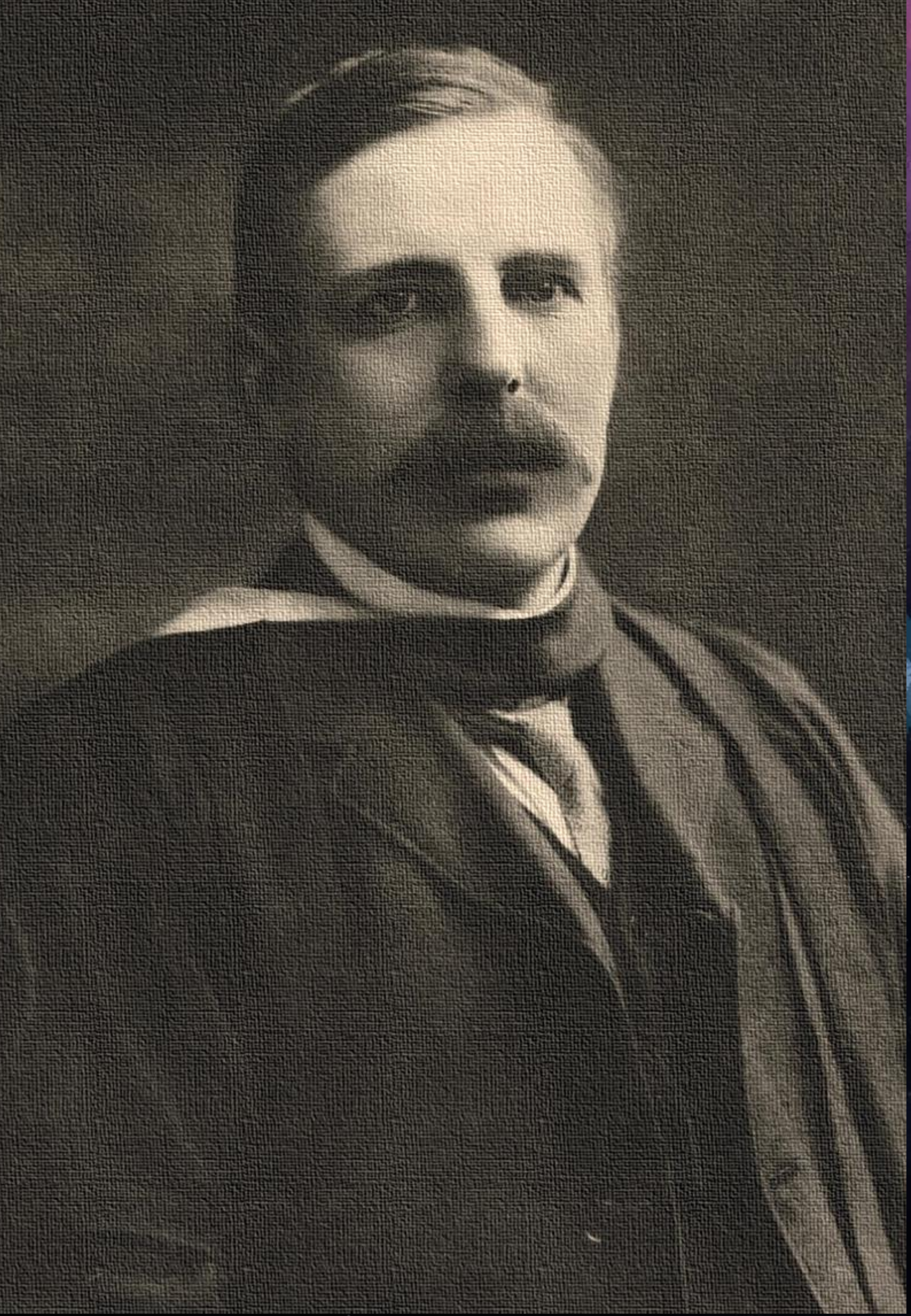

A Revolution Around the Life of Ernest Rutherford

Presentation in Chemistry

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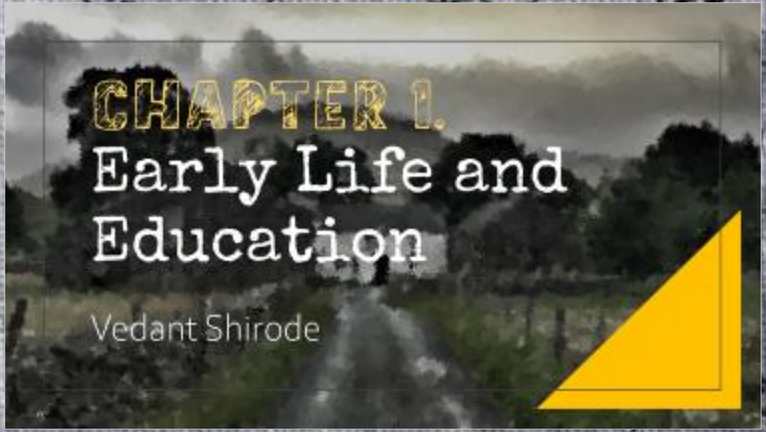
CHAPTER 1.
Early Life and Education
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CHAPTER 2.
The Story of Discovering Alpha and Beta Rays
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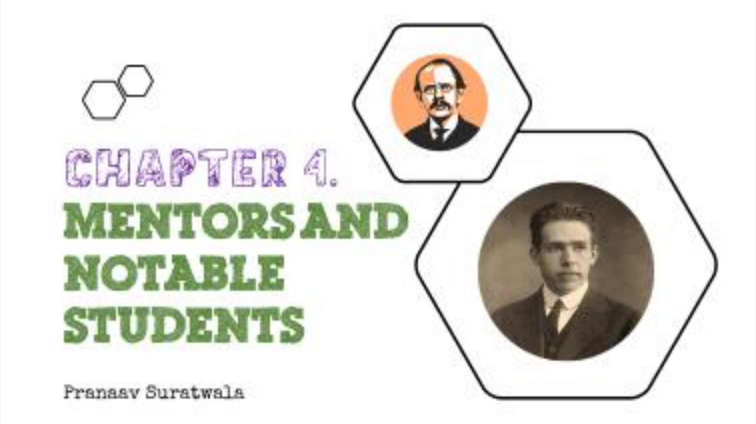
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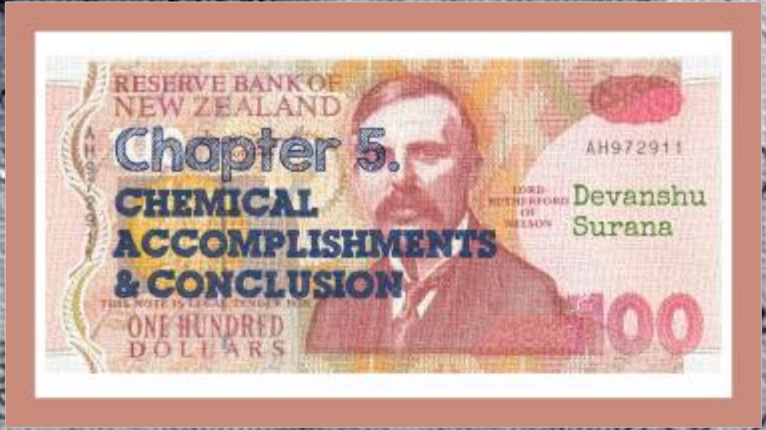
MENTORS AND NOTABLE STUDENTS
Pranaav Suratwala


RESERVE BANK OF NEW ZEALAND
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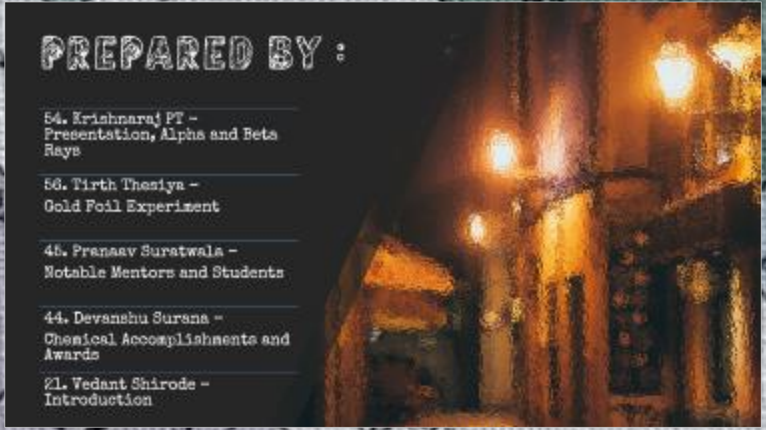
CHEMICAL ACCOMPLISHMENTS & CONCLUSION
Devanshu Surana
ONE HUNDRED DOLLARS
100


PREPARED BY :
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44. Devanshu Surana - Chemical Accomplishments and Awards
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CHAPTER 1.

Early Life and Education

Vedant Shirode

BIRTH

Ernest Rutherford (30 August 1871) was the son of James Rutherford, a farmer, and his wife Martha Thompson, originally from Hornchurch, Essex, England. James had emigrated to New Zealand. Ernest was born at Brightwater, near Nelson, New Zealand.

Educational Background

- Ernest Rutherford attended the free state schools through 1886, when he won a scholarship to attend Nelson Collegiate School, a private secondary school.
- Another scholarship took Rutherford in 1890 to Canterbury College in Christchurch, one of the four campuses of the University of New Zealand.
- Rutherford's investigation of the ability of a high-frequency electrical discharge, such as that from a capacitor, to magnetize iron earned him a bachelor of science (B.S.) degree at the end of 1894.

During this period he fell in love with Mary Newton, the daughter of the woman in whose house he boarded.

