

# The Lady of Radium

## The Life of Maria Skłodowska-Curie

**M**aria Skłodowska-Curie, born in 1867 in Warsaw, was a visionary scientist whose discoveries paved the way for effective cancer treatments and created the foundations of several scientific disciplines.

Maria Skłodowska-Curie was a trailblazer – the first woman to become a professor at the University of Paris (Sorbonne) and to win the Nobel Prize, and the only person to have been awarded two Nobel Prizes in two different scientific fields. Skłodowska-Curie was a tireless advocate for international scientific cooperation through the exchange of scientists, open access to international scientific literature, and enhancing the working conditions of the intellectual workforce.

She was also deeply devoted to the development and strengthening of scientific institutions. In 1921 and 1929, she embarked on two fundraising missions to the United States to procure radium for Radium Institutes in Paris and Warsaw. The radium obtained during her visits to the U.S. fueled Skłodowska-Curie's research and led to discoveries that revolutionized cancer treatment. Both institutes perform vital cancer treatment research to this day.

Although she mostly worked in France, Skłodowska-Curie remained a Polish patriot, fervently supporting the causes of Poland's independence and scientific development. Maria Skłodowska-Curie died in 1934 at the Sancellemoz sanatorium, Passy, in Haute-Savoie, from aplastic anemia, caused by a lifetime of exposure to radiation.

