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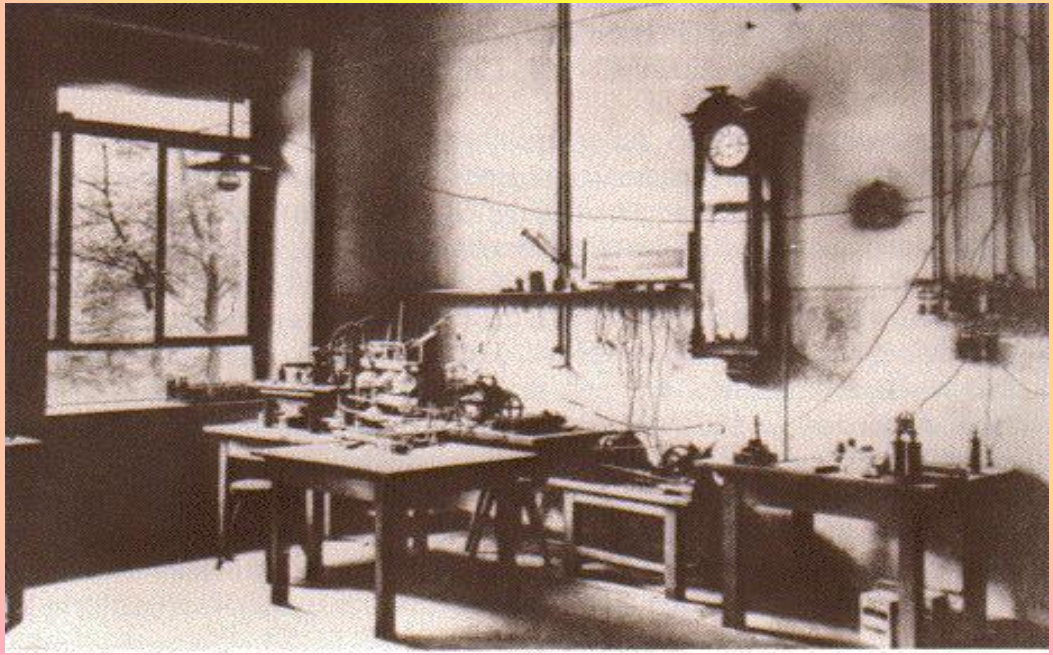
HISTORY OF DISCOVERY AND IMPLEMENTATION OF RADIOACTIVITY

Through the release of atomic energy, our generation has brought into the world the most revolutionary force since prehistoric man's discovery of fire …

We scientists recognize our inescapable responsibility to carry to our fellow citizens an understanding of atomic energy and its implication for society. In this lies our only security and our only hope …

Albert Einstein

In 1895, while experimenting with electric current flow in a partially evacuated glass tube (cathode-ray tube), **Wilhelm Conrad Röntgen** [1845–1923] observed that a nearby laid piece of **barium platinocyanide** gave off light when the tube was in operation.

