

Actor Packet

The Half-Life of Marie Curie

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Table of Contents

■ Ode to a Playwright

- About: Lauren Gunderson
- The New Yorker: “You’ve Probably Never Heard of America’s Most Popular Playwright” article by Daniel Pollack-Pelzner
- The Huffington Post: “Theater’s Audiences are Mostly Female, Why Not the Roles?” article by Lauren Gunderson
- Datebook: “Four Historic Scientists Who Are Stars in Lauren Gunderson’s plays” article by Lily Janiak
- Production History: *The Half-Life of Marie Curie*
- The New York Times: review of the NY premier of *The Half-Life of Marie Curie*

■ Ode to a Play

- Lexicon of Terms: references in the play explained
- Scene Breakdown: time and location of each scene
- Dialects & Translations: Dialect and accent notes, French and Polish translations and pronunciations
- Social Context: literature and music of early 1900s Britain
- Marie and Hertha: a timeline of their friendship
- Highcliffe House: photos and a note from Hertha to Marie

■ Ode to a Physicist

- About: Dr. Marie Curie
- What is Radium: How it was discovered and used
- In Her Words: Marie’s notes about working with her husband Pierre in the “miserable old shed”
- “The Great Scandal”: Marie’s affair with Paul Langevin
- Albert Einstein’s letter of support

■ Ode to an Engineer

- About: Hertha Ayrton
- Hertha: poem by Algernon Charles Swinburne

DIALECTS & ACCENTS

Hertha was born in a small coastal town called Portsea in [Hampshire](#) in South East England (about a 2 ½ hr train ride from London today) where English and Hebrew were spoken at home. She would have spoken [Southern English](#) which refers to a set of different dialects spoken in Southern England, which includes Hampshire county. At the age of 9, she moved to the Whitechapel district in the East End of London to live with her aunt and uncle.

- The East End is known for the cockney accent, but considering Hertha's educational and social background it's doubtful that her own speech was influenced by this accent.
- The [Received Pronunciation](#) accent (aka RP or BBC English) was traditionally defined as the standard upper-class speech used in London and southeastern England in the early 20th Century. While Hertha's immediate family wasn't upper class, in her late teens/early 20s she ran in highly educated circles rubbing shoulders with writers, teachers, and scientists. It's possible that she took on some of the characteristics of this non-regional accent.
- [Example of the Hampshire dialect](#) (male born in Hampshire, U.K.)
- [Example of conservative RP accent](#) (this is likely too formal for Hertha)
- [Example of mainstream RP accent](#)
- Hertha's accent was likely a blend of Southern English and mainstream RP.

Marie was born in Warsaw, Poland where she learned to speak Polish, Russian, and German. When she moved to France at the age of 24, she spoke no French but picked it up quickly.

- [Example of someone speaking Polish](#) (female born in Poland)
- [Example of English-speaking French accent](#) (female born in France, father from Poland)
- [Example of English-speaking Polish accent](#) (female born in Poland)
- Marie's English accent likely leaned more toward Polish than French as that was her primary language for more than twenty years.

TRANSLATION & PRONUNCIATION

The [Collins Dictionary](#) has a great translator that breaks down the words one by one. All you have to do is copy the text you'd like to translate and select the translation from French to English or from Polish to English. I've checked the translations and pronunciations on several different sites for accuracy, and this site is the easiest and most helpful.

English

- **Pg 28 Hertha:** Algernon
 - Pronunciation: use a soft “g” (sounds more like a “j”)
- **Pg 38 Marie:** Langevin
 - Pronunciation: Lang-eh-vin

French

- **Pg 9 Hertha / Pg 64 Marie:** Èvie and Irène
 - Pronunciation: the “È” sound like the “e” in the word “best”
- **Pg 10 Marie:** Tout va bien, mon ange, je vais bien, continue à jouer le piano si tu aimes.
 - Translation: “Everything is fine, my angel, I am fine, keep playing the piano if you like.”
- **Pg 20 Marie:** Calais
 - Pronunciation: ka-lay
- **Pg 55 Marie:** Non non non! C'était merveilleux. Je suis si heureux que j'y suis alle!
 - Translation: No, no, no, it was wonderful. I am so happy that I went!
- **Pg 55 Hertha:** Mais comment cela peut-il être vrai?
 - Translation: But how can that be true?
- **Pg 65 Marie:** Èvie, mon ange. Tu continue à jouer!
 - Translation: Èvie, my angel. Keep playing!

