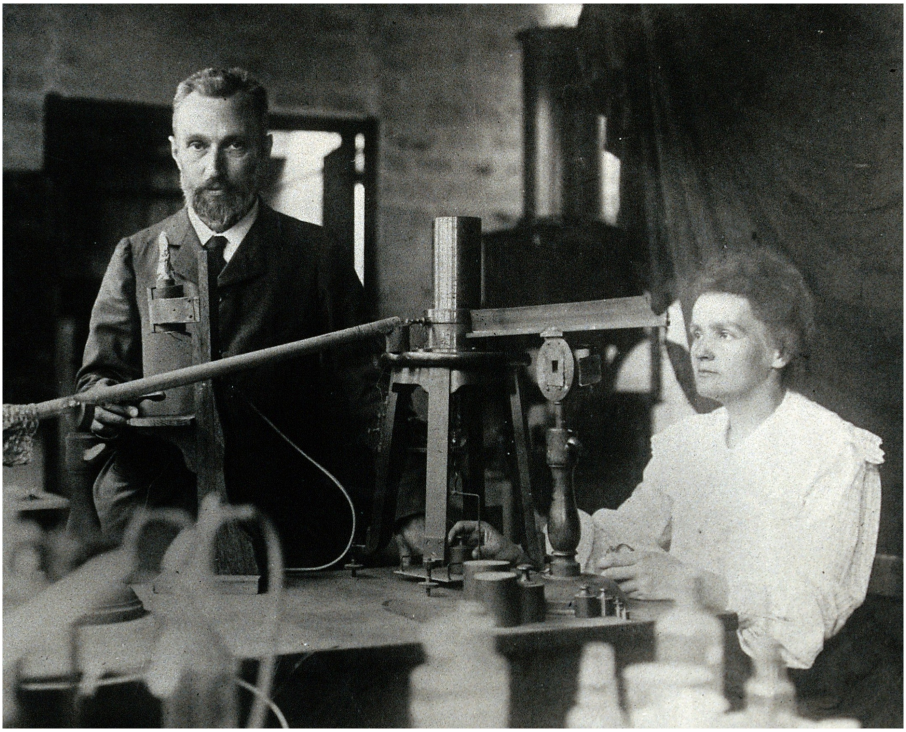
Marie Curie: Radium, Polonium

Chapter 5

Radium and Polonium



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This photo of Marie and Pierre Curie was taken as they worked in their laboratory in 1904.

Marie won two Nobel Prizes. The first she shared with her husband, Pierre and with Henri Becquerel. The three scientists were awarded for their contributions to the study of radioactivity. Marie's second Nobel Prize was shared with no one--although in her acceptance speech she declared that the prize was as much Pierre's, who was deceased, as it was hers.

Was Marie correct?

Marie's second Nobel Prize was awarded for the discovery of polonium and radium, two radioactive elements on the periodic table. There is no doubt that Pierre was with Marie when each of these elements was discovered. There is no doubt that Pierre's contribution to Marie's work was enormous. This was true especially with Marie's work on radium, because by the time Pierre died, the Curie's knew a great deal about this element.

However, polonium was a bit trickier to work with than radium. The story of the Curie's work with these two elements is one of partnership, dedication and inspiration.

In 1895 and 1896, two scientists, William Conrad Roentgen and Henri Becquerel had discovered and worked with X-rays. This was a new field and one that Marie found quite exciting as she began her life as a research scientist. Very little had been done in the field since Becquerel's work when Marie began her studies in 1898. It didn't take her long to make progress.

As she worked with uranium and pitchblende, she noticed that pitchblende seemed to contain an element that was much more active than uranium. Upon further investigation, she discovered that this was indeed true. The new element, she guessed, was 300 times more active than uranium.

At this point in Marie's research, Pierre became very interested. He had been working on magnetism and measuring electrical charges. He decided to join Marie in her new investigations. His work measuring electrical charges came in handy, for it was an invention that he had made with his brother that allowed

Marie to measure the activity of the new element.

