Medicine in Stamps

Wilhelm Conrad Röntgen (1845–1923): a light in the dark

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Wilhelm Conrad Röntgen's discovery of X-rays occurred one fateful day in 1895, when he shut himself in a room in total darkness to study a cathode ray tube enclosed within an opaque cardboard container. It is ironic that his discovery came about in the dark, because his life was quite the opposite. Röntgen was a man of vitality, a lover of the great outdoors, and a scientist who played by his own rules.

FAILED STUDENT Röntgen passed his childhood in Apeldoorn, the picturesque countryside of Holland. When his wealthy parents enrolled him in the Utrecht Technical School, he mostly ignored his studies, spending his time instead exploring the countryside and getting into trouble at school. He was eventually expelled for refusing to name the classmate who had drawn a caricature of an unpopular teacher. Despite Röntgen's academic shortcomings, his father wished for him to receive a proper college education, so Röntgen obligingly prepared for the entrance examination. Unfortunately, he failed. At the age of 20, he opted instead to register at the University of Utrecht in the Netherlands to audit courses. Then, on a whim, he headed for the less demanding Polytechnical School in Zürich, where he settled on applied mathematics and mechanical engineering.

In Zürich, Röntgen found himself drawn to the basic rather than applied sciences. He enjoyed physics in particular, spending many hours in the laboratory. He completed a doctorate and became both a passionate teacher and a talented and thorough researcher. Röntgen took pleasure in demonstrating his experiments in the classroom to highlight his lecture topics. And in the laboratory, he researched such topics as electromagnetic rotation in gases, conduction of heat in crystals, discharges of electricity through conductors and insulators, and the dielectric constants of various liquids.

BEGINNING OF A GLOW Röntgen was a prolific researcher in multiple areas of physics, but the work of Hittorf & Crookes and of Hertz & Lenard intrigued him as he turned his focus to the topic of cathode ray tubes. These tubes were created by passing an induction coil through a vacuum tube and running a discharge of electricity through it to form a beam of high speed electrons. Röntgen painstakingly replicated many of the classic experiments involving cathode ray tubes, and performed original studies as well. In one such experiment, he covered a cathode ray tube in foil and placed it within an opaque cardboard covering to prevent light from entering. He next created a paper screen painted with barium platinocyanide. When he ran the experiment in total darkness, he saw a light, a fluorescence, where the cathode ray landed on the barium platinocyanide screen. His tentative conclusion: under some conditions, cathode rays generate new and different rays upon impact on an object, *"and to distinguish them from others I shall use the name 'X-rays'."*

Skeptical of his results, Röntgen held up objects in front of the beam, and each time, the barium platinocyanide screen would light up. The beam was visible through a playing card or a book, as well as paper, tinfoil, rubber and wood. He also noticed that a sheet of lead would completely block the rays. In one frightening moment, he held a disc of lead between his fingers and recognized the outline of his own bones. As a non-physician unaccustomed to the sight of bones, he saw not promise but horror. He entitled his manuscript: *"A new kind of ray,"* and noted: *"If one holds a hand between the discharge apparatus and the screen, one*

sees the darker shadow of the bones within the slightly fainter shadow image of the hand itself."

MEDICAL COMMUNITY RESPONDS The manuscript was promptly published, but Röntgen did not fully realise the implications of his work, considering it an inconsequential natural phenomenon. But the medical world paid attention, and the press touted it as a "sensational discovery" to aid medical diagnosis. Within four weeks, Röntgen's name was in nearly every scientific publication in Europe. In January 1896, one month after his discovery, Röntgen received a picture of an amputated hand from Viennese X-ray photographers, Hascheck and Lindenthal, who had injected a mixture of bismuth, lead and barium salts into the blood vessels of the hand. The veins stood out clearly on the imaging, the first approximation of an angiogram. Scientists in the United States and Europe bought up tubes to further explore Röntgen's discovery, some of them running X-rays continuously for hours at a time, oblivious to the danger they created.

A case report of another sort began to appear in the literature. Surgeons were reporting the use of X-ray photographs, not only in diagnosing fractures, but in postoperative care. Imbedded bullets were being located using X-rays, resulting in less painful extraction. In April 1896, a case was discussed in the *Literary Digest*, about a woman who fell down the stairs in a theatre and injured her foot. Her physician referred her to the university hospital whereupon an X-ray photograph revealed a displaced cuboid bone in her left foot. These photographs were later taken to court in an early malpractice suit.

Before long, safety concerns surfaced. The story is told of a student at Columbia University by the name of Herbert D Hawks, who took on a side job of showcasing the novelty of X-rays in an exhibit at a department store. He would place his head next to the tube to show the transparency of his skull. After continued exposure to these X-rays, he described a sunburn effect on his skin that many others began to experience as well. The burns began to cause him pain, and the skin began to peel. He also noticed that his hair was falling out, his fingernails had stopped growing, and his vision was impaired. He described these symptoms in the *Electrical Engineer* in July 1896. In later years, other ill effects of X-rays were documented, such as radiation sickness, infertility and malignancies.

Röntgen published a series of three scientific articles on X-rays, and was recognised with awards and honours from universities and governments around the world. In 1901, he travelled alone to Stockholm where he was presented with the first Nobel Prize in physics. Unfortunately, his wife, Bertha, who had been suffering from poor health, was unable to attend.

LOVE AND DEATH TOGETHER In his youth, Röntgen had spent many an hour traipsing through the beautiful city of Zürich and its mountains to the south, frequently climbing the Betelberg mountain to its peak, Leiterli. His favourite spot was Pontresina, one of the Swiss alpine villages. Röntgen became a regular at the local inn, the Zum Grünen Glas, and eventually courted and married the innkeeper's daughter, Bertha. The couple went on romantic expeditions such as mountain climbing and rowing on the lake, and even late into their marriage, continued to revisit Switzerland every summer vacation to climb Leiterli.

The Röentgens lived by the Englischen Garten in Munich and maintained a peaceful life as they aged. In 1919, after years of chronic pain and daily narcotics, Bertha died, leaving behind her lonely and weary husband. Röntgen's death soon followed, caused by intestinal carcinoma, but this was not believed to have been radiation induced. In a stroke of good fortune, he had conducted his X-ray experiments from within a zinc box with a lead lining in order to protect his photographic plates and to provide easy access to his tools.

Röntgen's ashes were sent to Gießen, where he was buried next to Bertha and her parents. After his death, a number of monuments and scholarships were created in his name, including one at his favourite lookout mountain spot at Pontresina. The plaque still remains to this day, honouring him as the inventor of the X-ray.

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