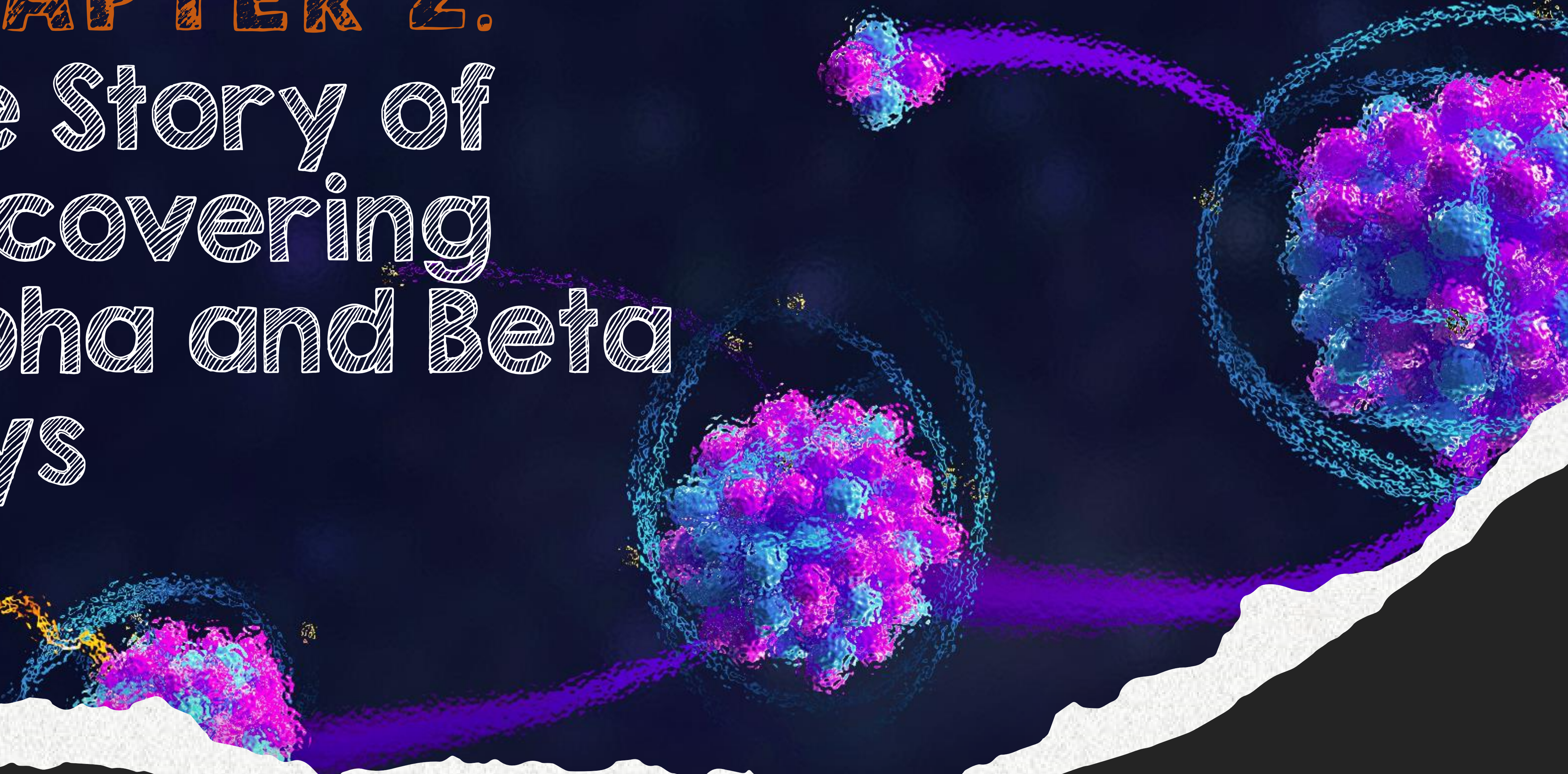
He chose to continue his study at the Cavendish Laboratory of the University of Cambridge, which J.J. Thomson, Europe's leading expert on electromagnetic radiation, had taken over in 1884.

In 1898, Thomson recommended Rutherford for a position at McGill University in Montreal, Canada.

In 1901, Rutherford gained a DSc from the University of New Zealand. In 1907, he returned to Britain to take the chair of physics at the Victoria University of Manchester.

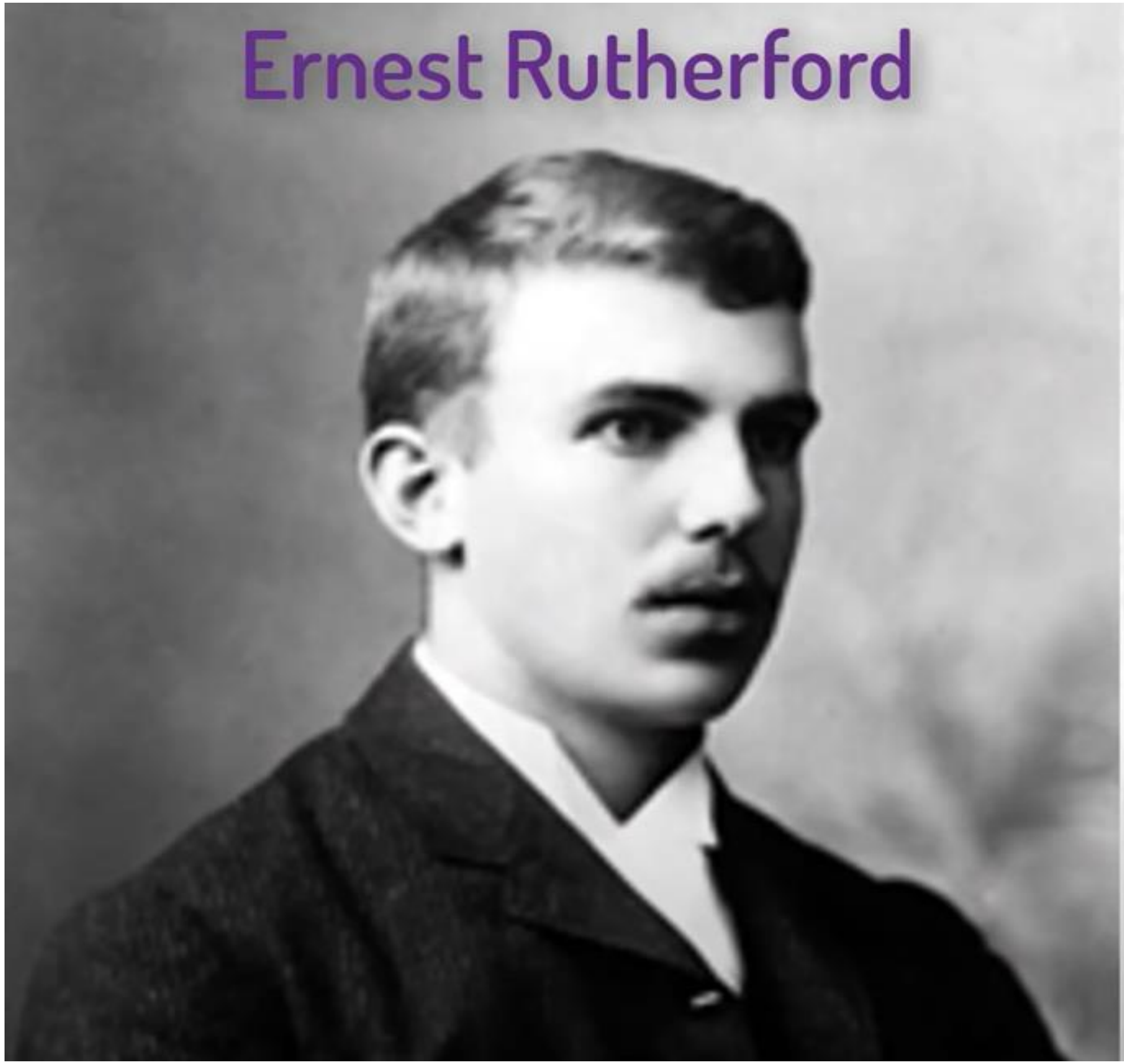
CHAPTER 2.

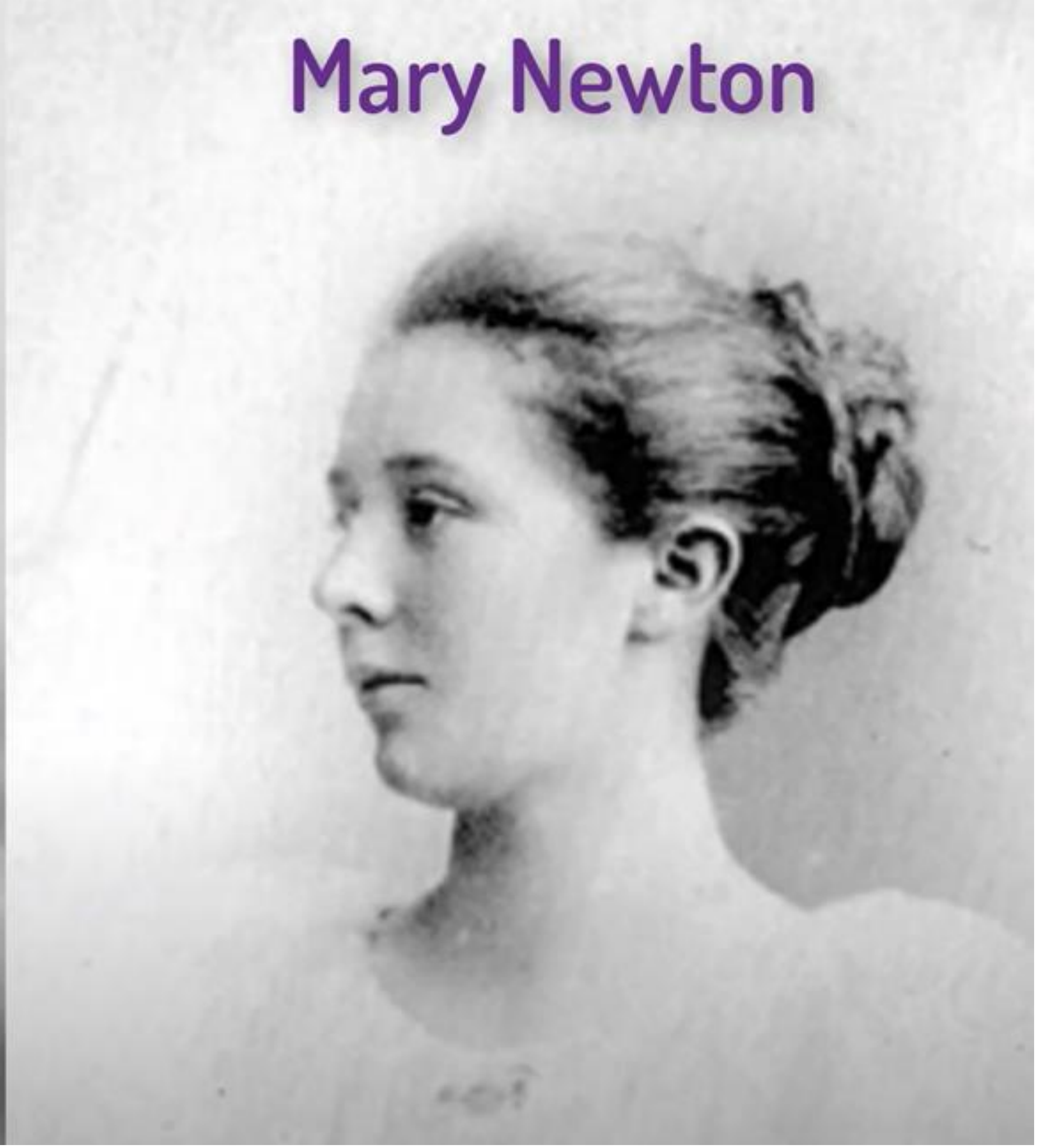
The Story of Discovering Alpha and Beta Rays



