

Lip, Dip, Paint

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I suspect my chosen profession, orthopaedic surgery, had its roots in early childhood. One of my first memories was going with my mother to Potter's Shoe Store in Hyde Park Square to purchase a new pair of Stride-Rite shoes for the upcoming school year. Now, I'm sure you're wondering why would a trip to Potter's Shoe Store some seventy years ago be indelibly engraved in my memory. The answer is simple: the store had a shoe-fitting fluoroscope. Visually reminiscent of a nickelodeon, it had 2 or 3 viewing portals. I stuck my feet under the fluoroscope while the salesman visually assessed shoe fit. He used this device as a marketing tool to assure Mom that the shoes she was about to purchase were a perfect fit and could not deform my growing foot bones. I, on the other hand, was fascinated by the movement of the bones when I wiggled my toes--- I could see my skeleton. I had no idea that I was being exposed to invisible and insidious ionizing radiation. Radioactive elements such as radium and uranium have long half-lives and with prolonged or excessive exposure a sundry of lethal cancers can develop decades after exposure.

My radiation exposure at Potter's was negligible. My story, nevertheless, typifies the casual attitude Americans had towards radiation in the first half of the twentieth century. No one appreciated its destructive power; ignorance was bliss. With the bombings of Hiroshima and Nagasaki in August 1945 the world woke up and we became aware of the devastation atomic energy could wreak.

Radium was discovered at the end of the nineteenth century by an extraordinary woman, Marie Curie and her husband. In 1903 she received the Nobel Prize in physics and in 1911 in chemistry. Interestingly, despite her knowledge of the harmful long-term effects of radiation exposure, she ignored them and at the age of 66 she succumbed to aplastic anemia; her bone marrow destroyed from the many years of exposure to radiation.

At the turn of the twentieth century, radium was considered a wonder element. It was sold in pharmacies as a treatment for such maladies as cancer, gout, constipation, lumbago, and hay fever. Hucksters made a killing selling radium in tonic water to the rich and famous. Even FDR supposedly drank it. It was marketed as a panacea and was used to treat arthritis, pulmonary and vascular disorders. Also known as *liquid sunshine* it was topically applied to everything from jockstraps, lingerie and even tooth paste for a brighter smile. At the turn of the century, one of the biggest scammers was William J.A. Bailey, a Harvard College dropout. He created a concoction

of radium and drinking water marketed as Radithor; a panacea for all illnesses. He was a snake-oil salesman extraordinaire and died a rich man of bladder cancer. When his body was exhumed 20 years postmortem, his remains were riddled with radium.

Another application of radium at the turn of the century was in the luminous watch dial industry, the topic of my presentation. Although radium paint was invented in the United States in 1902, it was first commercially used in Switzerland where the luminous paint was applied to the dials of expensive watches and clocks. Dial painters meticulously applied the paint with a glass applicator or a fine brush.

In 1914, the U.S. Radium Dial Corporation in Orange, New Jersey was formed by a physician, Dr. Sabin Arnold von Sochocky. Although he was well aware of the lethal effects of radiation, he threw caution to the wind. Ultimately, he burned several of his fingers necessitating amputation and like madame Curie he succumbed to aplastic anemia. Von Sochocky's partner, Dr. George S. Willis met a similar fate when he developed a radiation induced sarcoma of his thumb. In 1923 (a year prior to his death) he published an article in the *Journal of the American Medical Association* prophetically stating, "the reputation for harmlessness ... enjoyed by radium may depend on the fact that, so far, not many persons have been exposed to large amounts of radium ... and there is good reason to fear neglect of precautions may result in serious-injury."

Meanwhile, the United States Radium Corporation became the largest producer of radium dials in the world. When our country entered World War I, the company saw its sales incrementally increase. Company workers painted the dials for our soldier's wrist watches, artillery gunsights, and the instrument dials on airplanes. By 1920, the company had produced four million radium dial watches.