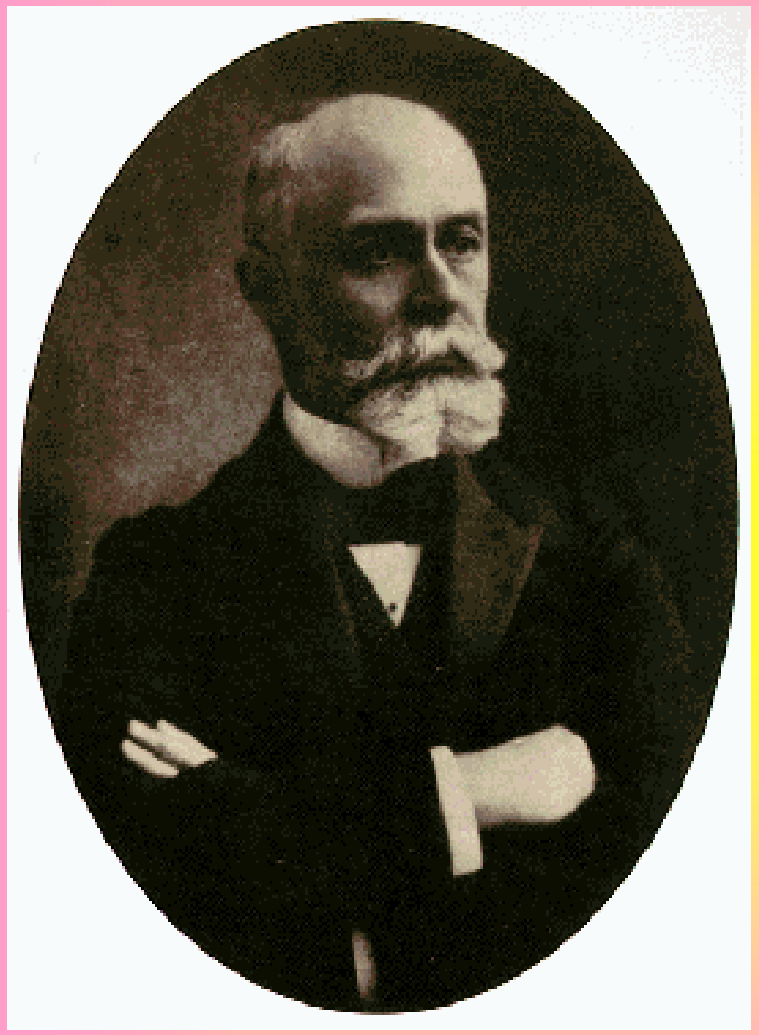


Laboratory of Wilhelm Röntgen

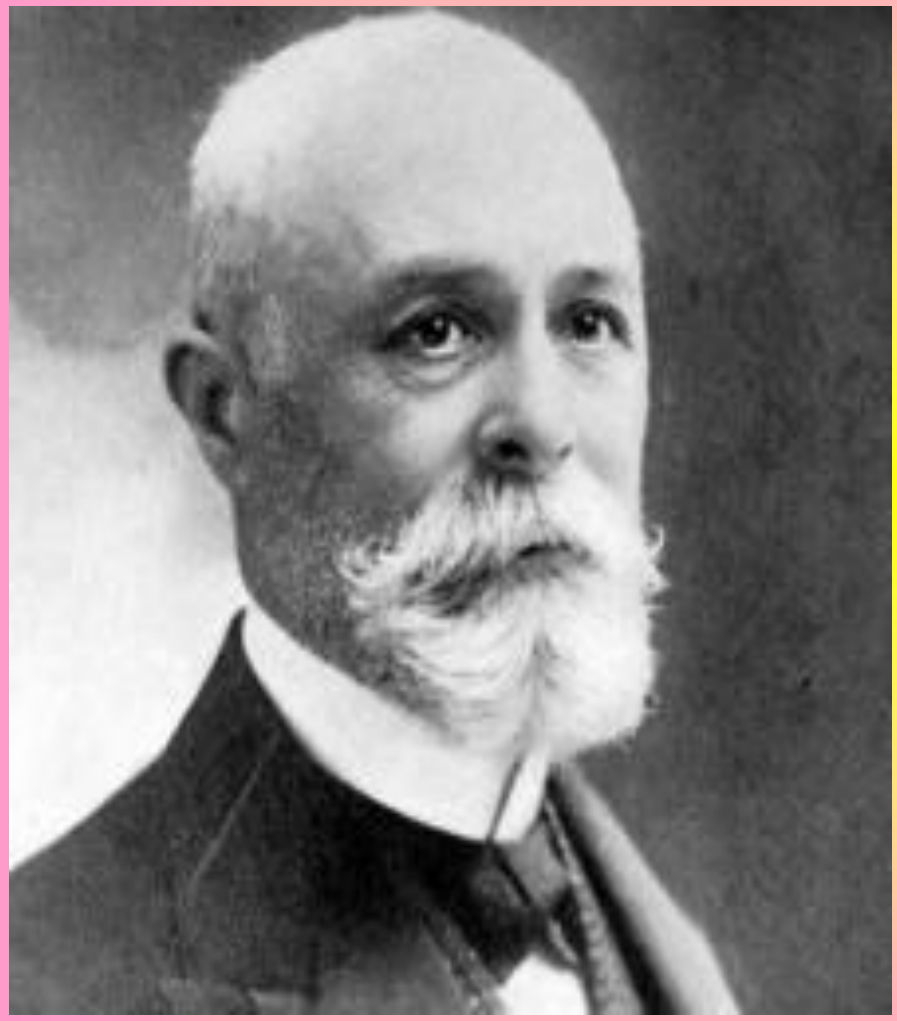
He theorized that when the cathode rays (electrons) struck the glass wall of the tube, some unknown radiation was formed that traveled across the room, struck the chemical, and caused the fluorescence. Further investigation revealed that paper, wood, and aluminum, among other materials, are transparent to this new form of radiation.