Krishnaraj Thadesar

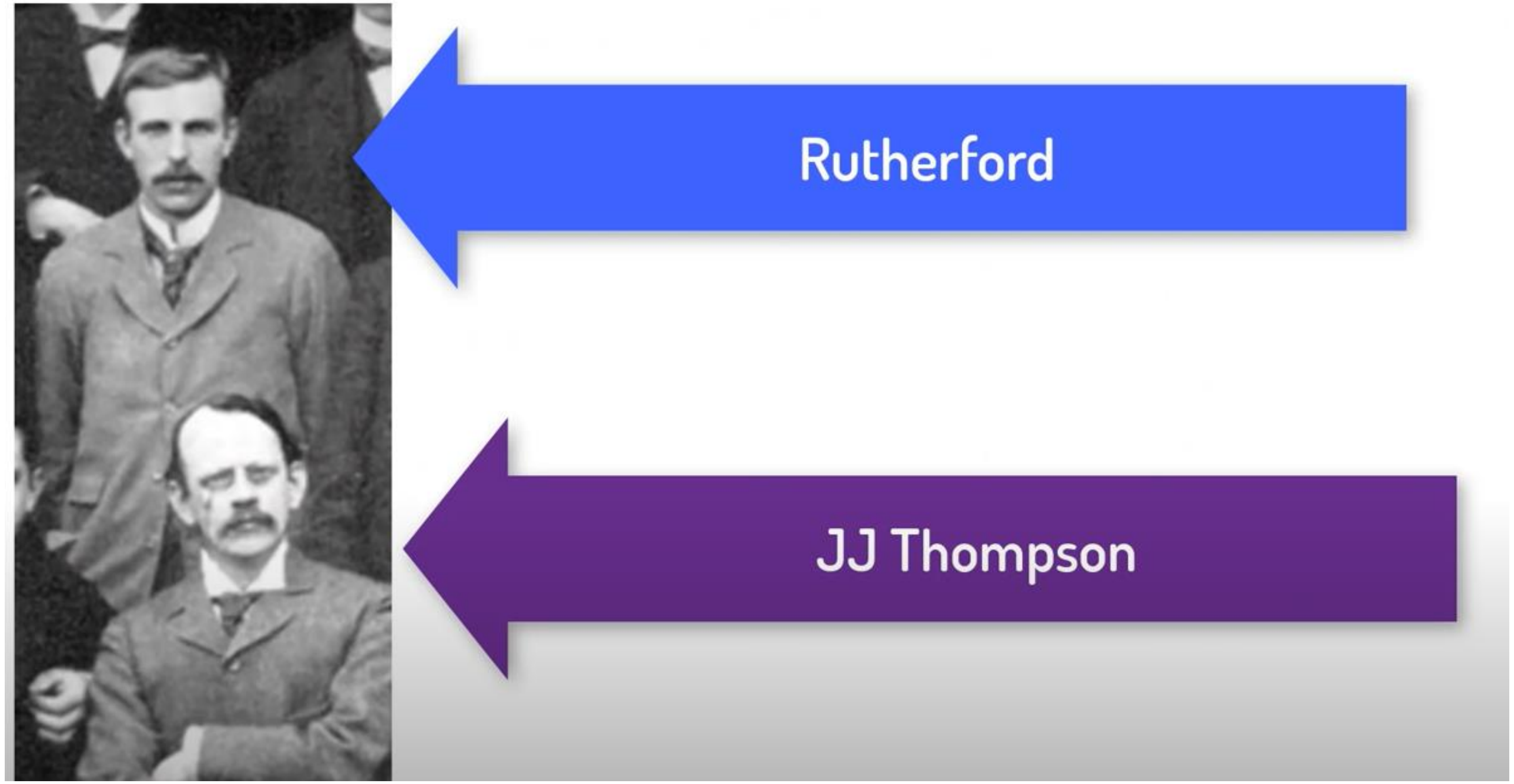
Statue of young Ernest Rutherford


Ernest Rutherford


Mary Newton

Ernest Rutherford
1895
"Winner" of Research
Fellowship from the
Royal Exhibition of 1851

JJ Asks him to Do some Research on X Rays's Effect on Gases



PHYSIQUE. — *Sur les radiations émises par phosphorescence.* Note de M. HENRI BECQUEREL.

On the invisible rays emitted by phosphorescent bodies.

[read before the French Academy of Science 2 March 1896 (*Comptes Rendus* **122**, 5

In the previous session, I summarized the experiments which I had been led to make
bodies, rays which pass through various bodies that are opaque to light.

I was able to extend these observations, and although I intend to continue and to ela
announce as early as today the first results I obtained.

The experiments which I shall report were done with the rays emitted by crystalline
substance whose phosphorescence is very vivid and persists for less than 1/100th of
have been studied previously by my father, and in the meantime I have had occasion
manifest.

One can confirm very simply that the rays emitted by this substance, when it is expo
black paper but also various metals, for example a plate of aluminum and a thin she


Marie Sklodowska
Curie

Pitchblende Ore

Rutherford Thinks to Try the Effect of These Uranium Rays on Gas instead of X rays

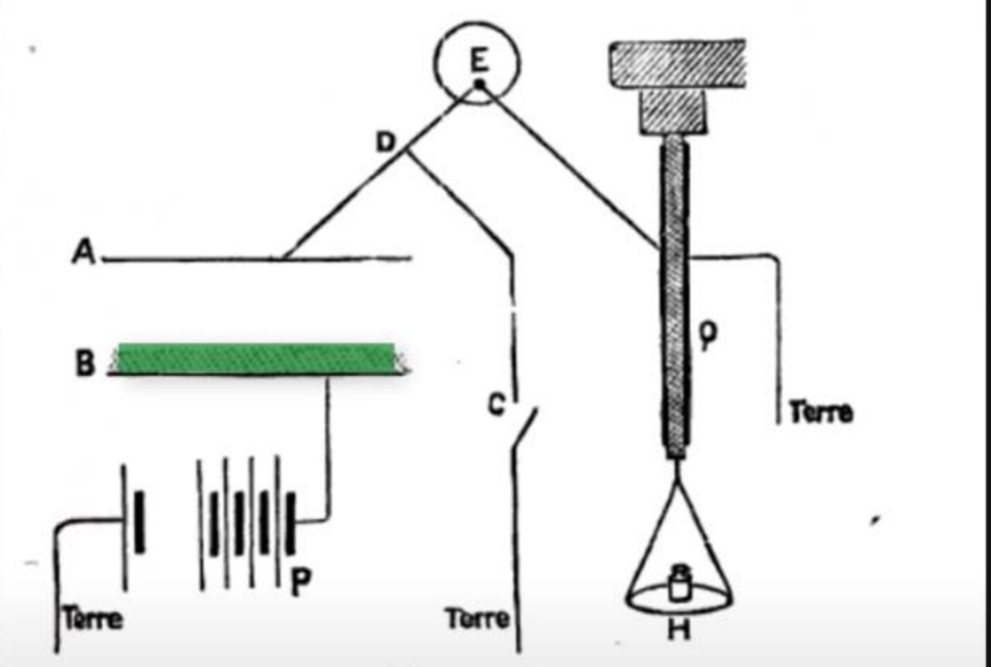


FIG. I.

