PITTSBURGH LINK TO A DEADLY CURE

JOSEPH M. FLANNERY had all the attributes of a turn-of-the-century industrialist, including a Teddy Roosevelt demeanor and an Indiana Jones attraction for low odds and high adventure.

By dumping $20,000 in gold on a Peruvian chieftain's desktop in 1905, the brawny Pittsburgh native gained control of a mother lode of vanadium ore 16,000 feet in the Andes Mountains. He and his brother, James J. Flannery, proceeded to pioneer production of vanadium steel that, among other impacts, enhanced the American automotive industry and construction of the Panama Canal.

When cancer struck the Flannerys' younger sister, Joseph adapted his expertise in vanadium to the production of radium — the elusive radioactive metal touted as a cancer cure — and soon was producing commercial quantities for $180,000 a gram (less than a thimbleful).

All this from two funeral directors who studied metallurgy in their spare time before launching careers as high-risk entrepreneurs. Through ambitious achievements, the Flannerys became an important supporting cast for American industrialism of the early 20th century. Their accomplishments with radium and vanadium drew respect and enhanced the works of Marie Curie, Henry Ford and Col. George W. Goethals, the U.S. Army engineer in charge of construction of the Panama Canal.

When the brothers died three weeks apart in 1920, the nation's top newspapers used big headlines to proclaim them benefactors of mankind and industrial giants who forged America's superiority in alloys and radium. By then the world had grown frantic for radium: "A story unequaled in the world's history," proclaimed G.W.C. Kaye in a 1917 article in Scientific American Supplement. S.A. Von Sochocky, a leading radium scientist, described radium in 1921 as "one of the most wonderful stories in the world" that has affected "health and even life itself."

"What radium means to us today is a great romance in itself," he wrote. "But what it may mean to us tomorrow, no man can foretell."

Tomorrow, however, has arrived and Sochocky's statement begs a response. How should the modern era regard two ingenious entrepreneurs whose ventures advanced the industrial age but began a burgeoning radiation contamination problem that now requires a projected $1.2-billion cleanup by the U.S. Department of Energy?

The $1.2 billion doesn't include cleaning up more than 30 active uranium mine sites in Colorado, Utah, New Mexico and Wyoming that each will cost mining companies $5 million to $40 million.

The DOE's pilot cleanup project was staged from 1983 through 1986 in Canonsburg, where Joseph Flannery established his Standard Chemical Co. plant in 1911 and pioneered production of radium. The cleanup of low-level radioactive waste in Canonsburg cost $43.2 million.

Joseph Flannery, right, atop a Peruvian ore deposit, which was shipped to Bridgeville plant.

Because of the 1,600-year half-life of radium (the time it takes for half the material to undergo radioactive decay), the 30-acre dead spot in the Washington County community must be maintained and monitored for a millennium. Maintenance and monitoring costs last year were $30,000.

The fact is, radium was killing Sochocky as he praised it. Within a few years of his upbeat account, the unwitting scientist was dead from anemia caused from drinking radium nostrums, handling radium with bare hands and using glow-in-the-dark radium paint. Within a decade of the Flannerys' deaths, it became obvious to the medical community that radium was not the benign healer as was thought, but a "deadly life saver" that required careful handling.

So what was it that Sochocky could not foretell in 1921?

That in time, the Flannery legacy would pit a former era's whirlwind industrialism against growing concern for environment and health. That, if caution isn't practiced from the outset, one generation's cure can become another's curse.

WHAT'S AMAZING about the Flannerys was the energy, native intelligence and business savvy they used to progress from a thriving funeral business in Oakland to worldwide fame as producers of flexible staybolts (which prevent steam from separating the firebox and boiler sheet in a locomotive), vanadium steel, then radium.