Polish

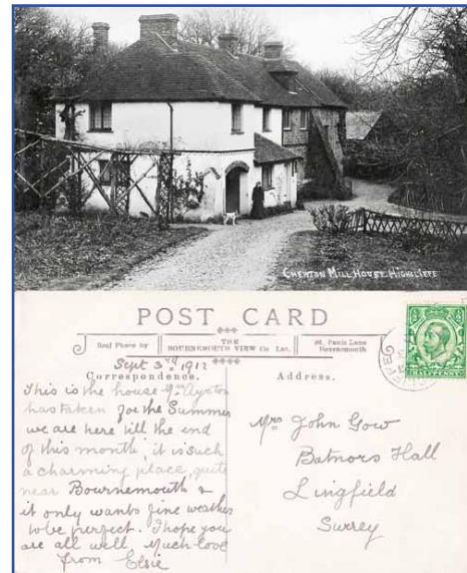
- **Pg 20 Marie:** Skłodowska
 - Pronunciation: [skwah-dofskuh](#) The “dof” sound has a narrower “O” sound rather than a fat “O” sound.
- **Pg 62 Both:** Na Zdrowie
 - Translation: Cheers
 - Pronunciation: [Naz drovia](#) The emphasis is on the “drov.”

HIGHCLIFFE HOUSE



In February 1912, Hertha wrote to Marie:

“I shall take a house by the sea in Devonshire or Cornwall for the months of August and September, so you and your daughters will be able to have two months of sea bathing...You will not need to come to London before going there. I will meet you at Dover, or whichever port you come to, and we will all travel along the coast...in this way, no one will know anything about your visit and if you come under another name you will be absolutely safe from intruding visitors...If we can quite re-establish your health during your visit it will be a real joy to me.”



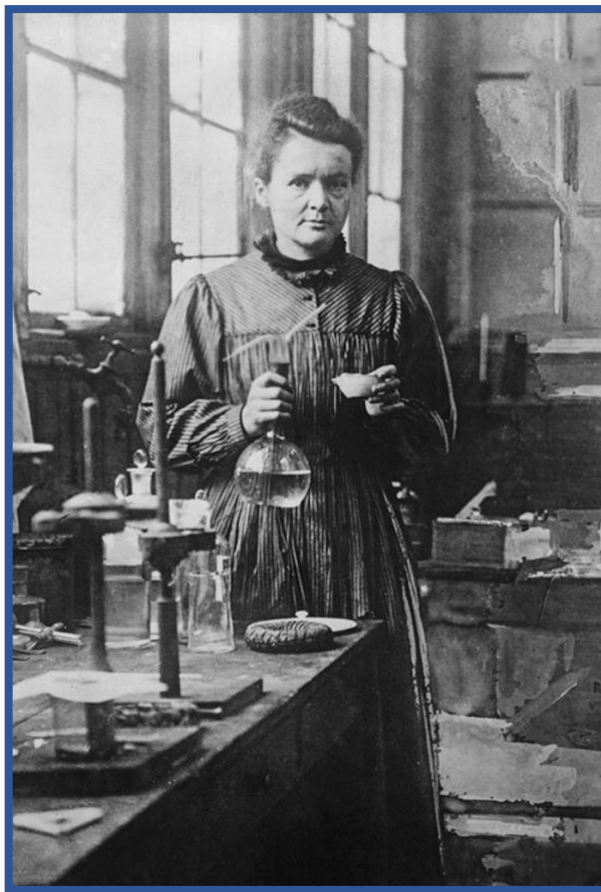
In her 1936 biography of her mother, Eve recalled that summer of 1912:

“Tracked down by physical ills and human baseness, she hid herself like a beast at bay...In the summer her friend, Mrs. Ayrton, received her and her daughters in a peaceful house on the English coast. There she found care and protection.”

The text on the postcard reads: “Sept 3, 1912. This is the house Mrs. Ayrton has taken for the summer. We are here till the end of this month. It is such a charming place, quite near Bournemouth [illegible] ...”

Ode to a Physicist

- [About:](#) Dr. Marie Curie
- [What is Radium:](#) How it was discovered and used
- [In Her Words:](#) Marie's notes about working with her husband Pierre in the "miserable old shed"
- ["The Great Scandal":](#) Marie's affair with Paul Langevin
- [Albert Einstein's letter of support](#)

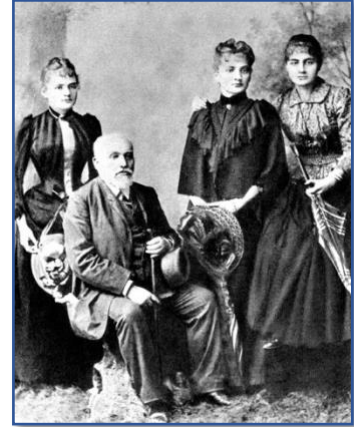


DR. MARIE CURIE

“Nothing in life is to be feared. It is only to be understood.”

