Biography: Irene Joliot - Curie (1897-1956)

Irène Joliot-Curie - older daughter of Marie Skłodowska - Curie. She gained the knowledge about the radioactivity under her mother's wing, and she assisted her in the Radium Institute in the university in Paris from 1918. In 1925 she defended the doctoral thesis on alpha particles emitted by Polonium, and in 1926 she married her mother's assistant, Frederic Joliot, who was 3 years younger than Irene. They had two children: the daughter, Helene, and the son, Pierre. The Joliots did not discover the neutron and the positron as the first people, because they wrongly interpreted their measurements. However, in 1935 they were honoured with the Nobel Prize in chemistry for their discovery of the induced, artificial radioactivity.

Irene Curie, the daughter of famous and outstanding scientists, Pierre Curie and Marie Skłodowska-Curie was born on 12th September 1897 in Paris. From early years, she showed signs of the outstanding capabilities in the fields of maths and physics. She was taught by the professors of Sorbonne in quite not typical way: she spent one day in the maths laboratory, one in chemistry laboratory and one at history teacher's house, and she was taught physics by her mother. In the following years, her knowledge about maths and chemistry let her teach her peers from the college in Sevigne.

The girl's character, her world-view and love to science were shaped by her mother. The father, Pierre, had also the huge impact on Irene. Unfortunately, he died tragically on 19th April 1906 while he was trying to cross the Dauphine street in Paris. Doctor Curie (Pierre's father) helped in bringing-up his granddaughters, Irene and Eve, by replacing their often absent mother and dead father.

In 1914, after finishing the science-maths high school, Irene Curie started her studies at the faculty of the Sciences at the University of Paris. In the middle of 1916, she interrupted her studies, because she enrolled in the radiology service of the French Red Cross, organised by her mother. Irene assisted her mother in the front of the First World War as the radiology nurse in ambulances, helping the injured people.

After the war, in 1918, she restarted her studies. Shortly after that, she agreed on the post of the laboratory technician in the Radium Institute in Paris, and later she became the assistant, and as a result, the co-worker of her mother. Thanks to that job, she gained the valuable experience. In 1921, she already had the bachelor's degree in physics and maths, and she finished her research in which she indicated the atomic mass of chlorine, gained from different materials. She was also interested in radioactivity. She worked out the equipment used to measure the radioactivity in the substances used in farming, and in 1924, together with Catherine Chamie, she published the work on radioactive decay constant of radon.

While assisting her mother, and even replacing her in working in the Institute, Irene took up the research on the alpha particles emitted by the polonium – the element discovered by Marie Skłodowska -Curie in 1898. The results of that research she included in her doctoral thesis, which she submitted in 1925. The dissertation on the properties of radiation was published in the magazine Annales de Physique. Young Irene set the amount of alpha particles emitted by polonium samples with the specified activity. She deeply investigated the range, energy, and the ionisation, which is caused by the alpha particle along its track. She conducted her experiments using the Wilson chamber. Basing on the ionisation method she determined (together with František Běhounek) Bragg curve, representing the average density of ionization caused by the alpha particle depending on the way in the absorbent (air or different gases).

In the following years, Irene still referred in her works to the number of ions appearing in the air under the effect of the element radium C radioactivity. She conducted this research in the years 1927-1929, together with Frederic Joliot, whom she met in the Radium Institute in Paris

and married in 1926. They took the name "Joliot-Curie".

Frédéric Joliot was the physics engineer. He graduated from Engineering School in Paris, where one of the professors was Paul Langevin, a friend of Curie's family. With his recommendation, Joliot was given the job in the Radium Institute.

After the marriage, both spouses started their research. Their co-operation was easier thanks to their common interests and their infinite aiming at gaining knowledge. The resemblance between Irene and Frederic was similar to the one that connected Pierre Curie and Marie Skłodowska. Frédéric, like Pierre, was more a physicist, while Irene was more interested in the chemistry, like her mother.

