

The Inspirational Life of Madame Curie, The Goddess of Science

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Abstract

In the history of world science, Madame Curie is an immortal name. This great scientist has made outstanding contributions in the fields of physics and chemistry with his talent and diligence, and won the Nobel Prize twice in 1903 and 1911. The meritorious service she established and the qualities she possessed were deeply impressed by future generations. This paper briefly reviews the extraordinary life of this great woman, and the scientific spirit of being practical, hardworking, simple, tenacious and not vain, which is reflected from her, is always worth learning by our future generations.

Keywords: Goddess of science; Madame Curie; Scientist spirit; History of physics.

1). The Polish daughter has just grown up

On the evening of November 7, 1867, a little girl was born in an ordinary teacher's home at No.16 Fretta Street in Warsaw, the Polish capital. This is their fifth child. Her name is Marie Sklodowska. The family affectionately called her "Maria". No one expected that it was the youngest daughter, Maria, who went to a glorious life and went to eternity after enduring great hardships in the future. Maria's father and mother are both middle school teachers, and they have created a relatively relaxed and United family atmosphere for the children. After Maria was born, the mother who had the initial symptoms of tuberculosis concentrated on raising five children at home (Figure 1). A warm family of seven lives happily in the apartment shared by their father.



Figure 1: Five children in the apartment in 1872, from left to right: the eldest sister Zosia, the third sister Hela, Marie (Madame Curie), the elder brother Joseph and the second sister Bronya.

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Unfortunately, in the autumn of 1873, the upright father was dismissed and his salary was reduced because he offended the headmaster. In January 1876, the elder sister Zosia died of typhus. Zosia's death suddenly aggravated her mother's illness, and on May 9, 1878, her mother, who loved them the most, closed her eyes forever. The oppression of the Russians and the death of two relatives were cruel blows to Maria. She made up her mind to use her unrelenting struggle to regain the happiness, joy and success that she and every Polish deserved from an unfair life. Warsaw in the 19th century was under the cruel rule of czarist Russia. In order to get a high school diploma, Marie had to transfer to a public middle school (Figure 2) under Russian control, burying her patriotism deeply.



Figure 2: A group of photos (about 15–16 years old) when Madame Curie was in middle school.

On June 12, 1883, Marie graduated from high school. She got excellent grades in every subject, and got full marks in Russian, German, Mathematics and Geography. At the graduation ceremony, the name “Marie Skłodowska” resounded through the hall again and again. Marie wore a delicate black dress and walked to the high platform again and again with steady steps. First, she won the gold medal, and then she won the subject prize because she won the first place in all subjects. As a father, his eyes were filled with tears with excitement when Mr. Skłodowska looked at Marie with a diploma and a gold medal in her hand.

2). From Warsaw to Paris

Although her grades were excellent, but her family conditions were limited, Marie couldn't go to college immediately after graduating from high school. She first stayed at her relatives' home in the countryside for 14 months, and then returned to Warsaw to do several tutoring jobs, during which she also participated in the “Mobile University” to make up her homework. Marie's study in the mobile university has benefited a lot, which has strengthened her determination to continue studying mathematics and physics. In order to go to college, she consulted with her sister Bronya, helped each other, and went to college by turns. Marie offered to go to the countryside as a tutor to earn money for her sister to study in Paris, and then funded herself to go to college after her sister graduated. The sisters' plan was approved by their father.

At the beginning of March, 1890, Bronya's studies were about to end smoothly, and it was finally Marie's turn to go to Paris to study. In the winter of 1891, Marie took all her clothes and savings, chose the cheapest fourth-class carriage, bid farewell to her elderly father with tears, and ran to the hall of science in her mind. It's been eight years since I graduated from high school, a long eight years! This is enough to bury any talented person forever for eight years! But Marie stood firm, how hard it was to insist! we will soon see that a new scientific star will rise in Paris over the French Republic!

After three days' long journey, the destination is close at hand, and the fatigue of the long journey has not reduced Marie's excitement. Paris is a rumored art paradise. The magnificent Eiffel Tower stands tall and seems to be greeting Marie who has just arrived in Paris. After arriving in Paris, Marie took a short rest at her sister Bronya's house for a few days (Figure 3), and then went to the Sorbonne University to report that she correctly wrote “Marie Skłodowska” on the registration form.

