The Mysterious Illnesses of the Dial Painters

The Story of Amelia Maggia

Amelia Maggia (1896-1922) is one of seven daughters born to Italian immigrant parents. Upon arrival in America, her mother and father move to Orange, New Jersey. In 1917, at the age of twenty, Amelia starts a new job as a dial painter. By a stroke of good luck, two of Amelia's sisters also gain employment as dial painters at the same factory. Her older sister Albina (1895-1946) had begun work some months earlier, while her younger sister Quinta (1900-1929) begins a few months after Amelia (Mullner 1999, 47).

The sisters work together along with many other young women, mostly between the ages of 16 and 20. In this line of work, the more they painted the more they earned, which was about eight cents a dial (or approximately ninety-eight cents in 2016 dollars). There is also the added benefit of working with a new and exciting paint product. The paint used on the dials glowed and could be seen in the dark (Mullner 1999, 47). The women understand that their time at the factory would be short lived as they would eventually get married and start families.

Amelia, like the other dial painters, gets trained in how to carefully and speedily paint the dials with the luminescent paint. She, like the other dial painters is also required to mix together the ingredients of the paint in small batches so that it would not dry out. She mixes a yellow powder with an adhesive so that it would adhere to the numbers and dial hands of wrist watches. Increasing the turnout of luminous dial watches and military instruments iss of great importance in 1917-1918 due to World War I. While men are at battle, women worked domestically, fulfilling their patriotic duty by painting as many dials as they could, often working seven days a week (Mullner 1999, 48). The dial painters know that a technique, called "pointing", where the

painter uses her lips to put a point on the paint brush prior to painting, is the quickest and most efficient way to perform their job. However, the women are told that, for sanitary reasons, using their mouths to form a tip with which to paint their delicate strokes was officially against the rules. Because of the financial incentive, "pointing" is a standard practice. Even though those in charge know that pointing is widespread they do not prevent it from occurring as it would slow down production.

In 1921, Amelia, now 24, begins to suffer from various physical problems. Her teeth ache constantly and the pain is so debilitating that she has one of her teeth removed. Over time, the dentist, Dr. Joseph P. Knef, (1879-1946), notices that the empty tooth sockets are not healing and that Amelia requires further treatment. Unfortunately, the treatments do not improve her condition. In January 1922, Amelia visits another doctor in hopes of finding a treatment or cure for her crippling joint and jaw pain. She is diagnosed with rheumatism and prescribed aspirin for pain relief. Follow-up visits with Dr. Knef yield no further insights into her downward health spiral. Dr. Knef observes that Amelia's jaw has actually been disintegrating over this time; the necrosis gets so bad that he is finally able to lift parts of her fragmented jaw out or her mouth with his fingers (Mullner 1999, 48-49).

It seems that nothing could be done for Amelia. The diagnostics lab that processes her tests diagnoses her with syphilis, for which she is treated without improvement of her symptoms. Later on, she becomes severely anemic and the necrosis of her jaw spread further to the roof of her mouth and the bones of her ears. On September 12th, 1922 at the age of 25, Amelia dies. Her cause of death was listed as ulcerative stomatitis, a complication associated with syphilis. (Mullner 1999, 49).

THINK 1: Imagine that you are a doctor or dentist treating Amelia Maggia. What questions do you ask to help determine the cause of her symptoms?

The story continues…

Amelia Maggia, who died in 1922, is not the only dial painter who fell ill around this time. News begins to spread among dial painters that many of their ex-colleagues are suffering from unexplained physical problems. At maximum capacity, as many as one hundred women are working as dial painters at the Orange New Jersey dial painting factory which had opened in 1917. By 1920 the number of dial painters decreases substantially due to the end of WWI, but overall the factory has employed over four hundred women. By the time the news of the dial painters' illnesses spread in 1924, there has been only a few deaths, including Amelia's, but the tooth and jaw infections that Amelia suffered is alarmingly common and was referred to as "jaw rot." (Clark 1993, 76).

At a meeting of ex-dial painters on January 19, 1924, Katherine Schaub (1902-1933), whose cousin and dial painting colleague Irene Rudolph (1902-1923) has recently died from a jaw infection, describes her "instructress" position in the dial painting factory. She states: "I instructed them to have a very good point on the brush… I instructed them to put the brush in their mouth to get the best point on it" (Schaub 1932, 68). This technique has proven efficient in the china painting industry and many of the first recruits into the fledgling dial painting factory are drafted from this field (Clark 1993, 76-77).

Katherine Shaub: http://www.njwomenshistory.org/discover/biographies/katherine-schaub/

Many of the dial painters are related or come from the same neighbourhoods. This bonds the women together as they attempt to make sense of their failing health and that of their friends and loved ones. In 1922, both Schaub and Rudolph seek answers regarding their jaw and dental maladies. The cousins consult Dentist Dr. James Davidson (1887-1957) and oral surgeon Dr. Walter Barry (1878-1942) to determine the cause of their illnesses and to develop a treatment plan. However, Schaub and Rudolf are not the first dial painters to seek the medical advice of Dr. Davidson and Dr. Barry. Other dial painters have been taken on as patients by the doctors, including Marguerite Carlough (1901-1925), and Hazel Vincent Kuser (1899-1924 (Clark 1993, 77).

