

The Marie Skłodowska-Curie Institute of Oncology in Warsaw

Radium: The Cornerstone



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Some of the greatest scientific breakthroughs of the late 19th century – the discovery of X-rays by Roentgen in 1895, and of radium by Pierre and Marie Skłodowska-Curie in 1898 – ushered in a new era in cancer treatment

X-rays were first used to treat cancer within a year of their discovery. However, due to the relatively low energy generated by the radiation, the complex physical principles guiding its distribution in matter, and difficulties in its collimation, its application was limited mainly to the treatment of skin cancers. The physiological effects of radium were first de-

scribed in 1900 by the German scientists Otto Walkhoff and Friedrich Giesel. A range of tests conducted on animals encouraged French doctors to attempt to use it to treat cancers of the skin and later of other organs; the treatment was known as curietherapy. Even before the First World War, curietherapy was regarded as the most effective (after surgery) method of treating cancer, and it was a worthy rival to X-ray therapy. In contrast to the latter, radium did not require complex installation, large rooms or specialist handling: it was simply convenient and durable, albeit expensive. In Warsaw, the institution conducting physical research into radium was the Radiological Laboratory, opened in 1913 at the Warsaw Scientific Association. The Laboratory received a donation from Marie Skłodowska-Curie of 100 mg of radium bromide and 1000 US dollars.

Committee for Combating Cancer

Poland's medics established the Committee for Researching and Combating Cancer in 1906. One of its aims was to set up institutions for treating cancer, although they were mostly small and ephemeral. Skłodowska-Curie's greatest dream was to establish a Radium Institute in Poland, and she had very firm views on how such an institution should be organized and how it should operate. Her experiences from setting up the Radium Institute in Paris strengthened her conviction that this Warsaw institute – similarly to its Paris counterpart – should have the rank of a central national institution and conduct scientific research, and that it should also have its own hospital (something the Paris institute did not have). She wrote: *Medical activities in such a new field must require a strong foundation in physical and chemical research into new bodies (...) where this does not exist, the theory becomes empirical and routine through the uncritical use of popular methods, often riddled with fundamental errors.* The research was to focus on biology and medicine.

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Prof. Barbara
Gwiazdowska
identifying a radium
tube

Skłodowska-Curie's initiative, which she started putting in place when Poland regained independence after the end of the First World War, fell on fertile ground. She received personal help from Prof. Stanisław Wojciechowski, Skłodowska-Curie's colleague from their days as students at the Sorbonne and later president of Poland. Her family, in particular her sister Dr. Bronisława Dłuska - full of energy and with plenty of experience from her own project constructing a TB sanatorium - was at Marie's disposal; she also received interest and support from the Polish Committee for Combating Cancer and the University of Warsaw.

National Donation for Marie

In December 1923, the Committee appealed to the Polish nation to raise funds for Poland's "National Donation for Marie Skłodowska-Curie." The proclamation stated that the donation should fund a Marie Skłodowska-Curie Radium Institute. The National Donation Committee included leaders of Poland's political, cultural, and scientific spheres, and the Institute itself was designed by the architects Zygmunt Wóycicki and Tadeusz Zieliński, working alongside Skłodowska-Curie and Dr. Claudius Regaud (director of the Pasteur Laboratory in Paris). The extensive financial and material contributions - the latter including construction materials - meant building work soon started at a plot by Wawelska Street. Skłodowska-Curie attended a plaque-laying ceremony in June 1925, delivering a lecture stressing the need to combine research and medical work.

During her stay in Warsaw, Skłodowska-Curie established a working relationship with the Faculty of Physics at the University of Warsaw, in particular with Prof. Stefan Pieńkowski. One of Pieńkowski's assis-

tants, the experienced physicist Dr. Cezary Pawłowski, was assigned to work with Skłodowska-Curie in 1927, remaining in her laboratory for 4 years. He would later recall: *As the future director of the Physics Department at the Radium Institute in Warsaw I was looked after very well by our great scientist; she always managed to find time in her busy schedule to discuss the results of my research... All my work there contributed to my habilitation thesis.* Dr. Franciszek Łukaszczyk, regarded as the future director of the Clinical Department and the Institute, received training with Dr. Regaud at the Pasteur Institute, and then with Prof. Blumenthal in Berlin and Prof. Holthusen in Hamburg.