Curie's Method

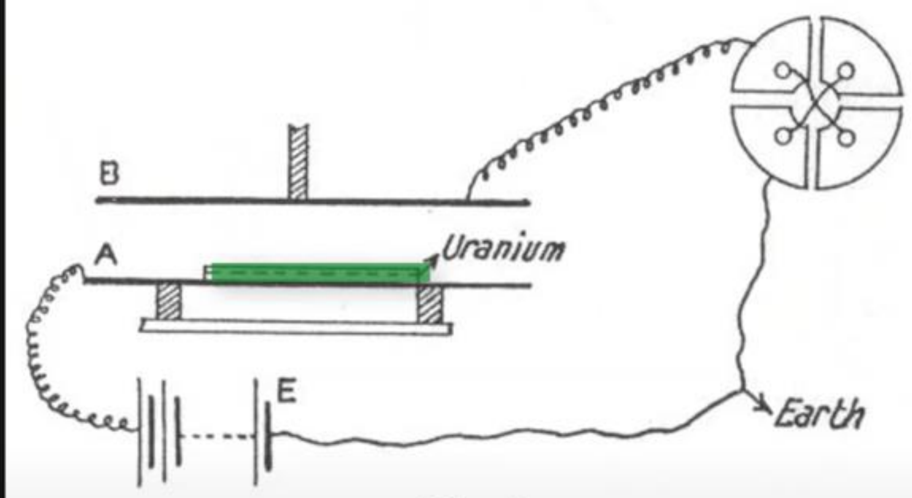
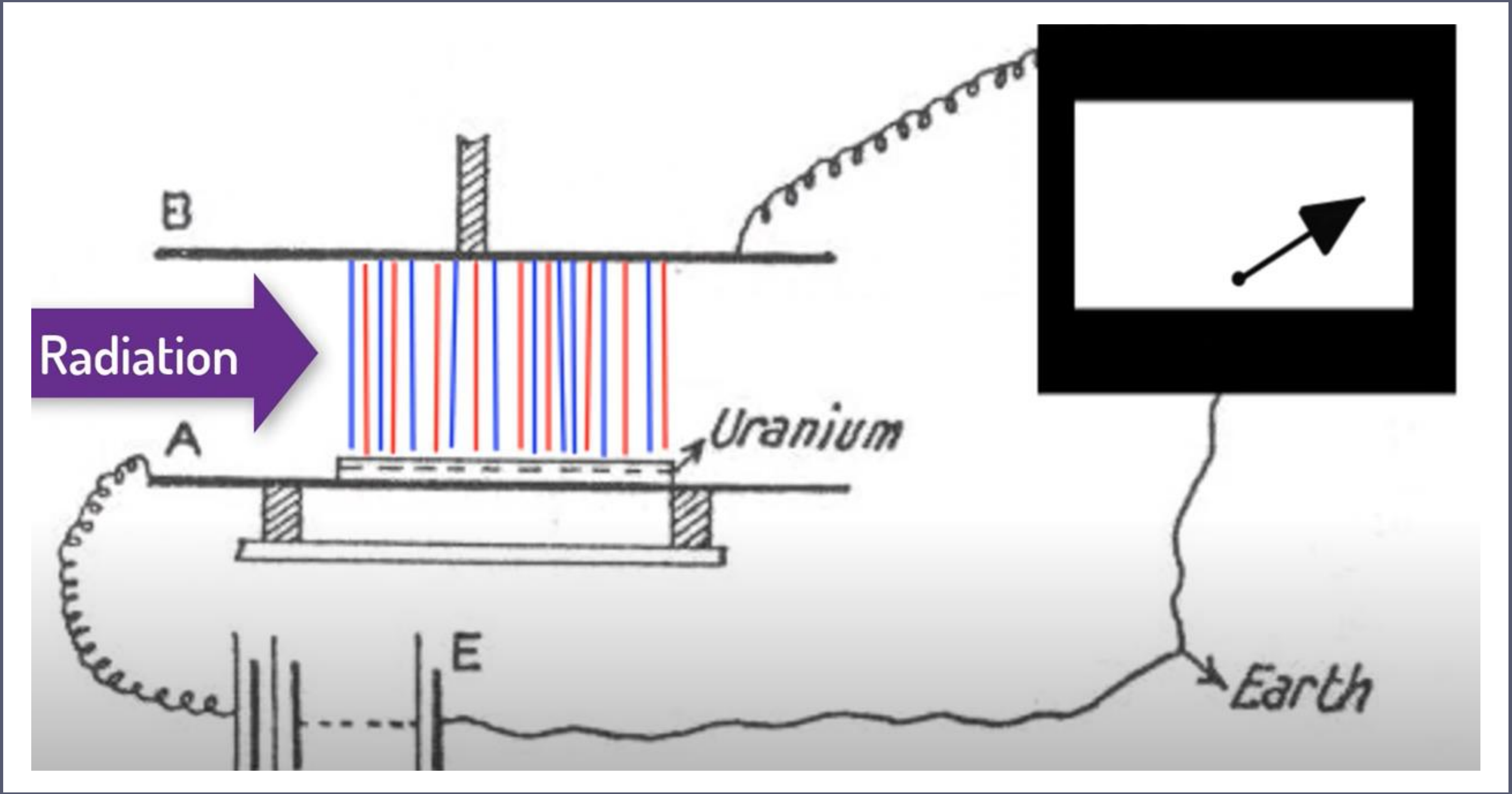
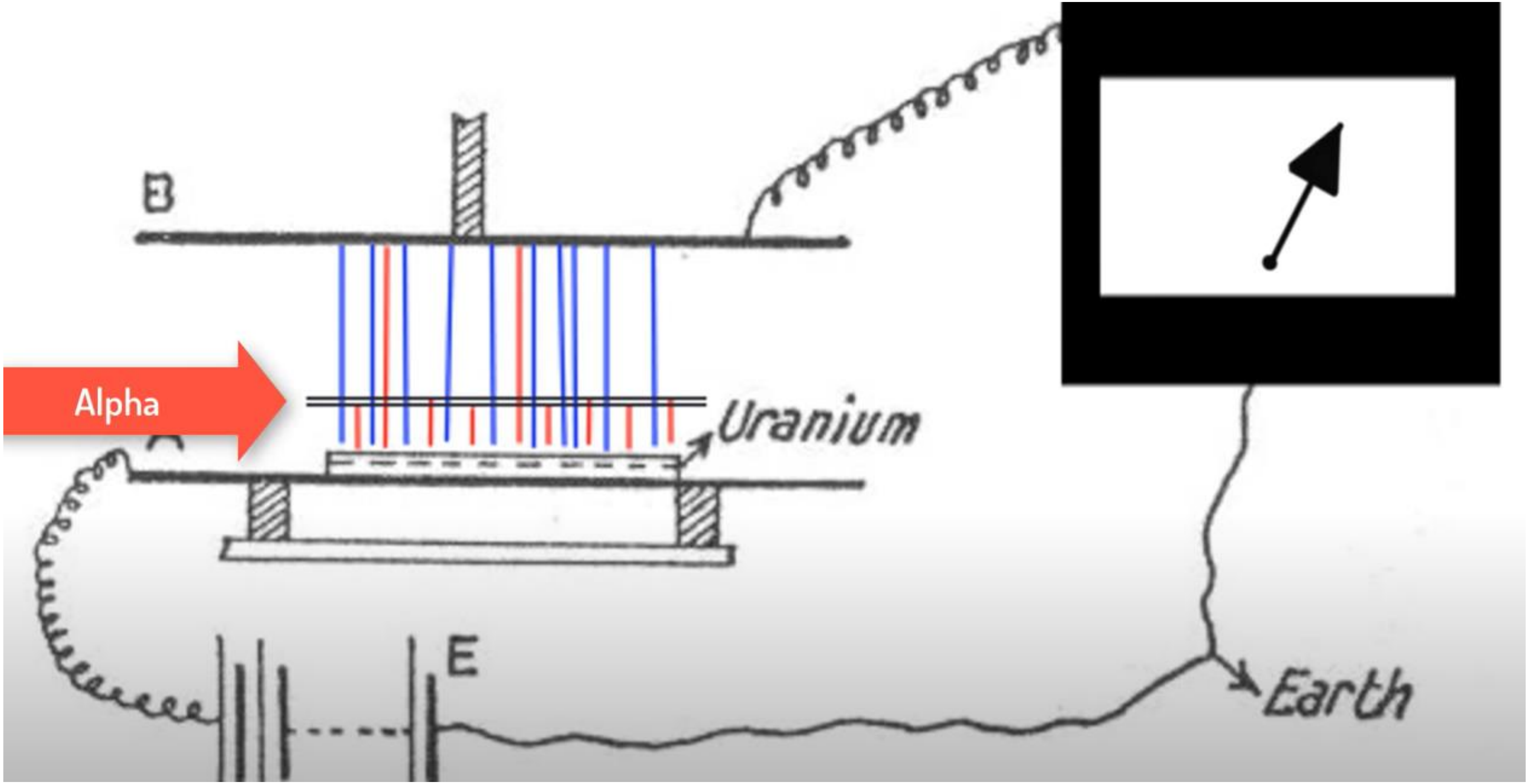