By David Templeton

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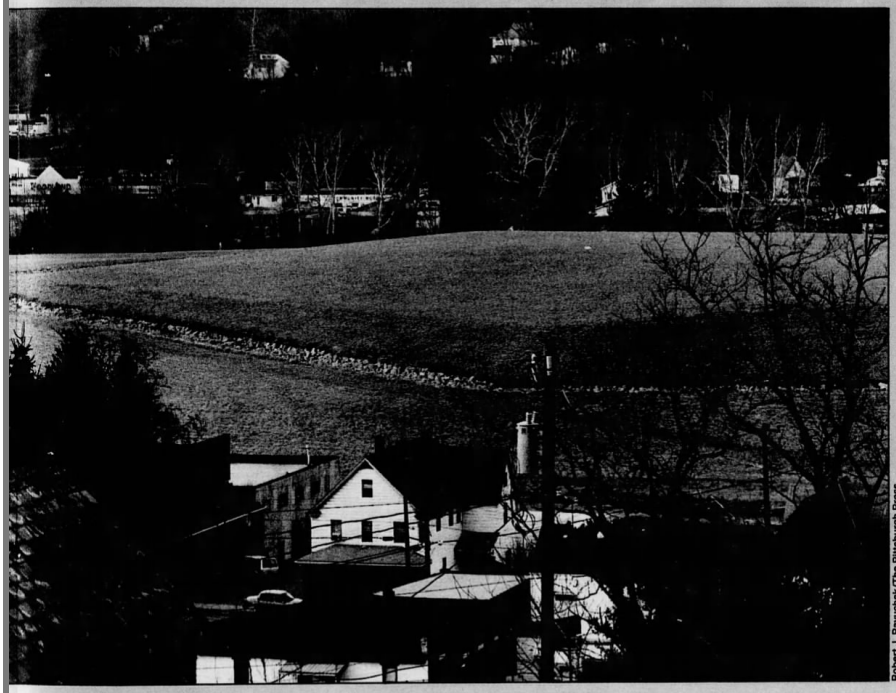
Joseph Flannery's Standard Chemical Co. produced radium in Canonsburg. The plant site underwent a $43.2 million cleanup in the mid-'80s.



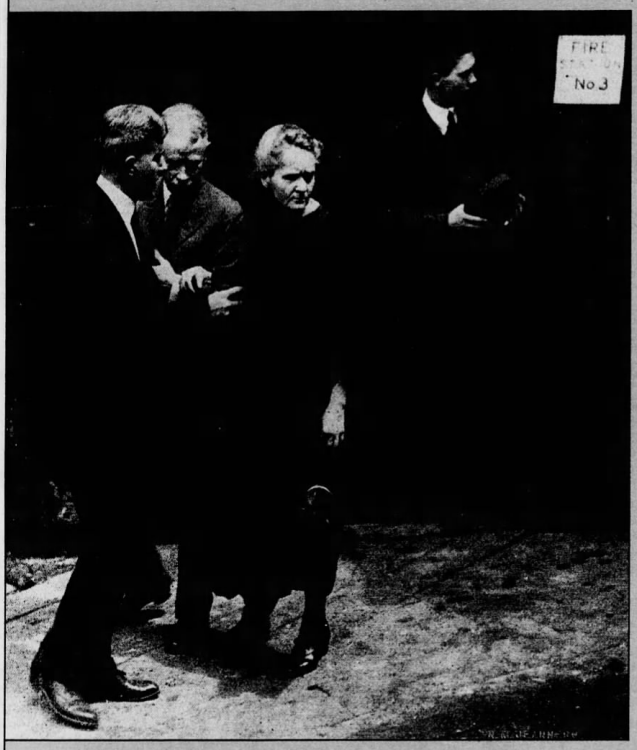
Robert J. Pavuchak/The Pittsburgh Press

The self-taught metallurgists purchased a patent in 1903 for a flexible staybolt used in locomotives, and opened the Flannery Bolt Co. in Bridgeville. The bolt was a success, but a restless desire to upgrade their product sent the Flannerys searching for better metals, such as the vanadium steel used in Scandinavian swords. Discovery of rich vanadium deposits in the Mina Ragra region of the Andes in 1905 caused European steelmakers to rush to obtain mineral rights.

With only $20,000 to invest, Joseph Flannery sent two men by steamboat to purchase rights. Although his agents verified the richness of the ore, they were unable to acquire rights from a Peruvian chieftain who had no need for Flannery's money. So Flannery himself landed on Peru's west coast — arriving barely ahead of European prospectors who were climbing the Andes from the east.

