

A Brief History of

Atomic Theory



The man of science does not want to discover in order to know - he wants to know in order to discover.
- Alfred Whitehead

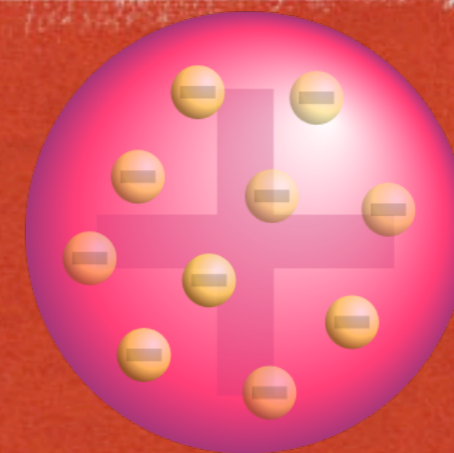
*2007 - Douglas Gilliland
Honors Physical Science @ Sarasota High*

Atomic Models

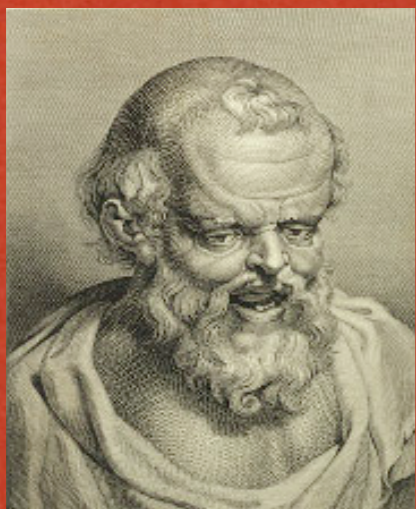
1897



JJ Thomson



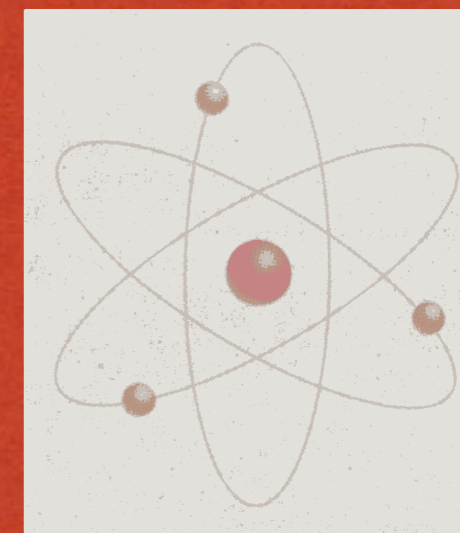
400BC



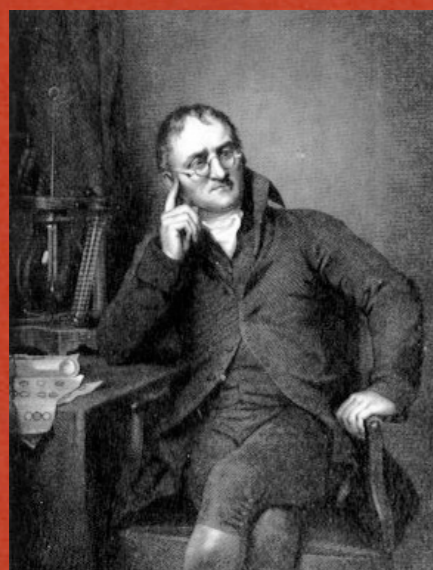
1907



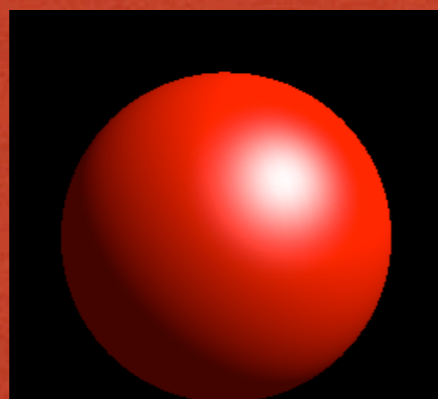
Rutherford



1809



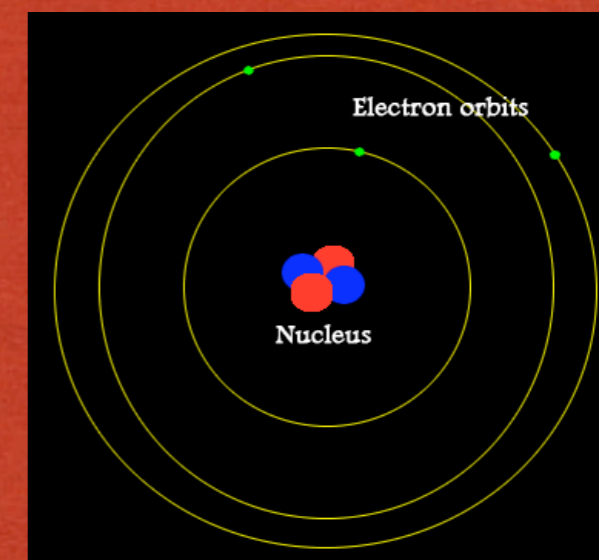
Dalton



1911

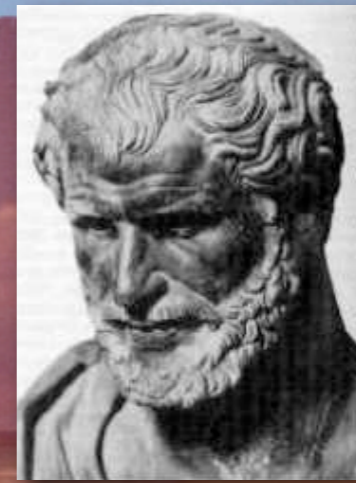


Bohr



DEMOCRITUS

460 - 370 BC



The Greek philosopher Democritus proposed that all matter was made of small, unbreakable particles he called atoms which means unbreakable. He believed that atoms were too small to be seen.

Philosophers are not scientists. They do not test their ideas.

Instead they use reasoning to back up their beliefs.

To them, human reasoning was superior to experimentation.

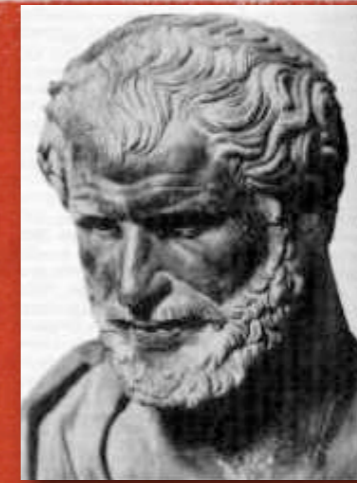
Democritus used an example of a beach to support his theory.