The profile and demographics of the Radium Corporation dial painters was uniform. They were all young women from mid-teens to age twenty-five. They were generally unskilled immigrants from Europe and often 2-3 sisters from the same family worked there. Salaries were based solely on productivity and varied from 30-300 dials/day. The workspace, *unlike* the squalid sweatshops at the turn of the century, was fresh and airy, and the workers enjoyed a pleasant social environment.

When a new employee was hired, she was taught how to prepare and apply the paint. A tiny amount of radium powder was mixed in a dish along with an adhesive and water. The paint was then applied with a fine tipped camel-haired brush. The workers were told, for sanitary purposes, that it was against company policy to tip or point the brush with one's lips. The taste of the paint varied; gritty and often hard to stomach. Despite this, speed of application was the name of the game. Many of the girls ignored the caveat and got into the routine of: "**lip, dip, paint.**" The company foreman invariably ignored company policy. After all, profit, and productivity not safety was U.S. Radium's modus operandi.

Sometime in 1921, Mollie Maggia, a young dial-painter, developed a toothache. She consulted a dentist who extracted what was thought to be an abscessed tooth. Despite the tooth's removal, unbearable pain, inflammation, and drainage persisted. She consulted another dentist, Dr. Knef, who diagnosed her with pyorrhea, a bacterial condition affecting gums. He was confident he could help her and extracted more teeth. Despite his efforts, her jaw began to disintegrate, and teeth fell out spontaneously. The cause of her condition, which now included fatigue and joint pain could not be determined. She consulted a medical doctor who diagnosed her with syphilis, the great simulator. The test for syphilis, however, was negative. At this point, Dr. Knef, her dentist, suspected her condition might be occupationally related. He was aware of a very similar dental condition, *phossy jaw*, affecting matchstick workers who inhaled the fumes of white phosphorus resulting in necrosis or disintegration of the jaw. This turned out to be another dead end, there was no phosphorus in the dial-paint. Less than two years after the onset of symptoms, the infection eroded into her jugular vein leading to exsanguination and death at the age of twenty-one. Her family was told she died of syphilis, which couldn't have been further from the truth.

At about the same time, another radium-dial painter, Hazel Kuser, was suffering unbearable pain and was losing teeth. She developed jawbone necrosis requiring partial removal of much of her mandible. Her hometown dentists could not establish a diagnosis. Frustrated, she consulted Dr. Theodor Blum, a highly respected pioneer in oral surgery in New York City. Although he had not seen a similar case, her occupational history led him to conclude that she suffered from bone necrosis and poisoning from a radioactive substance which he termed "radium jaw". He subsequently published his findings in a prestigious medical journal, but his article went

unnoticed. Meanwhile, her medical bills were out of control. Dr Blum contacted the radium company in hopes the company would provide some compensation. No such luck; the company flatly refused and stated that it would be an unwise precedent.

Another employee at USRC was Grace Fryer. She worked there from 1917-1920 when she left to take a better paying job. About 3 years after leaving, she began to lose her teeth and developed agonizingly painful infections in her gums. Later, the radium had destroyed her spine and she commented “radium eats the bone as steadily and surely as fire burns wood.” As she deteriorated, she was visited by Frederick Flinn, a specialist from Columbia University, who conducted an extensive examination of Fryer. Based on his expert opinion, Flinn concluded that any problems she was having could not be attributed to her work at the Radium Corporation. It later turned out that Flinn was not a physician; he was a toxicologist and was on the payroll of the Radium Corporation.

Grace Fryer flat out denied Flinn’s conclusion. After two years of trying, she found an attorney, Raymond Berry, who took her case. Four other employees joined in a lawsuit and the five became known as *the radium girls*. They sought a settlement of \$250,000 each. From the get-go it would be an uphill battle. Attorneys were loath to be involved, the Compensation Bureau in New Jersey had a 5-month statute of limitations, and the Radium Corporation was a powerful company with deep pockets and political connections. Furthermore, little was known about the long-term effects of radium exposure. The legal process dragged on interminably with the Radium Corporation stalling at every opportunity. By the time proceedings began, two of the litigants were bedridden; unable to raise an arm to take an oath before testimony. Their lawsuit, through voices of social activism had gained national attention. Walter Lippmann who would become the nation’s most widely respected political analyst wrote: “this is one of the most damnable travesties on justice that has ever come to our attention. It is an outrage that the company should attempt to keep these women from suing. It is an even greater outrage that Jersey justice should tease them along for fourteen months before deciding whether they have the right to sue.” The trial of the five women ‘Doomed to Die’ began in January 1928. It dragged on and was characterized by extensive maneuvering by attorney Berry, defending counsel, and the media. With increasing public outcries, the Radium Corporation finally agreed to arbitration leading to an out of court settlement. The Corporation agreed to compensate each claimant