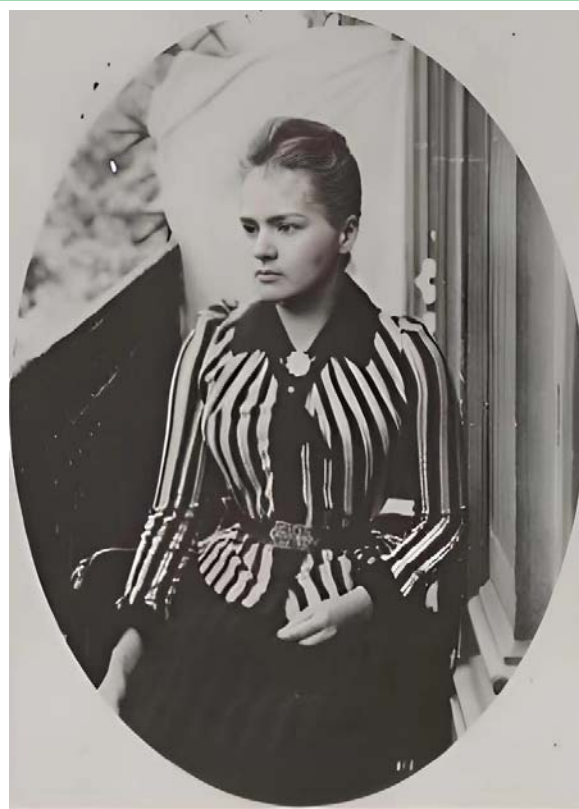


Figure 3: When Madame Curie first arrived in Paris in 1891, she took the first photo at her sister Bronya's house.

It can be seen from Marie's simple clothes that she is out of step with fashionable Paris. But she never cares. Learning is the most important thing for her. No matter which course, Marie always comes to the classroom early, sits in the first row, and concentrates on the professor's lecture without missing anything. In order to gain more study time for herself, with the consent of her brother-in-law and sister, Marie finally moved into a small attic on the fourth floor closer to the school, although there was no heating or water and electricity facilities. But it's

cheaper and closer to the school. Marie works harder than before, and it is common to study until two or three in the morning. Everything comes to him who waits. In July 1893, Marie got a bachelor's degree in physics with the first place. Shortly after returning home, she won an Alexandria scholarship with a total of 600 rubles, which was a piece of good news from the sky. Marie could continue to study for a degree in mathematics in Paris. In September, 1893, Marie rented another house and continued to devote herself to the study of mathematics. In 1894, under the recommendation of her teacher Professor Lipman, Marie took part in an important project with funds: studying the magnetism of different steel grades. Coincidentally, this topic made her meet Pierre Curie, the laboratory director from Paris School of Physics and Chemistry. After a period of contact, the friendship between Marie and Pierre gradually changed from "light blue" to "deep blue". On July 26th, 1895, Marie finally took the husband's surname and became Madame Curie. They promised each other that they would never give up fighting for science after marriage.

3).The first discovery of polonium and radium

After their marriage, the Curies still spent all their time on experiments, lectures and preparing for exams. In the hot August, Madame Curie finally passed the qualification examination for teaching in girls' schools with the first place. On September 12th, 1897, Madame Curie successfully gave birth to Irene, her first daughter with Pierre. As soon as she recovered from childbirth, she immediately returned to the laboratory and continued to prepare for her doctoral project-radioactive research.

Madame Curie mainly used the piezoelectric Shi Ying electrometer invented by Pierre, so as to better measure the weak current generated by Becquerel rays. Soon she detected radiation in a compound called thorium, which was similar to uranium rays in both nature and intensity. In order to describe the behavior of these two elements, Madame Curie coined the term "radioactivity". On February 17, 1898, when Madame Curie measured a mineral, she found that the radioactivity of this mineral was hundreds of times stronger than that of pure uranium or pure thorium samples. After she carefully repeated the measurement for more than 20 times, it was still the same. Because all the known elements had been tested one by one, they were not so radioactive. Madame Curie firmly believes that these minerals contain at least one unknown element that is more radioactive than uranium and thorium. Since March 18th, 1898, Pierre has put down his research on crystal growth and worked with Marie to test her hypothesis and look for new unknown elements. The Curies tracked this mysterious radioactive element all the way, and finally focused on pitchblende, which was hidden in two chemical components, one in a compound containing bismuth and the other in a compound containing barium. On July 18, 1898, they finally got a substance with radioac-

tivity 400 times higher than that of uranium in the compound containing bismuth. Although its purity is far from high, it is obviously an unknown metal close to bismuth. In order to express her love for the first motherland and to fulfill her dream in her youth, Madame Curie named this unknown metal "polonium".

