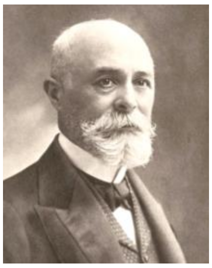
Biography: Henri Antoine Becquerel (1852 – 1908)



Henri Antoine Becquerel was an outstanding French physicist. He won the Nobel Prize in Physics for his discovery of natural radioactivity, together with Marie Skłodowska-Curie and Peter Curie, who studied this phenomenon in detail. Between 1899 and 1900, he measured the declination of Beta radiation in magnetic and electric fields, and identified this radiation as the electron beam, which had been previously discovered by Joseph John Thomson. In honor of Becquerel, the unit of the activity of a radioactive source in the International System of Units was named with his surname: 1 Becquerel = 1 decay/second.

Henri Antoine Becquerel was born in Paris on December 15, 1852, to a family which (including him and his son) created four generations of scientists. His grandfather, Antoine-César Becquerel, discovered the photovoltaic effect. Both his grandfather and his father, Alexandre-Edmond Becquerel, were famous physicists and the members of the French Academy of Sciences. Henri Becquerel's son, Jean Becquerel (1878-1952) also continued the family tradition and became a physicist. Henri Becquerel was married twice. In 1874, he married Lucie-Zoe-Marie Jasmin, who died soon after giving birth to their son. In 1890, he was married for the second time, to a woman named Louise Désirée Lorieux.

Henri Becquerel graduated first from École Polytechnique (1872–74) in Paris, and later from École des Ponts et Chaussées (1874–77). In 1875, he began working as an engineer for the Administration of Highways and Bridges, and in 1894 he became their chief engineer. At that time, he was conducting his own physics research at his father's laboratory. His father was a professor at the Museum of Natural History in Paris. After his father's death in 1892, Becquerel became a professor at that same museum and was also named chair of the faculty of Physics at the Conservatoire National des Arts et Métiers. In 1895, he became a professor of Physics at École Polytechnique. In recognition of his achievements in the fields of the light polarization in magnetic fields, phosphorescence, and the absorption of light in crystals, he was elected as a member of the Paris Academy of Sciences in 1889. In 1908, he became its president. He was also a member of the Royal Academy of Sciences, in Berlin. He died in Le Croisic on August 25, 1908, at the age of 56.

On January 20, 1896, during a session at the Paris Academy of Sciences, Becquerel listened to a report presented by Henri Poincaré about Röntgen's discovery of X-rays. Poincaré formulated a hypothesis that the ability to emit X-rays was likely connected with the phenomenon of phosphorescence, the delayed emission of light after irradiating a given substance. Becquerel decided to check this hypothesis. In his laboratory, he subjected a sample of Uranium-Potassium sulphate $K_2UO_2(SO_4)_2$ to sunlight. He then checked that this sample, left on photographic plates and wrapped in the black paper, would cause its distinct blackening. In doing so, he managed to confirm Poincaré's hypothesis. Nearing the end of February, 1896, Becquerel was still busy conducting his experiments. The weather in Paris was dreary and the sun was rarely shining. Unable to continue his experiments without sunlight, he put his sample and photographic plates into a dark drawer. After few days, on Sunday, March 1, he attempted to develop the photographic plates, but to his amazement he found that the photographic plate had exposed, as though they had been left in the sun! He stated that Poincaré's hypothesis was wrong. The next day, during the session of the Academy of Sciences, he announced that the uranium salt had emitted an unknown, pervasive radiation which exposed the photographic plate. It was both Poincaré's incorrect hypothesis and the bad weather which led Becquerel to the accidental discovery of natural radioactivity.

Very interested in this phenomenon, Becquerel tested the influence of other salts on the photographic plates and noticed that both uranium ores and uranium salts caused this phenomenon. The phenomenon of the plates becoming overexposed turned out not to be connected with phosphorescence itself. Becquerel started to study this issue in detail, trying to find reasons for this phenomenon. His research proved that the source of this new radiation was not only uranium salt and uranium ore, but in fact every chemical compound containing a sufficient amount of uranium and metallic uranium.

Becquerel continued his work and studied, very precisely, properties of the radiation he had just discovered. In March, 1896, he presented, no fewer than three times, the results of his research during a session of the Academy of Sciences. During these sessions, he stated, among other things, that the rays emitted by the uranium-potassium sulphate, when kept in darkness for a few days, had the ability to discharge a gold leaf electroscope after passing through a two-millimeter-thick aluminum plate. By using the photographic plates, he realized that these unseen rays

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might undergo reflection and deflection. Becquerel studied the nature of this radiation and drew the conclusion that electromagnetic radiation was very similar to x-rays. Today we know that this interpretation was wrong, and instead, that radiation consists of alpha, beta and gamma radiation, emitted by uranium and the products of its disintegration.

Henri Becquerel was a famous and respected physicist. His experiments were always conducted with a high amount of accuracy and care, and the results of his published research were not undermined by the other scientists of the time. Although he often presented his results at the Academy of Sciences sessions, his presentations did not arouse as much interest as the presentations on x-rays, which a very popular field of physics at the time. Henri Becquerel could not properly interpret the phenomenon of x-rays because, like his father, he was an expert on the phenomenon of phosphorescence. He proposed the existence of what he called delayed phosphorescence, which occurred a few days after irradiating the substance. He was limited by his equipment, as he only had photographic plates, which was an inexact method of experimentation.

Becquerel found the quantitative relationship between the power of the new-discovered radiation and the content of uranium in the sample. However, for some unknown reason, this relationship was not fulfilled in the case of one of his uranium ores. This problem was later explained by Maria Skłodowska-Curie.

At the end of 1897, Maria Skłodowska-Curie was searching for a research subject for her doctoral thesis when she started to study the radiation of uranium, a subject that was seen as uninteresting at the time. Instead of using photographic plates, she used a precise and sensitive electrometer. Created by Jacques and Peter Curie, this device was used to measure the stream of ionization caused by radiation. Maria noticed that the intensity of the radiation in different minerals containing uranium was not proportional to quantity of uranium in the compound. Thanks to that realization, she was able to confirm her hypothesis that there were new, unknown radioactive elements in nature. In June, 1898, Maria and Peter Curie announced that they had discovered the radioactive element called polonium (named in honor of Maria's mother country). In December of the same year, they discovered radium, which could be found in the general environment. The phenomenon of radiation, which was previously unknown, was called radioactivity.

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