\$10,000, a \$600 lifetime annual annuity and pay all medical and legal expenses. The media publicity played a big role in championing the radium girls cause. At one point when the hearings stalled, an editorial in the New York World called the trial "one of the most damnable travesties of justice that has ever come to our attention." Sadly, the girls were the living dead. Four of five died in misery before the age of forty from aplastic anemia, necrosis of multiple bones often precluding the ability to walk, and lethal bone sarcomas.

By 1924, more girls became sick, some died. The company's president, Arthur Roeder, was feeling the heat from the New Jersey labor department. On the advice of a friend, he invited Dr. Cecil K. Drinker, a prominent professor at the Harvard School of Public Health and a recognized authority in occupational disorders to investigate and provide an independent report. Initially, Dr Drinker suggested that the mysterious illnesses might be a coincidence, but later Drinker and colleagues made a one-day site visit and wrote Roeder (the company president). Here is an excerpt from Drinker's original report describing the contamination: "Dust samples collected in the work-room from various locations and from chairs were all luminous. Their hair, faces, hands, arms, necks, the dresses, the undergarments of the dial painters were luminous.....it would seem that radium is the probable cause of the trouble." A month later, Drinker made a second visit with a public health team. They were appalled by what they found. The company's response to this investigation was flat out denial. Roeder claimed he had done an internal investigation and found no problems. Several months later, Drinker asked permission to publish his team's findings, Roeder adamantly refused and threatened a lawsuit if Drinker and colleagues proceed with publication.

Meanwhile, the unscrupulous Roeder, not only refused to accept Drinker's report but he lied to his colleagues and told them Drinker's report had absolved him from all wrongdoing. He then went so far as to submit a forged report to the New Jersey Department of Labor. Drinker was furious. His report was grossly misrepresented by Roeder. So, despite threats of a lawsuit, Drinker and colleagues published their finding in the *Journal of Industrial Hygiene* in 1925.

About the same time the Consumers' League of New Jersey, a lobbying group for social and labor reform, undertook an investigation. Several dial-painters were personally interviewed, by the League's president, Katherine

Wiley. She found these young women were in deplorable condition and had become poverty stricken due to staggering medical bills and an inability to work. She brought her findings to the New Jersey Department of Labor. They were aware of the situation but thought her findings were inconclusive. Wiley then took her case to the Legal Aid Society of Newark as well as the US Public Health Service; neither organization was willing to investigate.

Before 1925, the cause of death of the dial painters was somewhat speculative from a strictly scientific perspective; nothing definitive. It took a brilliant forensic pathologist, Harrison S. Martland, MD to definitively prove that the ingestion of tiny amounts of radioactive material was the ultimate cause of death years following ingestion. Newspapers nicknamed him the Sherlock Holmes of medicine. Martland was the chief medical examiner for Essex County New Jersey and as such had legal authorization to investigate the mysterious deaths of the radium dial workers. He first became aware of the deaths when the director of the Newark health department brought this to his attention. Martland became suspicious that there was a connection between the decline and ultimate demise of the Radium Corporation employees and their place of work. Subsequently, he conducted an autopsy on the Radium Corporation's chief chemist who died at the age of 36 and had spent fourteen years processing radium. The clinical diagnosis was severe anemia, presumably secondary to suppression of blood production in the bone marrow. At the postmortem, the fingers were severely scarred, the lungs were filled with radium as were the bones and spleen. He conducted several other autopsies with similar findings. He also examined several living dial painters, who appeared to be in good health, and he found radon, a gas produced with radium decay, in their exhaled breath. In December 1925, he published his findings in *JAMA* and noted: "The cases reported in this study demonstrate the importance of, and possible tragedy due to, the late and largely underestimated effect of radioactivity."