Born:

- Marya Salomee Skłodowska on November 7, 1867 in Warsaw, Poland
 - Was the youngest of five children
 - Family nickname: Manya
 - Mother was the headmistress of a girls' school and later became a housekeeper
 - Died of tuberculosis when Marie was 10
 - Father was a professor of physics and mathematics and, later, opened a boy's boarding school



Died:

- July 4, 1934 in Passy, France of aplastic anemia, a blood disease caused by chronic, low-level radiation exposure.

Lived:

- **1867-1884:** Warsaw, Poland
- **1884-1891:** Szczuki, Poland (50 miles north of Warsaw) where she worked as a governess
- **1891:** At 24, she moved to Paris, France where she lived for the remainder of her life

Education:

- **1863:** Russian authorities restricted Polish professors from teaching physics and chemistry, and Marie's father was stripped of his laboratory. The Polish language was forbidden in schools, as was the teaching of Polish history and literature. So, Marie's father taught all his children at home while also sending them to formal schools.
- **1883:** At 15, Marie graduated first in her class from Russian Gymnasium Number Three
- **1884:** Marie attended an underground academy for women known as "the Flying University," based out of Warsaw.
- **1893:** became the first woman to secure a master's degree in physics at the College of Sorbonne in Paris.
- **1894:** earned a master's degree in mathematics at Sorbonne.
- **1903:** became the first woman in France to earn her PhD (in Physics, from Sorbonne).
- Languages: Polish, French, English, German



Marriage & Affair:

- Married physicist, Pierre Curie in 1895 (d. 1906)
 - **Daughter:** Irène b. 1897 (physicist)
 - Granddaughter: Hélène (physicist)
 - Grandson: Pierre (biologist)
 - In the summer of 1903, when Marie was five months pregnant she and Pierre were on a three-week bicycle trip when she suffered a miscarriage.
 - **Daughter:** Ève b. 1904 (Musician and journalist)
- Had an affair with physicist, Paul Langevin (1910-1912)



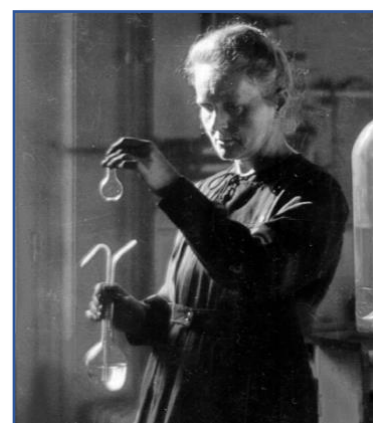
Health:

- Throughout her life, Marie was prone to depression, “nervous exhaustion,” and panic attacks-- usually brought on by stress and extreme fatigue. She referred to these episodes as “my nervous troubles.”
 - When Marie was 10, her mother and 12-year-old sister died of tuberculosis. She went into what she called “a profound depression,” the beginning of a pattern that would remain with her all her life.
 - At 15, after graduating from school, she had a “total nervous collapse” and her father sent her to stay with relatives outside of Warsaw, where she stayed for a year recuperating.
 - When Marie suffered a second-trimester miscarriage at the age of 36, she went into a deep depression that lasted more than six months. When the announcement of the Nobel Prize was made in November 1903, she and Pierre declined to attend the ceremony in Switzerland the following month due to Marie’s unstable health.
 - Later in life, Marie told her daughter, Eve, that when Pierre died she wanted to kill herself. But having lost so much weight from not eating, she was too weak to take action.
- Spending nearly 30 years working with radioactive materials, Marie was exposed to toxic radiation on a near-daily basis. The heat from the chemical processing often burned and charred her skin. She also experienced numbness in her hands and often lost feeling in her fingers. She spent years breathing in harmful chemical fumes which caused chronic lung and breathing issues. The prolonged exposure to radiation also damaged her bone marrow and several of her organs. All of this led to persistent bodily pain often making her physically weak.