Money from America

The next issue was raising funds to buy radium. As Pawłowski would recall: *After her return from Poland, Skłodowska-Curie wasted no time in trying to source sufficient radium to allow the Warsaw Radium Institute to commence research work and treating patients. Unfortunately buying enough of this precious element exceeded the financial capabilities of the newly reforming Polish state. Keen to obtain radium for her homeland, Skłodowska-Curie approached the renowned American journalist Marie Mattingly Meloney. Her efforts to raise funds from Polish émigrés in the US and friends of Poland brought sufficient money to buy 1 gram of the element.* In 1929, Skłodowska-Curie received the funds directly from the hands of President Herbert Hoover, without whose support the fundraising efforts would have been in vain. The price of radium was discounted especially for Skłodowska-Curie, and 1033.21 mg of the element was purchased from Belgium's Union Minière du Haut Katanga; it contained the correct arrangement of needles and tubes making it suitable for using the Parisian treatment



Marie Skłodowska-Curie
Medal awarded by the
Polish Chemical Society

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method. The radium was marked "RMS" for "radium of Marie Skłodowska".

The clinical department of the Warsaw Radium Institute was opened with a major ceremony on 29 May 1932. The event was attended by Skłodowska-Curie, Prof. Regaud (serving as a curietherapy consultant during the Warsaw Institute's early days), and Prof. Marie, director of the Institute of Physical Chemistry at the University of Paris. There was also a delegation of Polish women's associations from the US, accompanied by Meloney, who was awarded the Cross of Merit by Poland's government. Guests also included representatives of the highest state authorities, led by Prof. Ignacy Mościcki, President of the Republic of Poland, and many doctors and scientists.

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Radium Institute on Wawelska Street in Warsaw

The research facilities were completed in 1934, coinciding with Skłodowska-Curie's passing. Fulfilling Marie's wishes, Dr. Dłuska used her own funds to buy an additional 100 mg of radium, which she donated to Pawłowski for research. Irène and Frédéric Joliot-Curie donated 12,000 zlotys from their joint Nobel Prize for the purchase of an electromagnet for research purposes (now held at the Marie Skłodowska-Curie Museum). The Physics Department developed rapidly; it modeled itself on the Curie Laboratory in that it conducted research alongside work for the hospital at the Radium Institute and all Polish institutions using radium or X-rays.

Wartime fate

Treatment at the hospital was delivered on a social and humanitarian basis, which made it available to all patients including the poorest. Certain rooms were reserved for fully-paying patients, providing the hospital with a source of income. By the end of 1932, 950 patients were examined at the Radium Institute's clinic; 415 were qualified for treatment, with 300 patients being admitted. Over 5300 therapeutic

X-ray sessions were delivered, and over 170 patients were treated with radium. In 1938, the Institute purchased an additional 533.00 mg radium, which was assigned the code MSC ("Marie Skłodowska-Curie").

The radium used at the Warsaw Radium Institute was exclusively in the form of needles and tubes, and their specific level of activity and dimensions followed the Parisian treatment method. The tubes were engraved with the radium content in mg and the respective code.

The Institute's dynamic development was interrupted by the Second World War. In August 1939, concerned about the impending war, the City Hospital in Cieszyn deposited all its radium (320.00 mg), with an unknown code, at the Warsaw Radium Institute. As a result, at the outbreak of war, the Radium Institute held 1886.21 mg of radium (1033.21 mg donated by Skłodowska-Curie herself, code RMS; 533.00 mg purchased additionally, code MSC; and 320.00 mg from Cieszyn). During raids on Warsaw by the Nazi forces, Dr. Pawłowski evaporated most of the radium bromide solution, and buried it in the Institute's grounds after preparing and securing it. (After the war ended, this was officially retrieved and handed over to Prof. Pieńkowski for safekeeping.) Institute director Franciszek Łukaszczyk, fearing the Institute would be destroyed, placed the whole supply of radium in a rucksack, using makeshift and inadequate lead casing, and after spending many hours surrounded by throngs of people escaping the capital found his way to Józefów near Warsaw, where he buried the treasure in a friend's garden. He recalls, *Soon after the occupation of Warsaw started, two Gestapo officers arrived at the Institute to collect the radium. I warned them about the dangers of carrying it with them, so they sealed the radium and left it behind for the time being. I made the most of the delay, and talked to various Nazi institutions, including medical ones, pleading to let us keep the radium. As a result, the Nazi doctor officially assigned to Warsaw wanted to collect the radium himself - the only thing that stopped him were the Gestapo seals. Eventually Gestapo officers, accompanied by a physicist, collected the radium, and we had a 4-month-long investigation into the fate of the missing radium. I managed to convince them and to document that the*