"Realizing the psychological effects of gold, especially in a mountain town far from the commercial centers of the world, Flannery quickly obtained an old carpet bag, converted his money into gold coin, went to the home of the mine owner and dumped the whole glittering mass upon his office table," states an account published by the Vanadium Corp. of America, successor to Flannerys' American Vanadium Co. "Without an unnecessary word, the young Pittsburgher reached for a rule and divided the pile of coin into what seemed two equal parts. 'That half for your mine,' he said. 'This half to improve and work the mine and a good job for you at a big salary to run it for our company.' " The deal was closed then and there, the account says.

Flannerys' company relied on llamas to carry the ore out of the Andes to a Pacific



In May 1921, Madame Marie Curie, who discovered radium, visited Standard Chemical Co. plant in Canonsburg, where commercial quantities of radium that sold for $180,000 a gram were produced.

port, where it was shipped to Bridgeville. James took charge of the financial and mining interests. Joseph planned and single-handedly conducted "one of the most dramatic and successful campaigns of education and salesmanship the steel world has known," states an account published in 1921 in the journal Radium. His goal was to convince Henry Ford to use vanadium steel in his automobiles and Goethals to use it in the lock-gates of the Panama Canal, completed in 1914. A third goal was to convince a Canadian engineer to use vanadium steel in the construction of the Quebec Bridge.

The Radium account states that Flanerys' vanadium company built an automobile frame with the alloy, then invited Henry Ford's staff to watch as it was shoved over a cliff. The frame was twisted but intact. The demonstration convinced Ford to build his Model T Fords with the new metal.

Other accounts suggest Ford learned of vanadium steel after inspecting metal from a French race car that had crashed in Florida. He then sought help from the Flannerys to produce the metal in Canton, Ohio, where the first commercial heat of vanadium steel was accomplished in 1907. A photograph of the event shows the Flannery brothers towering over a diminutive Henry Ford.

As the photo bears out, "Joseph almost looked like Teddy Roosevelt, with a derby, walrus mustache and wire-rimmed spectacles. His brother was six inches taller without the mustache," according to Radium. "Joseph was a man of wonderful vision and winning personality. He had a marvelous ability to convince and convert others to the practicability of his dreams. He confined activities and energies to working out great industrial problems confronting him.

"James was of solid and well-balanced character and a constructive and financial genius who changed the visions of others into accomplished facts," it says.

Some steel-industry histories consider Ford's discovery of vanadium steel a mystery. They speculate that Ford chose to keep the circumstances secret to protect his product and competitive edge. Another theory: Ford never gave the Flannerys the credit they deserved because he was intimidated by their physical size and aggressive business style.

A year after Ford began using vanadium steel, Joseph Flannery convinced Goethals to use it in the lock-gates of the Panama Canal, but only after the government did exhaustive tests on the metal. According to accounts, "the engineering world was astonished" by Goethals' decision to order 5,000 tons of the revolutionary new metal. Irene Gonzalez of the Panama Canal Commission says the original lock-gates are still in operation. And vanadium continues to be used in steel alloys.

Flannery, however, failed to convince the construction engineer for the Quebec Bridge to use the steel. The bridge collapsed before its completion.

BUT JOSEPH'S involvement with vanadium would end when his sister (whose name does not appear in the research material) was diagnosed with cancer. Unable to acquire any radium in Europe, Joseph focused his attention on producing the miracle healer to meet the rising worldwide demand. He already was familiar with low-grade uranium ore because of his work with vanadium ores that he found in Colorado. He formed the Standard Chemical Co. in 1911 by investing $650,000 in western mining claims, mills and machinery. The major hurdle, however, was developing a chemical procedure to separate trace amounts of radium from low-grade uranium ore. Before any radium was produced, Flannery's sister died.

"With all the solemn determination of a head thus bowed and a heart thus weighted, he imposed upon himself an obligation to find a cure for the disease whose ravages he had witnessed," wrote Thomas C. Jeffries in 1922 in Current History, the monthly New York Times magazine.