From afar, the beach appears to be a solid mass.

But up close one finds that a beach is made of small grains of sand too small to be seen from a distance.

DEMOCRITUS

460 - 370 BC



Democritus proposed that the shape of an atom determined the properties of that substance.

Fire atoms had sharp points.
This is the reason it hurt you if you put your hand in a fire.

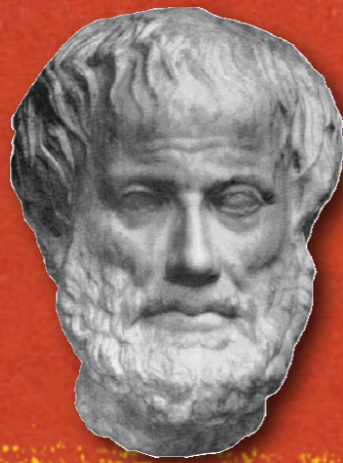


Wine atoms were spheres.
This is the reason that wine rolled around in a glass.



Clay atoms were jagged.
This is the reason why clay clumps together when it is molded.





ARISTOTOLE

The famous philosopher Aristotle, who also lived at that time, argued that all matter was made of only four elements.

For the next two thousand years, Aristotle overshadowed Democritus. Finally, in the early 1800s, the atomist's theory was revived by John Dalton.



EARTH



WATER



AIR



FIRE

JOHN DALTON

1766-1844

Nationality: English

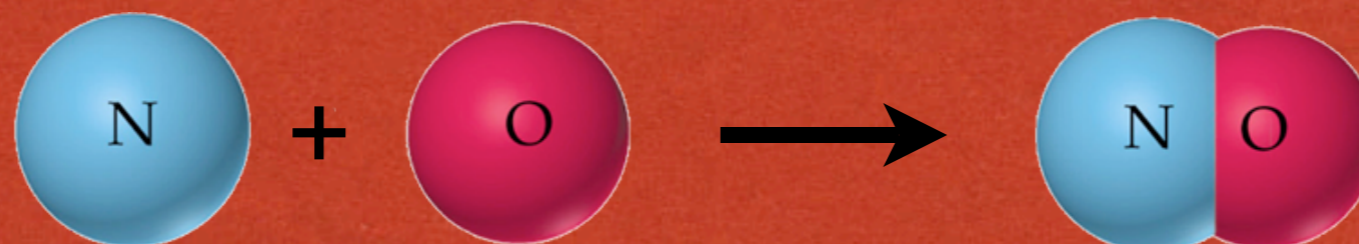


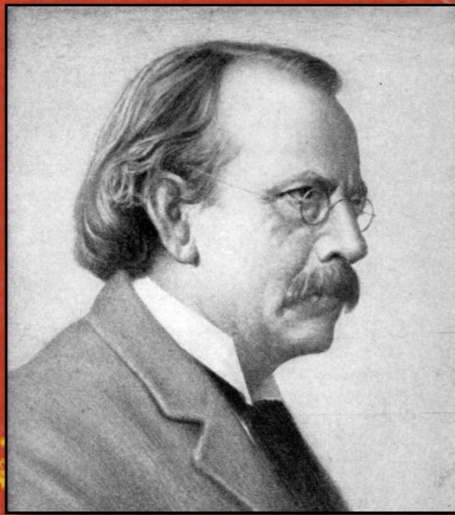
In 1809, Dalton by proposing the following:

- All matter was made of atoms.
- Atoms were solid spheres.
- Atoms of different elements differed in mass.



- Atoms were indivisible and indestructible.
- Atoms combine to form compounds.





J.J. THOMSON

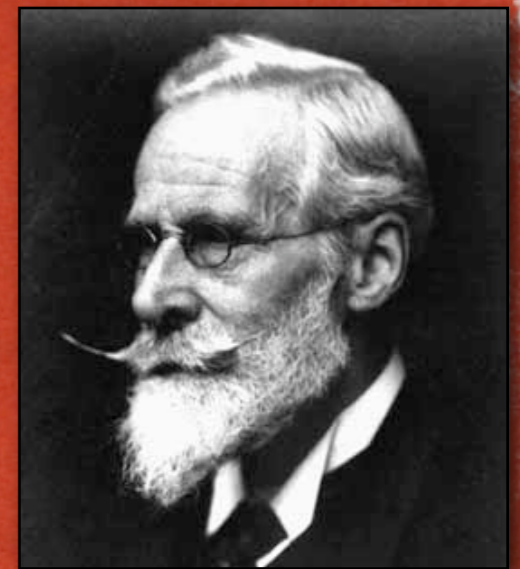
1856-1940

Nationality: English

The son of an English bookseller, Joseph John Thomson dreamed of being an engineer. At 14 he entered college but his father's early death made it impossible for him to pay the extra engineering fees so he changed his major to physics. Just as he graduated another Englishman made a discovery that would alter JJ's life forever.

In 1875 Sir William Crookes constructed a glass tube with two metal plates inside it. He removed almost all the air from the tube and sealed it.

When he connected the plates to the + and - terminals of a high voltage battery he observed a mysterious glowing ray. From experiments he was able to prove the ray was matter,



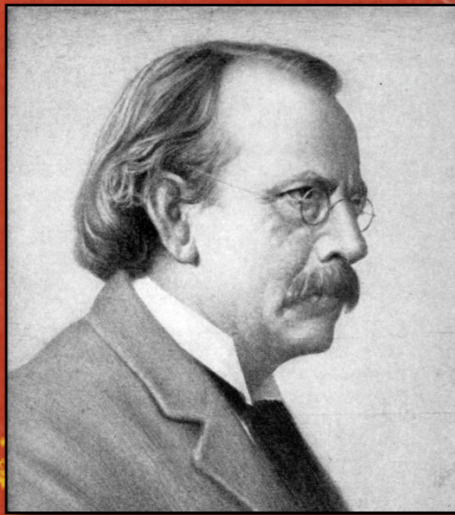
Sir William Crookes

THE CROOKE'S TUBE

This is the instrument that Mr. Gilliland demonstrated to the class in the lab during this presentation.

When connect to a high voltage current it produced a blue ray. Crooke found that this ray consisted of matter.