He found that it affected photographic plates, and, since it did not noticeably exhibit any properties of light, such as reflection or refraction. He mistakenly thought the rays were unrelated to light. **In view of its uncertain nature, he called the phenomenon X-radiation**, though it also became known as **Röntgen radiation**. He took the first X-ray photographs, of the interiors of metal objects and of the bones in his wife's hand.

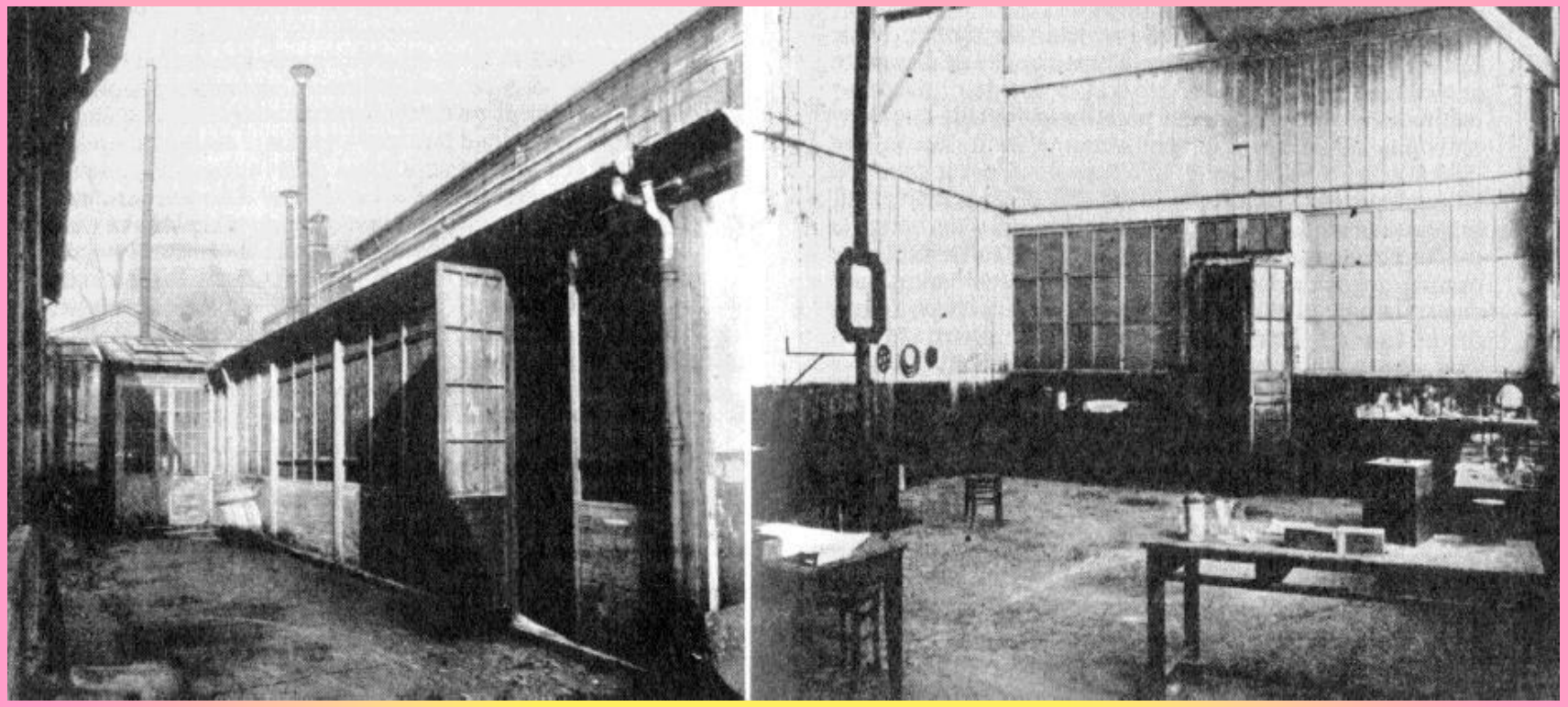
An achievement that earned him **the first Nobel Prize in Physics in 1901**. In honour of his accomplishments, the International Union of Pure and Applied Chemistry (IUPAC) the element 111, after him named **Roentgenium** – it is a very radioactive element with multiple unstable isotopes.



