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The brilliance of Maria Sklodowska Curie: understanding history is critical to forging the future

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Abstract

Ask most oncologists (especially radiation oncologists), and you may be hard pressed to find one who professes ignorance of Madame Curie and her historic contributions to medicine. Innumerable publications and media over the past century have correctly memorialised Madame Curie as one of the most brilliant minds in world history. However, do any of us really know the woman and the true extent of her sphere of influence? How, as well, does she fit into modern life and contemporary scientific advancement? Let us try to understand and learn from this complex scientist as more than just one of the most brilliant minds in human history.

Editorial

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Maria Sklodowska Curie. Courtesy: Getty Images.

'Of all the celebrated beings, the only one whom fame has not corrupted'.

Albert Einstein

Early years in Warsaw

In 1867, this giant of science was born in Warsaw, now well known as the capital of Poland. However, at the time of her birth, Poland had been twice partitioned into non-existence. She would lose her mother to tuberculosis at a young age, but her father and family had instilled in the young Maria Sklodowska values of hard work, traditional morality, the value of education

(both parents were educators) and patriotism (the family had lost nearly all material possessions in the struggle for Polish restoration). To promote a love of knowledge and continue their education despite government prohibition, Mr. Sklodowska would read classic literature to his children nightly. These nighttime sessions also fostered close family bonds.

At the age of 15, she was affected by a medical illness, characterised as 'nervous problems' and later identified as likely depression. In retrospect, she had been suffering for years. Despite this struggle, she graduated at the top of her class in school, winning a gold medal. However, she spent the following year in recovery. As girls were not admitted into formal higher education, Maria and her sister attended the famous Uniwersytet Latający (the 'Flying [or Floating] University'), which covertly operated from 1885 to 1905 to educate Polish youth absent government censorship or feminine prohibitions. A primary goal of the 'Flying University' was to increase intellectual curiosity and independent thought to help spur on Polish liberation from the partitioners. Maria's father and her sister, Bronislawa, were highly influential in supporting her in and through her university studies.

An unbreakable pact

The strong family educational background resulted in Bronislawa's acceptance into medical school in Paris. Maria had vowed to assist her financially, and at the age of 16, she went into the service of a farmer who required a nursemaid for his children. This she did for the next five years. During her employment, she asked, and was given permission, to teach the children of the laborers despite the threat of potential imprisonment as this was unallowed in the repressive Russian territory. Maria was separated from her beloved family and hundreds of kilometres from home in her mid-teenage years. Her promise would remain unbroken, and her sister would never forget the great sacrifice. Unbeknownst to Maria, her sister had made a pact with their father that some of the money earned by Maria as a nursemaid and thought to have been forwarded to her sister would be set aside to aid in Maria's own future studies.

On to Paris and La Sorbonne

At the age of 24, the young Sklodowska would finally enter the University of Paris after many years of self-sacrifice and managing her depression. She was of marginal funds, but shrewdly frugal and managed to support her studies. She found La Sorbonne particularly challenging as her background was deficient in (of all things) mathematics and the sciences. In addition, the instruction was in French. However, she excelled in her studies though brilliance and sheer determination. Her efforts paid off as she was awarded an academic scholarship and then commissioned to study the magnetic properties of steel. She required a laboratory for these studies.

Pierre and the great discoveries

An academic acquaintance and friend, Polish physicist Josef Kowalski-Wierusz knew of a laboratory with unused space, and he introduced Maria to Pierre Curie. It was she who convinced the brilliant Pierre to complete his doctorate. A pragmatist in most things, Maria came to a logical conclusion that she accept Pierre's marriage proposal. In a now famous quote, she would state 'Our work drew us closer and closer together, until we were both convinced that neither of us could find a better life companion'. Her famous lab coat would become her wedding dress, displayed at the Institute Curie of the University of Paris in their infamous lab to this day.

Radioactivity was first observed by Henri Bequerel, and the Curies immediately developed a great interest in this nascent field. Maria hypothesised that radiation came from the atom itself as a type of disintegration despite the expressed belief of most of the scientific community at the time, which maintained a theory of the indivisibility of the atom. This revolutionary idea created shockwaves in the sub-atomic world as the atom was (until then) hypothesised to be indivisible. The Curies soon discovered their first radioactive element, and Maria requested to name it polonium, to bring international awareness to Poland, which had been eliminated from the map and subjugated among three countries. Following 'The Great War' and during her lifetime, Poland would triumphantly be re-established by the Treaty of Versailles in 1919. The discovery of radium would post date polonium by 5 months, and shortly following, radium would be used to treat cancer a few years later. The era of brachytherapy was born and millions of patients worldwide would benefit as a result of their seminal work.