Together, husband and wife measured until they were certain they had indeed discovered a highly active, new element. This element they called polonium, and its extraordinary activity they described as radio-active--the first time that term had ever been used.

Most people would be surprised to learn that Marie and Pierre discovered polonium before they discovered radium, because the two scientists are closely identified with their work with radium. One of the reasons for this might be that polonium is so hard to work with that it took a long time to accumulate enough to prove to the scientific community, absolutely, that it actually existed.

By the time Marie was able to do this, Pierre had died and she had begun to teach at the Sorbonne.

Why was polonium so hard to study? The Curies asked themselves this question, because polonium in their lab seemed to disappear. What the Curies did not know was that every radioactive element eventually "disappears".

This process of disappearing is called an element's half life. The half life for polonium is so short --a matter of days--that no matter how much the Curies managed to collect, it would decay before they could do significant work with it.

<u>On the Following Page</u>

This building in Dayton, Ohio played a critical role in the development of the two atomic bombs that were used at the end of WWII. The building was occupied by Mound Laboratory, which became proficient at extracting polonium from lead ore and bismuth. The extracted polonium was sent to the team (working as the Manhattan Project) that was developing the first atomic bomb.

<u>Polonium and Radium Compared</u>

	Polonium ^{210}	Radium
Symbol	PO	Ra
Atomic Number	84	88
Half life:	138 days	1,200 years
Emits:	Alpha Rays	Alpha, Beta and Gamma Rays
Isotopes:	29 Known	33 Known

Mound Laboratory in Dayton, Ohio

Photo produced by a National Park Service employee. As such, it is in the public domain .

Radioactive material decays at a uniform rate. The half life of a radioactive element is the amount of time it takes for one half of an element to decay. Isotopes (slightly different forms) of an element decay at different rates. In the chart on the following page, Ernest Rutherford (see the biographical note on Rutherford in this book's Appendix) has calculated the half life of thorium. Rutherford's chart shows how different isotopes of thorium decay. The column on the right shows the kind of radiation emitted by each isotope during the decay process.

Though radium also decays, it is at a slow rate. As the thorium chart shows, the half life for radium is more than 1,200 years. An interesting aspect of the chart is that it demonstrates how one element decays until it becomes another. Note that thorium becomes radium.

The long half life of radium explains how it was easier for Marie to progress in her understanding of this element than it was for her when she worked with polonium. As she painstakingly collected radium from her pitchblende sample, she enjoyed the luxury of putting the material aside and going back to it over and over again.

Was Marie correct that Pierre deserved to share her second Nobel Prize? It certainly seems that she isolated polonium and was able to present it to the community after Pierre's death. However, the essential work on the element had been done early on, when the husband and wife worked in the laboratory together. A less generous person might have tried to claim credit alone for the discovery of radium and polonium, but that is not the Marie Curie that colleagues and her family described.

Rutherford's Chart of Thorium's Half Life

Product	Time to be half transformed	Radiations
Thorium	—	α rays
↓		
Th. X	4 days	α rays
↓		
Emanation	54 seconds	α rays
↓		
Thorium A	11 hours (Active Deposit)	no rays
↓		
Thorium B	55 minutes (Active Deposit)	α, β, γ rays
↓		
?	—	—
Actinium	?	no rays
Actinium X	10.2 days	α (β and γ)
Emanation	3.9 seconds	α rays
Actinium A	35.7 minutes	no rays
Actinium B	2.15 minutes	α, β and γ
Radium	1,200 years	α rays
↓		
Emanation	3.8 days	α rays
↓		
Radium A (Active Deposit of Rapid Change)	3 minutes	α rays
↓		
Radium B (Active Deposit of Rapid Change)	21 minutes	no rays
↓		
Radium C (Active Deposit of Rapid Change)	28 minutes	α, β, γ rays
↓		
Radium D (Active Deposit of Slow Change)	about 40 years	no rays
↓		
Radium E (Active Deposit of Slow Change)	6 days	β (and γ) rays
↓		
Radium F (Active Deposit of Slow Change)	143 days	α rays
?	—	—

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