Awards & Achievements:

- **1898:** Gagnier Prize from the French Academy of Sciences (for research on the magnetic properties of steel)
- **1903:** Nobel Prize in Physics (for research on spontaneous radioactivity)
 - First female Nobel Laurette!
 - Shared with her husband, Pierre Curie, and physicist Henri Becquerel
 - The Nobel Committee initially did not include Marie as an awardee, but Pierre was adamant that she be acknowledged for her research and he threatened not to accept the award if his wife was not included.
 - Included 70,000 gold francs in prize money
- **1903:** Davy Medal from the Royal Society of London (for research on spontaneous radioactivity)
 - Shared with her husband, Pierre Curie
- **1908:** First woman to become a professor at the College of Sorbonne (teaching physics)
 - **In her own words:** “The death of my husband...was felt by the public, and especially by the scientific circles, to be a national misfortune. It was largely under the influence of this emotion that the Faculty of Sciences of Paris decided to offer me the chair, as professor, which my husband had occupied only one year and a half in the Sorbonne...Up to then no woman had held such a position...The honor that now came to me was deeply painful under the cruel circumstances of its coming.”
- **1911:** Nobel Prize in Chemistry (for the isolation of radium and polonium)
 - First person (male or female) to win two Nobel Prizes
 - First (and only!) scientist to win Nobel Prizes in two different fields
 - Marie chose to name the element, “Polonium” after her home country, Poland.
 - **From the Nobel Committee:** “Many chemists believe that the discovery and isolation of radium was the greatest event in chemistry since the discovery of oxygen.”
 - Marie’s discoveries lead to an entirely new method of understanding elements by measuring their radioactivity, thereby throwing open the door to atomic science.
- **1918:** Founded the Radium Institute at the University of Paris
- **1920:** Founded The Curie Institute in Paris



- **1925:** Founded The Radium Institute in Warsaw (now known as the Maria Sklodowska-Curie National Research Institute of Oncology)
- **1932:** Founded The Curie Institute in Warsaw

Learn more!

- **TedEd:** “[The Genius of Marie Curie](#)” (an animated, easy-to-follow breakdown of the work that inspired her Nobel Prizes)
- **France 24:** “[Marie Curie’s Legacy: How her discoveries still apply today](#)” (includes live video footage of her laboratory)
- [A look inside Marie Curie’s Paris laboratory](#) (90-second video of her workspace and instruments)
- **Today I found Out:** “[Marie Curie’s Affair and the Duels that Followed](#)” (a humorous but accurate account of her affair with Paul Langevin)

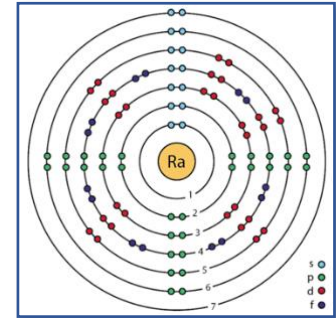


Sources: Obsessive Genius: The Inner World of Marie Curie by Barbara Goldsmith, [Biography](#), [MSK Cancer Center](#), [Nobel Prize](#) (Marie Curie’s life), [Nobel Prize](#) (the discovery of Radium & Polonium), [Smithsonian Magazine](#), [The New Atlantis](#)

RADIUM

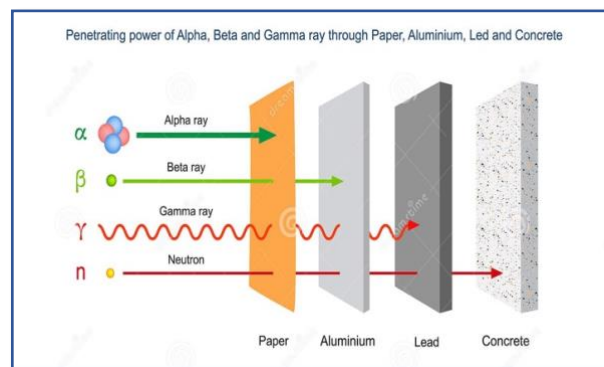
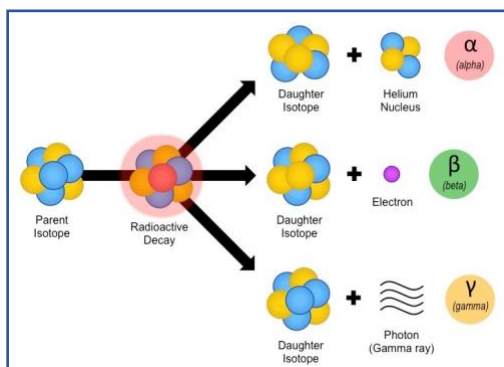
What is radium?

- Radium is produced by the radioactive decay of uranium. It is a silvery white metal and radioactive chemical, and is the heaviest of the alkaline-earth metals of the periodic table. It oxidizes when exposed to oxygen, turning from white to black. Its compounds display a faint bluish glow in the dark, a result of electrons releasing their energy as light.
- There are 34 known isotopes (i.e. atoms of a chemical element) of radium, all of which are radioactive. Their half-lives, except for radium-226 (1,600 years) and radium-228 (5.75 years), are less than a few weeks.
- In the natural environment, radium occurs at trace levels in virtually all rock, soil, water, plants, and animals.



