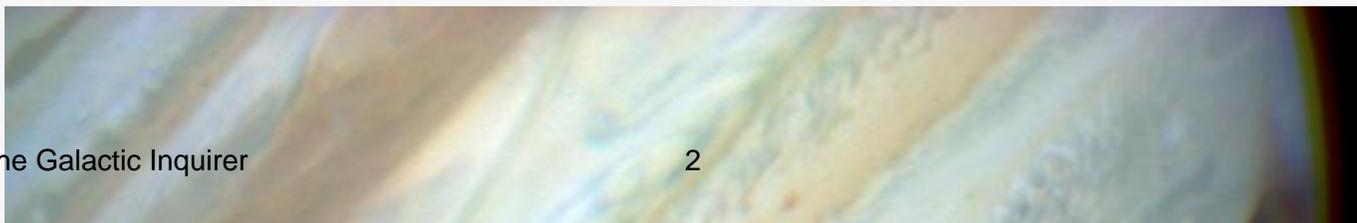
I began my search for comets on 17 December 1965. The idea to start a patrol actually was seeded during the summer of 1965, when I was a camper at the Adirondack Science Camp near Lewis, New York. This was a wonderful place. Designed to instill in the minds of its campers an admiration for nature, for me it accomplished that beyond my wildest dreams. Decades later, my wife and I continue to use the place every summer for an astronomy retreat.

Back in 1965, our camp director had instructed us to come up with a science fair project, but not one typical of high school science fairs. He wanted his charges to excel, to come up with ideas so challenging that they might fail, and even if they succeeded, last a lifetime. I did propose something but it was hardly what I should have done, and after the summer ended I still thought about trying something more ambitious. Meanwhile, on September 18, 1965, Kaoru Ikeya and Tsutomu Seki, two amateur astronomers from Japan, discovered an eighth magnitude comet that was heading for a very close passage around the Sun. In late October I saw that comet in the predawn sky above Montreal.

As I walked toward my French Oral examination at Westmount High School in Montreal on a brisk morning that fall, I knew that one of the questions would involve my career plans. I needed to come up with something that was believable, but also something that could be easily translated into French. I thought about the comet, and suddenly it hit me: I want someday to discover a comet. Mr. Hutchison, the examiner, stared at me in disbelief when I said "Je veux de?couvrir une comete." (I want to discover a comet.) He was rather surprised but accepted my answer, adding that "if you don't discover one within twenty years, I will come back and lower your grade."

Thus I began my comet search a few minutes before midnight, through a break in the clouds on the evening of December 17. A few months later, during the summer of 1966, I missed finding Comet Kilston by a few telescopic fields of view. Over the ensuing years my search waxed and waned, but it never stopped. On Tuesday, November 13, 1984, nineteen years after I began, at last I discovered my first comet.

Over the subsequent years, I have found or co-discovered 23 comets. In 1989 I participated in a photographic patrol, joining with Gene and Carolyn Shoemaker to locate 13 comets. One of these turned out to be the first comet to collide with a planet. In its spectacular crash into the atmosphere of Jupiter in May 1994, this comet gave humanity a lesson in one of the most basic acts in all of nature — that when comets hit planets they deposit materials that could lead, eventually, to the dawn of life. This notion of comets possibly delivering the seeds of life ("panspermia") was confirmed when spectroscopic studies of the impacts on Jupiter revealed the presence of ammonia (NH₃), hydrogen sulfide (H₂S), carbon disulfide (CH₂), hydrogen cyanide (HCN), and other compounds fundamental to prebiotic chemistry.



(Top) Fragments of Comet Shoemaker-Levy 9 shortly before their collision with Jupiter in May 1994 (NASA, ESA, and H. Weaver and E. Smith (STScI)). (Bottom) Effects of the collisions between these fragments and Jupiter's atmosphere (Hubble Space Telescope Comet Team and NASA).

Later I developed several electronic imaging searches, some by myself, and others in collaboration with other observers. It was during one of these searches, a program done with Canadian amateur astronomer Tom Glinos, that Comet Jarnac (P/2010 E2) was discovered. In the late winter of 2010, Glinos reported a newly found object that he thought was an asteroid. However, other observations confirmed that it sported a dusty coma, and therefore was a comet. According to the rules of such discoveries, the comet is named not for the discoverer (Glinos) but instead for the place of discovery (my own Jarnac Observatory).

I was especially gratified by that particular discovery because it brought me back to some of my earliest observing sessions held at my grandfather's cottage, named Jarnac after the area of its Canadian location, Jarnac au Quebec. In particular I recall an observing session there on the evening of August 11, 1962, during which my Grandfather William, Grandmother Genie, and I observed a brilliant Perseid meteor falling to the west in a darkening sky. Its estimated magnitude was minus 10, as bright as the Moon at quarter phase. On the following night, August 12, I observed 112 meteors as the Perseid meteor shower reached its maximum. My grandfather died early in 1973. I think he would have been thrilled that all these years later, a comet bearing the name of his beloved cottage would fly forever through the Solar System. I cannot imagine a more appropriate gift to honor the memory of my grandfather than that.

A Predawn Comet Search

In hopes of sharing what it's like to search for comets, I would like to describe a typical predawn observing session that I conduct nowadays.