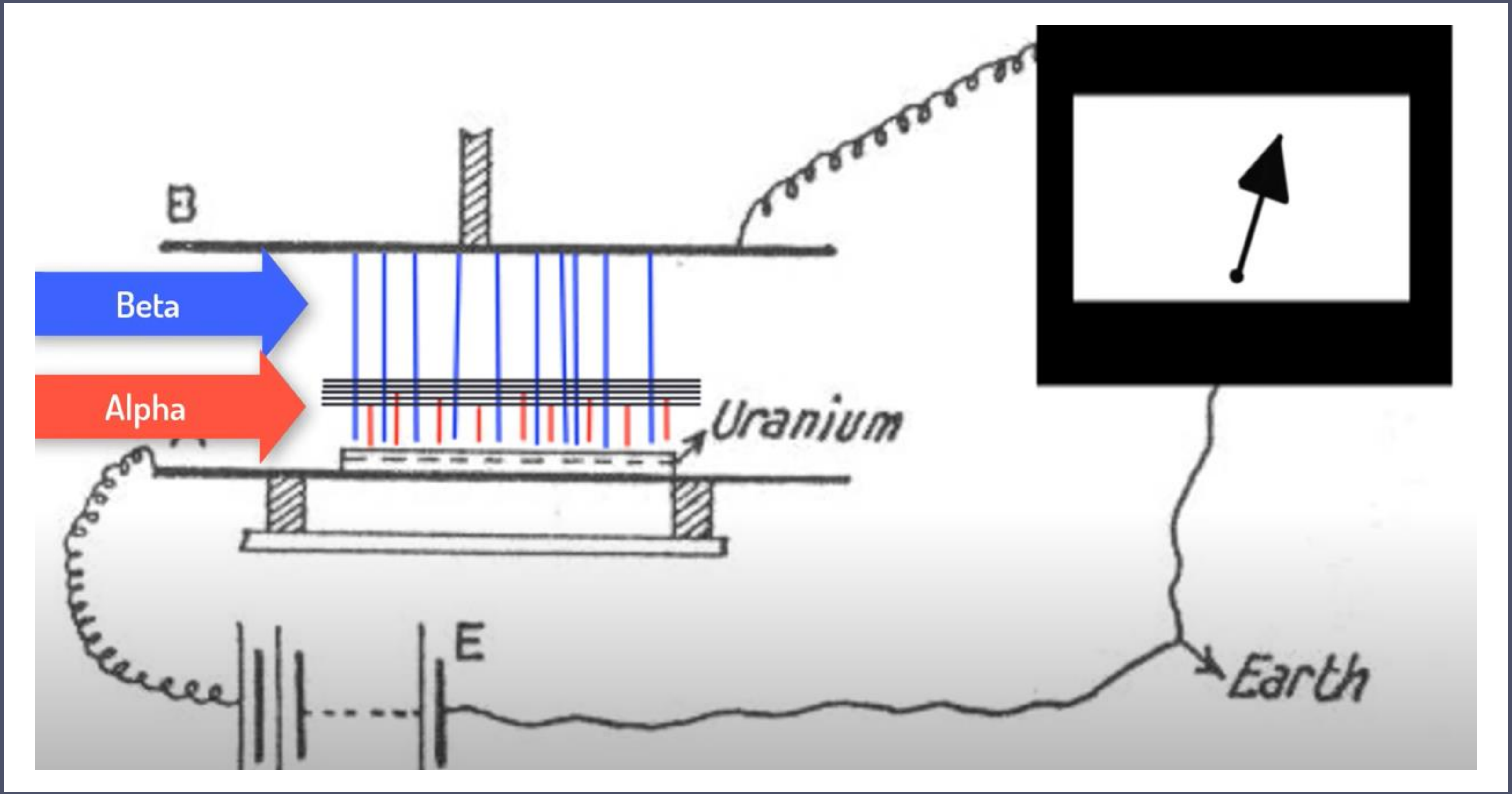
Fig. 1

Rutherford's Method

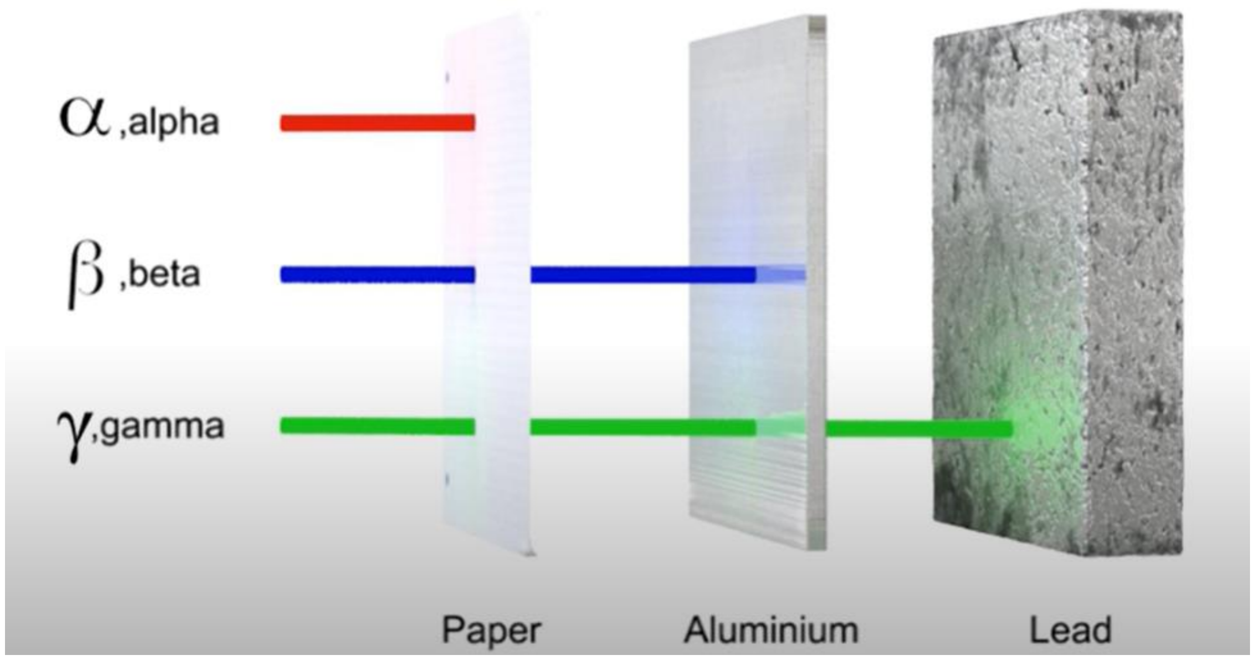

B
Radiation
A
Uranium
E
Earth



B
Alpha
A
Uranium
E
Earth


B
Beta
Alpha
Uranium
E
Earth

Radiation Rays

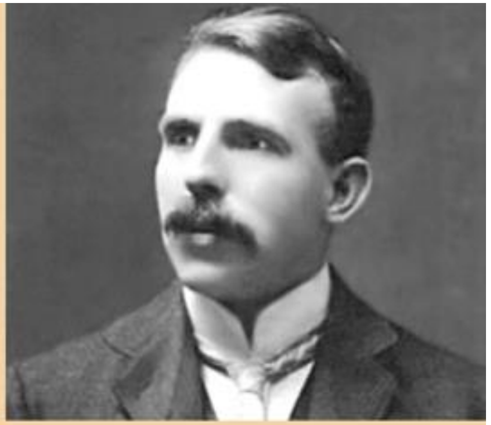


VIII. *Uranium Radiation and the Electrical Conduction produced by it.* By E. RUTHERFORD, *M.A.*, *B.Sc.*, *formerly 1851 Science Scholar, Coutts Trotter Student, Trinity College, Cambridge; McDonald Professor of Physics, McGill University, Montreal**.

These experiments show that the **uranium radiation is complex, and that there are present at least two distinct types of radiation—one that is very readily absorbed, which will be termed for convenience the α radiation, and the other of a more penetrative character, which will be termed the β radiation.**

γ rays .... 8 cms.

In this paper an account will be given of some experiments which show that the α rays are deviable by a strong magnetic and electric field. The deviation is in the opposite sense to that of the cathode rays, so that the radiations must consist of positively charged bodies projected with great velocity. In a previous paper* I have given an account of the indirect experimental evidence in support of the view that the α rays consist of projected charged particles. Preliminary experiments undertaken to settle this question during the past two years gave negative results. The magnetic deviation, even in a strong magnetic field, is so small that very special methods are necessary to detect and measure it. The smallness of the magnetic deviation of the α rays, compared with that of the cathode rays in a vacuum-tube, may be judged from the fact that the α rays, projected at right angles to a magnetic field of strength 10,000 C.G.S. units, describe the arc of a circle of radius about 39 cms., while under the same conditions



Complex Nature of the Radiation.

The researches of various physicists (MM. Becquerel, Meyer and von Schweidler, Giesel, Villard, Rutherford, M. and Mdme. Curie) have proved the complex nature of the radiation of radio-active bodies. It will be convenient to specify three kinds of rays, which I shall denote, according to the notation adopted by Mr. Rutherford, by the letters α, β, γ.

I. The α-rays are very slightly penetrating, and appear to constitute the principal part of the radiation. These rays are characterised by the laws by which they are absorbed by matter. The magnetic field acts very slightly upon them, and they were formerly thought to be quite unaffected by the action of this field. However, in a strong magnetic field, the α-rays are slightly deflected

II. The β-rays are less absorbable as a whole than the preceding ones. They are deflected by a magnetic field in the same manner and direction as cathode rays.