The Joliot-Curie co-operation resulted in genius scientific discoveries, like it was previously in case of Irene's parents. Unfortunately, in winning fame, they were forestalled by others twice, because they wrongly interpreted the results of their measurements. In the first discovery, they were forestalled by James Chadwick, who in 1932 finally and undeniably proved the existence of neutron in the reaction:

$$ {}^{9}_{4}Be + {}^{4}_{2}He \rightarrow {}^{12}_{6}C + {}^{1}_{0}n \qquad (1) $$

For this discovery in 1935 he received the Nobel Prize in physics. But in the summer of the same year, Carl David Anderson proved the existence of positron, using the Wilson chamber.

Between 1932 and 1934 the Joliot – Curies jointly published a number of important papers on the effect of alpha particles on various elements. In January 1934, Frédéric and Irene Joliot-Curie conducted the nuclear transformation reactions in which they discovered the artificial radioactive elements, eg:

$$ {}^{27}_{13}Al + {}^{4}_{2}He \rightarrow {}^{30}_{15}P + {}^{1}_{0}n \qquad {}^{30}_{15}P \rightarrow {}^{30}_{14}Si + {}^{0}_{1}e + \nu_e \qquad (2) $$

$$ {}^{10}_{5}B + {}^{4}_{2}He \rightarrow {}^{13}_{7}N + {}^{1}_{0}n \qquad {}^{13}_{7}N \rightarrow {}^{13}_{6}C + {}^{0}_{1}e + \nu_e \qquad (3) $$

$$ {}^{24}_{12}Mg + {}^{4}_{2}He \rightarrow {}^{27}_{14}Si + {}^{1}_{0}n \qquad {}^{27}_{14}Si \rightarrow {}^{27}_{13}Al + {}^{0}_{1}e + \nu_e \qquad (4) $$

On that day Frédéric said: "we were late with neutron, we were late with positron, now we are on time". They proved that the element can be forced to release some part of the energy in the process of radioactive decay. The elements such as aluminium (2), boron (3) or magnesium (4) become the source of another radiation after being bombarded with the alpha radiation, and they start to act like radioactive elements. After removing the source of the alpha radiation, these elements emit the positive electron (positrons) and antineutrino for some time.

The euphoria of this discovery was dimmed by the bad health condition of Marie Curie-Skłodowska at that time. This great scientist died on 4th July, 1934, because of the illness caused by the long lasting work with the radioactive substances. After her mother's death, Irene took over many of her functions. She took over the management in the Radium Institute where she studied the properties of the radioactive elements.

The discovery of the artificial radioactivity gave Frédéric and Irene Joliot-Curie in 1935 the Nobel Prize in the field of chemistry. It gave the new direction for the actions not only in physics and chemistry, but also in biology, medicine and technology. From 1936 Irene and Frédéric worked separately, because Joliot took over the professorship in College de France.

At the end of the 30's of the 20th century, Irene became the Under-Secretary of State in terms of scientific research in the French government, and in 1937 she took over the chair of the General Physics and Radioactivity in Sorbonne University. During 34 years of work, Irene published over 30 scientific papers, most of them she published together with her husband. In 1946 she wrote a monograph on radioactivity. She should be also owed the editing and publishing of "Radioactivity" by Marie Curie-Skłodowska after her death. Irene Joliot-Curie was made an officer of the Legion of Honor in 1939.

Besides very involving scientific work, Irene Joliot-Curie took part also in the social-political activity, although she was not in any political party, like her mother. She was involved in the activities concerning world peace. As a result, she was chosen to be the member of the World Peace Council in 1950 during the second World Peace Congress. She enrolled to the French Women Association during her studies, to fight for the equal rights for women. She was also interested in education of students. She was given the honorary doctorate by many universities, including Polish

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universities: the University of Marie Curie-Skłodowska in Lublin (1950) and the Jagiellonian University in Cracow (1951). Irene Joliot-Curie showed friendship for Polish scientists. She visited Warsaw few times and supported the rebuilding of the Polish scientific institutions destroyed during the war.

During last years of her life, her health broke down. The long-lasting contact with the radioactive substances left the negative trail. She died of leukaemia, like her mother. On the 17th March 1956 in France the day of mourning was announced. The children of Joliot-Curie's, daughter Helene and son Pierre, also became acknowledged scientists.

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