

TITLE: The Radium Dial Painters: Unforeseen Consequences of the Industrial Revolution

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Introduction

From its discovery by Marie Curie in 1898 to its sudden popularity in common household objects, radium held an appeal for people due to its mysterious and fascinating nature. One of the most common uses for this radioactive substance was to label the numbers on watch dials, and it became a trend among soldiers during World War I, and eventually became wildly popular among the public. Watch dial factories opened in Illinois, Connecticut, and New Jersey, employing young female workers who were drawn to these factories due to decent pay and what appeared to be comfortable working conditions. Yet little did they know that the substance they handled daily was a deadly, radioactive element that would eventually lead to the deaths of many fellow dial painters. The plight of the radium dial painters took several years to be acknowledged due to limited awareness of radium's harmful properties, profit-driven officials, and various misdiagnoses, but was a story that eventually became publicized, leading to developments in worker rights, compensation, and safety standards. Had this case of ethics, worker safety, and careless handling of a deadly substance not been exposed, safety standards in the workplace and treatment of radium would be absent of regard for employees' health and lacking in caution when handling radium.

Radium's Beginnings, Promotion, and Reception

In 1896, a scientist named Henri Becquerel had discovered that the element uranium emitted radioactive rays, similar to that of X-rays. Marie Curie desired to learn more about the radioactive element, and by taking pitchblende, a mineral that contained uranium ore, she discovered that the radioactive rays were much stronger than those emitted by uranium, leading her to conclude that there was some other substance present in the pitchblende causing high

readings of radioactivity. In 1898, she and her husband Pierre announced their discovery of radium. By refining several tons of pitchblende, she was able to obtain miniscule samples of radium. This process was painstakingly difficult, and it took her nearly four years to produce only one-tenth of a gram of pure radium salt (The Element Radium).

Following its discovery, Pierre Curie decided to test the effects of radium by taking a small amount of the element and binding it to his arm, and he left it there for 10 hours. He repeatedly conducted this test, and he discovered that each time he removed the radium, the area beneath it had turned red, and it gradually developed into a wound that took months to heal (Henry Clarke). Becquerel also discovered its physiological effects by accidentally placing a vial of it in his pocket for several hours. Upon removing it, he discovered that he had developed a sore in the area where the radium was placed, leading to the conclusion that radium would kill cells given this prolonged contact. This reasoning led to its application in various medicines, as doctors thought it could destroy tumors, treat skin diseases, and cure lupus (Mould 74-82).

Radium was not only innovatory in medicine, but it was also used in various household products. By 1910, radium was being manufactured in the U.S. Companies were selling radium water, radium chocolate, radium nightlights, radium toothpaste, radium cosmetics. Newspapers hailed radium as revolutionary and magical, scientists and physicians attested to its healing properties and to the endless possibilities of applications in medicines and injections. One of the most shocking incidents involving recreational uses of radium was in Hot Springs, Arkansas. Radioactivity was detected in the springs, and many believed that because of this, the springs had healing powers and could cure numerous diseases. Congress established a military hospital at the springs, thinking the water would be beneficial for soldiers (Frame).

Given these examples of uses of radium and why the public came to regard radium with fanatical appreciation, it can now be understood why radium was being used so carelessly: radioactivity was a novel concept at the time, misunderstood and accepted as beneficial. Because it could take years for radium to manifest itself in the body and cause life-threatening injuries, scientists, manufactures, and consumers paid little regard to the few who cautioned against such liberal use of radium. The erroneous view of the majority can be encapsulated by this declaration in an article that appeared in the *Scientific American*: "...radium is absorbed into the blood and circulates throughout the system. No actual chemical action takes place, however, even when the radium is taken internally. It simply attacks useless tissues, which are then ejected from the body by the excretory system" (Mount 375). This collective outlook led to deadly consequences as time went on.

