

KARNATAKA RADIOLOGY EDUCATION PROGRAM

Discovery of X rays

"THE MAGIC WAVES OF ROENTGEN"

WILHELM CONRAD ROENTGEN (1845-1923)



- was a German physicist on 8th November 1895, produced and detected electromagnetic radiation in a wavelength range today known as X-rays or Rontgen rays, an achievement that earned him the first Nobel Prize in Physics in 1901.
- Today, Roentgen is considered the father of diagnostic radiology, the medical specialty which uses imaging to diagnose disease.

- In 1862 ,17year old who was not a military cadet but a simple student was pressed by the headmaster of his gymnasium to reveal the identity of a classmate guilty of drawing an unflattering portrait of one of the school teachers.
- He refused to do so even though he was aware that the headmaster knew, he had recognized the culprit.
- Thus he could not receive a diploma certifying that he had graduated from a gymnasium without which admission to any university was impossible at that time in Germany.

- Roentgen was forced to matriculate in 1865 at the polytechnic school in Zurich, which did not require a diploma.
- He had marvelous skill in designing and constructing instruments which attracted doctor August Kundt ,one of the most distinguished theoretical physicist in Europe.
- Thus he recognized the capability of Roentgen and he persuaded Roentgen to forget about becoming mechanical engineering inspite he had the degree.
- Then he became assistant to Kundt at the university of Zurich. At the same time he made it possible to Roentgen simultaneously to study for doctorate in theoretical physics.

- When Kundt left university of Zurich in 1870, for a new position at university of Wurzburg and again when in 1872 he accepted a post at the university of Stransbourg, Roentgen faithfully followed with pleasure to work as an assistant to Kundt.
- Finally in 1874, at the age of 29 he was appointed as instructor at the university of Stransbourg and in 1876 he was made as an assistant professor under professor Kundt.
- 3 years later in 1879 he parted from Kundt accepting for professorship in the university of Giessen.

- Back in 1872, Roentgen aged 27 decided to marry Bertha Ludwig, a daughter of a prosperous educated inn keeper. Bertha was slender attractive fairly well educated and totally satisfied to be the wife of physics professor.
- Strangely as it is true to certify the love is blind and deaf, she was 6 years elder to him and subject to intermittent, but prolonged bouts of psychosomatic illness.
- Neither of these factors never seemed to interfere with their marriage that continued until she died at the age of 80 years.

- At the late stage of her life, Roentgen used to give multiple injection of morphine daily and he never felt it was cumbersome.
- The psychosomatic illness of Bertha isolated Roentgen from the social life and after 4 years they adopted Bertha's 6 year old niece also named as Bertha(Josephine Bertha Ludwig) as they could not have any issues.



Roentgen's predecessors sir William Crooks, the England's most distinguished physicist having discovered thallium in 1861, he became interested in investigating the possible effect of discharges of electricity on rare gases. To accomplish this sort of research he constructed what is now called as CROOKS TUBE, a fabricated vacuum glass cylinder. The cylinder with a specific gas ,charged with electricity passed from cathode to anode, the rays that gas emitted

was called Anode rays. It happened that Crook occasionally dropped wooden cassettes containing unexposed photographic plates on to the same table upon which he had vacuum cylinder.

When he had an occasion to use the plates he found some of them were flawed by shadows, it never occurred to him that the plates seemingly protected from light by the wooden cassettes, still might have exposed to a new type of ray generated by cathodes.

Surprisingly he wrote to the manufactures complaining the photographic plates has been light damaged.

At the same time the distinguished physicist from London Phillip Lenard started experimenting on electrode Crooks tube & discovered that cathode rays can pass



through alluminium sheet with the help of Crooks tube and he got Nobel prize for this. Hence total credit of invention of cathode rays cannot go to Roentgen alone. Roentgen in 1895 did repeat the Lenard's experiment with Crook's tube with covered window. Roentgen placed a small screen coated with Barium Platinocyanide crystals very near to window.

When the tube was discharged it caused the faint fluorescence of the screen.

He covered Crooke's tube with a opaque cardboard strips to avoid all visible light then also shut the curtains of all his windows so that the laboratory was in complete darkness. As he was about to begin his experiment, from the corner of his eye he glimpsed a mass of greening yellow color flickering very brightly in the absolute darkness from a yard distance.

It was the divine light of humanity.

Started by this flashing, he immediately spotted another screen coated with barium plantino-cyanide that he had left on his bench.

Excitedly he switched the current to the tube on and off each time the screen began to fluorescence explaining in part, the strange burst of colors he had seen.

Hence bright thought to his mind that he might be producing a new kind of electromagnetic wave .