III. The γ-rays are penetrating rays, unaffected by the

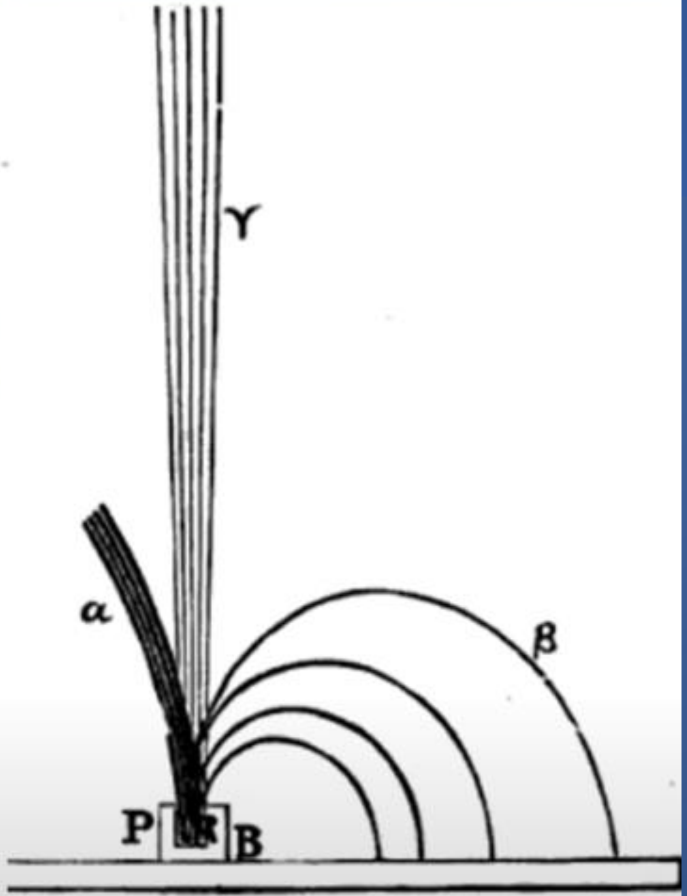
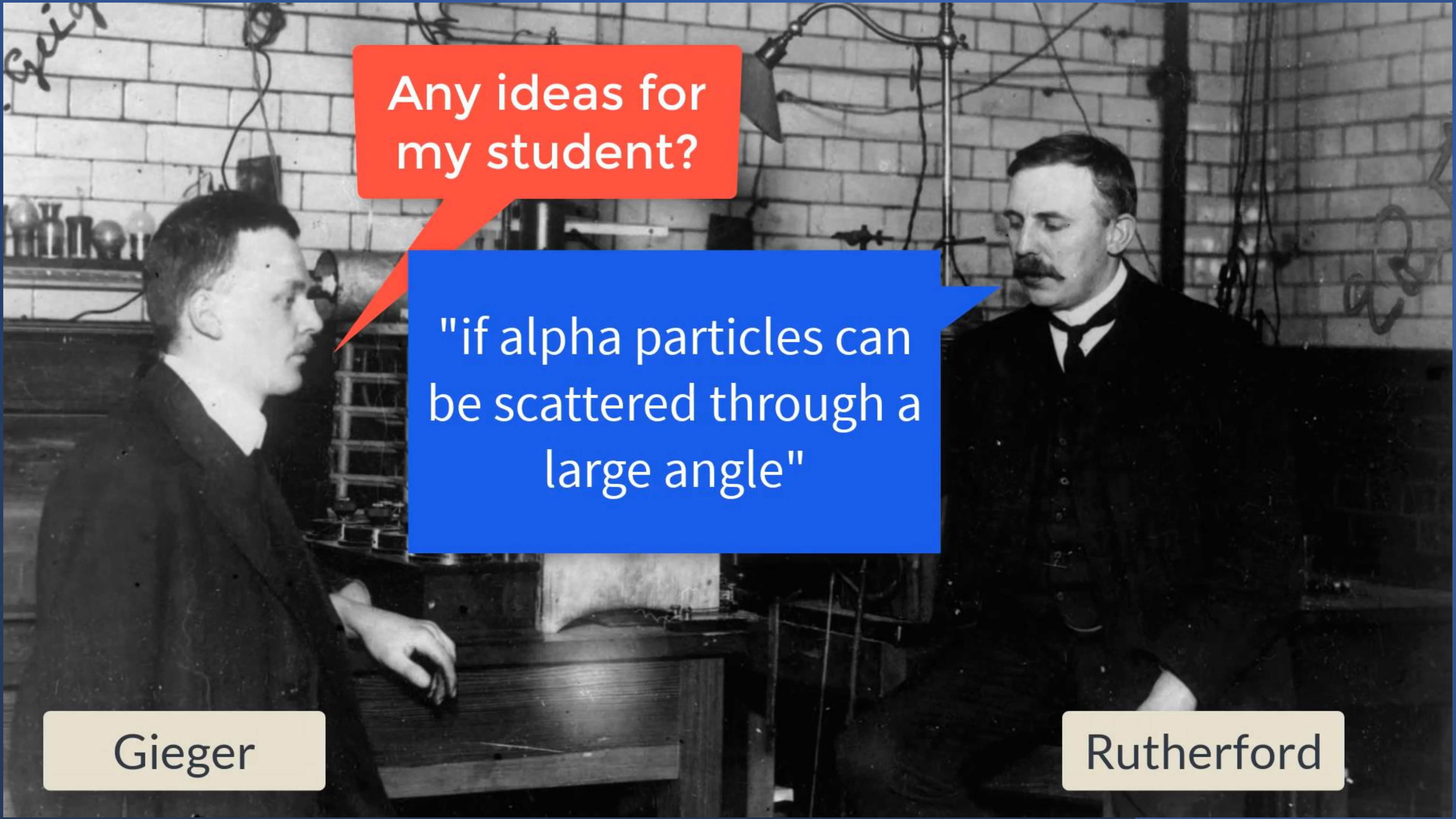
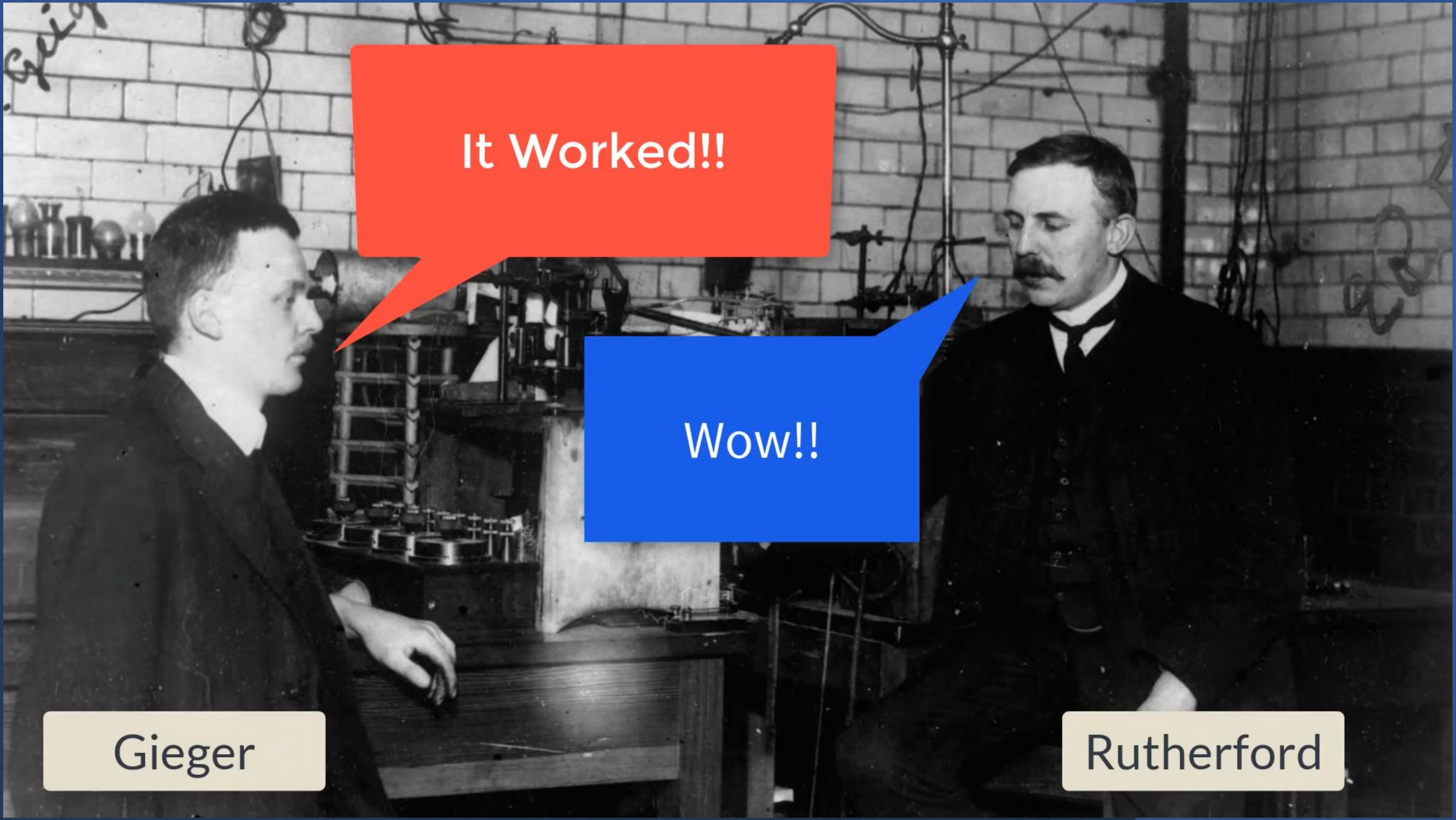
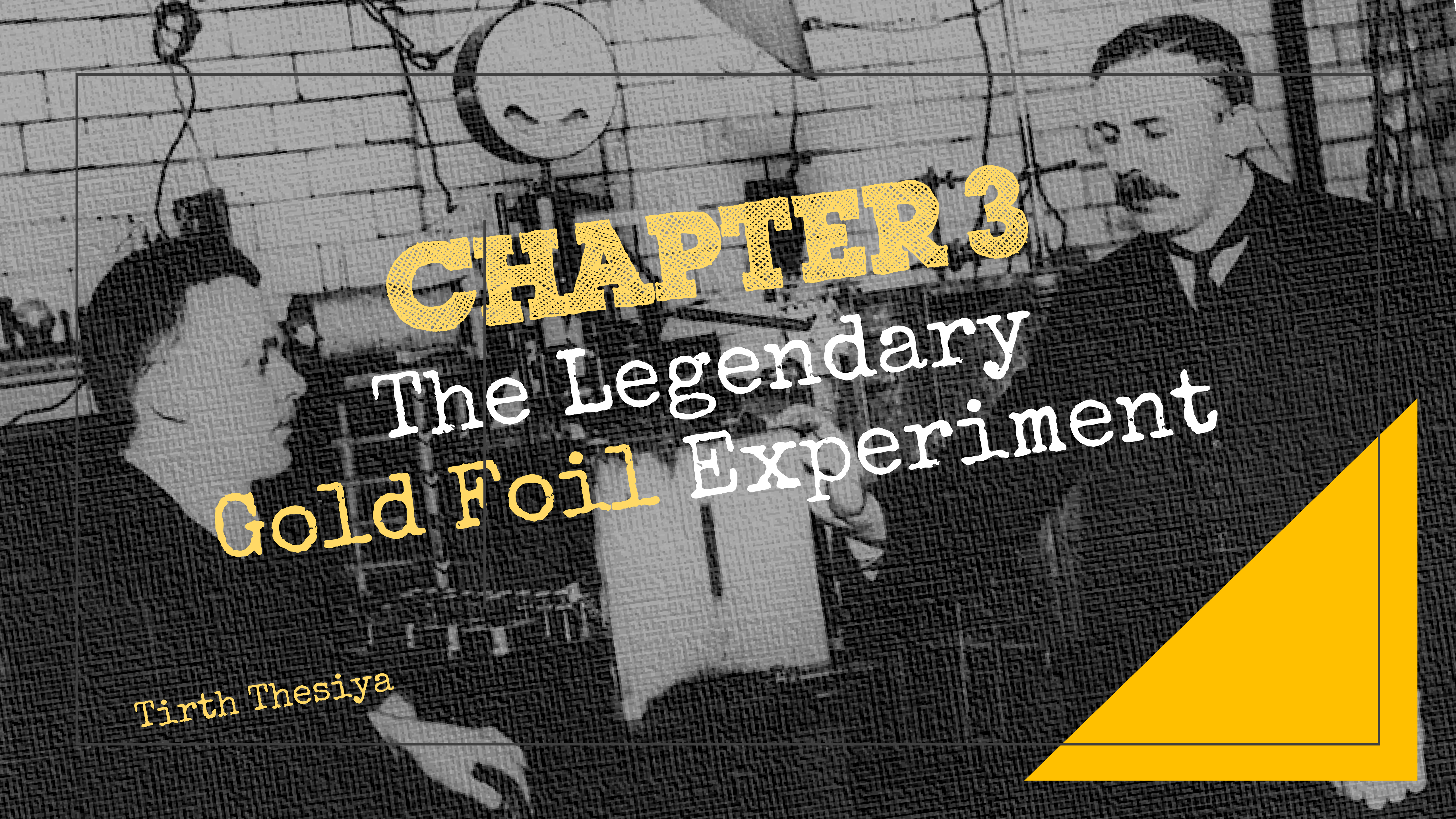


FIG. 4.