In November, 1898, the Curies cooperated with Gustav Bemont, the director of chemistry, to excavate another new element hidden in barium compounds. In order to separate this element from barium, we can only adopt the method of fractional crystallization. With the help of Gustav Bemont (Figure 4), the chloride they got became more and more radioactive until it was 900 times higher than uranium. On December 19th, 1898, the Curies confidently announced the existence of a second new radioactive element, and proposed to name it "Radium".

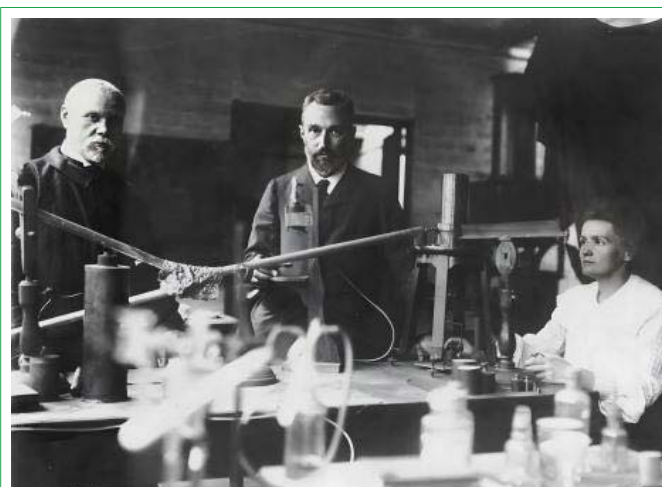


Figure4: In 1900, the Curies were in the laboratory with their assistant, Gustav Bemont, the head of chemistry.

Although there is no doubt about the existence of two new elements, polonium and radium, scientists at that time thought that a new element could not be believed until it was seen, touched, weighed and its atomic weight was determined. In order to quell doubts, the Curies rolled up their sleeves and re-entered the difficult road of purification. After that, the couple fought the most difficult struggle in the history of science for four years, which can be said to be the most unforgettable years in Madame Curie's life. Because the content of new elements is very small, the Curies need to purify from tons of pitchblende. Thanks to the dredging of Vienna Academy of Sciences, they were able to buy several tons of pitchblende residue at a preferential price. The next step is to consider where several tons of waste residue are piled up. In the end, the dean of the physical and chemical school agreed to lend them the abandoned warehouse (Figure 5) that was originally used as an anatomy classroom in the school. This abandoned warehouse is actually a wooden shed, with asphalt on the ground and leaking rain on the glass roof. All the objects inside are just a few worn pine tables, a pig iron stove and a blackboard that can no longer be used. Although it is simple, it is better than nothing.



Figure5: Abandoned warehouse of Paris School of Physics and Chemistry (circa 1898)

It's freezing in winter, freezing indoors, and hot in summer. The laboratory with a glass roof turns into a steamer in an instant. These are nothing. If it rains, they have to move away from the equipment and work notes on the workbench because of the leakage of rain in the house. However, all kinds of difficulties did not dampen the confidence of the Curie couple. The couple made detailed plans for their work. Pierre continued to study the properties of radium, while Marie was responsible for extracting pure radium salt from slag. She has to deal with materials weighing 20 kilograms at a time, and there are big jars full of sediment and liquid everywhere in the shed. Moving these utensils, dumping the liquid and stirring the boiling materials in the pool with iron bars for hours made Madame Curie exhausted. The results obtained by the end of the year clearly showed that it was easier to separate radium than polonium, so they concentrated on separating radium and set a goal to measure the atomic weight of radium. The method adopted by the couple is to gradually concentrate barium chloride to increase the content of radium chloride. The analysis method is to measure the radioactivity of the product and the relative intensity of the radium spectral line. On March 28th, 1902, after a long period of about four years, with the last concentration, Madame Curie finally obtained about 0.1g of pure radium chloride. She titrated the chlorine content in radium chloride by silver chloride precipitation, and calculated that the atomic weight of radium was 225 (now the more accurate value is 226), which was much higher than that of barium. So Madame Curie classified radium in the same family of barium in Mendeleev's periodic table, ranking below barium, which is the 88th. The couple submitted "On the Atomic Weight of Radium" to the French Academy of Sciences with conclusive evidence, proving that radium, as a new element, really exists. The appearance of radium became a "great achievement" in Madame Curie's scientific research career, and the light even covered up the discovered polonium.

4). Won the Nobel Prize twice

Since the Curie couple extracted pure radium salt in 1902, the shack laboratory on Loumeng Road has become a hot spot in an instant. The names of Radium's parents, Mr. and Mrs. Curie, have spread all over the world. On the way to fame, it is not sweat but blood that flows. Indeed, the names of the Curies were written not with pens but with life. Although it took the Curies four years to extract 0.1 gram of pure radium salt from five tons of residue, for the sake of scientific research, the Curies voluntarily gave up the patent and announced the relevant information and preparation method of radium to the world. This move made by the couple was far-reaching than they expected, and in the years to come, it brought good news to all countries in the world.