Henri Becquerel [1852-1908] decided to study the existence of a possible relation between X-rays and the fluorescence phenomena. In those times, he was studying the fluorescence of uranium salts.



In 1896 he discovered by chance that uranium salts emitted rays that resembled X-rays in their penetrating power. He demonstrated that this radiation, did not depend on an external source of energy.



Some hundred meters from the "Jardin des Plantes",
where was working Becquerel was Curie’s laboratory

In fact H. Becquerel **had discovered radioactivity**. But the first use of the word "**radioactivity**" appeared in 1899 in the publication by **Marie Sklodowska-Curie** [1867–1934] and Pierre **Curie** [1859-1906].

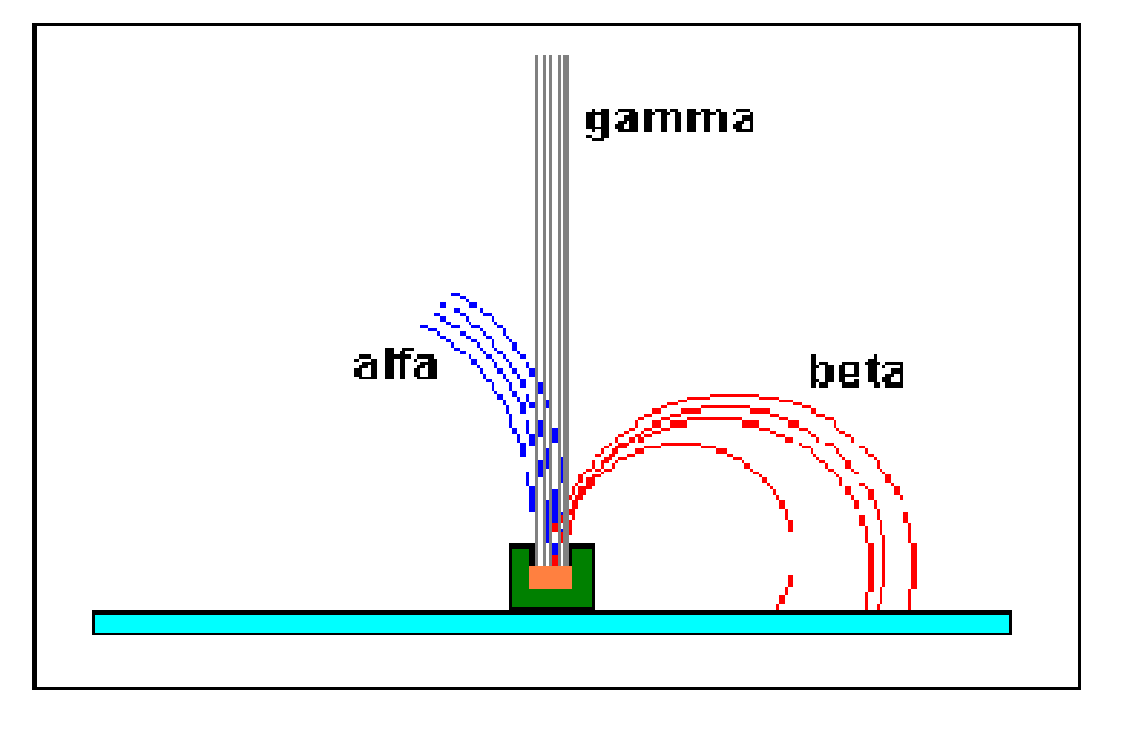
They found that the activity of the uranium compounds depended only on the quantity of uranium present in the sample.