Lip-pointing, Negligent Supervisors, and Uninformed Workers

The women who were employed at dial painting factories in Orange New Jersey, Ottawa, Illinois, and Waterbury, Connecticut gave little thought to handling the deadly substance known as radium. Hundreds had flocked to the factories, which paid about 8 cents per dial painted (equivalent to about \$1.92 in today's standards) , and offered enjoyable, profitable work in a comfortable setting where workers could converse with one another and carefully apply the luminescent paint to watch dials (Williamson). Skilled workers could paint as many as 300 dials per day, earning about \$17 per week, a fortune in the young women's eyes, as other jobs paid a third of the amount that the workers earned at the factories; however, no amount of money would make up for the amount of damage that would ensue as a result of handling the chemical. Hundreds would become victims to a substance they knew nothing about, eventually succumbing to an inevitable demise at the hands of the glowing element.

When working in the factories, the workers were all taught to practice lip-pointing, a technique where the dial painters would dip their paintbrushes into the paint (a blend of water-based glue, radium, and zinc sulfide) and lick the tips of the brushes so it would have a finer point, a method which would help with the precision of painting the miniscule numbers on the face of the watch. However, in practicing this technique, workers would ingest small amounts of radium, which would accumulate in the body. Radium emits alpha particles, which is the least dangerous of the radioactive rays, and is unable to penetrate paper (Radium). Yet once inside the body, it releases its energy, affecting the blood, liver and spleen. The dial painters were completely unaware of this, as Grace Fryer, a worker in the New Jersey factory, would later testify “I think I pointed [the brush] with my lips about six times to every watch dial. It didn’t taste funny. It didn’t have any taste, and I didn’t know it was harmful” (Unger).

However, the founder of the U.S. Radium Corporation was well aware of the fact that radium was deadly but stated “This...is nothing compared with the risks and sacrifices which scientific experimenters are undergoing all the time, and I would not mention it if I had not been asked to do so in telling you just as plainly as I can all about the remarkable powers of radium” (Sochocky 24-27). Dr. von Sochocky had been the corporation’s president and technical director from 1914 to 1921, and was fascinated with radium, handling the substance without protection, even going so far as immersing “his bare arm up to the elbow in solutions of radium...he would take tubes of radium out of the company safe and hold them in his bare hands and watch them glow...” Sochocky adopted a zealous, obsessed manner with regard to radium; he was convinced that the element would be revolutionary, expounding on its possible uses from curing night terrors to lighting up concert halls (Mullner). His careless handling of the chemical was testament to why the dial painters were oblivious about the substance they were handling; if the

president of the very company they were working for would carelessly toy with radium, how were the dial painters to receive any word of caution when working with the chemical? Von Sochocky later died from radium-induced aplastic anemia, and was succeeded by a man named Arthur Roeder.

Undeniably, all of the illnesses that arose in the factories stemmed from this practice of lip pointing, yet both dial painters and factory managers were unaware that the strange ailments that were occurring resulted from this method. A worker named Frances Splettstoher was the first to die in Waterbury. She had worked at the Waterbury Clock Company for four years, and in 1925, she had developed anemia, leaving her weak. Her teeth and jaw began to ache, and when she saw a dentist who tried to relieve her pain by pulling out a tooth, part of her jaw came out as well, and the tissue in her mouth began to rot until she had a hole in her cheek (Quigley). A few workers in Ottawa were also experiencing similar symptoms; a worker named Margaret Looney had worked Radium Dial from 1923 to 1929, and was found to be positive for the presence of radium in 1925 when an examination was conducted. When she started developing pains in her jaw, she went to a dentist to have her tooth pulled, but the area never healed. As she gradually succumbed to her condition and entered the hospital, her siblings were prevented from seeing her. When she died, a physician from Chicago requested to conduct an autopsy, which the family agreed to, so long as their doctor was present. However, the physician from Chicago had conducted an autopsy before the doctor could arrive, and he had diagnosed her as having diphtheria. When she was buried, she was encased in a lead container but her family was unaware as to why she was buried in this manner- it can be inferred that this mysterious method of burial was a safety measure, as Looney's body was highly radioactive; this fact is quite contrary to the physician's autopsy report, which read "The teeth are in excellent condition. The

gums appear normal. There is no ulceration of the gums...” (Langer). What, then, was the cause of Looney’s death if she was found to be in such “excellent condition?”