How was it discovered?

- In 1896, French physicist, Henri Becquerel, discovered that uranium ore could emit invisible rays (i.e. phosphoresce), something Marie Curie later called “radioactivity.”



- Inspired by Becquerel’s work, Marie started researching the radioactive properties of uranium ore as a possible subject for her Ph.D. thesis in Physics. Pierre, her husband and fellow physicist, eventually joined her and the pair spent five years refining and processing ten tons of pitchblende (i.e. a radioactive, uranium-rich mineral now known as uraninite), and by 1901 they were able to isolate a single gram of what would later become element 88 on the periodic table: Radium.
 - Marie named it “radium” after the Latin “radius,” meaning ray

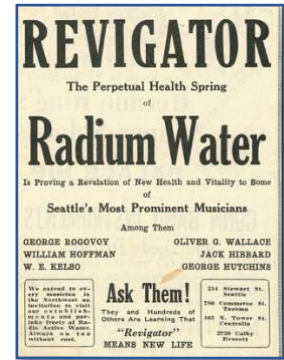
- Just one gram of pure radium salts (i.e. about $\frac{1}{4}$ teaspoon) can fuel thousands of experiments!
- Pierre Curie's experiments with radium revealed that "the energy radium released produced enough heat to bring its weight in water from freezing to boiling in only one hour."
- Pierre "liked to keep a sample in his pocket so he could demonstrate its glowing and heating properties to the curious, and even once strapped a vial of the stuff to his bare arm for ten hours in order to study the curious way it painlessly burned his skin. Curie, in turn, kept a sample at home next to her bed as a nightlight."
- **The first gram of radium:** When WWI erupted in 1914, Marie stayed in Paris to protect her precious remaining radium salts and then personally escorted it (in a 45-pound lead container) to Bordeaux in western France where it was stored in a bank vault for safekeeping. The French government later confiscated the vial of radium and redirected it to doctors for cancer treatment.
- **The second gram of radium:** Marie and Pierre never patented their process for purifying radium, so other scientists and chemical companies quickly started processing and selling radium for "health" treatments and research for \$100,000 per gram (roughly \$1.5 million today). This meant that Marie could no longer afford the element that she discovered. In 1921, American journalist, Missy Meloney, interviewed Marie in Paris and upon her return to the U.S., started the Marie Curie Radium Fund to raise money to purchase 1 gram of radium for Marie's continuing research. In total, Meloney raised \$156,413 (roughly \$2.3 million today), securing a bid for the radium, and using the extra funds to set up a trust fund for Marie and her daughters. Meloney then invited Marie to visit the U.S. for a seven-week speaking tour. The 1 gram vial of radium salts was presented to Marie by President Warren Harding at the White House. The vial also came with a protective case which was lined with lead and weighed 101 pounds.
- "At the turn of the century, the scientific community was hotly debating the structure of the atom. Marie's claims about radioactivity suggested [that the atom contained something else](#)—something that gave off energy." The discovery of radioactivity "launched a new era of scientific inquiry into the structure of the atom. [Scientists](#) increasingly understood that atoms were not the smallest solid particle of matter but could be broken up into subatomic particles. When



released, some of these particles provided a jolt to tissues in their path, causing burns.” Marie Curie’s discoveries revolutionized the understanding of the structure of the atom, and opened the door to radiation therapy for cancer and to the use of nuclear energy.

How was it used?

- **Radium Dials:** “When a radium salt is mixed with a paste of zinc sulfide, the alpha radiation causes the zinc sulfide to glow, yielding a self-luminescent paint used for watch, clock, and instrument dials. From about 1913 up until the 1970s, several million [radium dials](#) were manufactured.”
- **Household products:** Through the 1930s, radium was hailed as an all-around health and beauty elixir, and was added to everyday items such as water, coffee, beer, chocolate, tea, bath salts, toothpaste, face creams, makeup, and tonics. It was even put into chicken feed with the hope that the eggs would self-incubate.
- **Cancer treatment:** For decades, radium was used for the treatment of cancer by subjecting tumors to the gamma radiation of its daughter isotopes. But after World War II, “it became possible to create man-made radioactive elements (radioisotopes) in nuclear reactors, instead of isolating radium from uranium ore. These new [isotopes](#) were much safer to handle and administer than radium or radon seeds.”



Is it dangerous?