In their systematic search they had found that the element thorium was also radioactive.

On the date 18th July 1898**, Curies published a paper, announcing the existence of an element which they named polonium,** in honor, as they wrote of her native country.

In the same year the Curies announced the existence of a second element, which they named „radium” for its intense *radioactivity* **-** a word that they coined**.**

Marie Sklodowska-Curie in her Ph D. thesis described the three kinds of rays (α, β and γ) - they have different trajectories in a magnetic field.



Mme Curie's second Nobel Prize (in 1911), **enabled her to ask the French government for funding the building of Radium Institute** (*Institut du radium*, now the *Institut Curie*), **which was built in 1914** and at which research was conducted in chemistry, physics, and medicine.

The Institute became a crucible of Nobel Prise winners, including also her daughter **Irène Joliot-Curie** [1897-1956] and her son-in-law, **Frédéric Joliot-Curie** [1900-1958].

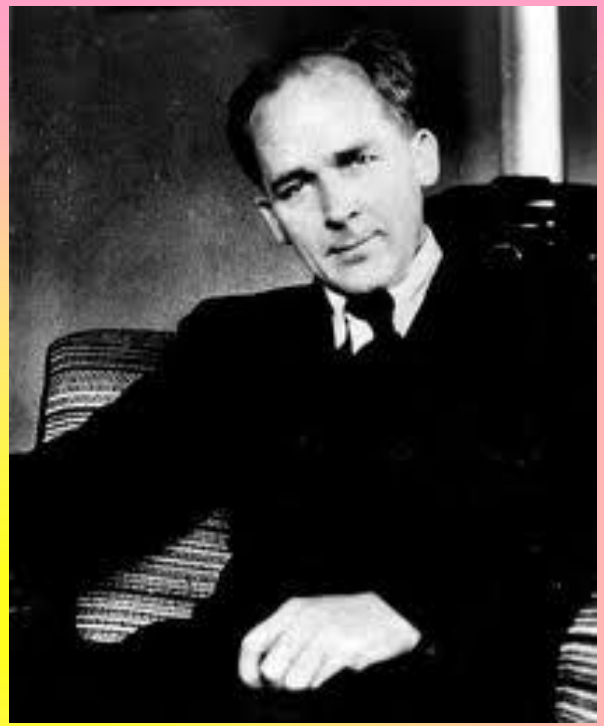
In 1934, **Irene Joliot-Curie** and **Jean Frederic Joliot-Curie** discovered the artificial radioactivity, making a great step toward the use and the control of radioactivity. For this discovery, they received the **Nobel Prise of chemistry** in 1935.