As a result of the careless procedure of lip pointing, hundreds of dial painters became ill and at least 500 dial painters died from cancer, infection, jaw necrosis, and anemia (this number is difficult to determine, given misdiagnoses and unreported deaths. Also, it could take a couple to several years for radium to inflict life-threatening injuries, depending on the amount of time that a dial painter worked in the factory as well as the amount of radium ingested over time). Had this policy of lip pointing had not been enforced in the first place, the thousands of illnesses and eventual deaths that occurred could have been prevented; this practice demonstrates “the tendency of companies to regard the body, specifically the female body, as their property” (Roelcke, Maio). Officials of the company exploited the workers, implementing a process without any investigation as to its possible effects- they even told the dial painters that ingesting the substance would “make their cheeks rosy,” and assured them that the paint was harmless (Irvine). Even though radium was highly promoted at the time, celebrated as a miracle cure for anything from cancer to arthritis, it was known to destroy tissue given prolonged contact. Yet the officials ignored this fact, either too infatuated with the fascinating properties of radium to pay any mind to its detrimental effects, or also consumed with greed, as lip pointing resulted in a higher rate of production, and therefore a greater profit.

The officials at the factories grew alarmed at the growing number of illnesses occurring, and investigations were conducted at all three factories. The U.S. Radium Corporation in Orange, New Jersey, was the first to request for an investigation into the dial painters’ illnesses. The first few who died were diagnosed as suffering from phosphorous jaw, diphtheria, and even syphilis, as doctors were puzzled over the cause of such rapid bone decay. Arthur Roeder

contacted Dr. Cecil Drinker of Harvard University, who investigated the factory and concluded that the cause of the dial painters' deaths was due to radium. Roeder, however, refused to accept the report's findings, even going so far as to falsely claim that Drinker's report on the factory completely cleared the company and "that all of the dial painters were found to be in perfect health" (Mullner). In Waterbury as well, investigations were conducted on some of the dial painters, yet information was misconstrued as a result of the company's actions. A man named Frederick Flinn served as a consultant for the U.S. Radium Corporation in New Jersey, and was hired in order to refute a paper published physician and forensic pathologist Dr. Harrison Martland. Flinn had submitted findings arguing that the dial painters' deaths were not caused by radium. Yet when he tested a woman who was previously employed at the Waterbury Clock Company, he found signs of radon on her breath, a substance that is released when radium decays. Despite this sudden development, he had refused to withdraw his previous findings, yet he later timidly admitted that radium was most likely the cause.

Martland, on the other hand, had conducted an autopsy on the radium plant's chief chemist, and found his lungs to be highly radioactive, suggesting that radioactive dust had been inhaled. Radium had also collected in his spleen and bones, indicating that the chemist's death was a result of radium poisoning (Wasserman). He also studied living dial painters and measured the amounts of radium in their bodies. He detailed his findings in a paper titled "Some Unrecognized Dangers in the Use and Handling of Radioactive Substances," which appeared in the *Journal of the American Medical Association* in 1925. The paper was initially disregarded, even ridiculed, suggesting the extent of the public's as well as scientists' unbending view of radium as an extraordinary element. Martland's findings were even unfathomable to the editor of the very magazine his paper was published in, who believed "radium was just too widely used,

and too miraculous, to be considered deadly (Mullner).” Martland’s work would later be regarded as a medical classic, as he shed light on radioactivity and the radium dial painter tragedy.