- **Radium Girls:** In the 1920s, there were three U.S. factories manufacturing radium dials (in NJ, IL, and CT). The women employed at the factories used a technique called “lip-pointing” which required them to use their lips and tongues to shape their paintbrushes before applying the paint to the dial. Ingesting considerable amounts of radium on a daily basis eventually led to severe anemia, tooth loss, jaw decay, and bone cancer. In New Jersey, [the Radium Girls](#), as they became known, brought a lawsuit against the US Radium Corporation in 1927. While they eventually won their suit, most of the women died within the next decade.



- **Cancer:** Chronic exposure to high levels of radium can result in increased chances of bone, liver or breast cancer, as well as severe anemia.
 - As radium decays it creates a radioactive gas called [radon](#) (i.e. an odorless, colorless, radioactive gas found in most rocks and soils). Radon can travel from the ground through cracks in floors and walls of buildings. It is the second leading cause of lung cancer in the U.S.
- **TedEd:** [“Is Radiation Dangerous?”](#) (a short, animated lesson on where radiation comes from and its effects).

Sources: [Biography](#), [Britannica](#), [MSK Cancer Center](#), [Science History Institute](#), [Scientific History](#), [Smithsonian Magazine](#), [The Atlantic](#)

“THE GREAT SCANDAL”

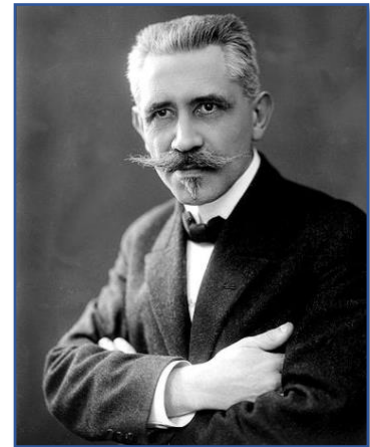
Marie Curie’s affair with Paul Langevin

“I was drawn to her as a light...and I began to seek from her a little of the tenderness which I missed at home.”

~Paul Langevin about Marie Curie

Paul Langevin

- B. January 23, 1872 | D. December 19, 1946
- 1898: Married Emma Jeanne Desfosses with whom he had four children
- Pierre Curie’s student and longtime friend of the Curies
- A physicist who developed “Langevin Dynamics” (an approach to the mathematical modeling of the dynamics of molecular systems) and “The Langevin Equation” (plays a central role in the theory of critical dynamics)
- His affair with Marie Curie is believed to have started in 1910 and ended in 1912.



Emma Jeanne Desfosses finds out about the affair

- According to Paul, his wife Emma had a violent nature. He once showed Marie “a half-healed gash where Emma had broken a bottle over his head.”
- In April 1911, Emma hired a private detective who learned that Paul was renting a small Paris apartment (presumably where he and Marie met), where the detective found letters Marie had written to Paul. That summer, Emma had the letters printed in the newspaper, *Excelsior*.
- Emma threatened to kill Marie, and one night she and her sister waited outside Marie’s apartment where she physically accosted Marie and ordered her to “leave France immediately or die.”

The second Nobel Prize / the love letters are released

- In November 1911, Marie and Paul both attended the Solvay Conference (see photo) in Brussels. While at the conference, Marie received a telegram from the Nobel committee announcing that she was the sole winner of a second Nobel Prize. Later that same day, she received a second telegram informing her that Paul’s wife had released the love letters to the press.



The duel that never happened

- The right-wing journalist, Gustave Tery, wrote that Langevin was a “boor and a coward.” Langevin challenged Tery to a duel (which was illegal in France at the time). “After elaborate preparations, Tery refused to fire his pistol, saying that he did not wish to deprive France of one of its greatest minds. Langevin, too, never raised his pistol. ‘I am not an assassin,’ he said.”

A smack from the Nobel Committee

- “Shortly after the scandal broke, a member of the Nobel Committee wrote to Marie on behalf of the committee asking her to refrain from coming to Sweden to accept her prize. He cited her published love letters” and added that had the Academy known about the affair they likely would not have awarded her the prize at all. She wrote back:
“...I cannot accept the idea in principle that the appreciation of the value of my scientific work should be influenced by libel and slander concerning private life. I am convinced that this opinion is shared by many people.”
- On December 11, 1911 Marie gave her Nobel lecture in Stockholm.

From Marie's Letters to Paul:

“It would be so good to gain the freedom to see each other as much as our various occupations permit, to work together, to walk or to travel together when conditions lend themselves. There are very deep affinities between us which only need a favorable life situation to develop...The instinct which led us to each other was very powerful...What couldn't come out of this feeling?... I believe that we could derive everything from it; good work in common, a good solid friendship, courage for life, and even beautiful children of love in the most beautiful meaning of the word.”

“Think of that, my Paul, when you feel too invaded by fear of wronging your children; they will never risk as much as my poor little girls, who could become orphans between one day and the next if we don't arrive at a stable solution.”