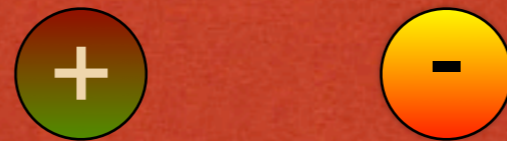
J.J. THOMSON

1856-1940

Nationality: English

Before you can understand Thomson's experiment, you need to understand 3 properties about electrical charges:

a) There are two types of electrical charge: positive and negative.

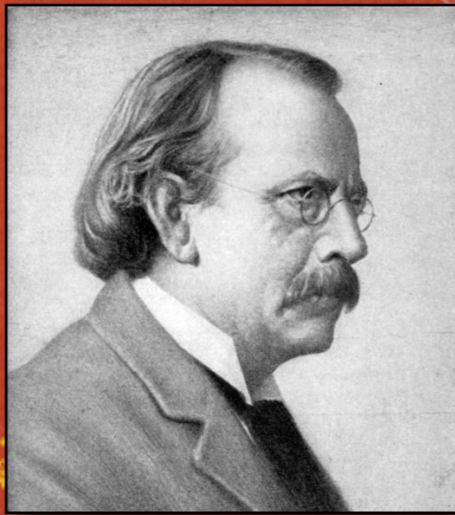


b) Opposite charges attract.



c) Like charges repel.





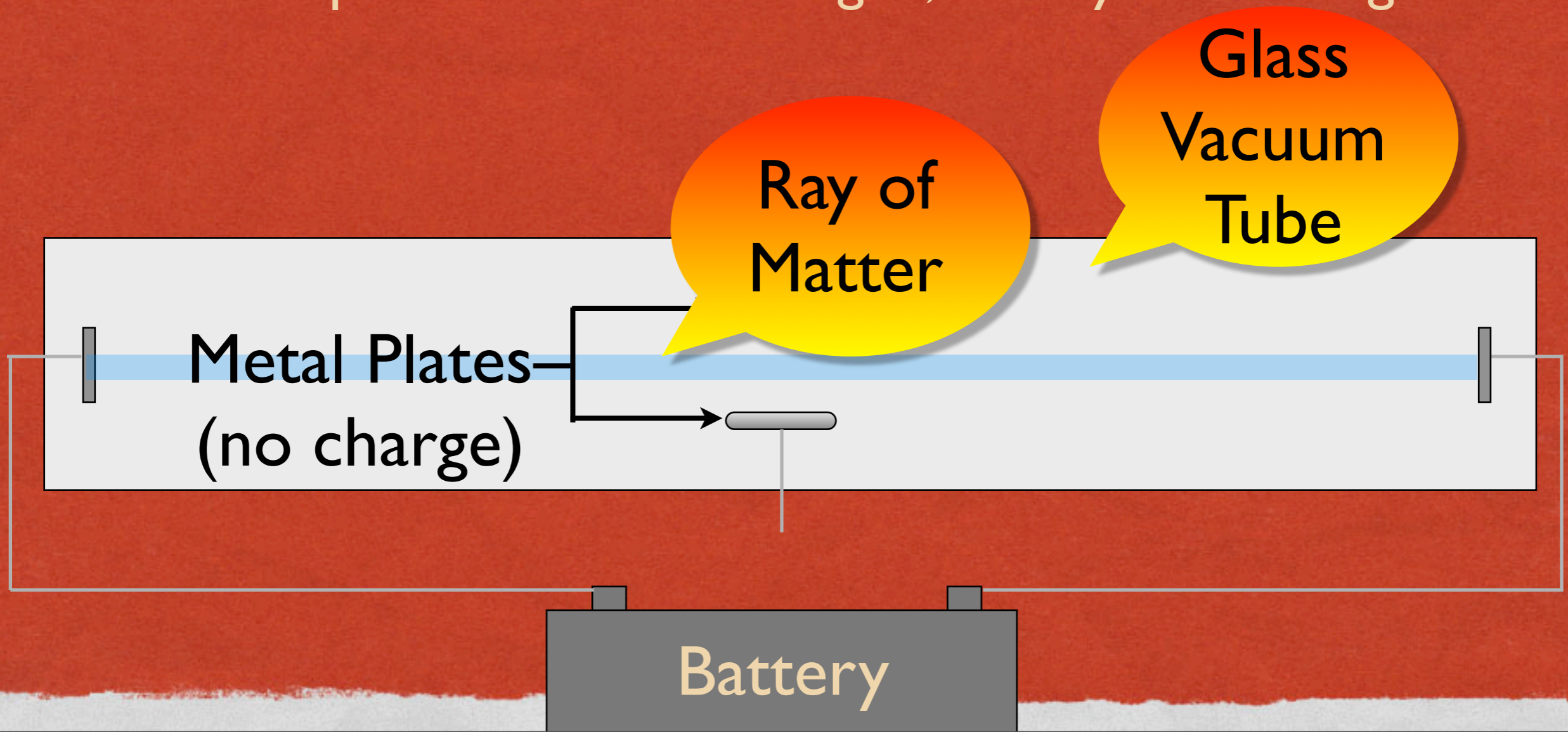
J.J. THOMSON

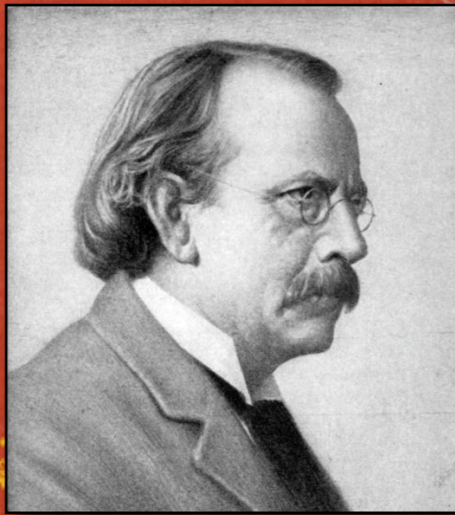
1856-1940

Nationality: English

Thomson took Crooke's tube and added two plates inside the tube and connected them with a wire.

When the plates were not charged, the ray shot straight.