In another 1922 article, Louis Fenn Vogt of the Standard Chemical Co. stated that "friends thought Flannery foolish. Bankers

felt he was jeopardizing his wealth. With a small staff and great expense, he worked quietly for 14 months."

In the company's first year, Flannery and his staff encountered a series of disappointments. But they finally worked out an extraction process in late 1912 in company laboratories in Pittsburgh and radium production started January 1913. "The little organization had to work out its own salvation," Vogt wrote. "Many men would have given up in those early days, but not Mr. Flannery. He had just been through a pioneering proposition in starting the American Vanadium Co., a remarkable success, so he was seasoned for the radium struggle."

Radium extraction required a long series of carefully calculated chemical reactions over a period of six months, and enormous quantities of resources. As it turned out, production of one gram of radium required 300 to 1,600 tons of carnotite ore from Colorado, 1,000 tons of coal, 500 tons of chemicals and acids, and 10,000 tons of distilled and treated water, among other resources. Flannery said that no less than 1,400 railroad carloads of raw material were needed to produce an ounce of radium. An unidentified Pittsburgh rabbi commented that, were he not a cleric, his reaction to Flannery's production method would be, "Damn the tonnage."

"It requires many thousands of laboratory control tests and analyses each month to control the various production steps," Vogt wrote. "It takes infinite patience and careful supervision to obtain ultimate success. To produce a gram of radium per month requires the work of 200 miners and mill men in Colorado, 150 men in Canonsburg and 15 technical men in Pittsburgh, without making allowance for the auditing, sales and executive departments."

From 1913 through April 1921, the company produced 71.8 grams of radium. By 1920, the company was producing more than 18 grams of radium a year and selling it for $3.5 million. By then, 5 ounces (140 grams) of radium had been produced in the world — more than half by the Standard Chemical Co.

In May 1921, Madame Curie visited the plant in Canonsburg, where she received a gram of radium stored inside 10 glass tubes, a steel container, 2-inch-thick lead screens and a mahogany case. She expressed regret that she was too late to meet Joseph Flannery, who had died from pneumonia on Feb. 18, 1920, at age 52. James, 67, had died on March 6. Obituaries in the nation's leading newspapers memorialized them for using industry to advance humanitarian ideals.

Eulogizing the Flannerys, Jeffries wrote in The New York Times magazine in 1922 that the world "owes a debt of gratitude to the courageous and unselfish pioneers who so benefited mankind with their contributions."

"Unfortunately," Jeffries continued, "Joseph and James Flannery both died within the last two years and can in no event share in humanity's verdict."

Many scientists and workers at Standard Chemical died from cancers and anemia caused by exposure to radium, which took several steps to produce, such as fractional crystallization, above.

AS RADIUM undergoes radioactive decay, helium particles are released at a speed of 10,000 miles per second — 20,000 times the speed of a rifle bullet, Vogt explained in 1922. The power locked in one gram of radium, if released all at once, would be sufficient "to raise a dreadnought battleship of 28,000 tons, or even the Woolworth Building in New York, 100 feet in the air," Sochocky noted.

In truth, the energy is expended over 20,000 years. But a 1923 article in Science explained that radium possesses astounding energy, even in the most minuscule amounts: "If half a gram of radium were divided equally among every human being in the world, one such portion could be detected."

Despite radium's terrific energies, Dr. C. Everett Field, a radium proponent, offered the consensus opinion of the medical community prior to 1920 when he said: "Radium has absolutely no toxic effects, it being accepted as harmoniously by the human system as is sunlight by the plant." Such perceptions created an enormous public demand for "nature's Roman candle." As Curie's biography states, radium quickly "acquired a commercial personality. It had its market value and its press."

Radium, the journal published by Flannery's company, provided a steady stream of upbeat medical reports on the element, including "before and after" pictures of people suffering grotesque tumors, sarcomas and goiters and the positive effects of radium treatments.

Lawrence Babash, in "Radioactivity in America: The Growth and Decay of a Science," states that newspapers carried reports of radium's successes and failures, as well as the uncertainties about its ability to kill bacteria, cure blindness, turn the skin of Negroes white and determine the sex of unborn children.