They were the first to show that mankind could build under control some new radioactive nuclei. By shooting an aluminium sheet with alpha particles (helium nuclei), they were able to make radioactive phosphorus, a **new isotope** of the stable phosphorus **that was never observed in nature.**

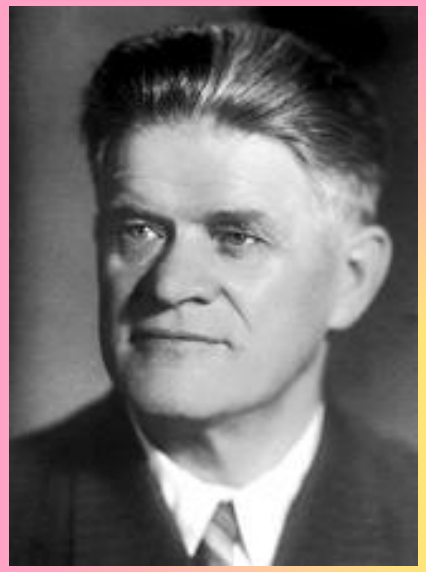
Ernest Lawrence [1901–1958] - he conceived (1929) and built the **cyclotron**, a device found today in many hospitals for the on-site production of artificial radioisotopes of short half-life needed in medical diagnosis and treatment.

In 1939, Lawrence was awarded the **Nobel Prize in Physics** for his work in inventing the cyclotron and developing its applications.

Chemical element number 103 is named "**lawrencium**" in Lawrence's honor.



In 1938 **Otto Hahn** [1879-1968] and **Fritz Wilhelm Strassmann** [1902-1980] demonstrated that the uranium atom had split into two lighter atoms. **Lise Meitner** [1878-1968] and **Otto Frisch**[1904-1979] explained the process, to which they gave the name **nuclear fission**.



Pavel Alekseyevich Cherenkov [1904–1990]

Il´ja Mikhailovich Frank [1908–1990]

Igor Yevgenyevich Tamm [1895–1971]

The Nobel Prize in Physics 1958 was awarded jointly to Pavel Cherenkov, Il´ja Frank and Igor Tamm *for the discovery and the interpretation of the Cherenkov effect.*

In 1934, while working under prof. Sergey I. Vavilov [1891–1951] **at Lebedev Physical Institute of the Russian Academy of Sciences , Cherenkov observed the emission of blue light from a bottle of water subjected to radioactive bombardment.**

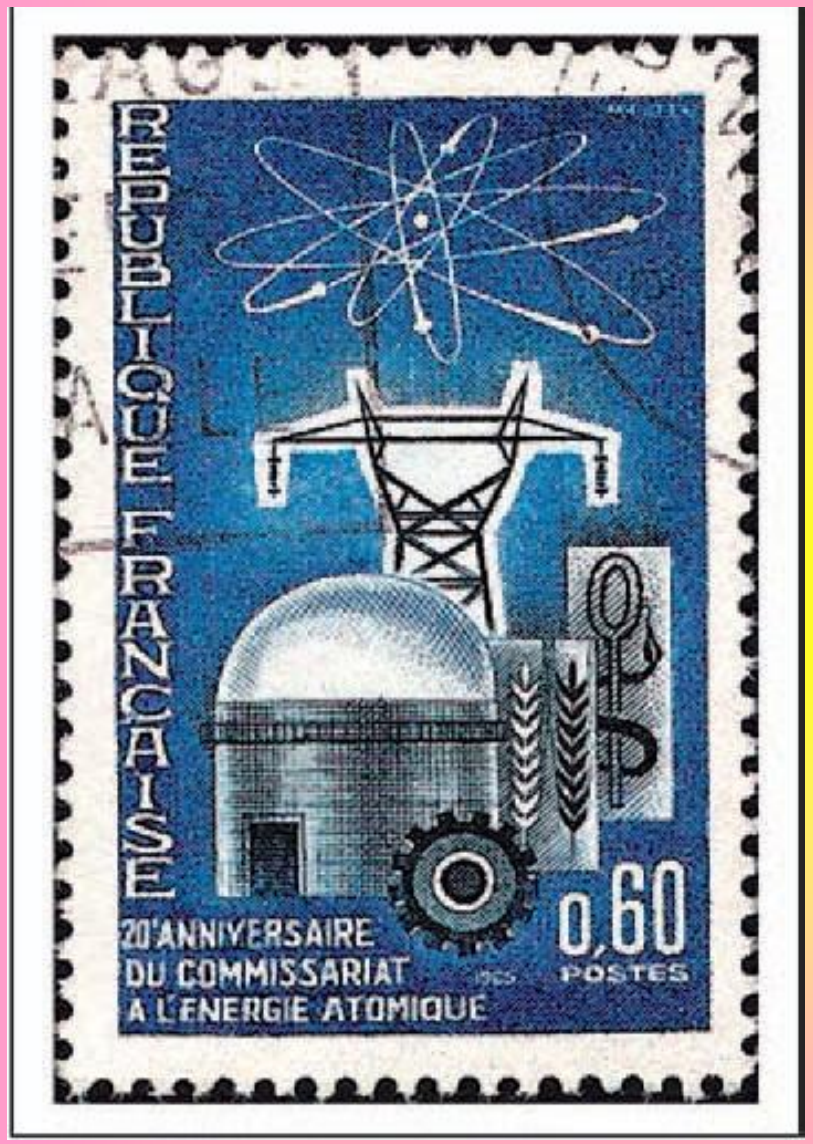
Cherenkov radiation is commonly used in experimental particle physics for particle identification.