In 1924, another possible diagnosis emerges. Records exist about phosphorous poisoning commonly observed in workers involved in the production of matches and fireworks, both of

which contained phosphorous. The symptoms suffered by the dial painters and that of phosphorous poisoning which caused "phossy jaw" were similar. Phossy jaw is caused by phosphorous fumes being absorbed through the gums or through cavitations in the teeth. The phosphorous damages the tissues and eventually lead to infection and necrosis. Those suffering from advanced phossy jaw are also prone to anemia, a common symptom suffered by the dial painters. Dr. Davidson suspected phosphorous poisoning in the case of Irene Rudolph prior to her death in 1922, and her family physician concurred. Because phossy jaw is understood to be a disease with industrial underpinnings, Rudolph's doctor reported her case to the Newark Department of Health for further appraisal (Clark 1993, 77-78).

THINK 2: What kind of investigation would you conduct to determine the role phosphorous might be playing in the deteriorating health conditions of these women?

The submission of an official report to the department of health precipitates a series of state investigations into the conditions within the dial painting factory. The Newark Health Department hands the case over to the New Jersey Department of Labour who then inspect the dial painting factory and assess the composition of the glowing paint used to paint the dials. Lillian Erskine, the chief of the Bureau of Industrial Statistics of New Jersey's Department of Labour is assigned to the investigation. The Department performs chemical analyses of the paint and the results show that there is no phosphorous present (Clark 1993, 79). The chemist who performs the analysis, however, does note that the paint does contain radium. He adds that this was a concern because it is known that "radium has a very violent action on the skin and it is my belief that the serious condition of the jaw has been caused by the influence of radium. I would suggest that every operator be warned…of the dangers of getting this material on the skin or into the system, especially into the mouth" (Szamatolski 1923). In January of 1923, the labour

department continues on with its investigation; They conduct an inspection of the factory and the working conditions of the dial painters, and conclude that the factory has not violated any state laws and that there was no grounds to shut the factory down or sanction the management in any way (Mulner 1999, 51).

In July of 1923, after Irene Rudolph had died, a second investigation takes place. This investigation is the result of Katherine Schaub filing formal complaints to both the Public Health and Labour Departments regarding her cousin's death. Despite the compositional analysis of the paint not listing phosphorous, Rudolph's family, dial painting colleagues and even her physician believed that phosphorous poisoning was the cause of her illness and death.

THINK 3: How can you explain this reasoning?

The symptoms the dial painters are suffering from are so much like those suffered by the matchstick workers that possible phosphorous poisoning could not be easily dismissed despite the previous labour department investigation confirming that the paint does not contain any phosphorous whatsoever. The ensuing case is handled by Orange, New Jersey health officer Lenore Young. Young is alerted not only to Rudolph's death and of Amelia Maggia's but also the failing health of another dial painter, Hazel Vincent Kuser. Young still maintains that the factory has been operating within an appropriate framework and that the work conditions and paint formulation are safe (Clark 1993, 80).

Still, the dial workers and their advocates are not satisfied. Yes, the factory is up to current standards but the reality that dial painting seems to be a common link between all these sick women could not be ignored. As such, a third round of investigation takes place, once again by Lenore Young, working for the Department of Health. Hazel Vincent Kuser's condition

begins to worsen and her symptoms mirror those of Maggia's. Her jaw disintegrates and needs to be removed and she is suffering from severe anemia. Through her continued research, Young assesses a new report just published by the Public Health Service which suggests that radiation given off by radium and uranium are physically harmful. Like the report written by the chemist who originally assesses the composition of the luminous paint for the initial labour department case, the possible ill-effects of radium are now taken into consideration. Some scientists at this time also know that ingested radium would accumulate in bones and could destroy red blood cells, leading to anemia. Howeer, the therapeutic benefits of radium in a medical capacity (destroying cancerous tumors, for instance) were seen by many physicians and medical professionals as outweighing these potential risks (Clark 1993, 81).

Because radium is incredibly lucrative in industry and in medicine, most experts in the field work for companies that produce radium-based medicine.

THINK 4: How might this fact influence the way in which scientists making money from radium use understand the possible health effects of the substance?

Some physicians use radium treatments in their practices to treat ailments ranging from skin disorders to cancerous tumors. The key to radium's curative effect in medicine appears to be its ability to destroy diseased tissues when applied carefully to the treatment area so as to not harm the healthy tissues surrounding the area. This new evidence accumulating in Young's report is starting to suggest that there could be some serious concerns surrounding the industrial use of radium given its deleterious effects on living tissues. (Clark 1993, 82).