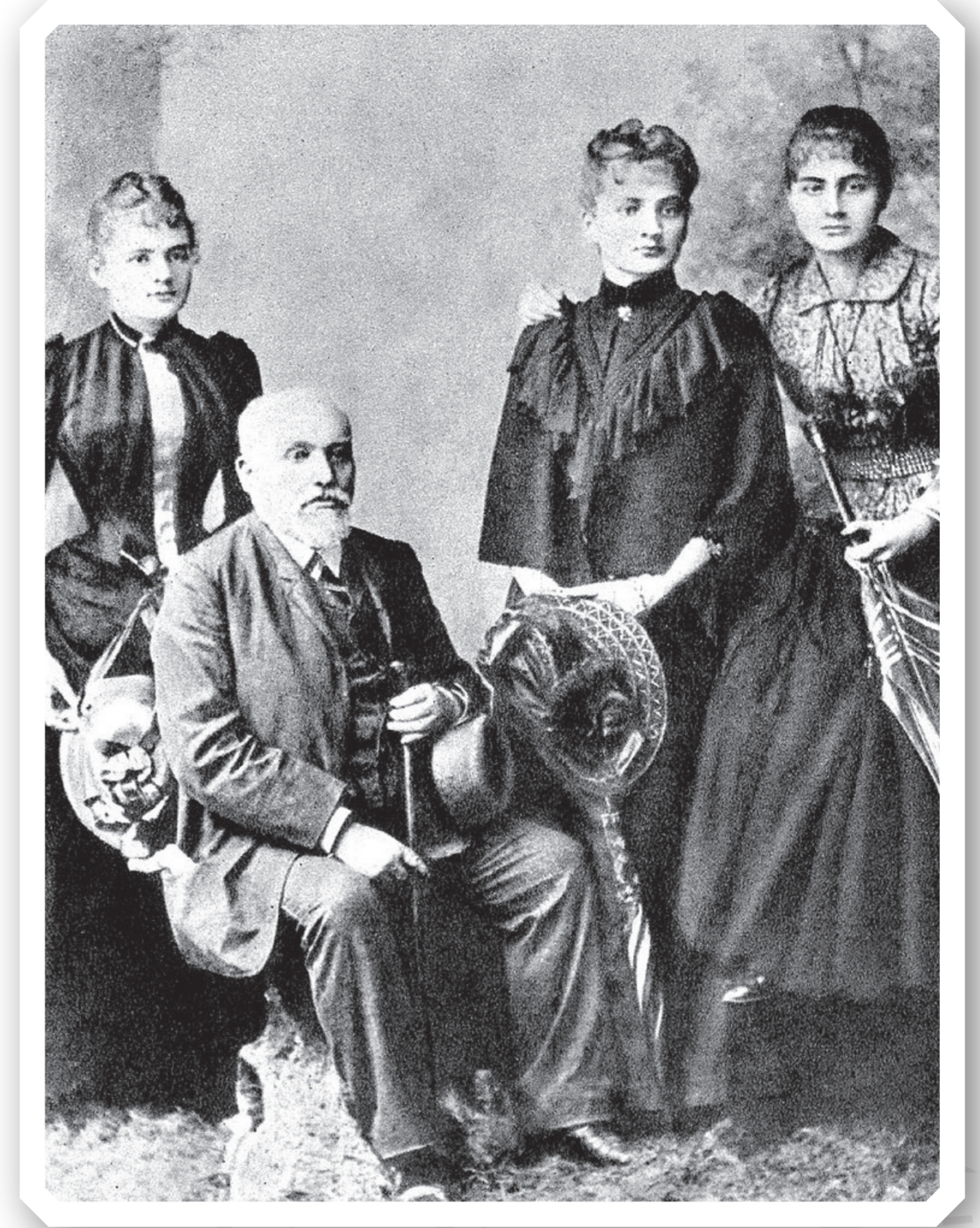


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Maria Skłodowska-Curie in her Paris laboratory, 1912.



Parents of Maria Skłodowska, ca. 1870.



Władysław Skłodowski and daughters.  
From left: Maria, Bronisława, Helena, 1890.  
Despite the family's modest means, all Skłodowski siblings received a thorough education, learning Latin, Greek, French, English, German and Russian. The family spoke Polish at home.



16-year old Maria Skłodowska.

**M**aria Skłodowska-Curie, was born on November 7th, 1867 in Warsaw, the youngest of five children. Both of her parents were well-respected educators.

At the time, Poland had been partitioned among the Russian Empire, Habsburg Austria, and the Kingdom of Prussia for over seven decades. In the years following Maria's birth, the repressions against Poles inflicted by the occupying Russian forces intensified; learning the Polish language and history was forbidden, and those exhibiting pro-Polish sentiments were deported to Siberia.

Maria's father, Władysław Skłodowski, who was a teacher of mathematics, biology and physics, organized secret gatherings where Maria was first exposed to Polish literature and history.

The young Maria Skłodowska began her formal schooling at a private boarding school in Warsaw. An excellent student, she graduated from high school at age fifteen with top grades in all subjects and a gold medal of excellence. She later attended the **FLYING UNIVERSITY** – underground, university-level courses taught by Polish scholars, clandestinely organized in private homes and ever-changing locations to evade the Russian authorities.



Maria with sister Bronisława, ca. 1886.



The Skłodowski children.  
From left: Zofia, Helena, Maria, Józef, Bronisława, ca. 1871.

**A**lthough university level education was inaccessible to her as a woman, Maria Skłodowska's greatest dream was to study at the University of Paris, known for its academic excellence. It was also one of the very few institutions of higher learning in Europe open to both men and women.

Maria made a pact with her sister Bronisława – Maria would help finance Bronisława's medical studies in Paris, after which Bronisława would help finance Maria's own studies. To fund her dream, Maria spent three years working as a governess on an estate outside of Warsaw. In her free time, she worked to improve her knowledge of chemistry and mathematics by taking lessons from a chemist at a local beet-sugar factory and completing an advanced mathematics course taught by mail by her father. Upon returning to Warsaw in 1890, Maria began research at the physics and chemistry laboratories at the **MUSEUM OF INDUSTRY AND AGRICULTURE**, where she trained herself in chemical analysis and the fundamentals of scientific research.

In 1891, Maria Skłodowska left Warsaw in a fourth-class train compartment with some personal essentials, a wooden stool and enough food for a 40 hour train ride to Paris. Her sister Bronisława awaited her at Gare du Nord.



**“A scientist in his laboratory is not a mere technician: he is also a child confronting natural phenomena that impress him as though they were fairy tales.”**



Maria Skłodowska-Curie in her chemistry laboratory at the Radium Institute in Paris, 1921. Musée Curie.

**M**aria Skłodowska began her studies in the fall of 1891 at the Faculty of Sciences at the Sorbonne. She obtained a bachelor’s degree in physics in 1893 and in mathematics the following year. Upon graduating, Maria returned to Poland, hoping to find employment at the physics laboratories of the Jagiellonian University in Kraków run by August Witkowski. Yet, despite Witkowski’s support of women’s right to higher education, he was unable to offer Skłodowska a position that would match her science ambitions. Maria returned to Paris and in 1895 married Pierre Curie, thus beginning one of the greatest collaborations in science history.