“[If you resume sexual relations with her] we would both be judged severely by all those, alas already numerous, who know. If that should happen it would mean a definite separation between us...I can risk my life and my position for you, but I could not accept this dishonor...”

“When I know that you are with her, my nights are atrocious. I can't sleep, I manage with great difficulty to sleep 2 or 3 hours; I wake up with a sensation of fever and I can't work. Do what you can and be done with it... We can't go on living in our current state.”

Source: Obsessive Genius: The Inner World of Marie Curie by Barbara Goldsmith

Ode to an Engineer

- [About:](#) Hertha Ayrton
- [Hertha:](#) poem by Algernon Charles Swinburne



HERTHA AYRTON

“Errors are notoriously hard to kill. But an error that ascribes to a man what was actually the work of a woman has more lives than a cat.”

Born:

- Phoebe Sarah Marks on April 28, 1854 in Portsea, Hampshire, U.K.
 - Was the third of eight children (6 brothers, 1 sister) in a Jewish family
 - Mother, Alice Theresa, was a seamstress
 - Known in their community for making herself “a center of public work and usefulness...always at everyone’s beck and call, and was never known to refuse an appeal for help.”
 - Father, Levi Marks, was a watchmaker and jeweler
 - Fled from Poland to England to escape Jewish persecution
 - Died when Hertha was 7, leaving the family desperately poor for several years
- Changed her name to “Hertha” around the time she entered Girton College (about age 22). The name is said to be inspired by one of two things:
 - Her friend Otilie Blind dubbed her Hertha after the heroine of a novel by Frederika Bremer.
 - She took the name herself after reading the poem “Hertha” by Algernon Charles Swinburne.



Died:

- August 26, 1923 in Bexhill, Sussex, U.K. of septicemia

Childhood:

- At the young age of 6, she began helping her mother with her younger siblings by making them toys from cardboard, sewing patches on their clothes, and watching them while her mother worked.
- In her words: “I always played in the streets at home and it never did me the slightest harm.”
- Was once caned on the hands at school and her mother promptly removed her from the institution. The incident is said to have made quite the impression on Hertha for “throughout her life, any suggestion of harshness or tyranny towards children would rouse her to instant protest.”

Lived:

- Moved to the Whitechapel district in the East End of London at age 9 where she lived with her aunt's family until she was 16.
- Lived in London (though we don't know where) with a family as their nursery governess from age 16-22, sending most of her money home to her mother.
 - During this time she was also tending to her sickly younger sister who had moved to London so that Hertha could take care of her. We don't know where they lived or how long the sister stayed with her.
- In 1876, she moved to Cambridge (about 56 miles north of London) to attend Girton College.
- After getting married in 1885, she and William lived in [Norfolk Square](#) in Paddington, London.
- The family moved to [Dorset, England](#) in 1901 for her husband's health.

Education:

- **1863:** at just 9 years old, Hertha moved to London to live with her maternal aunt, Marion Hartog, who was a published poet and ran a boarding school out of her home. While living with her aunt and uncle and their four children, she learned mathematics and music, as well as ancient and modern languages (including French).
- **1876:** attended Girton College (the first British college for women) at the University of Cambridge (about a 2hr train ride north of London today). The college did not grant degrees to women (only certificates), but she was able to study mathematics. While there, she was also the leader of the Choral Society and founded a mathematics club.
 - Received financial help from older female friends such as Barbara Bodichon (teacher, artist, activist), and Mary Ann Evans (aka novelist George Eliot).
 - Hertha didn't do well on her final examinations, earning a Third Level (on a scale of 1-3). She wrote to her friend and benefactress, Barabara Bodichon: "I think it is very hard on you after all you have done for me, that I should do no better. It is not for want of work, nor even entirely of brains, but rather a want of memory and still more presence of mind in the exam room. So I have turned out a failure."
- **1881:** received an external BS degree from the University of London and went on to teach mathematics at various high schools.
- **1884:** attended evening classes on electricity and physics at Finsbury Technical College which were taught by William Ayrton.
- **Languages:** English, French, Hebrew, Latin

Marriage:

- Married **William Ayrton** in 1885 (d. 1908), a physicist and electrical engineer who once wrote to Hertha's cousin, Dr. Philip Hartog, "You and I are able people, but Hertha is a genius."
 - Stepdaughter: Edith b. 1879
 - Edith's mother, Matilda Chaplin, studied medicine at the University of Edinburgh and was one of the [Edinburgh Seven](#).
 - Daughter: Barbara b. 1886 (British labor politician / Member of Parliament)
 - Grandson: Michael b. 1921 (painter / sculptor)