During this third investigation the U.S. Public Health Service comes out with an internal report in 1924 which indicates that through a review of the literature available on the effects of

radium, that while skin erosion, blood changes and anemia do occur, “no serious defects” are found (Williams 1923, 43-64). With the evidence mounting against radium, the U.S. Public Health Service suggests that stricter safe handling standards be followed in an industrial setting. They suggest that exposure to radiation be limited, that the workers should receive regular physical checkups and that they should take time off work if their blood showed signs of anemia (Clark 1993, 83).

THINK 5: Considering the resources at their disposal, what plan of action do you think the dial painters could take to acquire information regarding their exposure to potentially dangerous compounds at their workplace?

The discovery of radium

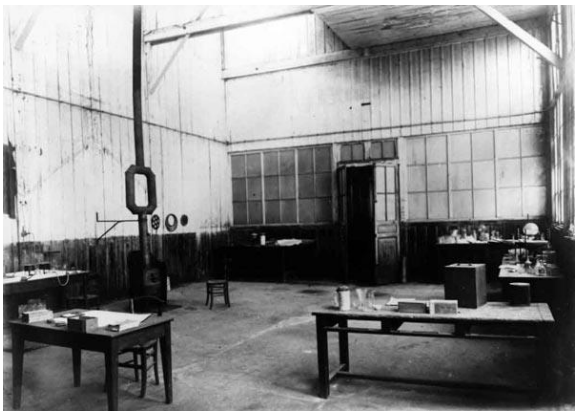
Ionizing radiation was discovered over one hundred years ago and the harmful health effects have been understood in some scientific circles for almost as long. Its discovery was exciting and was of great interest within the scientific community. Initially there was no concern regarding the long term health effects of radiation exposure. The idea that illness could take years to develop post exposure was not well understood and not yet applicable to the new discovery. It would take several decades before a concern over radium exposure for the general public and factory workers was taken seriously within the scientific community. As early as the 1890’s there were numerous reported occurrences of skin burns and hair loss attributed to radiation. These negative health consequences, though detrimental to the inflicted individuals, helped guide physicians to the potential therapeutic value of radiation in terms of cancer treatment (Lambert 2001, 31).

The discovery of radium in 1898 by Marie Sklodowska-Curie (1867-1934) and Pierre Curie (1859-1906) is a fundamental building block in the understanding of radioactivity and the properties of radioactive materials. Early on in their radium research, Marie and Pierre Curie,

along with their supervisor Henri Becquerel (1852-1908) became aware of the powerful effects of radium exposure (Mullner 1999, 9-10).

The Curie's discovery of radium occurs during their study of pitchblende ore, which is understood to be radioactive. However, the pitchblende is much more radioactive than expected based on its uranium content. The higher than expected radioactivity indicates to Marie Curie that the ore contains an element even more radioactive than uranium. Through a meticulous extraction process, the Curie's find a new element which they name polonium (named after Poland, Marie's home country). They discover only trace quantities radium after polonium. In order to confirm its existence, the Curie's have to extract enough radium to study its properties (Mullner 1999, 7).

The extraction was a huge undertaking. The isolation of radium from pitchblende was likened by Marie Curie to "creating something out of nothing," because it takes several tons of the ore to produce only milligrams of the pure element. To make matters worse the Curies have very few resources at their disposal. Their funding is meagre and the facilities lack the appropriate equipment to undertake the laborious extraction process. However, the Curies were highly motivated to continue their research and appropriated some equipment from Pierre's employer, the Paris School of Industrial Physics and Chemistry. They work out of an old wooden shed that had previously been used as a dissecting room by the university's medical school. The shed has an open skylight which leaves them partially exposed to the elements and its thin walls did little to keep out the cold in the winter. Humidity greatly interferes with the equipment and dust impedes the crystallization process used to isolate the constituent radium into its elemental form (Mullner 1999, 8-9).



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The Curies face other obstacles as well. Large quantities of pitchblende are required to harvest only a small amount of radium. Therefore, the Curie's seek the help of one of their colleagues at the Academy of Science in Vienna who, through the Austrian government, help them appropriate raw materials from uranium mines in St. Joachimst, Bohemia (now named Jachymov within the Czech Republic). At the time, the pitchblende donated to the Curies is considered a worthless waste product by the mines and the only cost incurred by the Curies is the shipment from the mines to their laboratory (Mullner 1999, 9).

The pitchblende used by the Curies contains as many as thirty different elements and isolating the radium requires multiple chemical separations. The pitchblende contains two main fractions: barium, which holds the radium; and, bismuth, which holds polonium. These two newly identified elements are actually quite different in their composition but were both highly radioactive (Mould 1999, 1768).

In order to push forward with their work, the Curies collaborate with the Central Chemical Products Company which is already working to market scientific instruments designed by Pierre. A colleague of the Curies, Andre Diebierne (1874-1949), adapts their small scale lab

techniques into full-fledged industrial style processes which produces a measurable amount of radium and polonium. Studies begin to try and understand their properties. Marie had mastered the extraction process, which involves stirring a huge cauldron with a rod that was as tall she is. She is also adept at using the piezoelectrometer which had been designed by Pierre and his brother Jacques (1856-1941) to assess the chemical constitution of a sample. Pierre concentrates his efforts on measuring the radioactivity of the various fractions (Mould 1999, 1767-1768).