Unwanted fame comes calling

In 1903, Maria Sklodowska-Curie was awarded a doctorate from the University of Paris; the first woman so awarded at that University and, in fact, the first in all of France. Shortly afterwards, the Curies were asked to speak about the new topic of 'radioactivity' at the Royal Institution in London; a term created and required by Maria. Since women were not permitted to address the Institute, Pierre delivered the address. Similarly, Pierre Curie was invited to address the Royal Swedish Academy of Sciences after he was awarded the Nobel Prize in physics concurrent with Henri Becquerel. Once again, a prohibition against women at the time prohibited women from winning a Nobel Prize until Swedish mathematician Magnus Goesta Mittag-Leffler demanded Maria be co-awarded. The Academy relented and history was made. The Curies decided not to attend the ceremony, not out of protest, but out of a wish not to be spotlighted and to allow them to focus on their work. Pierre was subsequently promoted to Chair of the Department of Physics and elected to the French Academy of Sciences.[1]

Tragedy and recovery

One year after his appointment, while walking across a Parisian street, Pierre Curie was struck by a horse-drawn coach during a heavy rain. He would immediately succumb to grave injuries. Maria was devastated by her loss; a loss compounded by her children's strife of immediately becoming fatherless. Always a working mother, Maria would have to become a mother and father while continuing her work. Devoted to her family, she arranged for both, and she subsequently was offered and accepted Pierre's former chair in physics, making her the first woman chair in the history of the University of Paris. Shortly afterwards, Professor Curie set the standard for quantifying radioactivity, and that standard (Curie) bears her name to this day.

Her appointment as Chair did not dissuade jealous colleagues and eliminate sexual discrimination. However, Curie had little time for such childishness, continuing her ground-breaking work. In 1911, she was awarded a second Nobel Prize (Chemistry), the first person in history to win two Nobel Prizes and still the only person

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to win two separate disciplines of science (Linus Pauling won one in Science and one for Peace). She stands now as she did more than 100 years ago; one of the greatest scientists of the ages.[2]

The triumphant journey home and adoption of a new home

In 1913, Maria Sklodowska Curie returned to a hero's welcome in Warsaw. Throngs of people wanted to see this highly favored daughter of Poland. Curie was proud yet humbled by the attention. Her welcome would be interrupted by World War I (identified as 'The Great War' until the 'greater war' broke out). Any semblance of victory and accomplishment would soon be eliminated by the most expansive war the globe had ever seen. Professor Curie would come to the aid of the Allied forces. In a famous quote, she would confirm adoption of France as her home country. She would write: 'I am resolved to put all my strength at the service of my adopted country since I cannot do anything for my unfortunate native country now'. Recognising her other role as mother and father she simultaneously would write to her children: 'We must keep firm hope that after these bad days, good times will return. It is in that hope that I lock you in my heart, my beloved daughters'.

In peacetime, Curie was a discoverer and scientist, in wartime, she was the angel of the battlefield. Curie was instrumental in the invention and deployment of mobile X-ray units named 'Petite Curies', estimated to have aided in the care of one million Allied troops. Additionally, she developed radon needles crafted from radium to aid in infection control. The French government, in desperate need of funds to support the war effort, appealed for citizens to donate their gold and silver. So passionate was Maria Curie in support of her adopted country that she delivered both of her Nobel Prize medals to the French National Bank. The bank officials were in shocked disbelief and brought to the brink of tears by this selfless patriotic act. They well realised the significance of these medals to France and the world from such a figure and refused to accept them. Undeterred, Curie would use most of her Nobel Prize money to buy War Bonds in support of France.[2,3]

After the horrific Great War ended, The Curie Laboratory was finally completed, and the Radium Institute was born. As with any massive undertaking, finances are always in short supply. While French monies from dignitaries, industry and philanthropists had funded her programs to date, the world was becoming aware of this great scientist and her groundbreaking works. Professor Curie granted a rare interview to the journalist Marie Mattingly Meloney, editor of *The Delineator* magazine. Meloney was so overwhelmed by the 'pale timid little woman in a black cotton dress' (as she would later describe Curie), that she lost her ability to question and just listened intently. This was no ordinary journalist humbled by Curie. Meloney had interviewed dictator Benito Mussolini on multiple occasions and had turned down an interview with Adolph Hitler! Meloney promised during that meeting to raise funds to deliver a second gram of radium to Professor Curie. A massive campaign led by a committee of women raised the funds and the Standard Chemical Company of Pittsburgh, Pennsylvania, USA, would refine and formulate the gram of radium, then the world's most precious commodity. In 1921, President Warren Harding would present the gram of radium to her on behalf of the women and girls of America.[4]

