Harriet Brooks

My 9.25" x 12.5" linocut portrait of physicist Harriet Brooks (1876 - 1933) shows her and her discovery of atomic recoil. Brooks also discovered Radon and measured its atomic mass and half-life. Her graduate supervisor and future Nobel laureate Ernest Rutherford also credited her with first recognizing that radioactive elements could undergo chains of transmutations into a series of new elements. He stated that she was second only to Marie Curie in her capacity for and ability as a radioactivity researcher. During her extraordinary 6 year career in physics she worked with 3 Nobel laureates (Rutherford, Thomson, and Curie) and made these fundamental contributions to the new field of nuclear physics!

When physicists first stumbled upon the phenomenon of radioactivity and shockingly found themselves becoming modern-day alchemists at the turn of the last century, a promising young Canadian woman made fundamental contributions to our understanding of the nascent field of nuclear physics. Rutherford (later Lord Rutherford the Nobel laureate) recruited Harriet Brooks while he was working at McGill University in Montreal. Rutherford, now considered one of the giants of early 20th century physics, was a frank New Zealander known for his dry humour, who famously described all of science as either physics or "stamp collecting." I do not imagine he was generous with his compliments, but he stated that Brooks was second only to Marie Curie in her capacity for and understanding of radioactivity. An excellent research physicist, Rutherford was clearly a dedicated and thoughtful supervisor who knew talent when her saw it.

Born July 2, 1876, in Exeter, Ontario, Harriet was one of nine children. Harriet entered McGill in 1894, only 6 years after the university had admitted its first female student. She graduated in 1898 with a B.A. in mathematics and natural science just as Rutherford arrived from England. He took her on as his first graduate student. After publishing her results in 1899 in the Transactions of the Canadian section of the Royal Society, Harriet completed her master's degree in 1901 on the "Damping of Electrical Oscillations," before embarking on radioactivity research. As a promising researcher, she was appointed a non-resident mathematics tutor for the new women's college Royal Victorian College at McGill in 1899.

Assigned to on the puzzle of the thorium "emanation" she discovered some of the earliest evidence of transmutation! At that time, physicists knew that some elements gave off alpha particles (which we now know are helium nuclei, two protons and two neutrons bound together), beta particles (which we now know are electrons) and

gamma rays, but these "emanations" were different. They knew it might be a radioactive gas, vapour, or even a fine powder, but she concluded that it must be a gas of lower atomic weight than thorium - something chemists of the day believed impossible. She co-authored the paper with Rutherford, "The New Gas from Radium" in 1901. This new gas was Radon. She went on to work on measuring the atomic mass of this new gas. While the complete story is messy, a strong case can be made that Harriet Brooks discovered Radon, a new element with a lower atomic mass. It is incontestable that she was amongst the first in the world to observe any form of the element and to attempt to measure its atomic mass.

Brooks proceeded to pursue a doctorate at the famous woman's college Bryn Mawr. She won the President's European Fellowship to go spend 1902-1903 in Cambridge working with (future Nobel laureate) J.J. Thomson. Thomson lacked Rutherford's dedication to guiding young researchers and largely left her on her own. She, like many, especially women before or since, suffered from impostor syndrome and described herself as "a terrible bungler in research work" in a letter to Rutherford. She wildly underestimated her own skills and accomplishments and was hindered by Thomson's erroneous belief at the time that radioactivity was a chemical process. Nonetheless, Brooks she made the first measurement of the half-life of Radon (her value: 1 minute, versus the modern value of 55 seconds) while working in Thomson's lab.

Instead of returning to Bryn Mawr to complete her doctorate, she went back to McGill to work with Rutherford for a year. While back at McGill, she noticed what she called the 'volatility' of radioactive substances, and how a non-radioactive plate placed in a radioactive container would become radioactive. She was seeing the first evidence of her discovery of atomic recoil. When the radioactive element emitted an alpha particle in one direction, the daughter nuclei would be propelled in the opposite direction - sometimes with such force that they became embedded in the plate (which hence becomes radioative). During this time she also charted the decays of Thorium, Radium, and Actinium, and discovered not only did radioactive elements transmutate into new elements, but that these products in turn decayed, laying the groundwork for the discovery of nuclear decay series. She published her results in 1904.

In 1904, she became a physics tutor at Columbia's women's college Barnard College. She met physics professor Bergen Davis, fell in love, and they became engaged in 1906. The dean demanded her resignation, insisting she couldn't be both a physicist and a wife. Brooks protested, writing, "I think also it is a duty I owe to my profession and to my sex to show that a woman has a right to the practice of her profession and cannot

be condemned to abandon it merely because she marries." Brooks ultimately broke off the engagement, and then nonetheless resigned due to the stress. She then took a step away from the scientific life.

In 1906 she spent her summer with the Fabian socialists at Summerbrook, the utopian commune established by Prestonia Mann Martin in the Adirondacks. She fell in with Marxist writer Maxim Gorky, his (then mistress, eventual second wife) Maria Andreyeva, and their entourage, and ended up, after a visit to Montreal, travelling with the couple by ship from New York to Naples and Capri! Eventually she seems to have bored of this and went to work with Marie Curie in Paris. Curie offered her a position for another year, but Rutherford, who was returning to England to work in Manchester offered her a fellowship. She accepted, but then suddenly withdrew. While in Montreal she had become re-acquainted with her engineering tutor Frank Pitcher. He had been writing her ever since insisting that she should marry him as he could provide a stable future. She had been encouraged by her friends Mrs. Mary Rutherford (Ernest's wife) and Prestonia Martin (who both harboured strong traditional ideas about marriage) and she ultimately gave in and accepted his proposal. He promptly took off on a mountain climbing tour of Europe, insisted on a religious ceremony despite her wishes and left her to return to Montreal and plan the wedding.

They had three children, but tragically lost one to spinal meningitis in childhood and a second to suicide while a student at McGill. Brooks, now Mrs. Frank Pitcher, never returned to research but took on the vocation of upper middle-class wife and mother until her premature death of leukemia at age 56, likely due to her exposure to Radon. She lived a quiet life after her remarkable 6 year science career, gardening and corresponding with those who had known her when she had been young and free. The social pressures and mores of the time robbed physics of one of its bright lights.