The Curies' arrangement with the Central Chemical Products Company involves the company supplying the chemicals used in the extraction process and wages for the laboratory staff. In exchange, the Curies give a share of their radium salts to the company. This exchange proves highly lucrative for the company as the radium salts are later marketed for medical and other various uses. But even with the assistance provided by the Central Chemical Products Company it took the Curies more than three years of non-stop work to isolate just one tenth of a gram of nearly pure radium (Mullner 1999, 9).

The radium that the Curies painstakingly extract is not a beautiful colour as Pierre had hoped. However, to the surprise of the Curies it glows. Marie remarks:

> Sometimes we returned in the evening after dinner for another survey of our domain. Our precious products, for which we had no shelter, were arranged on tables and boards; from all sides we could see their slightly luminous silhouettes, and these gleamings, which seemed suspended in the darkness, stirred us with ever new emotion and enchantment (M. Curie 1923, 104).

It does not take long for the Curies to understand that radium could have astounding effects upon the body. In 1900 a German researcher shares his findings regarding the burns he acquired from handling tubes of radium and exposing his unprotected skin to the radioactive element. Pierre set out to replicate these findings by exposing the skin of his arm to radium for various

stretches of time from eight to thirty minutes. Each time the area turned red and then over the subsequent days a wound would form which would then took months to fully heal. The Curies' supervisor, Henri Becquerel, also experiences the negative physical effects of acute radium exposure, though not intentionally: he develops the same sort of wound experienced by Pierre by leaving a tube of radium in his vest pocket for multiple hours (Mullner 1999, 9-10). The discovery of both radium and polonium lead the Curies and Becquerel to winning the Nobel prize in physics in 1903. Marie is the first woman to ever win such distinction. Marie will also win a Nobel Prize in chemistry for describing the behavior of the radioactive elements. She will be the first person and only woman ever to win two Nobel Prizes.

THINK 6: Given that the radium extraction process was labour intensive and expensive, how might the Curies and Henri Becquerel meet the funding needs for their research?

The story continues: the role of Harvard's Department of Industrial Hygiene

In March of 1924 the U.S Radium Corporation, in the midst of the ongoing public health and labour investigations, seeks the private investigatory services of the fledgling Industrial Hygiene Department at Harvard University. The department head is Dr. Cecil Drinker (1887-1956) and it is his duty to study the health of current dial painters and the working conditions at the dial painting factory. Dr. Drinker and his colleagues are well versed on the current understanding of radium's toxicity. They are aware that it gives off potentially dangerous gamma radiation, that it decays into harmful radon gas, and that it gets taken up into bones. In their official report to the corporation, Dr. Drinker and his team express their concern that radium could be causing the jaw necrosis and anemia observed in some of the ex-dial painters (Clark 1993, 84). In a letter to the radium company Dr. Drinker writes:

> From material which we have been able to dig out of the literature here and piece together with your experience…it would seem that radium is the probable cause of the trouble…

> There seems to be two possibilities in regard to the radium: first, that the rays are causing the damage; and, secondly, that radium itself, absorbed in minute quantities through the skin over long periods of time, is deposited in the bones. Since it apparently behaves like calcium this point of deposition seems highly probable to us. Once deposited in the bones, my associates who have been working with radium feel that it might exist for a good while and continue to slowly exert harm (Drinker, 1924).

In his final report, Dr. Drinker makes various recommendations to the corporation, but the president of the corporation, Arthur Roeder (1884-1960), deems them invalid and lacking in merit. Roeder wonders why dial painters in other factories across the country and in Europe are not suffering from the same illnesses, and thinks it imprudent to attribute a few similar cases to their factory in particular. Also, chemists working for the Radium Corporation work with larger quantities of radium than the dial painters and these individuals show no signs of illness. With Dr. Drinker's report concluded, and radium strongly suggested to be the source of disease, the company treats the results as unsubstantiated and insufficient to make any major changes to their protocols or infrastructure. Roeder, however, does put up a notice in the factory banning the dial painters from pointing brushes with their mouths (Clark 1993, 84).

When Dr. Drinker wants to publish his findings regarding the dial painting factory, Roeder (who had hired Dr. Drinker to undertake the investigation) refuses to let him do so. Roeder believes that the report will have a detrimental effect on his company and that it will slow the progression of radium research and the promotion of radium based consumer products. Dr. Drinker adheres to Roeder's wishes and does not publish the report at this time (Clark 1993, 84).

Think: Did Drinker have an obligation to publish what he knew about radium, or was he obligated to withhold such information because of the will of Roeder? Explain your answer.