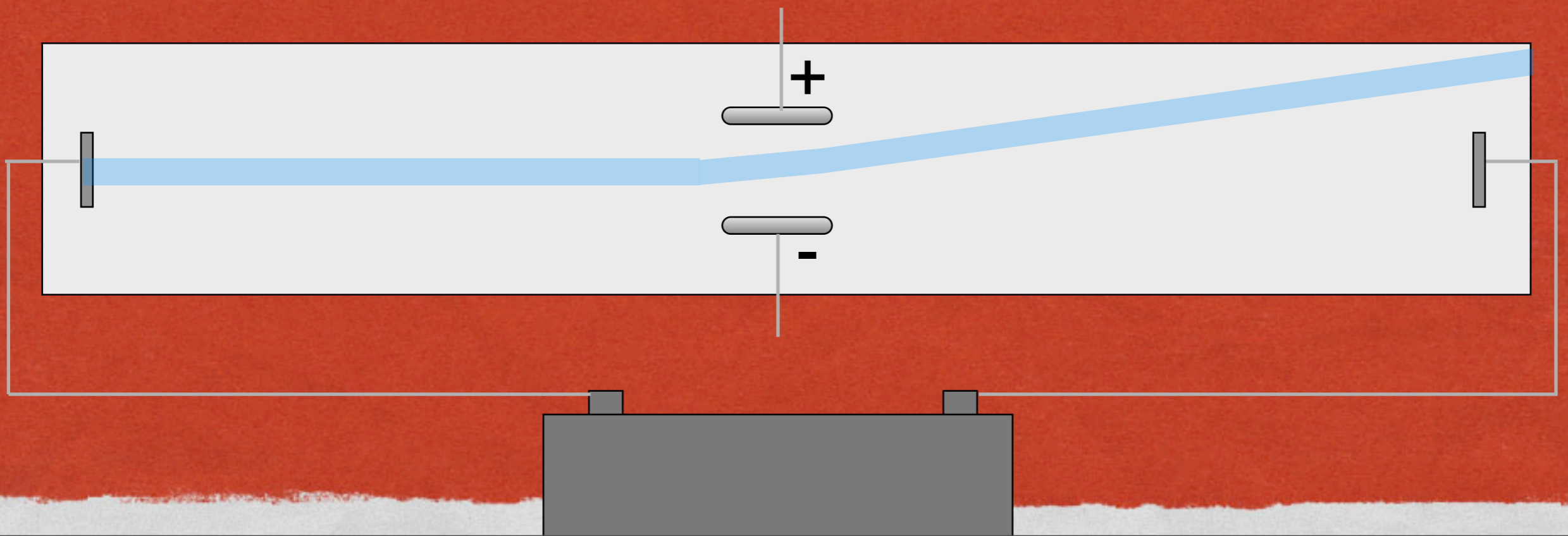


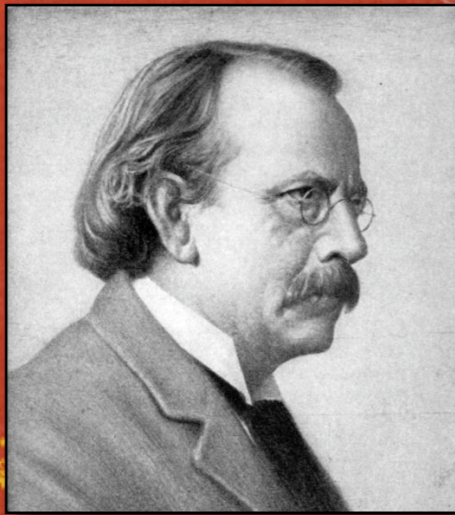
J.J. THOMSON

1856-1940

Nationality: English

But when he charged the plates a strange thing happened!



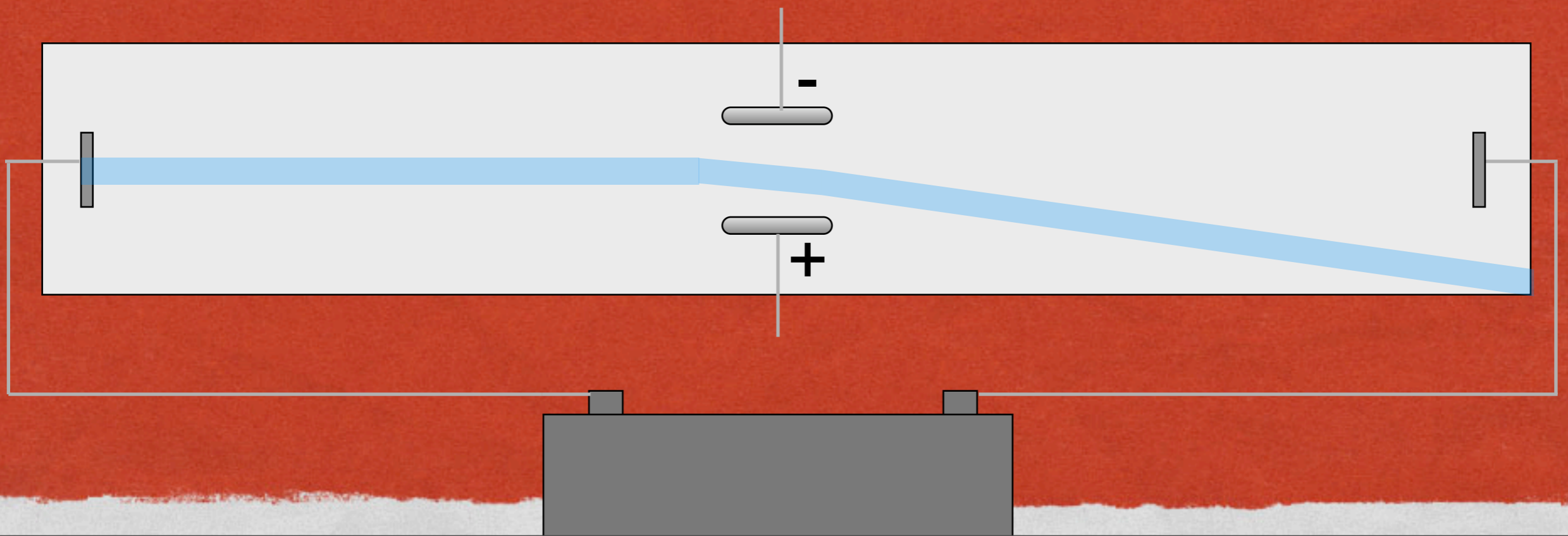


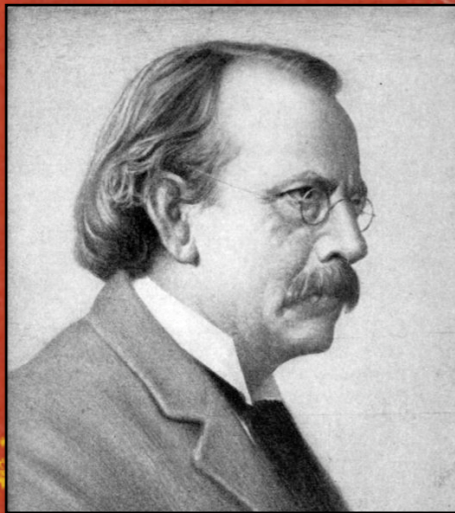
J.J. THOMSON

1856-1940

Nationality: English

When he reversed the charges on the plates he observed the ray reversed its position.