Products available to the public included radioactive mineral waters, mud packs and inhalants. Howard Kelly, a lecturer on radium, testified before Senate and House committees that radium fulfilled biblical prophecies. Academicians suggested that radium was a step toward understanding the ultimate secret of the universe.

It had an effect on other sectors of society, as well. Loie Fuller, the American "serpentine lady," created a number of radium dances in which monster moths and iridescent halos were formed with radium salts.

In New York, a casino owner sold radium beverages and painted a roulette wheel with radium for gambling in the dark. A farmer suggested feeding radium to chickens to produce hard-boiled eggs, or eggs that would not need incubation. Radium paints also were

used to paint theater seat numbers, while radium was used in fish bait and to make eyes glow in toy dolls and animals. Fear that clothing would no longer provide a barrier to X-rays and prying eyes prompted one company to market lead-lined undergarments for women. But to the horror of the medical community, half of all radium produced prior to 1920 was used for non-medical purposes, such as using radium-tinged paint on 4 million clock and watch dials.

Curie, however, had warned as early as 1905 that the metal she and her husband discovered in 1898 posed dangers. Flannery's staff scientists routinely suffered severe radiation burns by handling radium salts or carrying them in glass tubes in their pockets. Women who were employed to paint watch dials began dying of radium-induced illnesses in the 1920s. The chief scientists and many of the workers of the Standard Chemical Co. died from cancers and anemia caused by radium exposure. By 1930, the dangers of direct exposure to radium were irrefutable. Radioactive isotopes have replaced radium in medicine, and since World War II, radium's use has been limited to research.

But uranium mill tailings — low-level radioactive sand left from the production of radium and uranium — were not suspect until recent decades. Before concern arose, however, tailings from the Standard Chemical Co. site had been used throughout the Canonsburg area as landfill and concrete sand. A Canonsburg newspaper article in the 1930s boasted that the borough was paved with material more valuable than gold or platinum.

In the 1920s, the Standard Chemical Co. was forced out of business with the processing of rich pitchblende ores in the Congo. The Canonsburg site was later purchased by the Vitro Rare Metal Co., which processed other radioactive materials at the site for the Manhattan Project that produced America's first atomic bomb. Vitro discontinued operations in Canonsburg in 1957, leaving behind more than 200,000 tons of radioactive debris.

IN 1978, Congress passed the Uranium Mill Tailings Act to clean up 23 inactive sites in western states where uranium ore had been processed. But Canonsburg became the DOE's pilot project after U.S. Rep. Austin J. Murphy, D-Monongahela, had the site included as the priority project because of the site's proximity to residential areas. During the cleanup, debate raged over the health effects of low-level radiation exposure. An epidemiological study completed by the University of Pittsburgh revealed that women living near the site had increased thyroid abnormalities. A Pittsburgh Press survey of two neighborhoods near the site revealed a history of cancer.

Under the $43.2-million cleanup project, DOE contractors decontaminated about 150 vicinity sites in Canonsburg and buried the more dangerous low-level radioactive waste in a clay pit at the former Standard Chemical property. Controversy in Canonsburg has subsided with completion of the project, but national debate continues over the health impact of even slightly elevated exposure of low-level radiation.

The Flannerys surely died with the misconception about radium's beneficence. And the contamination legacy must be weighed against the curative powers that radium provided for a generation that had no other defense against cancer. Certainly most of the contamination now subject to expensive cleanup occurred long after the Flannerys had died.

Any search for accountability should lead back to Curie herself, who won Nobel Prizes in chemistry and physics for her work with radium. She could be criticized for not putting out stronger warnings about the element she discovered. She also espoused a cold motto that placed half-lives above lives: "In science we must be interested in things, not in persons," she often said.

Jeffries regretted 70 years ago that the Flannerys died before they could "share in humanity's verdict" on the fruits of their trial-and-error industrialism. What the Flannerys accomplished with vanadium was revolutionary. That they provided innovative medical treatment for cancer and other maladies is praiseworthy.

But by misunderstanding, mishandling and misusing radium, the Flannerys participated in unleashing a long-lasting radiation contamination problem. On that count, the verdict on the Flannerys' actions becomes humanity's sentence to serve.

(David Templeton is a staff writer for the magazine.)