In the year 1895,nov 8th roentgen then placed a deck of cards followed by 2 inch thick book between the Crooke's tube and his screen.

Regardless of these objects, when he excited the tube the screen promptly began to fluorescence.

Then he started thinking "what sort of ray or wave, what I see this one doing? Am I making some sort of mistake or am I possibly going mad?" these were the questions torturing his wonderfully older mind. It was sometime in early December, when he held a small lead pipe before the photographic plate and exposed the pipe to xray coming from the Crooke's tube and he became awestruck and just bit terrified.

Although the plate showed dark shadow he expected a lead pipe to produce, it also showed bones of his two fingers that he had been holding pipe.

This x ray could pass through his flesh and revealed his bones, "what I am seeing is not a scientific phenomenon, it is uncertainly its downright mystica, what will my colleagues think of this x ray, can reveal the most hidden part of human body, the Bones?". So one evening in December after he and his wife finished dinner he smiled happily and invited her to accompany him to his laboratory.

She was glad and enthusiastic. Once downstairs he asked her to place her left hand on the unexposed photographic plate.

She did so looking timidly at him.

He turned on the current of Crooke's tube placed directly over her left hand with its fourth finger bearing her wedding gold ring.

"What is going to happen?" She asked anxiously.

He answered "Don't worry. I am going to turn on the current going to this tube, it will flash and crackle a bit but don't let that frighten you, just keep your left hand flat and perfectly quite on the cassette."

After 6 min,he brought back still wet plates and handed it to her saying "Here is the picture of your hand that my new X ray made". "Oh, my God I am looking at my bones. It makes me somehow feel that I am looking at my own death".

The opaque density of two rings one was her wedding ring.

He knew only from his simple x-ray photograph of his wife's hand , that he had made one of histories greatest scientific discoveries.



On Roentgen primary report "on a new kind of ray: A preliminary communication" appeared in the journal ,only a few days after submission.

On new years day 1896, he sent reprints to 6 of the most important physicist in Europe.

With them he sent copies of his x-ray photograph of the metal weights showing through the wooden box and bones of Bertha's hand. Editor of Vienna's prestigious news paper recognized Roentgens discovery is fascinating and almost unbelievable.

He splashed across Sunday Jan 5th issue of "Die Presse". The correspondent from London chronicle ,the most distinguished chronicle of that time printed the story on Jan 6th on cable information from "Die Presse" Instantly the marvelous x-ray appeared in news paper through out the world. In deed in the 1st 6 months of 1896, when establishments were setup to take x-ray films of bones of a persons, many of the individuals fainted when they saw their bones.

Even the Kaiser Wilhelm 2 and his wife were fascinated to come to imperial court of Potsdam. At that time he was decorated with "the Prussian order of the crown" a great honor from the king.

He published a total of three papers on X-rays between 1895 and 1897.

On Jan 23rd he gave the lecture to the Wurzburg physical medical society. Roentgen invited Albert Von Kolliker, one of the Germans most distinguished anatomist and have his hand x-rayed, the old man did so, when the audience saw the bones of his hand, whole auditorium erupted in thunderstorm applause. This was Roentgens 1st and last formal lecture on x-rays, Because he used to become disoriented before addressing on a scientific gathering. He declined to give interviews to newspaper and magazines.

In 1921, when he was 76 years aged his last paper dealt with the effect of irradiation on the conduction of electricity in various crystals. During That time he accepted lot of certificates, medals, honorary degrees. The most important was "Royal order of merit of the Bavarian crown".

In 1901, Roentgen became the very first scientist to receive nobel prize for physics.

He willed the price money to the university of Wurzburg. Roentgen did not take patents out on his discoveries. Thus it appears to be the best of all words of Roentgen until 1914,then the troops of his beloved Kaiser invaded Belgium and set his world, and that of most other Germans on fire.

With the inflation following World War I, Roentgen fell into bankruptcy later in life, spending his final years at his country home near Munich. Bertha survived the hardship of the war but died in 1919. Roentgen then was 74, he did try to continue his emotional union with dead wife Bertha by reading aloud to her photograph letters written to him years ago, that he thought she might like to hear again.

Roentgen died on 10th February 1923 from carcinoma of the intestine. It is not believed his carcinoma was a result of his work with ionizing radiation because of the brief time he spent on those investigations, and because he was one of the few pioneers in the field who used protective lead shields routinely. In keeping with his will, all his personal and scientific correspondence were destroyed upon his death. In honor of his accomplishments, the International Union of Pure and Applied Chemistry (IUPAC)named element 111, Roentgenium, a very radioactive element with multiple unstable isotopes, after him.

> 111: Roentgenium 2,8,18, 32,32, 17,2

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