J.J. THOMSON

1856-1940

Nationality: English

From his observations Thomson concluded that, because the ray was always attracted to the + plate and repelled by the - , it was composed of negatively charged matter.

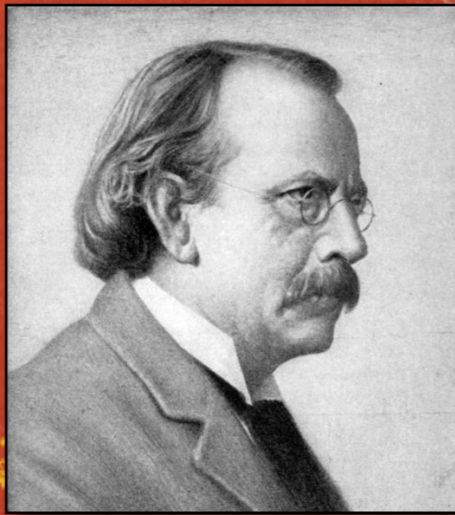
One hundred years earlier, Dalton had proposed that atoms were neutral, solid spheres.

Thomson's experiment disproved Dalton's theory.

Thomson and other scientists knew that all atoms are neutral. His new model proposed that matter was made of atoms with negatively charged particles embedded in a positive cloud.

He called these negative particles "electrons".

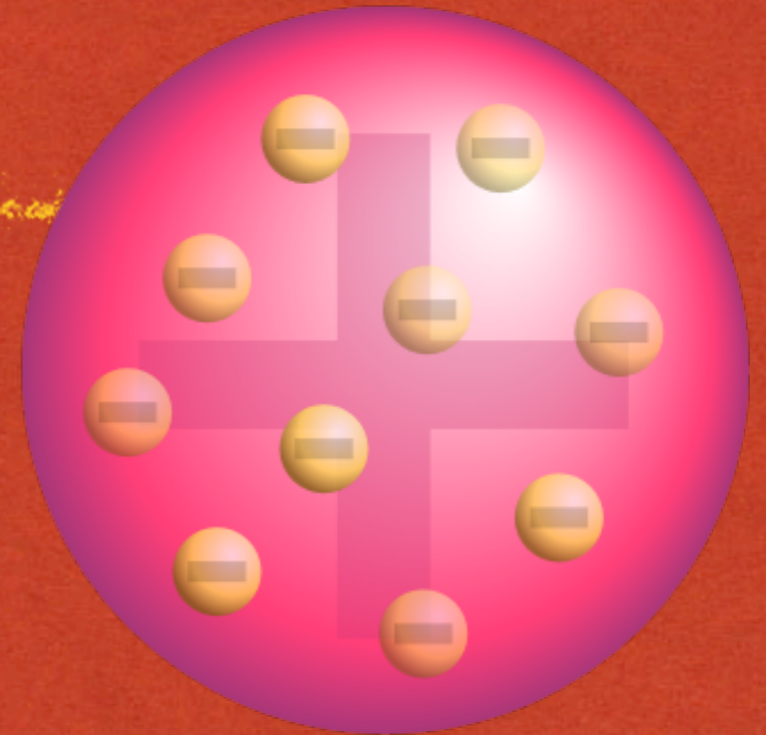
The negative particles and positive cloud neutralized each other so the atom had an overall neutral charge.



J.J. THOMSON

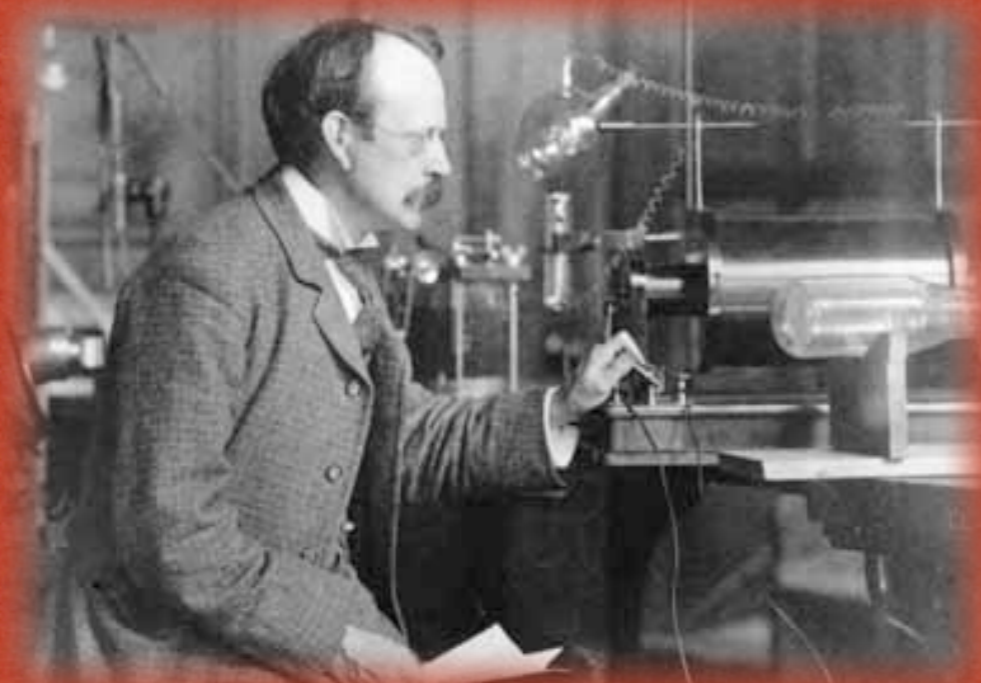
1856-1940

Nationality: English



Thomson's model was called the *Plum Pudding Model* was named after a popular dessert in England at that time. It was the first model to propose that smaller charged particles make up the atom.