rest had been plundered and taken abroad by Polish Army units abandoning Warsaw. This was possible because all the (falsified) entries and notes in the books supported the story. After a while Łukaszczyk, well-known in German medical circles (he trained as a radiologist in Berlin and Hamburg), was able to obtain a permit to use the Institute for administering therapy with radium hired from private owners. This existed in trace amounts, but it provided an ideal cover for expanding the Institute's medical activities by bringing in the concealed RMS radium; this required a fully dedicated and trustworthy team, and falsified documentation.

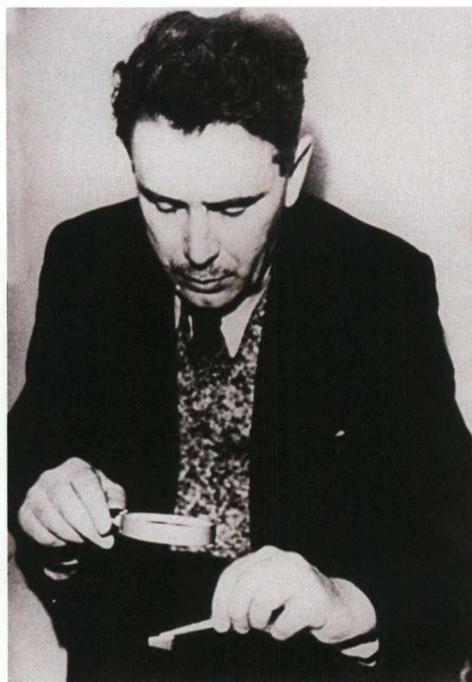
The Warsaw Uprising interrupted the Institute's activities. During the quelling of the uprising, Łukaszczyk was able to escape to Reguły near Warsaw, to join his wife and sons. The original radium (RMS) was concealed in cubby holes in ventilation and heating conduits, while the officially used radium remained in its safe. Using this friendship with a German patient treated at the Institute and bribing Nazi soldiers with his wife's jewelry, Łukaszczyk and his wife travelled by armored vehicle to the Institute under a pretext of collecting clothes and some knick-knacks left behind in the staff room. While his wife was collecting personal belongings, Łukaszczyk retrieved the tubes of radium, replacing them in the safe with replicas in case of any future searches. The radium was then taken to Reguły and buried in the garden.

During the liquidation of Warsaw, the radon extraction kit containing a small amount of radium bromide was smashed, and the research facilities set on fire. For many years after the war, traces of radioactive contamination were detected and neutralized in the building and its grounds.

Discovery in the rubble

In 1945 a decision was made to rebuild the Warsaw Radium Institute. Łukaszczyk returned to the city, bringing the RMS radium he had rescued during the war. During construction work, four more RMS specimens were discovered in the grounds (2 x 3.33 mg and 2 x 13.33 mg).

The Warsaw Institute continued providing radium therapy until the early 1990s. The development of brachytherapy using state-of-the art, automated equipment with radioactive sources including cobalt, cesium,



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**Prof. Łukaszczyk
identifying a radium
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and iridium led radium to be phased out, and radium specimens were being disposed of, since they were gradually becoming an inconvenient radioactive waste material.

In early 1998, certain hospital employees at the Wawelska Street building discovered their film badge dosimeters to be fully developed for no explicable reason. An investigation revealed that these individuals habitually left their lab coats near a recently opened small cloakroom, which should not have been exposed to ionizing radiation. Measurements taken at the cloakroom by the Radiological Protection Inspector indicated a ventilation shaft as the radiation source. The Radioactive Waste Treatment Facility team extracted from the shaft some rubble containing the remaining missing RMS sample of 6.66 mg radium.

And so exactly a century after the discovery of radium, the missing sample found at the Institute at Wawelska Street became a timely reminder of Skłodowska-Curie's donation and Łukaszczyk's daring struggle to recover the radium, for which he paid with his life: he died of pernicious anemia in 1956, at 59 years old. ■

Further reading:

This article is an abridged version of an article in Polish carried in the specialist journal *Nowotwory* 2000, 50, 410-416.