

David Levy's Guide to Observing and Discovering Comets

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Of history, superstition, magic, and science

When beggars die there are no comets seen;
The heavens themselves blaze forth the death of princes.

Shakespeare, *Julius Caesar*¹

When Shakespeare 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. No larger than a village, a comet moves lazily around the Sun, brightening and becoming more active as it closes in from a place beyond Jupiter, past the orbits of Mars, close to the orbit of Earth. Those of us who saw two spectacular comets in 1996 and 1997 will not soon forget those almost fearsome sights in the heavens. In March, 1996, the first of those two comets, Hyakutake, 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. Past cultures, dating back to biblical times, were terrified by appearances so unusual 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 Nicetus 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.”² As late as 1528, Ambroise Pare 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 ...²

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 planet.

A comet in the Bible?

Humanity's relation with comets dates back as far as historical records take us. This biblical passage from 1 Chronicles appears every year in the Passover Seder: "And David lifted up his eyes, and saw the angel of the Lord stand between the earth and the heaven, having a drawn sword in his hand stretched out over Jerusalem."³ It describes some "sign" that protested an ill-advised census King David had ordered for his city of Jerusalem. Could that sign have been a comet? The ancient Hebrews, like their Arabic neighbors, enjoyed looking at the night sky and sought meaning among its many stars and events. A bright comet, appearing once every two decades or so, would have attracted their attention as much then as now.

Could King David have witnessed the comet that was apparently observed in Leo in 1002 BC? Or might it have been the comet that appeared half a century later, in the northern sky, around 959 BC. For no special reason other than the timing being about right, I like to think that the 959 BC comet was the comet of David.

Broom stars and bushy stars

It is a good thing that people throughout history have been moved by the passages of comets. Had they been less interested, we would not have such detailed records of their paths across the sky, as well as what they looked like and how their appearance changed with time. We have records of comets dating back to 1059 BC, when a comet with a tail pointing to the east appeared in the evening sky. Chinese recorders eventually noted two types of comet, the *po* and the *hui*. The *po*, or bushy star comet, had large fuzzy "coma" or atmosphere. If such comets had tails, they were unremarkable. The *hui* or broom star comet, on the other hand, was noted especially for its tail. Centuries later, observing from a different time and place, the Greek philosopher Aristotle divided comets into two classification groups: tailed and tailless. The tailless variety he called fringed and bearded stars. However, Aristotle did more than offer descriptions: He attempted to define the *nature* of comets. He thought that they formed when the Earth exhales hot, dry air into the upper reaches of its atmosphere. This view lasted for so long that it became almost impossible to challenge.

The heavens blaze forth the death of princes

Our understanding of comets as portents lasted a very long time. The ancient Romans feared them, and at least some in the audiences who came to watch Shakespeare's *Julius Caesar* 1500 years later still feared them. Shakespeare invoked comets and their supposed effects frequently in his plays. In *Julius Caesar*, Calpurnia begs her husband to stay away from the Senate. When Caesar asks why, she explains:

Caesar, I never stood on ceremonies,
 Yet now they fright me. There is one within,
 Besides the things we have heard and seen,
 Recounts most horrid sights seen by the watch.
 A lioness hath whelped in the streets;
 And graves have yawn'd and yielded up their dead;
 Fierce fiery warriors fight upon the clouds, ...
 And ghosts did shriek and squeal about the streets.
 O Caesar, these things are beyond all use,
 And I do fear them!⁴

When all these events still did not move Caesar, Calpurnia added the appearance of comets in the night:

When beggars die there are no comets seen;
 The heavens themselves blaze forth the death of princes.¹

Did Calpurnia actually see a comet? Possibly she did in real life, but not *before* Caesar was murdered on the Ides of March, 44 BC at the foot of Pompey's statue. Two months later, during a series of games, a bright comet with a tail perhaps 12 degrees long – half the length of the Big Dipper (or Plough) – moved out of the northern sky. Plutarch wrote “among the divine portents there was also the great comet; it appeared very bright for seven nights after the murder of Caesar, then disappeared.”⁵ Calpurnius Siculus went further, blaming the comet for the civil war that followed: “when, on the murder of Caesar, a comet pronounced fatal war for the wretched people.”⁵

To the people of Caesar's time, as to some in Shakespeare's time, comets were portents. Yet from this fear and attention came the beginnings of wisdom in the mind of a member of Emperor Nero's government. He was the writer Lucius Annaeus Seneca, and he lived in Rome in the first century AD. His writings, particularly his *Quaestiones Naturales*, made him immortal, but his life was ended at the whim of Emperor Nero. One chapter of the *Quaestiones*, called *De Cometis*, is a priceless look into the past of what people thought about comets.