Plum Pudding Model, 1897



JJ Thomson with his cathode ray tube

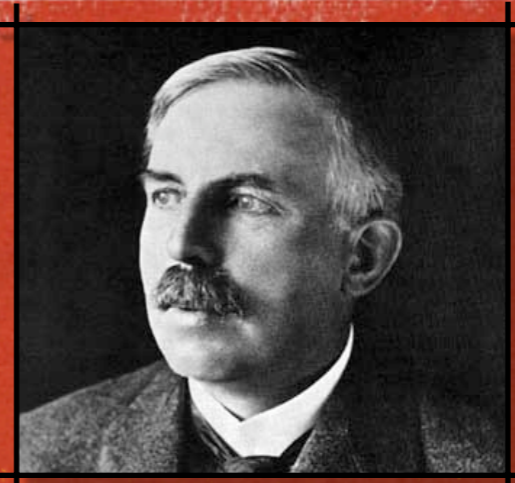
Thomson's model lasted less than two decades but it was first to propose the existence of subatomic particles.

In 1911 another scientist who worked in Thomson's lab improved on his atomic model.

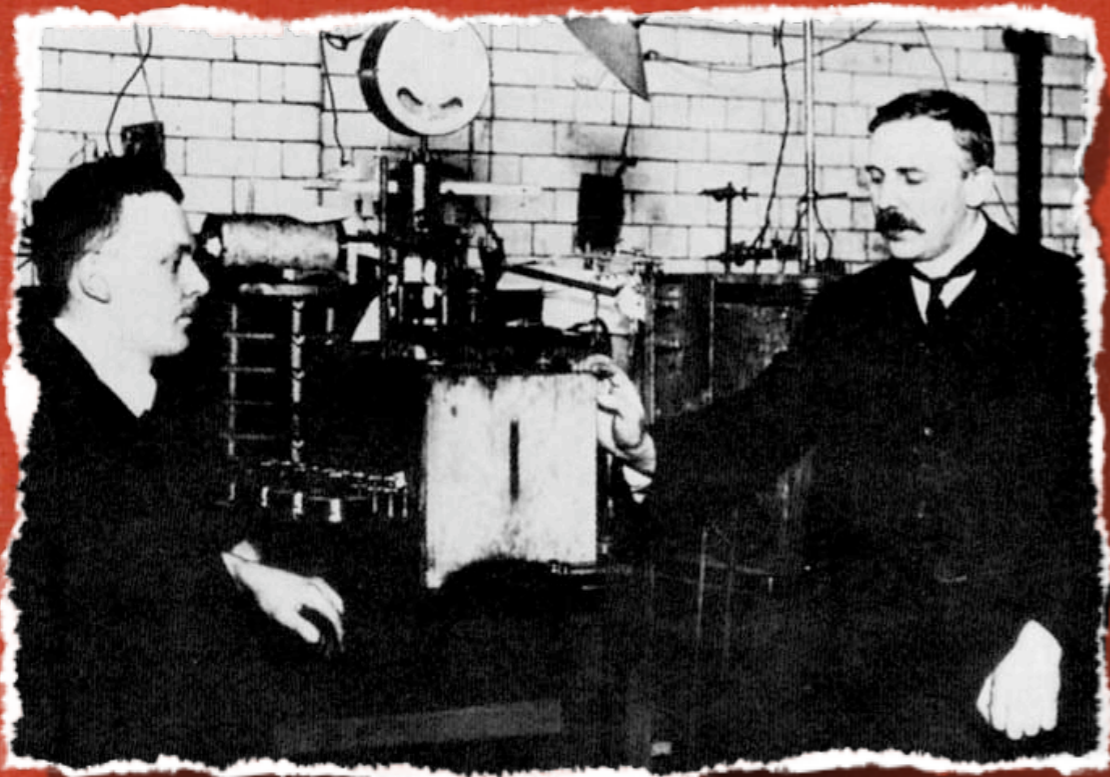
ERNEST RUTHERFORD

1871-1937

Nationality: New Zealander



Ernest Rutherford was born in 1871, the second of 11 children born to a New Zealand farmer. After graduating from college he traveled to England to work at the Cavendish Laboratory doing research with Hans Geiger on radioactivity.



Rutherford and Geiger in the Cavendish Lab

One type of radioactivity is when an atom throws out a positively charged particle from the nucleus.

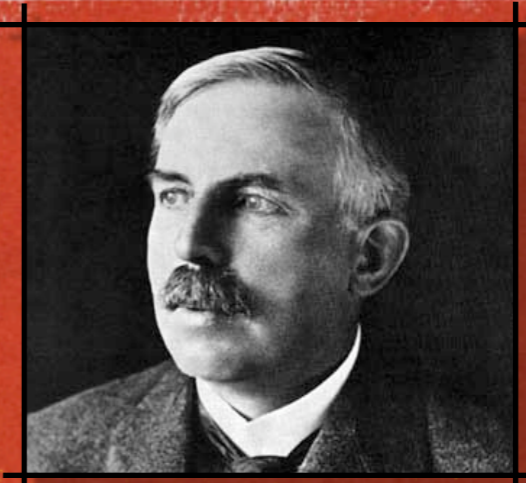
This particle was called an *alpha particle* (α).

Rutherford used this alpha particle to investigate the structure of the atom.