In July 1898, Maria and Pierre discovered **POLONIUM**, named in honor of Maria’s homeland, Poland. Maria hoped that naming the element after her native country would draw attention to the issue of Poland’s lost independence. In December of 1898, Maria and Pierre discovered **RADIUM**. Maria coined the term **RADIOACTIVITY**, establishing that it was a property of atoms themselves. The Curies’ theory of radioactive decay revolutionized chemistry and invalidated two of its long-established principles – that atoms are the smallest units of matter, and that one element cannot turn into another. In 1903, Maria, Pierre and Henri Becquerel received the **NOBEL PRIZE** in physics for their work on radiation.

Following the sudden death of Pierre Curie in 1906, Skłodowska-Curie continued her research and became the first female professor at the Sorbonne in 1906. Upon request by the International Radium Standards Committee, she prepared and defined the standard for radium emissions, named ‘the curie.’ In 1911, Maria received her second, **INDIVIDUAL NOBEL PRIZE** – in chemistry – for the discovery of the elements radium and polonium, isolating pure radium and studying the nature of the element.



Maria and Pierre Curie began their research on radioactivity in a modest room in the Municipal School of Physics and Industrial Chemistry in Paris.



Maria Skłodowska-Curie’s Nobel Prize Diplomas.



Maria in her laboratory, ca. 1900.

**T**hroughout her career, Maria Skłodowska-Curie maintained strong ties to the Polish scientific community. In 1900, she received an invitation to the 9th Congress of Polish Physicians and Naturalists held in Kraków. Although she was not able to attend, she requested for August Witkowski to present her lecture during the meeting. She also donated samples of radium compounds to be used for demonstrations during the Congress and later to be given to Witkowski to support his research.

In 1908, August Witkowski and Władysław Natanson submitted a request to the Academy of Arts and Sciences in Kraków to elect Maria Skłodowska-Curie as a foreign member of the Academy. A year later, Maria became the **FIRST FEMALE MEMBER OF THE ACADEMY OF ARTS AND SCIENCES IN KRAKÓW**, remaining the only woman in this scientific society until 1931.

In 1912, the Warsaw Scientific Society established a Radiology Laboratory, which Maria agreed to lead from afar, sending her assistants Jan Kazimierz Danysz and Ludwik Wertenstein as her deputies.



August Witkowski, Polish physicist, professor and rector of the Jagiellonian University in Kraków, 1905.



Jagiellonian University, Collegium Maius, Kraków.



Photo from the family archive of Dr. Piotr Chrzęstowski. From left: Józef Skłodowski, Bronisława Dłuska, Maria Skłodowska-Curie and Kazimierz Dłuski in Zakopane, Poland, 1911.

**M**aria Skłodowska-Curie never patented her discovery of radium or its medical applications. On the contrary, she freely shared information about the extraction process and the allocation of radium for use in medical treatments. At the time of the discovery, however, the price of one gram of radium was prohibitive, at USD 100,000 (USD 1.3 million in today's dollars), and Maria did not have the means to secure it.

In 1920, an American journalist and editor, Mrs. Marie Mattingly Meloney, was granted an interview with Maria Skłodowska-Curie at Maria's Parisian laboratory. During the interview, Skłodowska-Curie shared that her dream was to obtain a gram of radium to continue her research. Inspired by the scientist's trailblazing work, Mrs. Meloney launched a successful fundraising campaign among American women to support Skłodowska-Curie's research.

In May 1921, Skłodowska-Curie embarked on her first journey to the United States. The tour began with visits to women's colleges, including Smith College, Mt. Holyoke and Vassar College, where she encouraged female students to engage in the pursuit of scientific research. She also toured the U.S. Standard Chemical Company radium extraction plants in Pittsburgh and Canonsburg, the only producers of radium on the East Coast.

During her trip to the United States, Skłodowska-Curie received several honorary doctorates and awards, including membership in the American Philosophical Society and a medal of Willard Gibbs from the American Chemical Society.



President of Smith College William Allan Neilson and Maria Skłodowska-Curie, May 1920.



The Curies' 1921 visit to the United States. From left: Marie Mattingly Meloney, Irene, Marie and Eve Curie.