The story continues: The Consumers' League of New Jersey

While the U.S. Radium Company seeks the expertise of the Harvard department of industrial hygiene, the dial painters, with the help of Lillian Erskine (from the Labour Department) and Lenore Young (from the Health Department) contact the New Jersey Consumers' League. The Consumers' League is best known for its advocacy of women's and children's issues such as education and social justice. At this time the league is headed by Florence Kelly (1859-1932) with Katherine Wiley acting as executive secretary. Wiley, a champion of industrial disease reform, is keen to take on the dial painters' case as she has successfully fought for the rights of women potters who had been exposed to hazardous levels of lead. Another member of the Consumer's League is Dr. Alice Hamilton (1869-1970). Hamilton is also an assistant professor in the Industrial Hygiene Department at Harvard working under department chair Dr. Cecil Drinker (Clark 1993, 86).

Wiley interviews many of the dial painters, questioning them about their health and work history. She also interviews their dentists and physicians. In the process she discovers that many more dial painters are suffering from disease than had been previously known. Wiley's work and accumulation of medical information regarding the dial painters creates a clearer picture of what was causing their symptoms (Clark 1993, 88). She later remarks, "To a lay person, it seems impossible that a 'coincidence' can account for the fact that four persons have died, another is dying and others have apparently the beginning of the same trouble, when all of them have no common experience other than the same occupation" (Clark 1993, 88). Dial painters, their families and medical professionals are now convinced that radium is the cause, and that something has to be done to prevent further damage.

With evidence in hand, Wiley meets with the commissioner of New Jersey's Department of Labour, Andrew McBride (1869-?). McBride is not open to Wiley's take on the dial painters' plight. He is satisfied with the work done between the state agencies and believes that there is no substantiated link between the occupation of dial painting and the illnesses suffered by the dial painters. Wiley pressured McBride to instate a full Public Health Service investigation, but he refuses to take formal action. Wiley wants the federal labour department to hire Dr. Hamilton of the Consumer's League and the Harvard school of Industrial Hygiene, but this is denied due to budget constraints (Clark 1993, 88).

When Dr. Hamilton learns that Dr. Drinker had been contracted out by the Radium Corporation and that he was sitting on his final report, she is dismayed. Hamilton urges Drinker to publish his reports so that the dial painters' search for answers and resolution could be moved forward. Drinker refuses to do so as he was respecting the wishes of the Radium Corporation's president Arthur Roeder. In order to promote the publication of Drinker's report so that it could be used for the dial painters' cause, Wiley once again contacts the New Jersey Labour Department and urges them to procure a copy of the report which had been commissioned by the U.S. Radium Corporation. Wiley is taken aback when she learns that the labour department had already reviewed the report and saw no need to pursue it further as they believed that the company had played no role in the illnesses suffered by the dial painters (Clark 1993, 89).

With this plan to get the report out in the open and with working in the dial painters' favour no longer viable, Alice Hamilton writes a letter to Dr. Cecil Drinker's wife Dr. Katherine Drinker. Kathrine Drinker is also a member of the Department of Industrial Hygiene and participated in the U.S Radium Corporation study with her husband. Hamilton lets the Drinkers know that the Radium Corporation is using the report to promote their position that radium is not

causing the dial painters' illnesses. This does not sit well with the Drinkers and despite being hired by the Radium Corporation they feel justified in publishing the report, which they do in August of 1925. With the official publication of Drinker's report, the New Jersey labour commission clamps down on the Radium Corporation and indicates that they must adhere to the recommendations promoted in the report. However, the Radium Corporation chooses to close its factory in Orange, New Jersey and moved it to New York City to avoid changing their protocols (Clark 1993, 90-91).

In April of 1925, a federal labour investigation takes place which assesses not only the Orange, New Jersey factory but others as well. The approximately 120 companies in the United States that use radium laced luminescent paint are concerned that the New Jersey case was promoting anxiety about the potential dangers of working with radium. Some of these companies are also concerned that their workers would quit their jobs, leaving the factories short-handed and unable to meet their need for skilled workers. The federal investigation concludes that radium was indeed dangerous as it accumulated in the dial painters' bones, lead to necrosis of the jaw, and contributed to the development of anemia (Clark 1993, 91).

The role of forensic pathology:

Dr. Harrison Stanford Martland (1883-1954), a New Jersey physician and forensic pathologist and the chief medical examiner of Essex County, New Jersey, is a very well-known pathologist at the time as he is a common feature at high profile court cases in which forensic evidence is presented. The dial painter case piques Martland's interested in 1923 and he tries unsuccessfully to obtain the rights to perform an autopsy on a recently deceased dial painter (Mullner 1999, 66-67).