ERNEST RUTHERFORD

1871-1937

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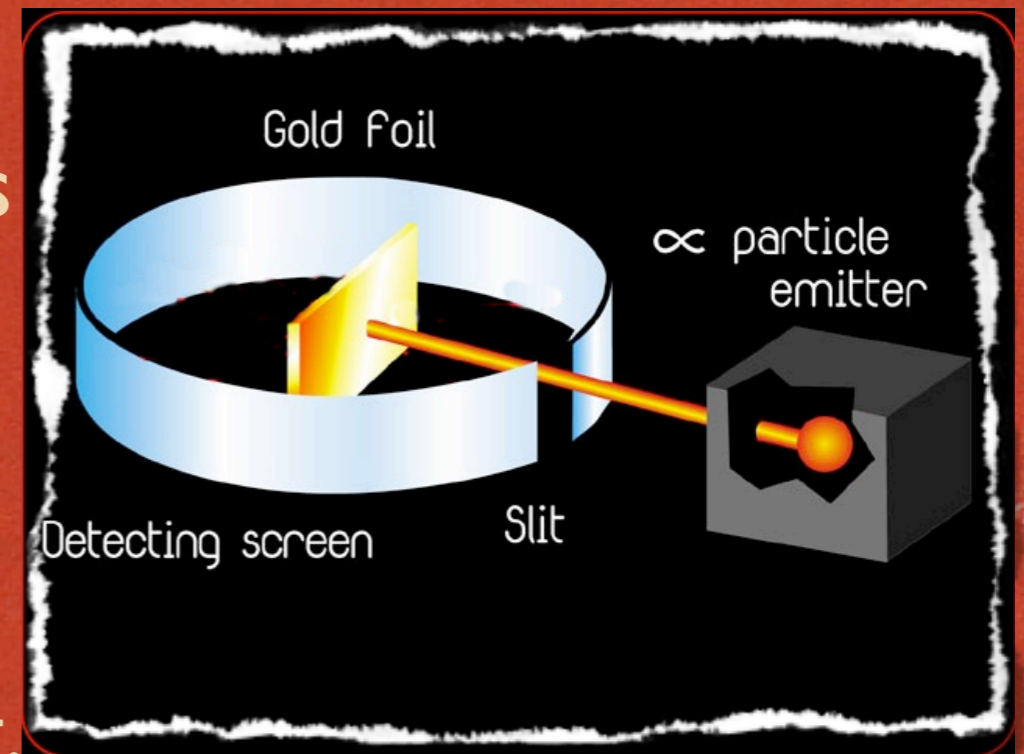
Uranium is a radioactive element that gives off positive particles (alpha particles). Rutherford used these positive particles to investigate the makeup of the atom.

Rutherford encased uranium in lead (which absorbs alpha particles).

This produced a beam of alpha particles traveling in a straight line.

He fired these positive particles at a thin piece of gold (dense metal).

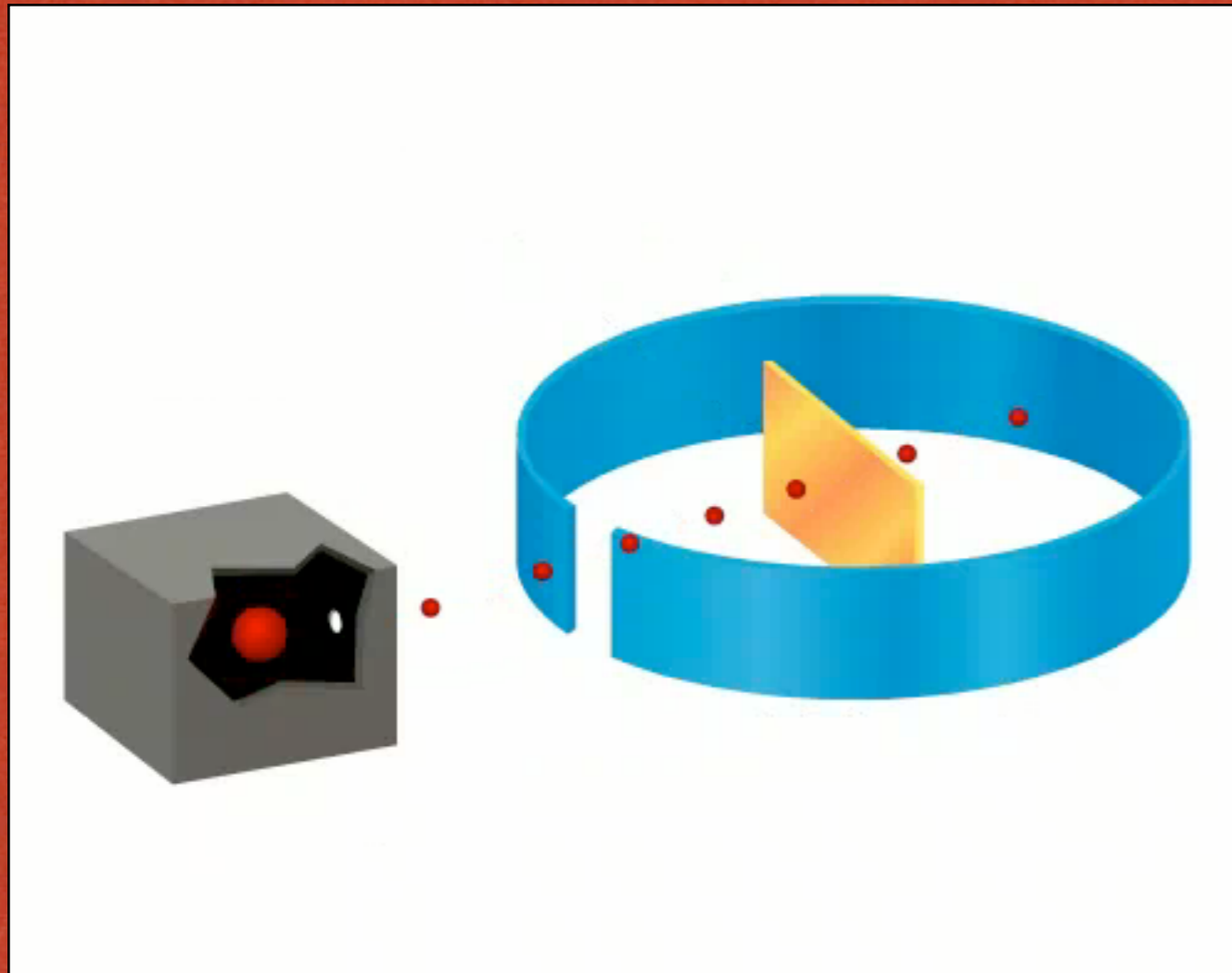
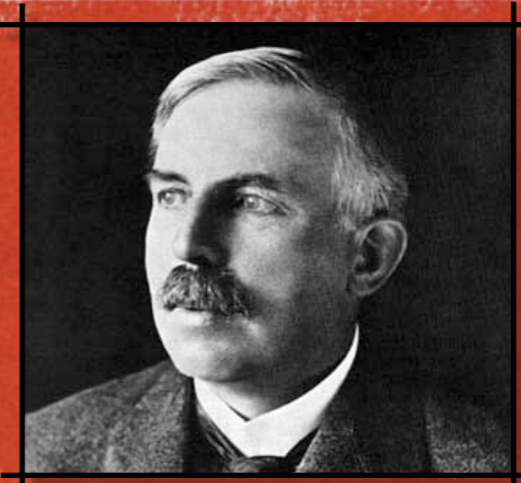
A screen around the gold to detect where the alpha particles were traveling.



