Arthur H. Compton
(1892-1962)

Presentation by:
Joseph Moore
Early Life

- Arthur Compton was born in the town of Wooster, Ohio, USA, on September 10, 1892.
- His father, Elias Compton, was a philosophy lecturer and minister of the Presbyterian Church who became dean of the University of Wooster. His mother, Otelia Augspurger, was a college graduate and former school teacher.
- Arthur was the youngest of four.
- His older sister Mary, who was very bright and achieved high marks in school became a missionary in India.
- His brother Karl was a physicist and president of the Massachusetts Institute of Technology.
- While his brother Wilson was a businessman, and president of Washington State University.
- From age 14, Arthur attended Wooster Preparatory School. His well-educated parents raised him in a house full of books and he soon developed a keen interest in science – especially astronomy and powered flight.
- When deciding what he wanted to do for the rest of his life he was torn between his two loves: science and his faith.
Arthur’s Passion for Science

- From a young age Arthur’s two passions in science were astronomy and airplanes.
- At age 12, Arthur read an astronomy book and was hooked. His first telescope was not very powerful. He got a real thrill when he realized that a puzzlingly shaped heavenly body he was looking at was Saturn – his telescope was not powerful enough to resolve Saturn’s rings.
- In 1907, at age 15, Arthur became interested in aviation, following the Wright Brothers’ powered flights which had taken place in 1903-05. He became so fascinated that he began designing and building model aircraft.
- By the time he was 16, working in a barn, he had built a full-sized glider.
- He built it using pinewood, cloth, and piano wire. The total cost was less than $35, financed by doing chores for neighbors.
- In 1909, after his flight he published two papers on aeronautics: one in *Fly* and one in *Aeronautics*. *Scientific American* published a letter he sent them about airplanes.
- At age 17, in 1910, Arthur pointed his homemade camera at Halley’s Comet and took a photograph of it. He treasured the photograph for the rest of his life.
Arthur’s Passion for his Faith

- Arthur’s family was very ingrained in the Presbyterian Church due to his father being a minister.
- This led his sister to being a missionary.
- Arthur almost went a similar route.
- However, his father convinced him that he would be a greater help to Christianity be being a scientist rather than a missionary.
- His faith would stick with him through the rest of his life.
- It troubled him while he worked on the Manhattan project.
- It caused him to write two philosophical books discussing the relationship between philosophy and science, *The Freedom of Man* (1935) and *The Human Meaning of Science* (1940).
- In his book *The Freedom of Man*, he said:
  - “We could, in fact, see the whole great drama of evolution moving toward the making of persons with free intelligence capable of glimpsing God’s purpose in nature and of sharing that purpose. In such a case we should not look upon consciousness as the mere servant of the biological organism, but as an end in itself. An intelligent mind would be its own reason for existence. “ (p. 140)
Arthur’s College Days

- Arthur originally enrolled for a Bachelor of Science at the University of Wooster as a Physics major. However, he found himself drawn to experimental work rather than theory.
- In 1913, Compton would begin his journey at Princeton University.
- Originally he intended to do graduate work in engineering.
- After his first year he switched to doing a Master’s Degree in Physics.
- In 1914 he officially began working for a Ph.D. in Physics at Princeton.
- He would go on to graduate in 1916.
- His thesis was titled *The intensity of X-ray reflection, and the distribution of the electrons in atoms.*
Compton Effect

- In his early days at Princeton, he developed a theory of the intensity of X-ray reflection from crystals as a means of studying the arrangement of electrons and atoms, and in 1918 he started a study of X-ray scattering.

- This would eventually lead to his discovery in 1922 of the increase of wavelength of X-rays due to scattering of the incident radiation by free electrons, which implies that the scattered quanta have less energy than the quanta of the original beam.

- This effect, nowadays known as the Compton effect, which clearly illustrates the particle concept of electromagnetic radiation, was afterwards substantiated by C. T. R. Wilson who, in his cloud chamber, could show the presence of the tracks of the recoil electrons.