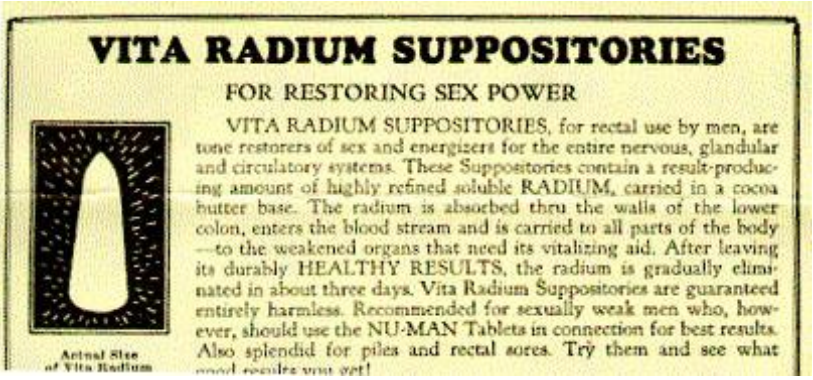
In May of 1925, after a lull in interest, Martland re-addresses the dial painters' strange illnesses, but this time through a chemist who also happens to work for the Radium Corporation, Edwin D. Leman (1888-1925). Leman had already developed scarring on his hands and severe anemia which was treated unsuccessfully with blood transfusions. He had been working with radium for fourteen years and had been working for the Radium Corporation for the last four. Leman's condition deteriorates quickly and he dies in June of 1925. This gave Martland the opportunity to perform an autopsy to determine the cause of his death. He determines Leman's internal organs to be radioactive. His lungs are highly radioactive due to the inhalation of radium dust. Martland buttresses his findings by performing an autopsy on dial painter Sarah Carlough Maillefer (1889-1925). He finds that her spleen, liver and bones contained large amounts of radium. He lists her cause of death as severe anemia caused by exposure to radium. Martland also measurs the amount of radon gas in the breath of other living, seemingly healthy, dial painters. They all exhaled radon, indicating that they had radium in their bodies (Clark 1993, 92).

Martland composes his findings in a paper entitled "Some Unrecognized Dangers in the Use and Handling of Radioactive Substances", which he publishes on December 5, 1925. It is not well received by many, especially those involved in the radium industry. But even with its mixed reviews, Martland's work promotes the recognition of the illnesses suffered by the dial painters which the Consumers League had been fighting to do since March of 1924 (Mullner 1999, 69).

THINK 7: With radium being the most likely culprit for the illnesses suffered by the dial painters, how might the dial painting factory mitigate the risk of radium exposure to its employees in the future?

Public perception of radium during the early 20th Century

During the 1920's, while the dial painters are suffering from the effects radium ingestion and external exposure, the public is immersed in the popular belief that radium is a panacea of good health and healing. It seems as though the benefits of radium are only limited by the imagination and the plethora of radium based products available to the consumer could attest to this.



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Soon after its discovery in 1898 by Marie Curie, radium's intense physiological powers become evident. As discussed, both Henri Becquerel and Pierre Curie experience strange delayed burns from handling the newfound

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http://www-tc.pbs.org/wgbh/americanexperience/media/uploads/special_features/photo_gallery/poisoners_gallery_06.jpg

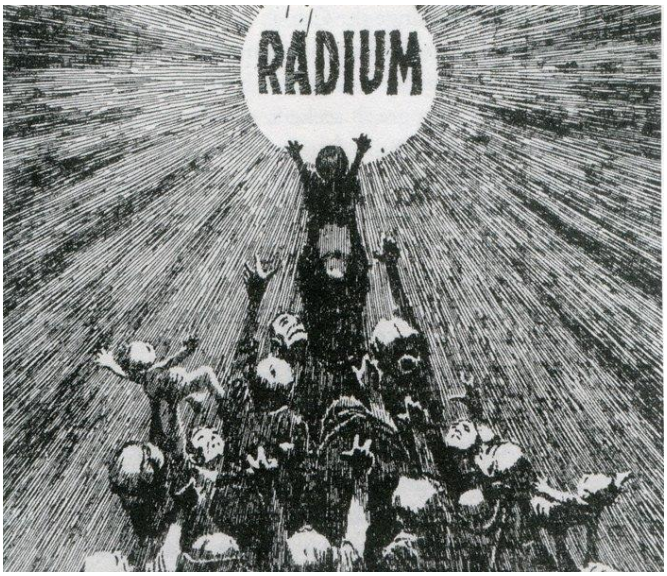
element and this tissue altering property is soon recognized to have meaningful applications in the field of medicine. The first medical use for radium is for the treatment of cutaneous lupus and it quickly catches on as a treatment for many other skin conditions. Even though it is in scarce supply, radium gets used extensively in radium therapy, or Curie therapy as it is called in France. It is used to treat tumors, first rudimentarily by applying the radium salts directly to the affected area and then, later, by boring encapsulated radium into the body (Lederman 1981, 643). The application of radium to internal cancerous tumors is also proven useful as it often shrinks the tumors or even fully cures the patient of cancer (Mullner 1999, 33).