It is also used to detect high-energy charged particles in pool-type nuclear reactors.

Cherenkov radiation is widely used to facilitate the detection of small amounts and low concentrations of biomolecules.

The radioactivity history ends with the **first nuclear bomb** which exploded on the 16th of July 1945, in the desert of Alamogordo, near the town of Los Alamos, and which prompted **Robert Oppenheimer** [1904-1967], director of the Manhattan project to say, looking at the explosion:

God bless us, we have created something more awful than hell.



The French postage stamp illustrates (1965) four fields where radioactivity and nuclear energy play a significant role:

- medicine,
- agriculture,
- industry,
- nuclear power for electricity.

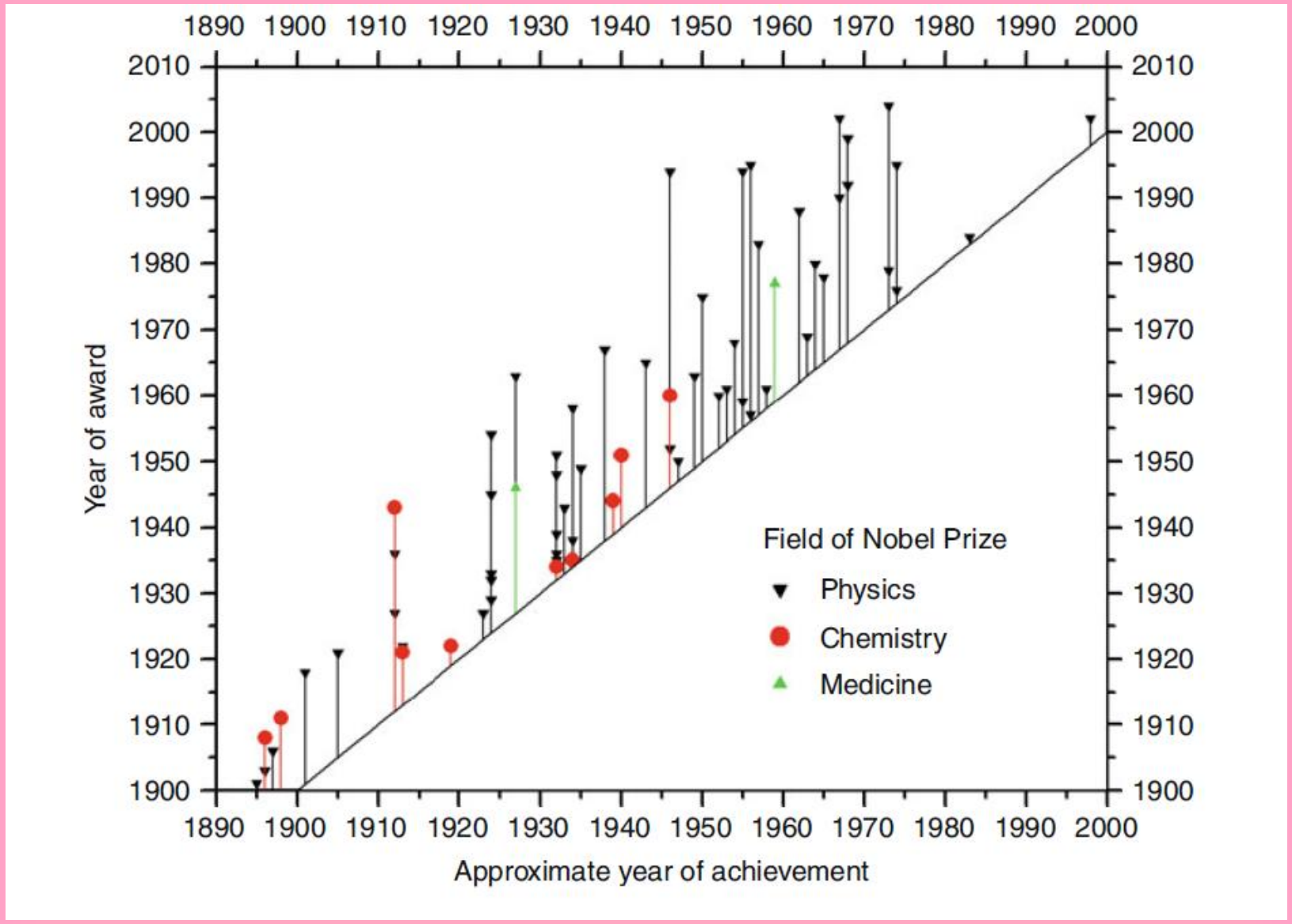
In 1905 Marie and Pierre Curie spearheaded the use of radium for the treatment of cancer.
It was **the first peaceful application of nuclear energy** and the birth of modern **nuclear medicine**, upon which we now depend for the diagnosis and treatment of cancer and many other infirmities of the human body.

During the First World War Marie Sklodowska-Curie organised the mobile radiological service.
The X-ray equipment was used mainly to search for shrapnel in the bodies of wounded soldiers.
These ambulances were nicknamed ***les petites Curies.***

XX century gave the horror of the two bombs of 1945 launched on human beings.
In 1948, thanks to the energy and the willpower of Joliot, the **first French nuclear stack**, named Zoe, began to run.
First nuclear Power Plant was put in motion in 1954 in Obninsk in USSR.
Today, about 80% of the French electricity comes from nuclear energy, in Belgium – 62%, in South Korea and Ukraine – 50%.
There are now over 430 commercial nuclear power reactors operating in 31 countries, with 372,000 MWe of total capacity. They provide about 13.5% of the world's electricity.

To sum up

In the twentieth century, called the Nuclear Age, **57 Nobel Prises** honored the chemical and physical results achieved by people who can be rightly called **nuclear scientists**. This number alone proves that **nuclear science must be recognised as one of the most powerful engines pushing science to new heights.**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Year of award
Approximate year of achievement
Field of Nobel Prize
Physics
Chemistry
Medicine

To sum up

There are many signs that nuclear science will remain important in the future as well.
Radiopharmaceutical chemistry is stimulating biomedical research and nuclear medicine (diagnosis and therapy).
The development of particle physics keeps its dynamism as demonstrated by the Nobel Prises awarded in this century (2002, 2004 and 2008).

Thank you for your attention