In 1903, Mr. and Mrs. Curie were frequently visited by honor. In May, the Curies accepted the invitation of the Royal Society to give a lecture on radium and won the David Medal. On June 25th, Marie defended her doctoral thesis, and won her doctorate with "excellent" comments. After that, the greatest glory in the life of the Curies finally came. On December 10th, 1903, the Curies and Becquerel won the Nobel Prize in Physics together (Figure 6). The successive honors did not make the Curie couple get carried away. To be fair, they didn't care about these awards. What really delighted them was that their research results could be affirmed by their international peers.

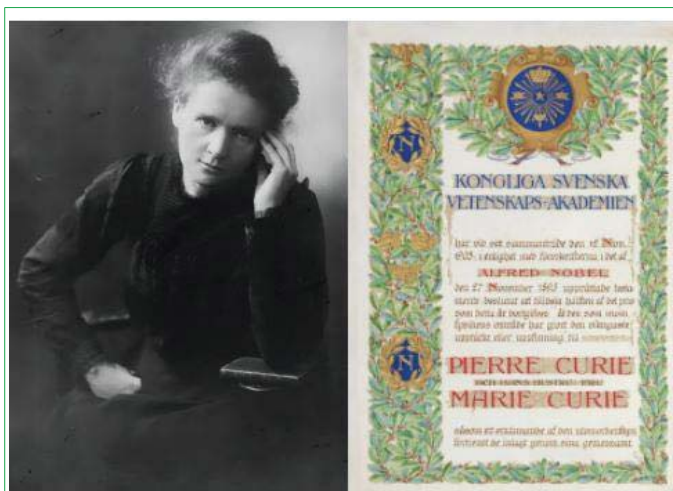


Figure6: On December 10th, 1903, Madame Curie won the Nobel Prize in Physics.

After a pleasant trip to Stockholm, Sweden, on July 3, 1905, Pierre was successfully elected as an academician of the French Academy of Sciences. However, his life is like a concert with a wonderful performance. Before the end of the song, it was forced to come to an abrupt end. April 19th, 1906 was the darkest day in Marie's life. Pierre was killed in a car accident. Pierre's death was the sorrow of the French nation, and it was a great blow to Marie. She lost her spiritual support and could only vent all her pains in her diary. In order to continue Pierre's professorship at

Sorbonne University, the Faculty of Science of Sorbonne University decided to let Madame Curie continue teaching in the name of “substitute”. Marie turned grief into strength and attended classes attentively. Only two years later, in 1908, Marie was really promoted from a substitute teacher to a full professor, which became the first female professor in French history.

During her teaching at Sorbonne University, Madame Curie set her goal: to extract a few grams of pure metal radium. Before, she and Pierre extracted pure radium salt, namely radium chloride (the only stable state of radium) in the shack laboratory of physics and chemistry school. Now she wants to move on. In August 1907, Marie first extracted 400 mg of radium chloride, and published a more accurate measurement result of radium atomic weight: 226.45 ± 0.5 . Next, Madame Curie cooperated with De Billner by distilling a mixture of radium in pure hydrogen, which was formed by electrolyzing chloride solution with a mercury cathode. They only treated one gram of salt and met with considerable difficulties. Until 1910, Madame Curie finally successfully prepared metal radium—a white metal that turns black immediately when it comes into contact with air, with a melting point of 700 degrees Celsius. On November 7, 1911, Madame Curie received a telegram from Sweden: “You will win this year’s Nobel Prize in Chemistry (Figure 7), and the letter will be sent later.” This news really encouraged Madame Curie, who was caught in a peach storm and worried and haggard. It was indeed a great honor for her, especially for the elements she discovered and the great praise for refining and separating radium. If winning the Nobel Prize with others for the first time in 1903 was partly due to her husband’s glory, then this time she won the prize alone, which fully proved her own ability. It is unprecedented to win two Nobel Prizes in one’s life.



Figure7: Madame Curie and the chemistry prize certificate who won the second Nobel Prize in 1911.

5). Quenching in the war

At the end of July, 1914, the Curie Museum of the Paris Radium Research Institute was finally completed. Just as Marie and de Billner moved into scientific instruments and put them into use with enthusiasm, World War I broke out and a ruthless storm began to sweep the world.