Radium's reputation as a powerful agent of healing in medicine is further reinforced by its lunimous nature. Scientists and the public alike are mesmerized by the glowing, energy emitting new element, and public displays of radium's seemingly magical nature add to its allure. A firsthand account of a radium demonstration put on by Pierre Curie, shows how awe inspiring radium proves to be just a short time after it was put into medical use:

> A Lecture was attended by a large group of people, in which the newly discovered metal, radium, was discussed, telling about its miraculous and sinister power and its surprising effect. A miniscule quantity of radium, so small that it was not noticeable, uncannily produced an intensive stream of light. The room had been darkened so that the spot where it lay shone, like a green eye. The professor put it into a metal capsule; the light penetrated the solid container. A man put it in his breast pocket and covered it with his hand, still the light shone clearly through the hand and the clothing. A mouse in a cage was immediately paralyzed and died, when a small amount of radium, in a closed container, was placed on the cage. The professor (Curie) stated that he would never going into a room in which a kilogram of radium lay because he would surely be badly burned and would die. Radium illustrates a certain power, the power of God, which penetrates everything and is as invisible and imperceptible as the power of radium, yet it can detect and destroy more completely than the mysterious radium (Katharina Rempel 1916, 3).

These kinds of public displays along with newspaper articles and endorsements from many doctors and scientists, solidify radium as an agent of hope: Hope in the form of a cure for cancer,

a seemingly infinite source of energy that could replace standard fuel and electricity, and even a proverbial fountain of youth that could stave off the aging process (Mullner 1999, 10).



Newspaper illustration entitled "Hope" from the Los Angeles Examiner, 1914.

https://www.google.ca/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwi6nPXh_4fNAhVROFIKHQTUBQ8QjRwIBw&url=http%3A%2F%2Fwww.kpbs.org%2Fnews%2F2014%2Fjan%2F06%2Famerican-experience-poisoners-handbook%2F&bvm=bv.123325700,d.aXo&psig=AFQjCNFIl91Df2lRc_SWbdFZdVMbSJ7IVQ&ust=1464910695374797

THINK 8: If you were present at a radium demonstration during the early 1900's, what would you think of radium?

The case continues: Litigation and settlements

Beginning in 1925, the dial painters and their lawyers face many obstacles when they pursue their claim for restitution in court. At the time, workers have no clearly defined right to a healthy work environment. Also, ignorance regarding the dangers of industrial radium use could be used as a defense by the U.S. Radium Corporation as the deleterious health effects caused by radium are not yet commonly understood. Most damaging to the dial painters' case however, is

the statute of limitations: They get shortened during the dial painters' struggle and this proves damaging due to the latency period of radium induced illness (Clark 1997, 112-113).

The first lawsuit gets filed by Margaret Carlough in March of 1925. Margaret's sister, Sarah Maillefer (1889-1925) has already died from radium poisoning and now Margaret is suffering from the same conditions. Margaret sues the U.S. Radium Corporation for $75,000. Others join Margaret's lawsuit, including, the family of Hazel Vincent Kuser and Dr. Joseph Knef who is trying to recoup the cost of treating Margaret and Sarah. The case gets settled out of court by the Radium Corporation for $13,000 and they assume no legal responsibility. Following the settlement of the case, Arthur Roeder loses his position as the President of the U.S. Radium Corporation as the board of directors was displeased with how he handled the dial painter case (Mullner 1999, 75-77).

This is not the end of the dial painters' struggle for justice and compensation. In 1927, five dial painters' file a lawsuit against the Radium Corporation for $1,250,000. The lawsuit sought damages for Quinta McDonald and Albina Larice (Amelia Maggia's sisters) Grace Fryer, Edna Hussman, and Katherine Schaub, all of whom had been hired by the corporation in 1917 and eventually died from bone sarcomas. This case, unlike the one preceding it, garners much interest and was referred to in newspapers as "The Case of the Five Women Doomed to Die" (Mullner 1999, 77). Publicity from this case also seems to bring about a change in society's perception of radium from a health inducing material to one of extreme danger.

The suit filed by the women's lawyer, Raymond H Berry (1897-1971), accuses the U.S. Radium Corporation of poisoning the women with an element that was known to be harmful and that the corporation did not have appropriate safety protocols in place to protect the women from

harm. The suit also condemns the corporation for withholding the results of Dr. Drinker's report and for using the information within it to promote their position that radium was not the cause of the dial painters' illnesses (Mullner 80-81).

In return, the U.S. Radium Corporation argues that the women had no right to sue as the New Jersey statute of limitations had run its course (i.e. suits needed to be filed within two years of disease being diagnosed). Berry sees things differently; He argues that the statute of limitations is not up as it should be counted from the day the women learned the true cause of their illness. In order to prevent the Radium Corporation from using their statute of limitations defence, in July of 1927 Berry has the case moved to chancery court so that a ruling could be made regarding the statutes applicability (Mullner 1999, 81).

The case is scheduled to take place in 1928 and in the meantime, Berry sets out to have the body of Amelia Maggia exhumed to determine her cause of death. Maggia's autopsy reveals that she had in fact not died from complications associated with syphilis, but rather radium poisoning. Her bones and tissues are highly radioactive and it is estimated that her body contained five hundred times more radium than was considered safe (Mullner 1999, 81).

