

Francis Perey's aunt died from the element she discovered

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Carolyn Krause brings you this *Historically Speaking* story from Joe McGrory. Another example of the interest in our history and the amazing stories readers bring to us.

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Francis Perey, a nuclear physicist retired from Oak Ridge National Laboratory, had a famous aunt whose life as a scientist and cancer victim was described recently by Veronique Greenwood, Perey's granddaughter. Her article "My Great-Great-Aunt Discovered Francium. And It Killed Her" was published in the Dec. 3, 2014, edition of New York Times magazine.

Marguerite Perey (1909-1975) began work at the age of 19 as a personal technician of Marie Curie, the famous Polish scientist who conducted her research with her husband Pierre at their Radium Institute in Paris. Curie was the first woman to be a Nobel Laureate and the first to win two Nobel prizes. She discovered two new elements—polonium and radium.

Perey discovered one new element in 1939—francium. Like polonium and radium, francium emits radioactivity—a word Marie Curie coined that refers to the emission of radiation and particles from spontaneously disintegrating atomic nuclei. Because of her discovery, in 1962 Perey was the first woman to be elected to the French Academy of Sciences. Her mentor Marie Curie had been denied such an honor.

The youngest of five children of a flour-mill owner in Villemomble, just east of Paris, Perey had to abandon her dream of becoming a physician when her father died. Instead she attended a vocational college to be trained as a chemistry technician. Curie interviewed and hired Perey in 1928 because she was the top chemistry student at the college.

According to Greenwood, Perey later recorded her first impression of Marie Curie: "Without a sound, someone entered like a shadow. It was a woman dressed entirely in black. She had gray hair, taken up in a bun, and wore thick glasses. She conveyed an impression of extreme frailty and paleness."

Shortly after Christmas of 1938, more than four years after Marie Curie had died, the 29-year-old Perey made her signature discovery. For 10 years Perey had been isolating actinium from all other components of uranium ore, so Curie could study the byproducts of uranium decay. Here's how Greenwood describes her great-great-aunt's work:

"In a glass vessel, she examined fluid containing metal salts. She carefully dosed it with lead and hydrogen sulfide, then with barium, causing the solution to separate into different substances. She was in the final stages of purifying actinium, one of the rarest and most dangerous elements yet discovered, from uranium ore."

Perey observed that the actinium she had been separating from lanthanum, another element in uranium ore, emitted radioactive decay particles with an unexpected energy level that was lower than that reported for actinium-227. She suspected that an unknown isotope was present.

"By adding cesium chloride, Perey coaxed the actinium to form crystals; then, through a series of meticulous tests, she laid down the proof that this radiation was something new," wrote Greenwood. "Like her mentor, she had discovered an element, which she named francium, in honor of her country."

She proposed naming element 87 catium (it was originally called eka-caesium in the periodic table), but her supervisor, Irène Joliot-Curie (daughter of Marie and Pierre Curie), opposed the idea. Perey then suggested francium, the name officially adopted in 1949 by the International Union of Pure and Applied Chemistry. The periodic table has two elements named after France, the other being gallium.

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Francium (Fr) is a highly radioactive metal that decays into astatine, radium and radon. It is the last element to be first discovered in nature rather than synthesized. Francium is the most unstable of the naturally occurring elements. Its most stable isotope, francium-223, has a half-life of only 22 minutes.

From 1925 through 1936, scientists from Russia, England, Romania and the United States had claimed they had discovered the element credited to Perey in 1939. Fred Allison, a native of Virginia, made the claim in 1930; in 1934 H. G. MacPherson—then with the University of California at Berkeley and later a researcher and manager at ORNL—disproved the effectiveness of Allison's magneto-optical machine and declared Allison's discovery invalid.

After her discovery of francium, Perey won a grant to study for her graduate degree. In 1946, she defended her Ph.D. thesis at the Sorbonne. In 1949 she was appointed head of the department of nuclear chemistry at the University of Strasbourg, where she began to explore the biological effects of the element. Perey had hoped that francium could be used to diagnose cancer. She published papers on her experiments that showed francium concentrating in tumors. But its application for cancer diagnosis was later proven impractical.

Like Marie Curie, Perey died of cancer from exposure to radiation. "She spent the last 15 years of her life in treatment for a gruesome bone cancer that spread throughout her body, claiming her eyesight, pieces of her hand and most of the years in which she had planned to study francium," Greenwood wrote. "As the disease progressed, she warned her students of the horrible consequences of radiation exposure. Francis, my grandfather, says he recalls hearing that when she walked into labs with radiation counters in her later years, they would go off.

"There is a common narrative in science of the tragic genius who suffers for a great reward, and the tale of Curie, who died from exposure to radiation as a result of her pioneering work, is one of the most famous. But in truth, you can't control what it is that you find—whether you've sacrificed your health for it, or simply years of your time."

Greenwood blames the Curies for "a long tradition of lax safety practices." She wrote: "Although radiation's connection to cancer was known and the lab's own employees had clearly suffered, the Curies made few adjustments to protocol. Marie Curie's principal adaptations were to ask scientists to submit to blood tests and to encourage workers to take short breaks in the garden, which provided no real protection."

Four months before Perey started work at the Radium Institute, the dying Radium Girls won a court case in June 1928 in what is called a landmark in the history of occupational health. Starting in 1917, Greenwood wrote, these young women were hired at the United States Radium Corporation factory in Orange, N.J., "to paint watch faces with glow-in-the-dark radium paint. The workers were told that the paint was harmless and were encouraged to lick the paintbrushes to make them pointy enough to inscribe small numbers. In the years that followed, the women began to suffer ghoulish physical deterioration. Their jaws melted and ballooned into masses of tumors larger than fists, and cancers riddled their bodies."

From the Curies' point of view, did dedication to scientific discovery demand a willingness to poison oneself? And was the sacrifice worth it?

"It turns out that at any given moment, there is far less than a gram of francium on earth: only a tiny fraction of actinium decays in a way that produces francium, and after a few fleeting minutes, it winks out of existence again," Greenwood wrote. "Perey, for all her suffering, discovered an element that almost doesn't exist."

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One scientist Greenwood talked with produces francium in an accelerator in the hope it might be useful for shedding light on the structure of matter. Regardless, one Perey "had achieved some measure of scientific immortality. But as I grew older, her legend took on a slightly different shape."

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Thanks Joe and Carolyn for an excellent glimpse into the early history of the discovery of radioactive elements. While such discoveries have been accompanied with danger, without the dedicated efforts of such individuals there would be less advances in knowledge and technology.



Sonia Cottelle (left) and Marguerite Perey (second from left) at the Curie laboratory in 1930. Each died from radiation exposure. Credit Musée Curie/ACJC Collection



Perey in 1938. Credit Musée Curie/ACJC Collection

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Perey (left) and Cotellet in the garden at the Radium Institute in 1930. Credit Musée Curie/ACJC Collection