Only 90 minutes of darkness remain as I crawl out of bed, walk the hundred or so feet to my observatory, roll open its roof, and turn Miranda, my 16-inch reflector, to the east. The sky has darkened a lot since I left it a few hours ago. Save for distant coyote calls and an occasional chirping of a cactus wren, the world around me sleeps. Wendee, my wife, is sound asleep inside our home. The night is still, poetic, and gorgeous. Starting and aligning the telescope's encoder system takes about a minute, but does nothing to spoil the artistry of this moment. Then I spend a much longer time setting up a group of telescopes in my observatory building, plus the big 25-inch telescope that I used to co-discover Comet Jarnac three years ago, in the building just to the south. Soon I'm ready to go, and I begin searching the sky in a prescribed pattern, moving the telescope from north to south near the eastern horizon at the rate of about a field per second.

As I search, my mind goes back to earlier times rich in comet sightings and lore. Such a period, the 1740s, comes to life this morning from an old book, *An Essay towards a History of Comets*, that I'd been reading. Those were the times of discoverers like Dirk Klinkenberg from The Hague and Jean-Philippe de Che?seaux of Lausanne, and their remarkable comet of 1744. Between March 6 and 9, of that year, the comet displayed an overwhelming fanned tail that featured as many as 11 rays.



The Great Comet of 1744, Comet de Che?seaux-Klinkenberg (Wikipedia Commons)

Still at my telescope, I have completed my first pass in a small up-and-down sweep that gradually moves from north to south. I return north, begin searching an area closer to the Sun, and return to my reverie. Who else, over time, has shared this passion for the cometary phantoms of the celestial opera? A hundred centuries ago, an early American native might have gazed at some long-departed comet from the very spot on which I now sit. More recently, this passion has been pursued by people like Jean-Louis Pons, who holds the record of at least 27 visual discoveries, and George P. Bond, who observed from Harvard

College Observatory as Donati's Comet completed its magnificent visit in 1857.

In each age, comet enthusiasts were amazed at how much their generation had learned about comets from the previous one. So it is with our time. Today we have the benefit of multiple spacecraft encounters with comets, a comet's collision with Jupiter, and comets being found in record numbers. In a sense we are far ahead of those earlier people, but in a greater sense we are not ahead of them at all. The great French scientist Pierre-Louis Moreau de Maupertuis predicted the return of what would become known as Halley's Comet, but he died in July 1759, just a few months before the comet announced its presence. I saw Halley's comet in 1986, four returns later, as part of the most ambitious observing program ever mounted for a single comet, the International Halley Watch. Included in its massive, 26-CD archive are the data from groundbased observatories and amateur astronomers, as well as from five spacecraft that studied the comet. Three of these craft, the Soviet Vega missions and the European Space Agency's Giotto, made very close passes by the comet and took in situ measurements and photographs. Halley, Maupertuis, and all the other people who have felt a passion for comets would have been astounded.



Nucleus and inner coma of Comet Halley as imaged by the Giotto space probe (European Space Agency)

With the first tinge of dawn appearing in the east, I swing Miranda back north again, lower the observing chair, and begin a final pass right at the horizon. It was during such a pass that one night during the summer of 2000 I independently discovered Comet 2P/Encke as it made one of its many returns about the Sun since the French comet hunter Pierre Mechain, and later Jean-Louis Pons, and still later Caroline Herschel, and even later Pons again, first picked it up at the close of the 18th century and the opening of the 19th. When I spotted that little comet, I felt that I was part of a chain of people who, throughout history, has identified with this visitor from space that comes by every 3.3 years. And it is quite a chain: On January 17, 1786, Pierre Mechain found the comet at fifth magnitude. Nine years later, on October 20, 1805, Caroline Herschel, observing from England, discovered the comet as it returned. On that same night, Jean-Louis Pons discovered it. Meanwhile, when the celebrated German mathematician Johann Franz Encke calculated an orbit for this comet, he was surprised to conclude that it might return every 12 years. On November 26, 1818, Pons once again discovered this very same comet. Encke then connected Pons's new comet to the 1805 one, but in so doing he shortened the orbital period from 12 to 3.3 years, and he connected it to the discoveries of Mechain and Herschel.

Since then, many people have recovered or observed Comet Encke, including Horace Tuttle in 1875. This famous cometeer had co-discovered comets Swift-Tuttle and Tempel-Tuttle, the parent comets of both the Perseid and Leonid meteor showers. But at the time of his recovery of Encke on January 25 that year, Tuttle was three days into a U.S. Navy court martial on charges of stealing more than \$8000 from the United States Navy—a very large amount of money at the time. Three weeks after Tuttle recovered Encke's Comet, the court found him guilty, but he received a light sentence, signed off by President Grant, of a dishonorable discharge from the Navy but no prison time. One speculates that Tuttle's fame with comets helped get him off.

Stories like this one show that the saga of comets is enriched by its human side. As I made my own "recovery" of a faint Encke's comet that morning, I was thankful that I didn't have eight thousand dollars to account for. But in a sense I was right there with Tuttle as he made his find during a terribly difficult period of his life. That human side of comets is something I think of now as I struggle to see the stars as they disappear into a brightening sky. As I close up the telescope and the roof and return to bed, my thoughts are filled with the sight of the Milky Way straddling overhead in a quiet, ethereal starfilled sky, in that last quiet hour before the end of night.

References

1. Lucien Rudaux and Georges de Vaucouleurs, Larousse Encyclopedia of Astronomy (New York: Prometheus Press, 1959), 241.