In Ottawa, the management of the Radium Dial Company first became aware of the lawsuits filed by the New Jersey dial painters in 1925. Anxious, the company had all of the workers medically examined, and many of the women tested positive for a radon breath test, indicating the presence of radium in their body. However, none of the painters were informed, as the officials did not want a riot, and they were also fearful of having to shut down the company. The company went as far as to fire workers who were developing symptoms of radium poisoning, and a dial painter would later testify that she was dismissed because her limping was becoming too noticeable and was frightening other employees. She claimed that her employers told her “Your limping will cause talk. We’re sorry, but you’ll have to go” (Moser). Her name was Catherine Donohue, and she had worked at the Radium Dial Company from 1922 to 1931, when she was dismissed. Indeed, despite requests from workers wanting to know the results of their tests, a supervisor told them “My dear girls, if we were to give a medical report to you girls, there would be a riot in the place” (Irvine). Repeated attempts to hide this information emphasized that the company officials were driven by fear of having to compensate their employees, and also understanding that if radium was publicly deemed as the cause of the dial painters’ death, then their company name would be tainted and most likely end in a shutdown of their factory.

In Ottawa, even though townspeople gradually learned of the dangers of radium, the Radium dial factory wasn’t torn down until 1968. Some from the community even took remnants from this site, such as furniture, to be used in their homes (Langer). The Luminous Processes

factory operated well in to the 1970s. While in Orange, New Jersey, the dial painters' stories were publicized, the situation in Ottawa stayed relatively unknown and disregarded.

The factory in Orange, New Jersey, received the most recognition due to the aid of the Consumers League as well as publicity from newspaper articles. It was the kind of aid that workers in both the Connecticut and Illinois should've received. Alice Hamilton from the National Consumers League as well as Walter Lippmann from the New York World publicized the Radium girls' cause. When the five dial painters went to court, Lippmann wrote an editorial condemning the judge's decision to delay the case. His article sparked national outrage, leading the hearing to be rescheduled for an earlier date. Each of the women received significantly higher compensation- \$10,000 each- than the women in Connecticut and Illinois who sued. However, this amount was just a fraction of what they requested- they had originally sued for \$250,000 each, an equivalent of about one million dollars today. The meager amount received was hardly just, considering the amount of pain they endured for reasons they were not informed of until it was too late.

The Consumers League: Critical Function in the Case

The Consumers League was founded in 1899 by Florence Kelley. It was an organization that initially sought to improve working conditions for women and children by enacting laws that established maximum hours, minimum wages, and restrictions on employment in dangerous occupations. Starting in the 1920s, however, the League focused on a new concern: industrial health. In 1924, a health official who was frustrated by the nonexistent effort of the state to investigate the strange illnesses occurring at the factory, informed Katherine Wiley, an executive secretary of the Consumers League of the deaths and sicknesses that were arising. Wiley

questioned workers, doctors, and state agencies, reaching dead ends as to the cause of the illness, and finding that the organizations she attempted to contact for help displayed disinterest.

After contacting a toxicologist, studies were eventually conducted and radium was confirmed to be the cause of the workers' illnesses. A man named Cecil Drinker published his findings on radium despite threats from U.S. Radium. Suspicions against the company were rapidly mounting.

In an effort to build public support for an investigation of dial painting, members of the Consumers League arranged for Walter Lippman's newspaper, *The New York World*, to publish several articles and editorials on the controversy surrounding the dial painters. Lippmann expressed his disgust for the progression of the trial, stating "...The whole thing becomes a legal nightmare when in order to obtain justice five women have to go to court and prove that they are dying while lawyers and experts on the other side [argue in the newspapers]..." When he later heard of the judge's postponement of the case Lippmann wrote: "...This is a heartless proceeding. It is unmanly, unjust and cruel. This is a case which calls not for fine-spun litigation but for simple, quick, direct justice..." (Kovarik). His articles voiced the outrage felt by the public, as they were horrified to discover that people were dying because they were handling the very product that consumers had been buying. Because of his popularity, and also in teaming up with Wiley, the public became fully aware of the consequences in accepting the claims made by scientists and manufacturers regarding radium.

Because of their efforts to publicize the story, the Consumers League succeeded in raising awareness about this health hazard, ensuring that the workers would receive the recognition and compensation they deserved. By bringing this tragedy to light, the League was critical not only

to the eventual success of the litigation against U.S. Radium, but also to the research and radiation standards that were ultimately implemented. If not for the Consumers League's labors, the dial painters' illnesses would've been forever hidden from the public, with no one to expose their dire circumstances.