When the country was in crisis, Madame Curie, like many brave French women, became a white nurse. She immediately obtained the certificate of working in the health service organ (Figure 8), and found a serious problem after investigating the health status of the army: there are only a limited number of X-ray machines in the military hospitals, both in the rear and in the front; Moreover, military doctors are not very good at using X-ray machines. However, X-rays can determine the location of fractures, especially bullets or shrapnel, before surgery.



Figure8: In mid-August, 1914, Madame Curie obtained the certificate that the French Ministry of War asked her to set up a radiation equipment operation team.

In August 1914, Madame Curie collected several X-ray machines in a short time, and accepted two cars donated by the French Women’s League to improve it. The car is equipped with a mobile X-ray machine and a generator, which is driven by the engine of the car to supply the current needed by the X-ray machine. Mary used her former energy of specializing in science to treat the wounded, and a great scientist became a skilled angels in white on the battlefield. In this way, although Madame Curie did not go to the front to fight, she placed more than 200 X-ray clinics and 20 modified X-ray cars in the rear for major hospitals. As the number of X-ray technicians was far from enough, Madame Curie quickly set up a training class for X-ray technicians at Radium Institute, and recruited her 17-year-old daughter Irene as an assistant. In order to improve efficiency, in July 1916, Madame Curie obtained a driver’s license. In October 1917, Madame Curie personally drove the “X-ray machine” to the front to do battlefield rescue work. X-ray clinics and X-ray vehicles have well treated more than one million wounded people. On November 11th, 1918, World War I, which lasted for four years and three months, finally ended in the victory of the Allies. Marie’s joy was twofold, both for France’s victory and for Poland’s independence.

In May, 1920, Madame Meloni, a famous American social activist and editor-in-chief of the feminist magazine *Depiction*, interviewed Madame Curie, and since then they have formed an indissoluble bond. With the help of Madame Meloni, Madame Curie visited the United States in

1921 (Figure 9) and 1929, and received generous donations from then President Harding and Hoover respectively.



Figure9: Mrs. Meloni, Mrs. Florence Harding, Mrs. Curie, American President Warren Harding and Irene took a group photo in front of the White House in Washington on May 20, 1921.

6). Eternal monument

After returning from the United States, Madame Curie became the most admired great man in France, and her reputation became more and more famous all over the world. She was a member of the Scientific Committee at every Solvey Conference. In February 1922, Madame Curie was automatically elected as an academician of the Paris Academy of Medical Sciences without running for election. In May 1922, the Council of the League of Nations decided to invite Madame Curie as a member of the International Committee for Intellectual and Cultural Cooperation. In 1933, she was elected as the vice-chairman of the Committee. After the war, Madame Curie gradually changed her previous habit of living alone and pursuing peace, and took time out of her busy schedule to strengthen ties with various international industries. She often attends all kinds of scientific conferences and university awards ceremonies in spite of illness. Madame Curie has been to Belgium, Switzerland, Brazil, Britain, Italy, the Netherlands, the Czech Republic and other countries. At the last stage of her life, she was still glowing and giving her all to science.

In the spring of 1933, Madame Curie presided over the seminar on "Future Culture" in Madrid. In October, she attended the seventh Solvey Conference and fell ill in December, but she did not stop working. On Easter Day in 1934, she and her elder sister, Bronya, went to the south of France, where they caught a cold. Although the fever persisted, Marie returned to the laboratory and continued her research on actinides. At the end of May, the fever became more serious, and the youngest daughter Eve accompanied her mother to the hospital in Sanselemo, Assi Plateau, Sava Province (Figure 10). On July 3rd, Madame Curie looked at the thermometer for the last time. Irene and Joliot also arrived. In the early morning of 4th, Madame Curie finished her great life because of pernicious anemia caused by long-term accumulated radiation.



Figure10: Madame Curie was in a sanatorium in Sanselemo in 1934, at the age of 66.

On November 23rd, 1935, at the memorial meeting of Madame Curie held in New York, USA, Einstein spoke highly of Madame Curie's life: "Even if a small part of Madame Curie's morality, strength and enthusiasm exists among European intellectuals, Europe will face a brighter future". Arriving in France from Poland, Madame Curie reached the peak of science. Her purity, her perseverance, her courage, her strength, her selflessness ... will always be an example for future generations to learn.

References:

1. Marie Curie: Η μεγάλη κυρία της επιστήμης και των 2 Νόμπελ | LiFO
2. Madame Curie w USA w 1921 roku – Piękniejsza Strona Nauki (piekniejszastronnanauki.pl)
3. Le blog du Musée Curie - Musée Curie
4. From Warsaw to Paris (1867-1891) | PSL Explore
5. 1921: Marie Curie visits the U.S. | NIST