Figure 1.1. A view of Comet Hyakutake (C/1996 B2) showing the comet behind a silhouette of a saguaro cactus plant, taken by the author on March 26, 1996, in Arizona, using a Yashika twin-lens camera.

Born around 4 BC, Seneca lived through the reigns of Caligula, Claudius, and Nero. When 17-year-old Nero became Emperor of Rome, Seneca, as his tutor, enjoyed considerable power in the government. In AD 59, Nero murdered his mother, and then sought Seneca's forgiveness. As Nero's tyranny set in, Seneca struggled to retain the Emperor's favor by using celestial events, like comets, to excuse his leader: A year after the murder, he invoked the comet of AD 60: "There is no reason to suppose," he wrote, "that the recent [comet] which appeared during the reign of Nero Caesar – which has redeemed comets

from their bad character – was similar to the one that burst out after the death of the late Emperor Julius Caesar, about sunset on the day of the games to Venus Genetrix.”⁶

It is amazing that Seneca found the time and energy to complete *De Cometis* in AD 60, while Nero was sinking into madness. “No man is so utterly dull and obtuse,” Seneca wrote “with head so bent on earth, as never to lift himself up and rise with all his soul to the contemplation of the starry heavens, especially when some fresh wonder shows a beacon-light in the sky.”⁶

Seneca had gifted insight about comets. “Blind to all the celestial bodies, each asks about the newcomer; one is not quite sure whether to admire or to fear it. Persons there are who seek to inspire terror by forecasting its grave import. But by my honour, no one could embark on a more exalted study.”⁶ Exalted, perhaps, but somewhat intolerant: Seneca viciously argued with those who, even though they had lived centuries earlier, had different opinions. “It requires no great effort to strip Ephorus [who lived more than three centuries earlier] of his authority; he is a mere chronicler.”⁶ Seneca accuses Ephorus of careless reporting: he says the Greek astronomer “asserts that the great comet [possibly the one of 373 BC] which, by its rising, sank Helice and Buris, which was carefully watched by the eyes of the whole world since it drew issues of great moment in its train, split up into two stars; but nobody besides him has recorded it.”⁶ Seneca could not imagine comets splitting into two or more pieces; but today we know that comets split with surprising frequency. Byzantine records show that around 822 “A comet was seen in the sky as a sort of two moons joined together brightly, and moreover separated by different attachments....”⁷ Comet Biela divided into two pieces in 1846, and returned as a pair of comets a few years later, although it was never seen again. Comet West broke into four pieces in 1976. Comets Levy 1998e and Shoemaker–Holt, which were a single comet before they divided some 12 000 years ago, were independently discovered by me and by the Shoemakers and Henry Holt in 1988. One of the many comets discovered by Project LINEAR, a modern automated comet and asteroid search, split apart in 2001. Lastly, the most famous and most recent example of a split comet was Shoemaker–Levy 9, which in 1993 divided into 21 fragments after an encounter with the tidal force of Jupiter, and was the next year destroyed by its collision with that planet.

As to the nature of the comets he loved, Seneca agreed with Aristotle that they are formed “by very dense air, and since the most sluggish air is in the north, they appear in greatest number in that direction.”⁸ Although comets are distributed across the sky almost at random, in Seneca’s own experience, comets happened to favor the sky in the north. The comet of June AD 54, widely blamed for the death of Nero’s predecessor Claudius, passed through



Figure 1.2. Comet Shoemaker–Levy 9 (D/1993 F2) as imaged through the NASA Hubble Space Telescope in January, 1994. This is one of the first images taken to test the telescope after it was repaired at the end of 1993. It shows the comet split into at least 21 fragments. NASA/HST.