ERNEST RUTHERFORD

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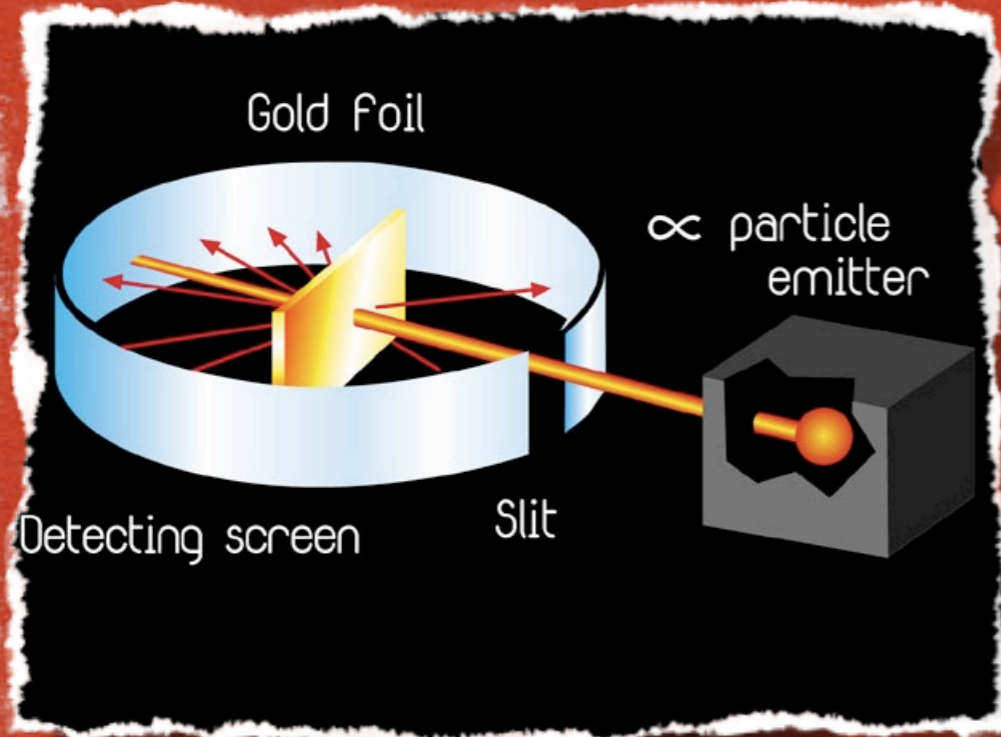
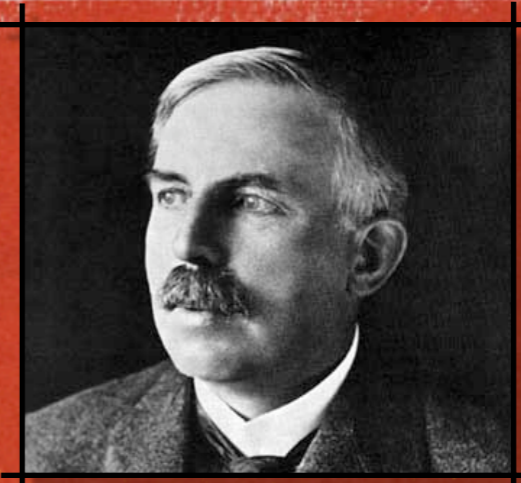
Goil Foil Movie

Rutherford shot alpha particles at a thin sheet of gold to observe what happened when the positive α particles pass through the gold atoms. If Thompson's model was correct the alpha particles should pass through the diffused positive cloud with ease.

ERNEST RUTHERFORD

1871-1937

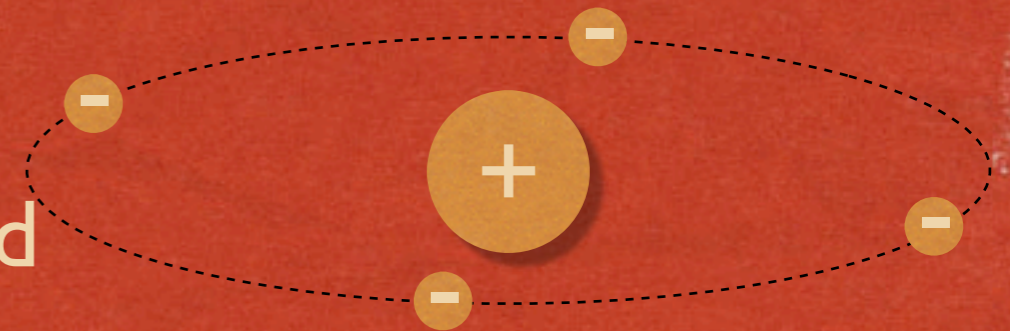
Nationality: New Zealander



From his observations Rutherford concluded that the atom had a dense, positive central nucleus composed of + charged protons. He stated that the electrons orbited the nucleus - like planets orbiting the Sun.

In 1909 Rutherford proposed his *Planetary Model of the Atom*.

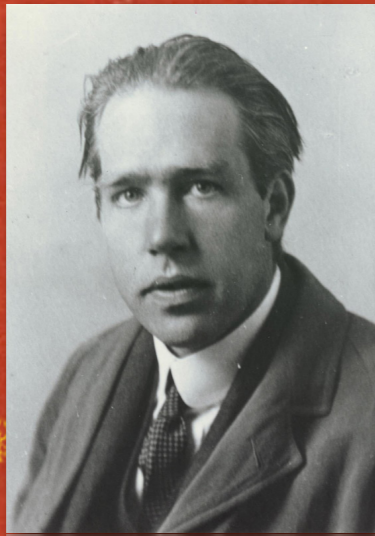
His model created positively charged protons located in the nucleus and placed electrons in orbit around the nucleus - like planets around the sun.



A YouTube Movie on Rutherford's Experiment



For Entertainment Purposes Only!



NIELS BOHR

1885 - 1962

Nationality: Danish

In 1913 Niels Bohr proposed that electrons are arranged in up to seven specific energy levels.

Since it is the model we will use in this class you will do a computer program to teach you how to draw the electrons in their proper levels.

The arrangement of these electrons in certain energy levels determines the chemical and physical properties of the elements.



JAMES CHADWICK

1891-1974

Nationality: English

In 1932 James Chadwick discovered a 3rd subatomic particle in the atom. He called this particle a neutron because it was neutral.

He proposed that neutrons resided in the nucleus of the atom along with protons.