The court hearings begin January 12, 1928 and last for several days. By this time the five women are suffering terribly. They are crippled due to their skeletons disintegrating and their faces are misshapen due to jaw necrosis. Some are so frail that they had to be carried to the witness stand. The women testify. They speak of pointing their brushed as they worked and how their health began to fail. Dr. Harrison Martland also testifies and speaks of his research regarding radium poisoning. Arthur Roeder also takes the stand to say under oath that he had never seen the dial painters' point their brushes in their mouths.

The last witness to testify is Katherine Wiley. She gives her account of how the Consumers' League advocated for the dial painters' and promoted the investigation to the Labour and Health Departments. Following Wiley's testimony, the U.S. Radium Corporation asks for the case to be adjourned until a later date. The corporation wants to submit testimony from experts in the field who are unavailable at this time. Berry objects to this as he believes that some of his clients may be dead before the trial could restart. The judge, however, allows for the case to be put on hold until September of 1928 (Mullner 1999, 82).

The public is now outraged by the stay of the trial. Newspaper and magazine articles criticize the U.S. Radium Corporation as well as the court system for delaying their search for justice. To mount a public relations defense, the Radium Corporation allows their consultant, Professor of Industrial Hygiene at Columbia University, Frederick Flinn (1876-1957) to speak to the press. Flinn tells the press that the women may yet improve if they take care of themselves and that they could go on to live long and happy lives. There was outcry from the press regarding Flinn's statement and even Marie Curie decries the statement regarding the fate of the five women. She offers them her sympathies as she believes that there was no hope for them. (Mullner 1999, 83).

1928 newspaper cartoon

http://blogs.plos.org/speakeasyscience/files/2011/03/radium-238x300.jpg

Finally, on June 4, 1928 the case is settled out of court. Again, like the previous case, the U.S. Radium Corporation accepts no legal responsibility or liability. However, the pay out to the dial painters is more substantial than what was paid previously. The Radium Corporation settles to pay each of the five women a lump sum of $10,000 and an annual pension of $600. The corporation would also pay their medical bills and legal costs. This settlement is the first of its kind as it is the first publicly known settlement given to people injured by radioactivity. News of the settlement spreads through the media and the public is relieved to have the case settled in the women's' favour (Mullner 1999, 85-86).

For the "five women doomed to die", the pay-out from the Radium Corporation proves to be an insufficient salve for their suffering. In 1929, Quinta McDonald dies, followed by Katherine Schaub and Grace Fryer in 1933, Edna Hussmann in 1939 and Albina Larice in 1946 (Mullner 1999, 88).

Notes on the health effects of radium exposure

Most radium that is ingested (80%) is excreted through the feces within 3 days and within a week about 95% will be excreted. The remaining radium acts like calcium and is thus taken up into the bones and teeth. If no further exposures occur, radium levels in the body will decrease over time as it continues to be released from the bones and excreted. However, this takes a long time and a portion will remain in the body for the remainder of the individual's life. Repeated ingestion will magnify the levels of radium found within the body (Canadian Nuclear Safety Commission 2014).

In terms of the health effects of external radium exposure, long term exposure leads to an increase in the risk of developing many different diseases. External exposure to the gamma radiation given off by radium decay increases the risk of cancer throughout the body. Increased exposure is positively correlated to an increase in risk. Radiation itself consists of energetic particles moving at various speeds. Under normal daily circumstances, such as eating food, getting sun on your face or having a shower, radiation levels are very low (almost undetectable). At high levels, radiation can kill you within hours and at moderately low levels, DNA damage can occur.

Because radium is acts chemically like calcium, it accumulates in the bones causing the irradiation of bone tissue increasing the risk of bone related diseases including lymphoma, bone cancer, leukemia and aplastic anemia (Marie Curie suffered from this). These disease states take years to develop and are the result of ingesting high levels of radium. For example, bone cancer develops in individuals exposed to 10,000 millisieverts (mSv) or 10,000 times the annual dose limit as set out by the Canadian Nuclear Safety Commission. (Canadian Nuclear Safety Commission 2014).

Video explaining millisieverts and exposure levels:
https://www.youtube.com/watch?v=TRL7o2kPqw0

Notes on Radium:

Radioactive decay involves unstable atomic nuclei releasing subatomic particles. Radium (atomic weight of 226.0254) as part of the alkaline earth series of metals, goes through a decay chain in which isotopes undergo a series of decays. Radium is part of the Uranium series which begins with naturally occurring uranium-238 and ends with lead-206. Radium has 33 isotopes

with radium-226 being the most stable. It is the emission of alpha particle from Ra-226 (half-life of 1620 years) which results in its conversion into radon gas (half-life of 3.8 days), this is followed by eight more radioactive decays, resulting in a non-radioactive atom of lead. Radium is over a million times more radioactive than its parent, uranium. Both radium and uranium exist in small quantities in the same type of mineral compounds and are usually mined from the same locations (Harvie 2005, 10).

NOS concept questions:

How does the case of the radium dial painters draw attention to the following NOS concepts?

- Medical and academic ethics
- The process of scientific inquiry
- The role of economic status in regards to access to information
- Communication between the public, scientists and industry

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