Any ideas for my student?
"if alpha particles can be scattered through a large angle"
Gieger
Rutherford


It Worked!!
Wow!!
Gieger
Rutherford

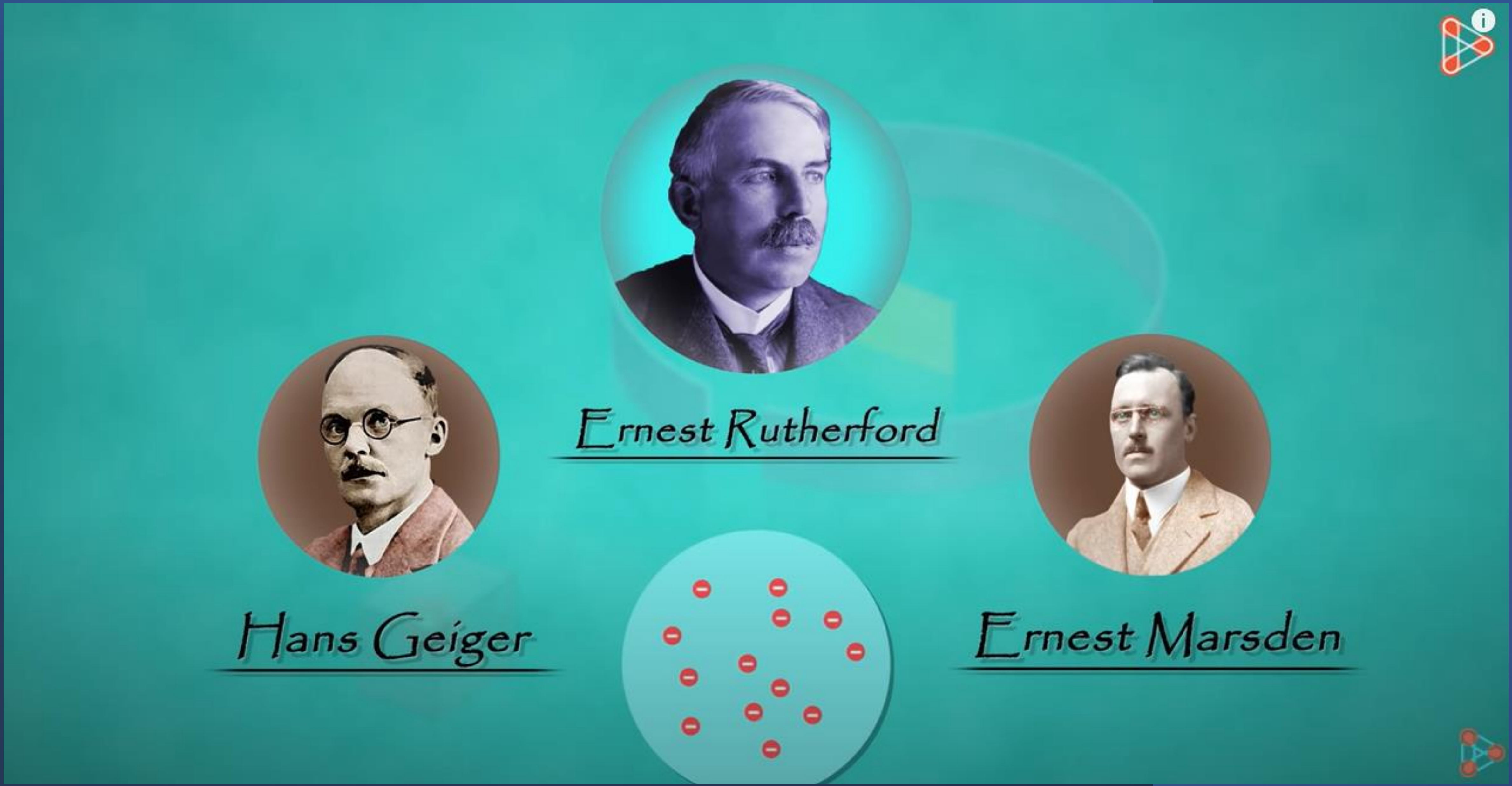
“Like Shooting a Bullet on A tissue Paper and Imagine that It reflects back from the Tissue and Hits you!”



CHAPTER 3

The Legendary Gold Foil Experiment

Tirth Thesiya


Ernest Rutherford
Hans Geiger
Ernest Marsden

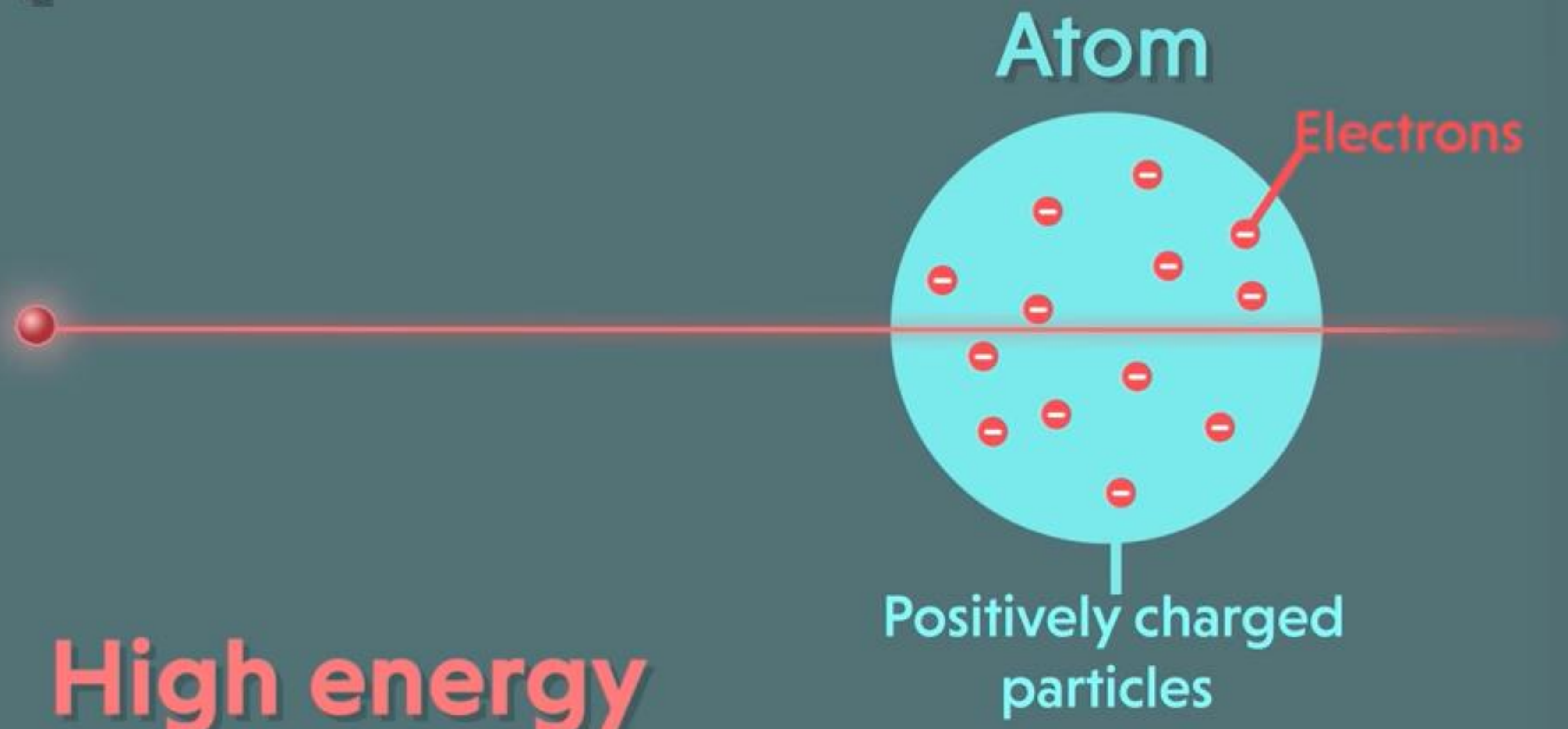
Rutherford's gold foil experiment

- In 1911, Rutherford and coworkers Hans Geiger and Ernest Marsden initiated a series of groundbreaking experiments that would completely change the accepted model of the atom.
- They bombarded very thin sheets of gold foil with fast moving alpha particles.
- Alpha particles, a type of natural radioactive particle, are positively charged particles with a mass about four times that of a hydrogen atom.

EXPECTED RESULT

According to the accepted atomic model of J.J. Thomson, in which an atom's mass and charge are uniformly distributed throughout the atom, the scientists expected that all of the alpha particles would pass through the gold foil with only a slight deflection or none at all.

Alpha Particles

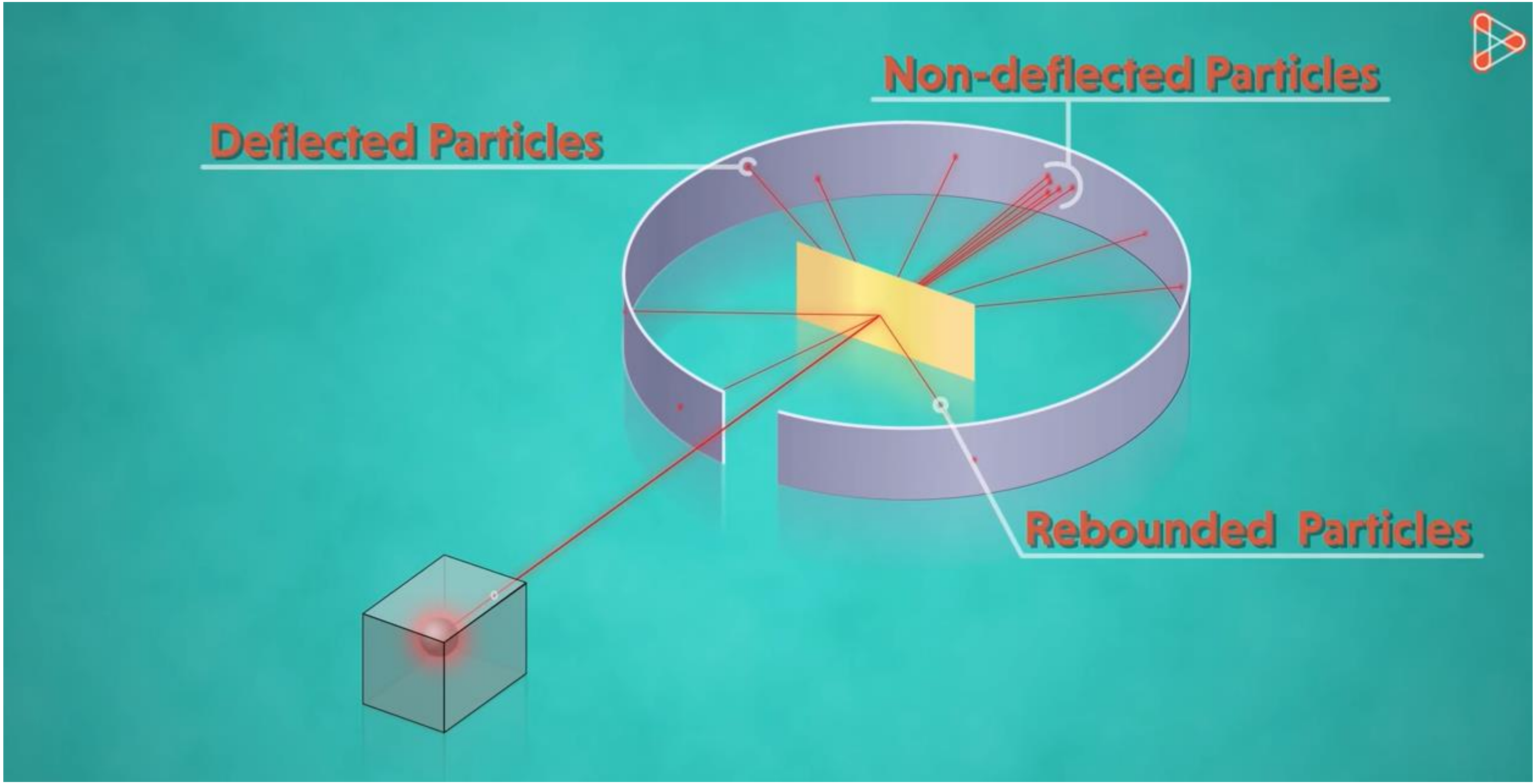


High energy

Heavier

OBSERVATIONS

- Most of the Alpha particles that bombarded the gold fell passed through without any deflection that shows that the nucleus is made up of a large empty space.
- Few of the Alpha particles that bombarded against the gold foil experienced a very minor deflection that shows that there is a presence of a counter positive charge.
- Still, some of the Alpha particles that bombarded against the gold foil deflected to a larger angle and some of them even bounced back showing that the positive charge is concentrated in a very small volume and its distribution is non-uniform.
- All the above points show that the volume occupied by positively charged particles in an atom is very small as compared to the total volume of the atom.