There were skeptics. One such individual, previously mentioned, was Frederick B. Flinn, an assistant professor of physiology at Columbia University and a proclaimed specialist in industrial hygiene. Not surprising, he also was a consultant to the Radium Corporation. He examined nearly every dial painter in America and published his findings in *JAMA* concluding that "an industrial hazard does not exist in the painting of luminous dials" and further wrote that the cause of death of the five Radium Corporation workers could not be determined. One scientist noted that Flinn's article was more

bias than science. Flinn ultimately lost credibility while Martland gained national and international fame for his work.

Martland longitudinally followed a list of sixty-three dial works throughout his career. From his list, in addition to anemia and jaw necrosis, he found several deaths secondary to osteogenic sarcoma, a then lethal bone malignancy. In the early 1950's, *Life* magazine published an article about Martland's life work including a picture of him sitting at his desk working on "The list of the Doomed." Forty-one workers over the twenty-five years he followed them had died of radium poisoning.

At about the same time, a second dial painting corporation, The Radium Dial Company, came into existence. Originally located in downtown Chicago, in 1920, it moved its facility to Ottawa, Illinois a small town southwest of Chicago. The painting studio employed approximated 100 young women. The studio consisted of a large, well lit room filled with rows of armchair like desks, like those of my elementary school days in the 1950's. Many of the girls considered this a dream job; they were comfortable and worked in a friendly social atmosphere. They were paid on a piecework basis with weekly salaries ranging from \$17-\$42. This put them in the upper 5% of women wage earners nationally.

In the mid-1920's, management first became aware of the lawsuits filed in New Jersey. Management had all the workers examined, drew lab test, and tested for the presence of radon in their breath. Several tested positive; however, the workers were never told of the results. The company sought additional methods of applying the paint and rather than brushes issued glass pens that did not require lip pointing. The pens were awkward and were infrequently used. By 1928, the situation in Ottawa had escalated. Public pressure from the media and social activism was compounded by the press reports from the New Jersey regarding the ongoing trial of the five doomed women. In response, The Radium Dial Company issued a public statement signed by the company's president maintaining that the company had its workers examined on several occasions by well know physicians and concluded: "Nothing even approaching such symptoms or conditions has ever been found by these men." The statement couldn't have been further from the truth, but it duped the public into a false sense of security. It failed to inform the public that several workers had tested positive for radium, cited outdated medical literature which disputed the deadly nature of radium and

claimed that mesothorium, which was never used, was the culprit rather than radium- when in fact both were equally lethal.

Despite fraudulent and misleading statements from the Radium Dial Corporation, the chinks in the company's armor began to crack. A 24-year-old, Mary Ellen Cruse, suffered for 3 years with fatigue and progressive loss of teeth. She developed a fulminant infection in her face and expired. The cause of death was listed as overwhelming sepsis, no mention of radium poisoning was made. Her parents filed a lawsuit with the Illinois Industrial Commission for their daughter's death and received a settlement of \$500, a pyrrhic victory at best.

A second worker, Margaret Looney was 23 when she died in 1929. Same story: progressive fatigue, teeth falling out with subsequent fracture of the jaw followed by an agonal death. Interestingly, the U.S. Department of Labor, a few months before Looney's demise, was carrying out an investigation on radium poisoning in the watch dial workers and requested information from the Ottawa based Radium Dial Corporation specifically on Margaret Looney. The Labor Department was stonewalled. When she died the Corporation requested permission from her parents for an autopsy; they consented. Not surprisingly, The Company hired its own physician to carry out the autopsy and he reported that her teeth and gums were normal. The death certificate cited the causes of death as anemia and diphtheria, flat out lies. Fifty years later, her remains were exhumed and were found to contain high levels of radiation and a part of her maxilla appeared to have been removed at the autopsy. By 1931, 6 years after Martland's 1925 report in *JAMA*, a fifth Radium Dial Corporation employee's death certificate correctly stated radium poisoning as the cause of death: no more obfuscation.

