Marie Curie: A life devoted to Science

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Marie Sklodowska was born on November 7, 1867 in Warsaw, a polish city dominated at that time by the Russians. She was the fifth and youngest daughter of Wladislaw Sklodowski and Bronislawa Boguska. Her father was a teacher of Physics and Chemistry at the Institute and her mother was the director of a prestigious school for girls in Warsaw. After Marie's birth her mother left her professional work and was dedicated to take care of her five children, 4 girls and 1 boy. The five children were educated with their parents ideals based in the value of knowledge and culture. Her mother died when Marie was 11 years old. In June, 1883 Marie finished her school period, obtaining a gold medal and being the number one of her class, something that was a constant in her life. Her dream was to go to Paris to study at the Sorbonne University. However, her father was about to retire and he could not afford to pay for it. For that reason, Marie decided to work as governess for three years to pay for her sister Bronia's studies and to save money for her own studies in Paris later on. Thus, in November 1891 she started at the Faculty of Sciences at the Sorbonne University. She was one of the twenty three women out of two thousand students matriculated at that Faculty. She was always seated in the first row of the lecture room and her only interest and passion was the study of sciences.

She was very shy to make friends with her French colleagues and she only visited her compatriots that lived in the Latin quartier of Paris. Even so, her life was fully devoted to her studies. She lived with great austerity making use of her savings from her work in Poland and a small amount that her father sent her. Altogether, she had three francs daily to pay for all her expenses, including her studies. To save

coal she did not light the heater and after hours and hours of studying, her fingers were numbed and she was shaking due to the cold. Frequently, she spent weeks eating only tea with bread and butter. Occasionally, she was able to buy two eggs, a tablet of chocolate and some fruit. Due to the scarce food she was eating, she became anemic. Some times she fainted. That was the kind of life that Marie followed at Paris. Neither love nor marriage were in Marie's projects. Thus, with twenty six years, she had a great personal independence and she got the degree in Physical Sciences. She then thought it would be convenient for her work to have a good basis in mathematics. So, after spending the summer vacation in Poland, she came back to Paris to get this training. At the same time, she started to work at the laboratory of Professor Lippmann at the Sorbonne on the magnetic properties of diverse steels, getting her first scientific work paid. Previously, she had received a fellowship of 600 roubles and she gave back the whole amount so that other student could benefit from it. Soon Marie had space problems to develop her work. She was lucky to meet the polish Professor Kowalski who knew Pierre Curie that worked at the Municipal School of Physics and Chemistry. Kowalski asked Marie to have tea with Pierre Curie, that likely could help her. Marie was twenty six years old and Pierre was thirty five and, as well as Marie, was fully devoted to research. Since the first moment they met, they got along very well. For Pierre, Marie was an amazing personality since he could talk with her in the most complicated science language. A few months later, Pierre asked Marie to marry. After some doubts, ten months later, Marie accepted Pierre's proposal.

Their honey moon consisted in rides through the country in the bicycles they had bought with the money they received as a wedding present. They ate bread, cheese and fruit and slept in cheap boarding houses.

When they returned to Paris, they rented a very small apartment located at the la Glaciere Street with very scarce furniture. Marie learned how to manage at the house and to prepare food in a very short time.

During the second year of their marriage they had their first daughter, Irene, later on married with Frederic Joliot, the parents of our guest Pierre Joliot Curie. Irene and Frederic obtained the Nobel Prize in Physics in 1935 for their research on the artificial production of radioactive elements. Marie, after the birth of Irene, was able to reconcile her scientific and family life.

By 1897 Marie had obtained two university titles and had published an important monograph regarding the magnetization of the steel. Her next aim was to get the doctorate. While looking for a research project she became very much interested by a recent publication by the French scientist Antoine Henri Becquerel, which had discovered that the uranium salts spontaneously emitted certain beams of unknown nature. An uranium compound placed on a photographic plate covered with black paper produced an impression of the plate through the paper. That was the first observation of the phenomenon that Marie later on called radioactivity. Thanks to the Director of the School of Physics, where Pierre was teaching, Marie obtained permission to use a small deposit in the cellar of the building. The atmosphere was very insane for Marie's health and not very convenient for the precision instruments. While working in the study of the uranium beams, Marie discovered that the compounds of other element, the thorium, also emitted spontaneously beams, like the uranium. In both cases, the radioactivity was much stronger than that expected for the amount of uranium and thorium contained in the products examined.