Maria Skłodowska-Curie participates in the dedication of the Hepburn Hall of Chemistry at St. Lawrence University, October 26, 1929.







**“Scientific work must not be considered from the point of view of the direct usefulness of it. It must be done for itself, for the beauty of science, and then there is always the chance that a scientific discovery may become like the radium, a benefit for mankind.”**

**M**aria Skłodowska-Curie's discoveries led to the development of several fields of modern science and medicine.

The discovery of polonium and radium laid the basis for a new science of radioactivity, aiding the discovery of further radioactive elements. The method of extraction of these chemical elements continues to be in use today. Maria and Pierre's discovery that radiation from radioactive substances causes chemical reactions marked the birth of radiation chemistry. Their theories challenged the indivisible nature of the atom and led to the development of nuclear physics and the harnessing of nuclear power.

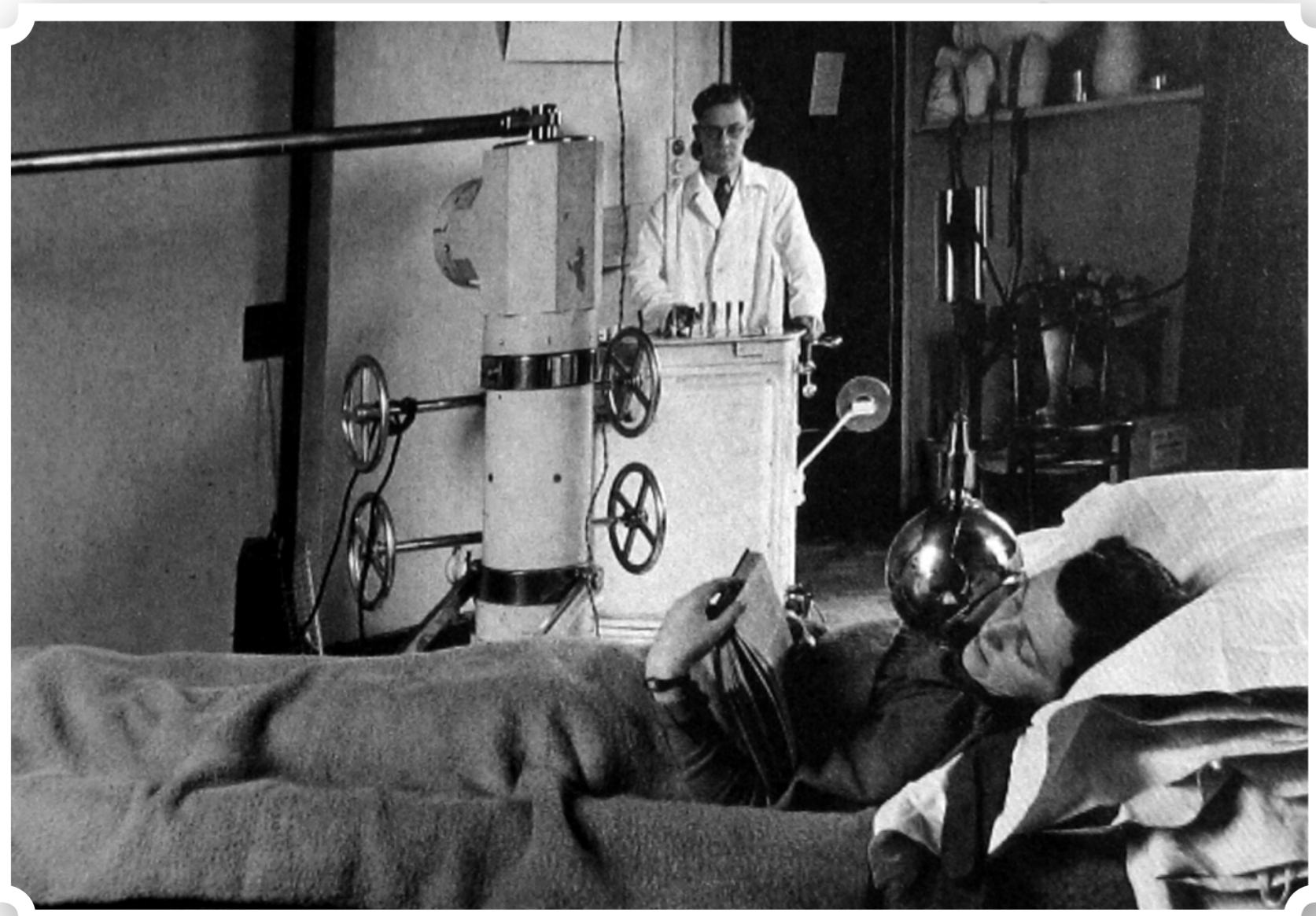
Skłodowska-Curie's discoveries proved to have key applications in medicine. During WWI, Maria served as the director of the Red Cross Radiology Service and created mobile radiological laboratories known as the "petites curies." In this way, she helped popularize the use of x-rays for the diagnosis and treatment of disease outside of a hospital setting, transforming field medicine.