In the early 1930's several individual workers litigated. They met with defeat at nearly every turn. Why?

- First, the plaintiffs had no money; medical expenses had virtually cleaned them out.
- Next, attorneys could ill-afford *pro bono* cases.
- Next, Radium Dial successfully argued that the Illinois statute of limitations had expired and voided their lawsuits.
- Next, local Ottawa physicians refused to testify despite incontestable evidence that radium was the cause of death because it would stain the image of their community and they feared losing a vital industry in Ottawa's economy, trumping the health of the dial workers.

Finally, in a 1935 the case was argued before the Illinois Supreme Court. Radium Dial attorneys successfully argued that the state's Occupational Disease Act was unconstitutional because its language was vague and uninterpretable. The plaintiffs lost their lawsuit on legal technicalities but had a pyrrhic victory when the Illinois legislature enacted a new and better Occupational Disease Act. The *Chicago Daily Times* called the trial "an almost unbelievable miscarriage of justice."

In 1937 the winds began to shift. Six dial workers, known as the "Living Dead", contacted Clarence Darrow, the famous champion of the underdog. Darrow was sympathetic to their cause but turned the case down and referred them to Leonard J. Grossman a former Chicago alderman and assistant corporate attorney for the City of Chicago. He took the case and realized it would be an uphill battle with little or no compensation. He chose 34-year-old Catherine Wolfe Donohue as his test case. She had worked for the company for nine years and over the years her health progressively declined. She was emaciated, experienced fainting spells, part of her jawbone had extruded through her gum, and she had a terribly painful limp which later proved to be a bone sarcoma. During her prolonged illness, local physicians provided little help. Bankruptcy inevitably ensued.

The industrial commission hearing took place in a packed courtroom and gained regional and national press attention. Catherine weighed 71 pounds; fifty pounds less than her normal weight. She had to be carried into the courtroom. In a barely audible voice, she described how the company taught her the technique of dial painting: Lip-Dip-Paint and communicated a progressive saga of decline. She finished by showing the commission a jewelry box that contained fragments of her extruded jawbone. Several physicians testified, including Dr. W.W. Dalitsch, a well-regarded maxillofacial surgeon from Chicago. He and others swore her condition was lethal and was secondary to the ingestion of radium. The following day, her cross-examination took place at her home; she was too infirm to appear in court. There she lay dying on a sofa. Finally in April 1938, the Industrial Commission ruled in her favor and found the Radium Dial Corporation liable. She received a direct disability settlement of \$3,500, payment for past medical expenses (\$2,500), and an annual lifetime pension of \$275; a pittance. The following day, the attorneys for the Radium Dial Corporation appealed the decision. Catherine, age 35, died four months later; never having received a payment. Her victory was ultimately confirmed

by the U.S. Supreme Court which refused to hear the corporate appeal thus proving to be the seventh time her case had been won. In 1984, her body was exhumed for research purposes; it remained luminous.

AFTERMATH

The case of the radium girls led to widespread recognition and protection from occupational hazards throughout the United States. By the mid-1930's the FDA ban 'therapeutic' radium from water and household products. The AMA blacklisted radium for internal use. By the late 1930's, the National Bureau of Standards established the maximum body exposure at one ten-millionth of a gram. Such creation of radium occupational safety standards not only protected future dial painters but importantly these standards were crucial in protecting those who worked with radioactive elements such as the Manhattan atomic bomb project workers.

Sadly, the exploitation of the radium dial painters by industry is hardly unique. Worker mistreatment has undoubtedly been present since the beginning of time and is alive and well today. In the United States, we have legislation, workers' compensation, and OSHA to protect employees; nevertheless, many companies, both large and small fly under the radar. The aphorism, "whoever has the gold makes the rules" from the 1967 comic strip "Wizard of Id" is as applicable today as it was at the turn of the century.