The only possible explanation was that the materials studied should contain a small amount of a radioactive substance more powerful than the uranium and the thorium. The question was: which was that substance ? Marie had examined all the known chemical elements, so that the minerals examined should contain a radioactive substance that had to be a chemical element unknown so far.
Pierre, that had followed with enormous interest the experiments of her wife, decided to abandon his own work to help Marie. Therefore, both worked in order to find the unknown element. They begun by separating and measuring the radioactivity of all elements that the pechblenda contains. Their finding indicated the existence of two new elements instead of one. On July 1898 the Curies announced the discovery of one of those substances. Marie named it polonium in memory of her beloved Poland. In December of the same year they revealed the existence of a second new chemical element that they named radium, an element of an extraordinary radioactivity. Four years later, the Curies could prove the existence of the polonium and the radium, but even though they knew the method to isolate both elements, they needed a high amount of gross material to get them. The mines of St. Joachimsthal, located in Bohemia, were rich in pechblenda, out of which uranium was obtained, used in the manufacture of lens. The Curies calculated that, after isolation of the uranium, the polonium and radium will remain intact. The idea would be to use the residues that had with very little value. The Austrian Government facilitated them a ton of such residues and they started to work in an abandoned barrack with no floor, some old kitchen tables, a blackboard and a small kitchen of old iron. “In spite of that, Marie would write later on, in that miserable barrack we spent the best and happiest years of our life, devoted to the work. Sometimes I spent the whole day stirring a boiling mass with

an iron stirrer as big as myself. At night, I was exhausted". Under those conditions the Curies worked from 1898 till 1902. Finally, in 1902, 45 months after the announcement of the probable existence of the radium, Marie was able to prepare one decigram of pure radium and had determined the atomic weight of the new element.

The salary of Pierre at the School of Physics was low and, due to the birth of Irene they had to hire a nanny. In 1898, the chair of chemistry at the Sorbonne was vacant and Pierre decided to apply for it. His application was turned down. Only six years later, in 1904, after getting the Nobel Prize, he obtained the chair. In turn, Marie got an appointment as teacher of a school of ladies close to Versailles.

The work of the Curies was so hard that sometimes they did not eat nor even sleep. In several occasions Pierre had to get in bed due to strong pain in his legs. Marie was very pale and slim. While the research on the radioactivity progressed the Curies got exhausted little by little.

Purified as chloride, the radium looked as a white powder with extraordinary properties. The intensity of its radiations was two million fold greater than that of the uranium. Only a thick sheet of lead could resist its destructive penetration. The good new was that the radium had a practical application. It could be used against cancer.

Both in Belgium and the United States they wanted to obtain the fabulous metal. But they do not know how to do it. At some time, Pierre received a letter from some engineers of United States asking for information on how to obtain the radium. Pierre told Marie that there were two ways: one to publish the results without any reservation including the purification process or to be the inventors of

the radium, to patent the technique for the treatment of the pechblenda and to have the rights to obtain the radium all over the world.

Marie thought for a few seconds, she said: “that is impossible, it would be contrary to the scientific spirit”.

Pierre smiled satisfied. Marie continued: “the physicists always publish the complete results of their research. If our discovery has commercial possibilities, we should not profit of it. In addition, the radium is going to be used against disease. It would be impossible to take advantage of it”.

Immediately Pierre wrote the American engineers to give them all the information they were asking for.

A quarter of an hour later, Pierre and Marie were riding in their bicycles towards the wood. They had chosen forever between fortune and poverty.

In June 1903, the Royal Institute of England awarded Pierre and Marie one of their most distinguished recognition: The Davy Medal.