Legacy

Various measures were taken in order to make sure that radium was, from now on, handled with care. While many of the laws and acts that follow were not established until some years after the incident, it can be concluded that the radium dial painter case indirectly influenced several laws and organizations in order to ensure the safety of the public.

In 1933, Robley D. Evans measured the amount of exhaled radon and radium excretion from over twenty dial painters. The National Bureau of Standards used this information in 1941 to establish the tolerance level for radium of 0.1 μCi (Rowland). It was now known that only miniscule amounts could be tolerated by the body, and that the amount the dial painters handled far exceeded this amount.

The Center for Human Radiobiology was established at Argonne National Laboratory in 1968, and it conducted several examinations on the surviving dial painters, gathering information and also tissue samples from these workers. When the project ended in 1993, detailed information of 2,400 cases had been collected. The center declared that "No symptoms were observed in those dial painter cases with less than 1,000 times the natural ^{226}Ra levels found in unexposed individuals, suggesting a threshold for radium-induced malignancies," meaning that the amount of radiation that had collected in the bodies of the dial painters far exceeded a tolerable amount, further confirming radium's deadliness (Rowland).

The case eventually led to the development of the Worker's Compensation Act, in which employers are liable to pay damages for injuries received by an employee. As detailed by the Department of Labor and Industry: "The term 'occupational disease,' as used in this act, shall mean only the following diseases: Radium poisoning or disability, due to radioactive properties of substances or to Roentgen-ray (X-rays) in any occupation involving direct contact with, handling thereof, or exposure thereto" (Worker's Compensation Act). This act is directly influenced by the radium dial painter case, and established the legal precedent of an employee's right to sue their employer. Similar terms are detailed in the Occupational Safety and Health Act of 1970. It was enacted to "assure safe and healthful working conditions for working men and women." Under these regulations, employers are now required to inform employees about hazardous chemicals or toxic substances are present.

The factory in New Jersey eventually prohibited dial painting, though this practice continued in both the Connecticut and Illinois factories. Because the case was so highly publicized, the dangers of lip pointing became known and eventually banned. The Public Health Service proposed safety guidelines for radium companies, but the guidelines were mostly disregarded. In the early 1960s, Consumers' League worked with labor unions to require reporting of radioactive spills, which served as a continuation of their work with the New Jersey dial painters, as they were able to draw on their knowledge of the dangers of radium.

Conclusion

Radium is no longer used in medicine, household items, or on watch dials. It has ceased to be a novelty, now considered a hazardous waste rather than a costly element. There are dozens of Superfund sites that have cost millions to remedy, as the EPA attempts to wipe away traces of

radioactivity. Clean-up has been an arduous project, as people have had to evacuate from their homes, as the structures were built atop radioactive sites, demonstrating that the story of the dial painters had eventually faded, a forgotten news story that people eventually lost interest over. Contaminated sites have been found in the former U.S. Radium Corporation plant in New Jersey, and communities of Glen Ridge, Montclair, and West Orange. More than 200 acres of radioactive soil have been found and over 750 homes labeled as hazardous due to unsafe levels of gamma radiation (Mullner). This is the damage that has been found in New Jersey alone. The widespread use of radium suggests that there could possibly be dozens of more sites that are contaminated.

The tragedy of the radium dial painters serves as a cautionary tale regarding the handling of a material without contemplation of potential damage. While the discovery of radium was groundbreaking, fascinating, and revolutionary to science, these benefits came at a high price. This public health case emphasizes the importance of handling a newly discovered substance with care, the necessity of corporate managers to remedy mistakes and not attempt to hide them, and the value in considering long-term consequences as opposed to indulging in short-term crazes. Today, the story of the radium dial painters is all but forgotten, a part of history that has been ignored and overlooked despite the critical impact the workers has had on countless lives, exposing the horrors of a substance that they themselves knew nothing about until it was too late.

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