the northern constellation of Gemini. Another comet the following year also appeared in the sky north of Cancer, and the one in AD 60, shortly after the beginning of Nero's reign, might have passed near the north celestial pole. Seneca's major contribution to the *science* of comets was that even though he saw them as atmospheric creations, he considered them permanent. "I rank it among Nature's permanent creations," he declared:

"In none of the ordinary fires in the sky is the route curved; it is distinctive of a star [meaning a planet] that it describes a curve in its orbit. Whether other comets had this circular orbit I cannot say. The two in our own age [the comets of AD 54 and AD 60] at any rate had.... A comet has its own settled position. For that reason it is not expelled in haste, but steadily traverses its course; it is not snuffed out, but takes its departure."⁹

A major contribution is Seneca's invocation of the work of earlier thinkers; in fact his summary of the views of Apollonius of Myndos, the fourth-century BC scholar, might be the only record of those views. A comet, Apollonius had thought, is "a distinctive heavenly body, just as the sun or the moon is."⁹ He even explained how comets brighten as they approach Earth, then fade as they depart. Four centuries before Seneca, Apollonius had hit upon the real nature of comets, only Seneca did not see it that way. If comets really brightened as they drew closer to Earth, then why, he asked, are some comets at their brightest when they first appear on the scene? Considering that Seneca did not have the benefit of our modern understanding of the nature of comets, his argument makes sense. Had Apollonius had access to a modern telescope, and to the mathematics of computing orbits, he would have countered that some comets might approach from behind the Sun, brightening as they arrive, but entirely unseen until they suddenly appear at their maximum brightness.

How wonderful it would be if we could gather all the great cometary thinkers, and have them debate comets! Imagine Seneca lecturing Apollonius, and then Apollonius getting the last word. Seneca's reality, sadly, was far darker. Years later the Roman historian Tacitus would look back on the days of Nero and his reaction to the comet of the summer of AD 60 – "a phenomenon which, according to the persuasion of the vulgar, portended change to kingdoms: hence, as if Nero had been already deposed, it became a topic of inquiry, who should be chosen to succeed him."¹⁰ Seneca was quite obviously still trying to stay on Nero's good side, but as Tacitus pointed out, the appearance of the comet of AD 60 was punctuated by another sign that hit close to home: "as Nero sat at meat in a villa called Sublaqueum, upon the banks of the Simbruine lakes, the viands were struck by lightning and the table overthrown...."¹⁰

In the year AD 65, Nero accused Seneca of participating in a attempted coup and ordered him to “prepare for death” – according to custom this gave Seneca his choice of demise. Seneca chose cutting his wrist and bleeding to death, leaving *Quaestiones Naturales*, his priceless treasure, to be lost for more than a thousand years. Finally, in the twelfth century his book was discovered. Two millennia after he wrote it, Seneca’s towering contribution still allows us to make sense of how thinking about comets has evolved over time.

NOTES

1. *Julius Caesar*, 2.2.30–31 (This and subsequent Shakespeare quotations are taken from *William Shakespeare: The Complete Works*, ed. Peter Alexander (London and Glasgow: Collins, 1964).
2. Lucien Rudaux and Georges de Vaucouleurs, *Larousse Encyclopedia of Astronomy* (New York: Prometheus Press, 1959), 241.
3. 1 Chronicles 21 : 16.
4. *Julius Caesar*, 2.2.13–19, 24–26.
5. A. A. Barrett, “Observations of comets in Greek and Roman sources before A.D. 410,” *Journal of the Royal Astronomical Society of Canada*, 72:2 (1978), 81–106.
6. Seneca, Lucius Annaeus, *Quaestiones Naturales*, VII, *De Cometis* I, 1, translated by John Clark and Sir Archibald Geikie (London: Macmillan, 1910).
7. R. F. Rodgers, “Newly-discovered Byzantine records of comets,” *Journal of the Royal Astronomical Society of Canada*, 56:5 (1952), 177–180.
8. Seneca, *De Cometis* XXIII, 1.
9. Seneca, *De Cometis*, XVII, 1.
10. *The Works of Tacitus*, Oxford translation (London: G. Bell & Sons, 1910), 367–368.