In December 1903, the Stockholm Academy of Sciences announced that the Nobel Prize in Physics would be awarded to Henri Becquerel and the Curies for their discoveries related to the radioactivity. The Prize was equivalent to 15,000 dollars. In this way, Pierre could reduce his teaching duties and improve his health. Marie had the pleasure to install a modern bathroom in their house and renew the paper of one room. There were also gifts for family, friends, polish students and several scientific societies.

In spring 1904 Marie wrote: “There is always noise around us. Honours and fame have spoiled our lives”.

At the end of her second pregnancy, Marie was completely exhausted. On December 6, 1904, the second daughter, Eve, was born.

On July 3, 1905, Pierre Curie joined the Academy of Sciences, and the Sorbonne created a chair of Physics for him, although he did nor have yet an appropriate laboratory.

On April 1906, Pierre died in a tragic accident. Marie could not believe it. She asked: ¿Pierre is dead? There is no hope of life? Since then, Marie became a solitary person.

The French Government proposed to grant Marie a national pension. Marie refused it. She said: "I do not want a pension. I am still young and able to earn enough to live on for me and for my daughters".

On May 13, 1906, the Council of the Faculty of Sciences, approved unanimously to give Marie Curie the chair that Pierre had occupied at the Sorbonne. That was the first time that a woman had an university chair in France.

The first day of her lecture, everybody was very expectant waiting for the words she would pronounce. Would she remember the memory of Pierre? Would she thank the Minister and the University Council for the chair ? When Marie entered the lecture room she went to her seat while the students were applauding her. Then, Marie seated and she started her lesson as follows: "When we consider the progresses obtained in Physics during the last ten years, we are surprised on the great advances of our ideas concerning electricity and matter…" Marie Curie had started the course with the same phrase that Pierre had said to finish his course.

The fame of Marie became very high. She received honours of different foreign academies. Although she was not admitted as member of the French Academy of Sciences -she lost the voting by one vote- she got the Nobel Prize of Chemistry in 1911. Marie was the first person to get the Nobel Prize twice.

The Sorbonne and the Pasteur Institute created the Institute Curie of Radium, divided in two sections: a radioactivity laboratory directed by Marie Curie, and another devoted to biological research and to the study of the treatment of cancer, directed by a physician. Marie donated to the Institute one gram of radium that she and Pierre had isolated with their own hands, with an estimated value of about one million gold francs. Until the end of her life, this lab was the center of her existence.
In 1921, American women collected one hundred thousand dollars, the value of one gram of radium, to donate to Marie Curie and they asked her in turn to go to the United States. Marie was hesitant but finally she accepted, at the age of fifty four years, an important official visit. She was awarded in many American universities medals, titles and honorary degrees. She felt very weak with all the traveling and the physicians recommended her to go back to France.
In Warsaw they built an institute of radium named Institute Marie Sklodowska Curie and the American women gathered again enough money to buy another gram of radium.
Marie was very little careful with the precautions to work that she imposed her disciples. Very seldom she had blood analysis that were obligatory in the Institute of Radium. These analysis showed that her blood formula was not normal, but she did not care. During thirty five years she had been manipulating the radium and breathing the air of its emanations and during the four years of the war she had been exposed to the radiations of the Roentgen rays instruments, still more dangerous. She also had painful burns in the hands. Marie did not care either about a light fever she got. But in May 1934, due to a flu, she had to be in bed. She did not get up again.

Marie died at 66 years of age from aplastic anemia due to the overexposure to the radiations. On July 6, 1934, Marie Curie was buried in the cemetery of Sceaux, in a grave near that of Pierre Curie. No politicians were present. Only family, friends and collaborators, assisted to the burial.

Since 1995, at the Pantheon of Paris, together with the writer Victor Hugo, among others, lie the mortal remains of Marie and Pierre Curie.

Marie was a courageous scientific woman that opened the field of nuclear physics and cancer therapy. Work that would end up with her life. Marie Curie is an example and model for scientists in general, and for women scientists in particular.