Non-deflected Particles
Deflected Particles
Rebounded Particles

EXPLAINING THE RESULTS

- Rutherford needed to come up with an entirely new model of the atom in order to explain his results. Because the vast majority of the alpha particles had passed through the gold, he reasoned that most of the atom was empty space. In contrast, the particles that were highly deflected must have experienced a tremendously powerful force within the atom.
- He concluded that all of the positive charge and the majority of the mass of the atom must be concentrated in a very small space in the atom's interior, which he called the nucleus. The nucleus is the tiny, dense, central core of the atom and is composed of protons and neutrons.

DRAWBACKS OF THIS MODEL

- This atomic model failed to explain the stability of atoms.
- According to the model, electrons revolve around the positively charged nucleus. It's not possible for the long run as we know atoms are stable while any particle in a circular orbit would undergo acceleration. During acceleration charged particles would radiate energy. Revolving electrons will lose energy and finally fall into the nucleus.
- This model of the atom also failed to explain the existence of definite lines in the hydrogen spectrum.

Video of the Experiment

CHAPTER 4.

MENTORS AND NOTABLE STUDENTS

Pranaav Suratwala

JJ THOMSON

After studying with J. J. Thomson at the Cavendish Laboratory at Cambridge University, Rutherford became a professor and chair of the Physics Department at McGill University in Montreal, Canada.

Sir Joseph John Thomson was a British physicist and Nobel Laureate in Physics, credited with the discovery of the *electron*, the first subatomic particle to be discovered and also credited with the discovery of *Isotopes*.

HIS STUDENTS

- James Chadwick
- John Cockcroft
- Ernest Walton
- Neils Bohr
- Otto Hahn

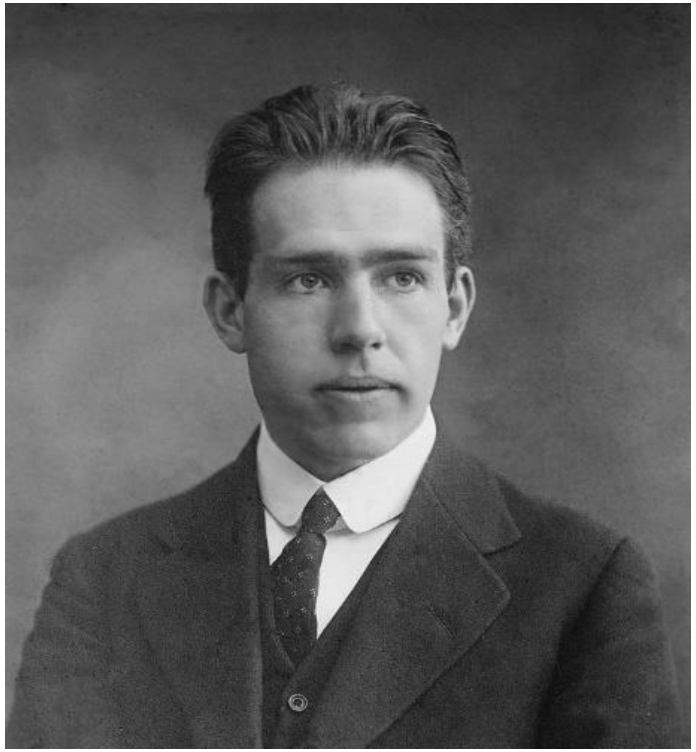
JAMES CHADWICK

James Chadwick as we know who helped discovered proton and theorized about existence of protons was a notable student of Ernest Rutherford.

JOHN COCKCROFT

Rutherford's speech touched on the 1932 work of his students John Cockcroft and Ernest Walton in "splitting" lithium into alpha particles by bombardment with protons from a particle accelerator they had constructed.

NEILS BOHR

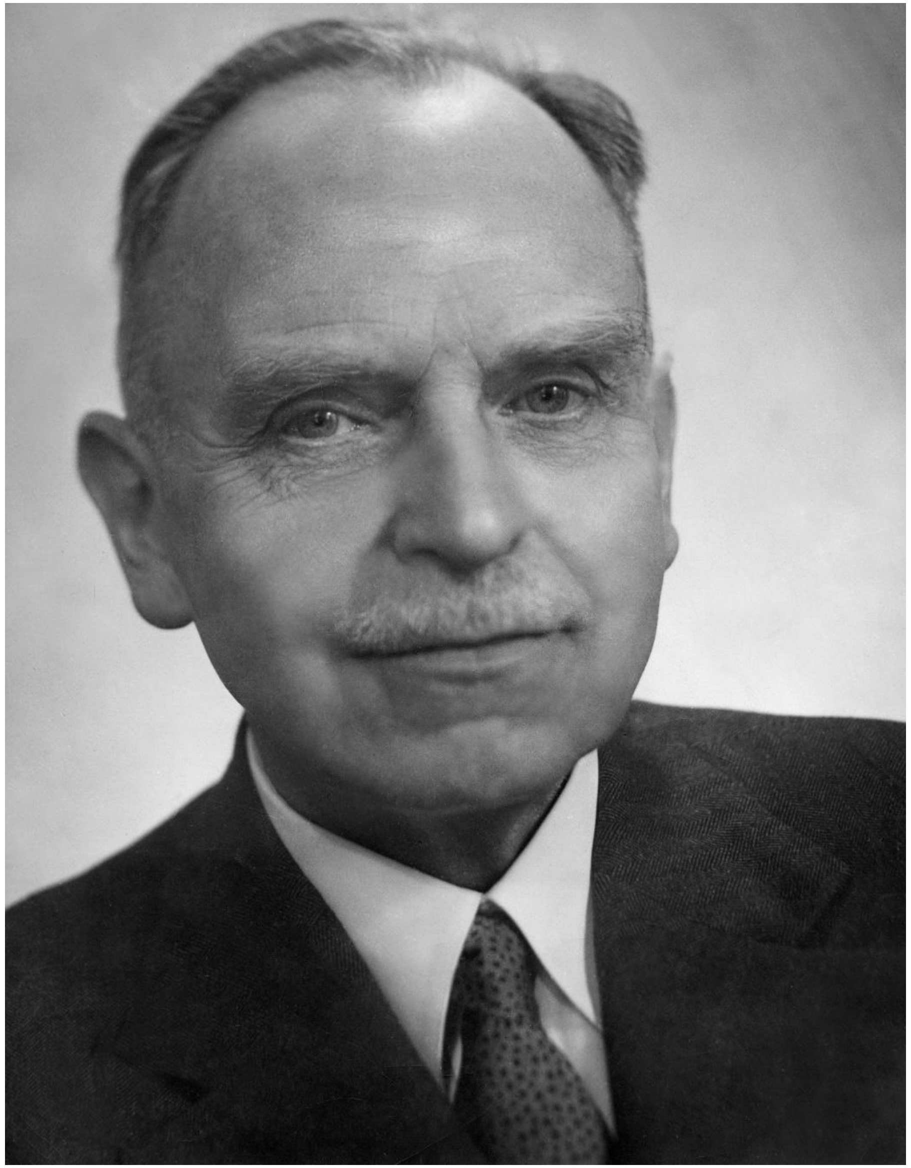


Rutherford had an enormous influence on the field of nuclear physics and **mentored** many future Nobel Prize winners and prominent scientists, including Niels Bohr and Otto Hahn.

Bohr was the first to discover *that electrons travel in separate orbits around the nucleus* and that *the number of electrons in the outer orbit determines the properties of an element.* The chemical element bohrium (Bh), No. 107 on the periodic table of elements, is named for him.

OTTO HAHN

Hahn discovered *the fission of uranium and thorium* in medium heavy atomic nuclei and his first work on these subjects appeared on 6th January and 10th February, 1939. He also discovered *Radioactive Elements*



Chapter 5.

CHEMICAL ACCOMPLISHMENTS & CONCLUSION

Devanshu Surana

AWARDS

AwardsRumford Medal (1904)	Nobel Prize in Chemistry (1908)	Barnard Medal (1910)	Elliott Cresson Medal (1910)	Associate of NSOS(1911)
Matteucci Medal (1913)	Hector Memorial Medal (1916)	Dalton Medal (1919)	Copley Medal (1922)	Franklin Medal (1924)
Albert Medal (1928)	Faraday Medal (1930)	Wilhelm Exner Medal (1936)	Faraday Lectureship Prize (1936)	

Chemical Accomplishments

A consummate experimentalist, Rutherford (1871–1937) was responsible for a remarkable series of discoveries in the fields of radioactivity and nuclear physics.

He discovered alpha and beta rays, set forth the laws of radioactive decay, and identified alpha particles as helium nuclei.

He discovered the Half Life of Radiation

Most important, he postulated the nuclear structure of the atom

Published more than 160 Papers in 30 Years

PREPARED BY :

54. Krishnaraj PT –
Presentation, Alpha and Beta Rays

56. Tirth Thesiya –
Gold Foil Experiment

45. Pranaav Suratwala –
Notable Mentors and Students

44. Devanshu Surana –
Chemical Accomplishments and Awards

21. Vedant Shirode –
Introduction

Thanks for Listening!