- For this discovery, Compton was awarded the Nobel Prize in Physics for 1927 (sharing this with C. T. R. Wilson who received the Prize for his discovery of the cloud chamber method).
The Experiment that Details how the Compton Effect Came to be

- In 1922, Compton observed that X-rays were modified by interacting with electrons. Following interaction, X-rays had lower frequencies and longer wavelengths, meaning they had lost energy.
- When he examined the paths and energies of X-rays that had interacted with electrons, the only interpretation that made sense was that the X-rays and electrons had behaved like two colliding particles, very approximately like two pool balls colliding. Compton established that a single X-ray does not interact with several electrons. A single X-ray interacts with a single electron.
- Compton called these particles of light **photons**.
- Compton’s experiment provided decisive proof that Einstein’s explanation of the photoelectric effect was correct — light could behave like a particle.
- Compton published his work in the *Physical Review* in May 1923. In technical terms, he established that X-rays can behave as particles with momentum given by the equation first proposed by Einstein:
  - where \( p \) is momentum, \( h \) is the Planck constant, \( \nu \) is the frequency of the light, and \( c \) is the speed of light.
Nobel Prize

- Compton was awarded the Nobel Prize in Physics in the year 1927 for his discovery of what is now known today as the Compton effect.
- He shared this win with C.T.R. Wilson who received the Prize for his discovery of the cloud chamber method which substantiated the Compton effect.
- Compton would be among the first Americans to win a Nobel Prize
  - The first American to win in Physics was Albert Michelson in 1907
  - Theodore Roosevelt was the first American to win in 1904-5
TIME Person of the Year

- Arthur was on the cover of TIME magazine on Jan. 13, 1936
- The feature article detailed what the first American Nobel Prize winner was doing after his big win.
- The author discussed his current work at the time and tried to capture the story of a man who was apart of the revolution changing the science world.
- [Click here to read the article](#)
Manhattan Project

- In 1941 he was chairman of the committee of the National Academy of Sciences that studied the military potential of atomic energy.
- In this capacity he was instrumental, with the physicist Ernest O. Lawrence, in initiating the Manhattan Project, which created the first atomic bomb.
- From 1942 to 1945 he was director of the Metallurgical Laboratory at the University of Chicago, which developed the first self-sustaining atomic chain reaction and paved the way for controlled release of nuclear energy.
- His investigations, carried out in cooperation with E. Fermi, L. Szilard, E. P. Wigner and others, led to the establishment of the first controlled uranium fission reactors, and, ultimately, to the large plutonium-producing reactors in Hanford, Washington, which produced the plutonium for the Nagasaki bomb, in August 1945.
- Pictured was from left: Ernest O. Lawrence, Arthur Compton, Vannevar Bush, James B. Conant, Karl Compton, and Alfred Loomis at U.C. Berkley discussing the 184 in cyclotron
Arthur’s Life outside of Science

- Arthur married Betty Charity McCloskey, a former classmate from Wooster in 1916.
- Together they had two sons, Arthur Jr. (1918) and John (1928)
- After the conclusion of his work on the Manhattan Project he returned to where he was teaching at the time, Washington University.
- In 1946 he became the university’s chancellor, he would stay chancellor until 1954 at age 62. He continued to teach until 1961.
- He would eventually die in Berkeley, California after he suffered a cerebral hemorrhage.
- Outside of science he was an avid tennis player, he loved music and photography, and continued his childhood obsession of astronomy.
- Picture: Four Nobel Laureates at the Washington University: Left to Right Dr. Carl F. Cori 1947 Nobel Laureate in Physiology/Medicine, Dr. Joseph Erlanger 1944 Nobel Laureate in Physiology or Medicine, Dr. Gerty T. Cori 1947 Nobel Laureate in Physiology/Medicine
Sources

- https://www.nobelprize.org/prizes/physics/1927/compton/biographical/
- https://www.atomicheritage.org/profile/arthur-h-compton
- https://www.famousscientists.org/arthur-compton/
- http://content.time.com/time/subscriber/article/0,33009,755635,00.html
- https://sciencemeetsfaith.wordpress.com/tag/physicist/