Carolyn S. Shoemaker
(1929–2021)

Co-discoverer of first comet known to collide with a planet in modern times.

For many years, Carolyn S. Shoemaker held the record for the largest number of comets discovered by an individual, but by far her most famous discovery was comet Shoemaker–Levy 9. From 16 to 22 July 1994, fragments of this comet, travelling at some 60 kilometres per second, collided with Jupiter, resulting in the most dramatic explosions in the Solar System ever witnessed by humanity. The dark spots left by the impacts were visible for almost a year. This singular experience had begun almost 16 months previously at the Palomar Observatory, California, when Shoemaker stopped scanning her photographic plates, looked up and said, "I do not know what I have, but it looks like a squashed comet." In the following few minutes, her husband Gene and I confirmed the sighting.

Shoemaker's achievements went far beyond this discovery. Between 1980 and 1994, as a member of the Palomar Asteroid and Comet Survey (PACS), she found 32 comets, plus more than 400 asteroids. Although PACS's objective was to find asteroids or comets that could pose a threat to civilization, the discovery of Shoemaker–Levy 9 completely overshadowed that aim. The interest generated by the comet's impacts with Jupiter was almost as spectacular as the collisions themselves. For the first time, people the world over grappled with questions about what transpires when comets strike planets, and how these impacts might offer an insight into the origins of life on Earth.

Born in Gallup, New Mexico, Shoemaker grew up in Chico, California. At what is now California State University, Chico, she earned bachelor's and master's degrees in history, political science and English literature. She had no interest in science. However, at her brother's wedding, she met geologist Gene Shoemaker, who was also her brother's roommate at the California Institute of Technology in Pasadena. Carolyn was enthralled by how Gene brought geology to life, and they married in 1951. She left her career as a schoolteacher to begin raising their three children, while her husband trained astronauts to conduct geology experiments during moonwalks.

As the children grew older, he suggested that she join his new programme to search for near-Earth asteroids. She proved to have a keen eye and an uncanny ability to use the stereomicroscope to look for differences in photographs of the same patch of sky taken

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short intervals apart, discovering her first comet on 3 September 1983. By the time I joined the team in 1989, Carolyn had found 17 new comets. During this time, she became familiar with the idiosyncrasies of the first and oldest telescope at Palomar, the 46-centimetre 'Schmidt camera'. It was never converted to today's electronic standards; instead, it used only photographic film. The most successful film Carolyn and Gene used was a very fine-grained Kodak 4415, hypersensitized in an oven for 6 hours beforehand.

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Each observation began by loading a 15-centimetre disc of film into a plateholder, mounting it into the telescope, and exposing the film for 8 minutes. It would then be placed in a light-tight box, and a new film inserted. Our nights would be divided into sets of four, sometimes five, fields; we then repeated each exposure. At our most efficient, the time between the end of one exposure and the start of the next was as little as 90 seconds. Our nights would be divided into observations of four, sometimes five, fields of the sky; we then repeated each exposure. It was during one of these routine sessions that we recorded the two 'discovery' images of Shoemaker–Levy 9. When Brian G. Marsden at the Harvard-Smithsonian Center for Astrophysics calculated that the comet was on a collision course with Jupiter, Gene thought: "In my lifetime, I am going to witness a cosmic impact." Carolyn thought: "I am going to lose one of my comets."

One consequence of these observations is that, since 1994, cosmic impacts have been taken seriously, and more programmes around the world are looking for comets and asteroids that could pose a threat to Earth. Other lines of research are pursuing the idea that life on Earth might have been seeded by simple organic molecules arriving from space on comets. And, parenthetically, the 'giggle factor' – the offhand reaction of journalists and laypeople to the idea of objects from space hitting Earth – has dissipated completely.

After the impacts, Carolyn resumed her search with PACS, along with her husband and me. Although the programme concluded at the end of December 1994, the team continued the work with two smaller Schmidt cameras at the Jarnac Observatory in Arizona. Gene was killed in a car accident in Australia in 1997. Carolyn bravely continued her work after that.

Over the years at Palomar, there were times when Carolyn needed to remind the rest of her team why our work was so important. During a rare display of the Northern Lights at Palomar, she forced Gene to stop observing for a short while and enjoy the shimmer in the sky. She understood clearly that although the scientific goals mattered, PACS would not have been worthwhile had the team members not retained their sense of wonder.

Carolyn never really considered herself a scientist, although she absorbed a large amount of geology and astronomy from her husband. She was a forthright person, gifted with inordinate patience and a fine sense of humour. Before the Jupiter impacts, a reporter asked her what would happen if all the comet's fragments were to hit Earth instead. "We would all die," she answered. The interviewer explained that this was for a children's programme, then posed the question again. Carolyn's second answer: "We would all be very uncomfortable."

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