Arriving in New York City, she was greeted by tens of thousands of Americans, all wanting to catch a glimpse of this internationally renowned scientist. Among the spectators were women and young girls who represented the sponsors of the gift of radium. Curie was overwhelmed by her celebrity in a land so far from home. She was also so impressed by the work involved (hundreds of thousands of man-hours) that during her short visit to America, she asked to visit the small town of Canonsburg (a suburb of Pittsburgh) to pay tribute to the blue-collar laborers who had mimicked her work in extracting the radium from carnotite. She well knew the laborious process of extraction, having personally done the work in her lab. She had developed an immediate bond with the workers which was passed down as legend to the Curie Laboratory curators.[5]

One of us (Thomas Julian) was an invited speaker at a University of Paris meeting in 2007 and visited the Institute Curie; the most famous radiation clinic in the world. Attached to the Hospital Curie is the original Curie Laboratory, now a museum. Visitation of the Curie Laboratory is a rare, limited event and reserved for very special persons. There the curator is the final arbiter of who may or may not visit. During the invited visit, the curator was asked if a visit was possible, and she initially declined. When she was informed by Julian's colleague that the visitor was from Pittsburgh, the curator broke into fluent English and immediately agreed to the visitation and a personal tour was given! The laboratory was left essentially untouched with her famous lab gown displayed prominently. The vessels, instruments and books, crude by today's standards, reflected the history and passion of the scientist. It was truly an event of a lifetime.

Shortly after the Great War, Curie founded the Warsaw Radium Institute in her renewed homeland of Poland. The Parisian Radium Institute would continue to produce discoveries, including that of a new element, actinium, which would confirm quantum theory, and the fourth and fifth Curie-related Nobel Prizes were subsequently awarded to her daughter Irene and her son-in-law Frederic Joliot (Chemistry). Sadly, Curie would not see these final Nobel awards as they occurred after her early death. A total of five Nobel Prize awards in a single family. A record of accomplishment unlikely to ever be matched.[5,6]

The blessing and the curse

Curie continued working and expanding her reach by working towards standardisation of intellectual property and assisting in the development of a database of scientific papers during her service on the Commission of Intellectual Cooperation of the League of Nations. She foresaw the power of collaboration and cooperation in worldwide research.

In the early 1900s, Belgian industrialist, Ernest Solvay convened several conferences inviting the greatest scientific minds of the day. To gauge how respected this woman Curie had become, we must consider some of the contemporary invitees of the 1927 conference: Pauli, Bohr, Compton, Planck, Heisenberg, Bragg, Heriot, Lorentz, Einstein and . . . . . Curie! Twenty-eight men and one woman. It has been stated that this meeting alone convened more concentrated intellect that any ever assembled.[6]

Sadly, she began to suffer fatigue from what was later diagnosed as aplastic anaemia. In the time of great radioactive discoveries, little was known about the dangers of the new frontier. In a cruel twist of fate, her life's work would take this life dedicated to discovery and selfless service to humanity. On 4 July 1934, Maria Curie would be enshrined with the Ages. Initially buried in a family plot next to her husband, their bodies were moved amid great pomp and circumstance to the Pantheon in Paris in 1995. Of the Curies, President Francois Mitterand would state: 'By transferring these ashes . . . .France not only performs an act of recognition, it

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Fifth Solvay Conference: Institut International de Physique Solvay, Leopold Park, Belgium 1927. Courtesy: Alamy.

also affirms a faith in science, in research, and its respect for those who dedicate themselves to science'. Of Maria, specifically, he would remark 'As the Country bows before her ashes . . . . I form the wish, in the name of France, that everywhere in the world the equality of the rights of women and men might progress'.[7]

Lessons to Humankind: What we can still learn after more than a century

The life of 'Madame Curie' is the life of a consummate scientist of the purest form. Her dedication to science, family, country (both natural and adopted) and humankind is the substance of legend. Here we have documented many highlights of her life, but certainly the totality of her accomplishments can scarcely be measured. As a scientist, she blazed a pathway of discovery teaching us the value of hard work and indefatigable inquiry. True to the scientific method, she was innovative enough to explore new concepts. In a modern era where financial gains sometimes pervert science, when unproven methodologies are promoted, when thinly veiled political outcomes are sometimes touted as truth, and evidence of outcome is masked by impurity, Maria Curie can still instruct us to follow the straight path. When the just cause appears, as it did during the Great War, Curie teaches us to follow a path of beneficence and righteousness, shunning worldly gains, even our most precious treasures. When we sometimes despair from either physical difficulty such as clinical depression or a loss of identity, she teaches us to persevere and overcome. She teaches us patriotism, duty, courage, the importance of family, honor and most of all, truth. A century after her death, the example of Madame Curie is as important today as she was then.

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