Inventions & Discoveries:

- **1878:** sphygmograph (used to measure a person's pulse)
- **1884:** line divider (a drafting tool for engineers and architects)
 - This became the first of 26 patents Hertha purchased in her lifetime (5 on mathematical dividers, 13 on arc lamps and electrodes, and 8 relating to the propulsion of air).
- **1893:** "tamed" the electric arc lamp
 - After taking over her husband's research, she discovered that the hissing, flickering, and instability of electric arc lighting was due to oxygen coming into contact with the carbon rods used to create the arc. She also found that when oxygen was excluded from the design, a steady (and more reliable, quieter) arc was obtained.
 - She published twelve articles on her analysis, research, and technical advances in the field of electric arc lighting. The results of her work were so impressive that she was invited to deliver a paper (the first woman to do so) on electric arcs before the Institution of Electrical Engineers.
 - Hertha's modification of the arc light influenced the future development of cinema projectors, searchlights, follow spots, lighthouses, 3D Printers, explosive detonators, and more-- all of which are still in use today.
- **1909-1915:** Analyzed the fluid dynamics of waves on the seashore, as well as the causes and process of formation of ripples in the sand. Her understanding of fluid dynamics informed her later invention of an anti-gas fan.
- **1915:** Ayrton anti-gas fan (used to clear poisonous gas from trenches during WWI)

Awards & Achievements:

- **1899:** Became first female member of the Institution of Electrical Engineers (IEE).
 - She remained the sole female member of the IEE until 1958.
- **1902:** Published a book, *The Electric Arc*.
- **1904:** Became the first woman to deliver her own paper, “The Motion of Ripples in Sand and Wave,” before the Royal Society.
- **1906:** Became the first woman to receive the Hughes medal (awarded to an outstanding researcher in the field of energy) from the Royal Society “...for an original discovery in the physical sciences, particularly as applied to the generation, storage, and use of energy in recognition of her work on the electric arc and her later research on the motion of ripples in sand and water.”
 - It was another 102 years before the Hughes medal was again awarded to a woman
- **1925:** Otilie Hancock, Hertha’s childhood friend, established the Hertha Ayrton Research Fellowship at Girton College.
- **2010:** Named [1 of the 10 Most Influential Women in British Science](#) History by the Royal Society.
- **2015:** The British Society for the History of Science creates [the Ayrton Prize](#).

Suffrage Work:

- Supported fellow suffragists with fiscal donations and shelter as needed. Attended rallies and marches, speaking often for the cause.
- **1907:** Became a member of the Women's Social and Political Union.
- **1913:** Was Vice-president of the British Federation of University Women (now known as the British Federation of Women Graduates).
- **1913:** Nursed [Mrs. Emmeline Pankhurst](#) and other suffragists back to health when they were released from Holloway jail after a violent protest.
- **1914:** Was Vice-president of the National Union of Women's Suffrage Societies.
- **1918:** Hertha voted for the first time, thanks to the Representation of the People Act which gave voting rights to women over 30.
- **1919:** Became a founding member of the International Federation of University Women (now known as Graduate Women International).
- **1919:** Became a member of the Women’s Engineering Society.

Additional:

- Having no laboratory of her own, Ayrton used her husband's lab at the Central Institution in London (now known as Imperial College) to conduct her research until his death in 1908 after which she performed experiments in her living room.
 - **In her words:** “All my scientific work has been carried out alone. My husband foresaw that if we collaborated any merit that might attach to our work would be attributed to him...and he, therefore, out of chivalrous regard for my scientific reputation, refused ever to collaborate with me...In

later days, he knew so little of what I was doing on the subject of sand ripples and oscillating water that he saw some of my experiments for the first time when I showed them in public.”

Learn More!

- [BBC Radio 4 *Science Stories* broadcast](#), “The Woman Who Tamed Lightning” on Hertha’s electric arc discovery and other inventions (2016)
- [BBC Radio 4 *Great Lives* broadcast](#) on Hertha’s life (2018)
- Hertha’s complete essay, “[The Origin and Growth of Ripple Mark](#)” (1904)
- [Hertha Ayrton’s Fight For Fellowship](#) (video with historical documents from the Royal Society)



Sources: Hertha Ayrton: A Memoir by Evelyn Sharp, [Britannica](#), [Jewish Women’s Archive](#) (Hertha Ayrton), [Jewish Women’s Archive](#) (Marion Hartog), [JSTOR](#), [Project Continua](#), [Science Museum Group Journal](#), [She Thought It](#), [The Guardian](#), [The New Inquiry](#), [The Royal Society](#)