Maria training nurses in the use of X-rays, ca. 1915.



Maria and her daughter, Irene, 1925. Irene Joliot-Curie, along with her husband Frédéric Joliot-Curie, was awarded the Nobel Prize in Chemistry in 1935 for the discovery of artificial radioactivity.



Radium teletherapy treatment using a 4 gram radium bomb, London, late 1930s.

$\gamma = 106$

$R = 10000$

$R = 1000$



1927 Solvay Conference on Quantum Mechanics. From back to front and from left to right: Auguste Piccard, Émile Henriot, Paul Ehrenfest, Édouard Herzen, Théophile de Donder, Erwin Schrödinger, Jules-Émile Verschaffelt, Wolfgang Pauli, Werner Heisenberg, Ralph Howard Fowler, Léon Brillouin, Peter Debye, Martin Knudsen, William Lawrence Bragg, Hendrik Anthony Kramers, Paul Dirac, Arthur Compton, Louis de Broglie, Max Born, Niels Bohr, Irving Langmuir, Max Planck, Maria Skłodowska Curie, Hendrik Lorentz, Albert Einstein, Paul Langevin, Charles Eugène Guye, Charles Thomson Rees Wilson, Owen Willans Richardson.

**A**fter WWI, Maria Skłodowska-Curie became the director of the physics and chemistry laboratory at the Radium Institute in Paris. The Institute consisted of two laboratories, the Pasteur laboratory for biological research, directed by Claudius Regaud, and the Curie laboratory for physics and chemistry research, directed by Maria Skłodowska-Curie. The Institute worked on medical applications of radioactivity, paving the way for the use of radiation therapy in cancer treatment. Radium therapy came to be known as **TELECURIE THERAPY** in France and involved placing small vials of radium around the tumor site. Skłodowska-Curie's research in radiation therapy and diagnostic radiological imaging laid the foundations for modern day medical physics.

Maria Skłodowska-Curie was an avid advocate for international scientific cooperation, open access to an international scientific bibliography, and standardization of international scientific scholarship. She used her position in the League of Nation's International Committee on Intellectual Cooperation, a predecessor to UNESCO, to advocate for the development of scientific institutions, including in Poland. She fostered international scientific exchange by hosting many foreign researchers in her laboratory in Paris, always ensuring that Polish scientists were well-represented.

The story of Maria Skłodowska-Curie is one of intellectual curiosity and perseverance. She declared that it would be opposed to the scientific spirit to profit from her discoveries, leaving a legacy of inspiration for generations of scientists.



Maria Skłodowska-Curie with Albert Einstein, 1929.

# Acknowledgments

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### AUREA DESIGN

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We are grateful to Dr. Alicja Rafalska-Łasocha, researcher from the Chemistry Department at the Jagiellonian University, Kraków, for her scientific consultation during the process of preparing this exhibition.

The design of the exhibition uses elements of Maria and Pierre Curie's notebook. The Curies' laboratory notebooks are stored in lead-lined boxes at the Bibliothèque Nationale de France and will continue to be radioactive for another 1500 years.

Maria Skłodowska-Curie's quotations, found at the top of the exhibition panels, are from the symposium *The Future of Culture*, organized by the League of Nations from 3-7 May, 1933 in Madrid and Skłodowska-Curie's lecture at Vassar College on May 14, 1921.

The photograph of radium teletherapy treatment in the 1930s originates from the book *Radium History Mosaic* by Richard F. Mould.

