

Analytical X-Ray Safety Training

2. History of X-Rays



Training Outline

- **history**
- sources and uses of X-Rays
- legislation
- biological and health effects
- X-ray safety in the lab
 - exposure
 - SOPs
 - security
 - emergencies
 - summary
- references
- quiz

In the beginning...



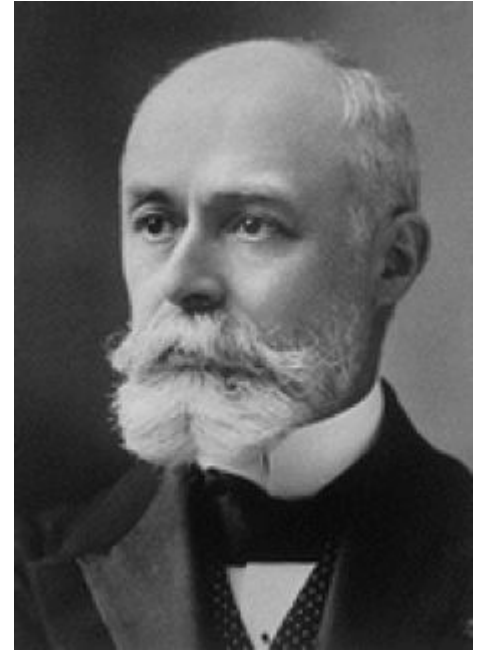
Wilhelm Roentgen (1845-1923) Discovers X-Rays

- German physicist discovers X-Rays November 8, 1895
- studying cathode ray tubes, he noticed that the fluorescence occurred even when outside light was shielded by black paper wrapped around cathode ray tube
- the discovery instantly revolutionized physics and medicine; lead to another field of research of radioactivity
- he was awarded the 1901 Nobel prize in physics for his discovery



Henri Becquerel (1852-1908) Discovers Radioactivity

- French physicist discovers radioactivity March 1, 1896
- believed sun's rays were absorbed by uranium then emitted as X-Rays
- due to overcast skies, returned uranium rocks to storage drawer on top of photographic plates
- developed plates showed clear and strong images (i.e., spontaneous emission of radiation by a natural material)
- shared Nobel Prize with Pierre and Marie Curie in 1903



Marie Sklodowska Curie (1867-1934)

- **double Nobel prize winner in physics and chemistry**
- contributes to WW1 French war effort by making public pleas for fund to equip ambulances with radiology equipment
- elected by Red Cross to be official head of Radiological Service
- devised courses in radiology and taught doctors new techniques to locate foreign objects in the human body



Nobel Prizes for Research using X-Rays

- 1901 (Physics) W.C. Roentgen discovery of X-Rays
- 1914 (Physics) M.von Laue X-ray diffraction from crystals
- 1917 (Physics) C. G. Barkla characteristic radiation of elements
- 1924 (Physics) W. H. Bragg and W. L. Bragg crystal structure from X-ray diffraction
- 1924 (Physics) K. M. G. Siegbahn X-ray diffraction
- 1927 (Physics) A. H. Compton scattering of X-Rays by electrons

Nobel Prizes for Research with X-Rays

- **1936 (Chemistry) P. Debye diffraction of X-Rays and electrons in gases**
- 1962 (Chemistry) M. Perutz & J. Kendrew **structure of hemoglobin**
- 1979 (Medicine) A. McLeod Cormack & G. Newbold Hounsfield **computed axial tomography**
- 1981 (Physics) K. M. Siegbahn **high resolution electron spectroscopy**
- 1985 (Chemistry) H. Hauptman and J. Karle **direct methods to determine X-Ray structures**
- 1988 (Chemistry) J. Deisenhofer, R. Huber and H. Michel **structures of proteins crucial to photosynthesis**

Evolution of X-Ray Equipment

Wimshurt Static Machine (circa 1890s)

- high voltage for X-ray tubes was provided by a static machine or an induction coil
- static machines were cheap and simple setup but could not provide as high a current as induction coils
- some machines used more than 12 discs up to 3ft. in diameter



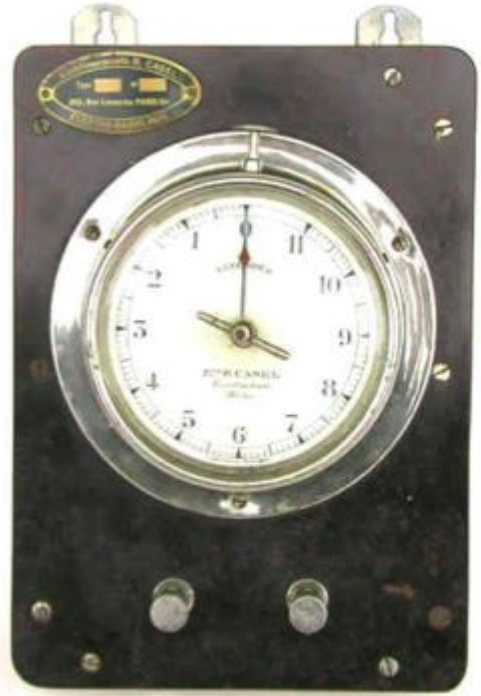
Induction Coil (circa 1900)

- until around 1910, the high voltages (10^4 volts required for X-ray tube operation provided by induction coils)
- operated off DC current provided by battery cells
- eventually replaced by transformers



X-ray Timer (French) (Circa 1900-1920)

- timer permitted X-ray tube to be operated for up to 11 seconds
- physician turned the dial to chosen exposure, pressed button on top of clock
- connected high voltage line (from induction coil or static machine) to X-ray tube
- 2 electrical terminals located below clock face



Shoe-Fitting Fluoroscope (ca.1930-1940)

- commonly seen in shoe stores in the 1930-1950s
- vertical cabinet with an opening at the bottom into which the feet were placed.
- image of the bones of the feet and the outline of the shoe could be seen through each of the three viewing ports on the top of the cabinet



Elephants?

*Globe and Mail article
February 3, 2004*

Help from the zoo

A cash-strapped hospital in Lisbon, Portugal, has asked the local zoo to lend X-ray equipment usually used on elephants so it can treat overweight patients, reports



the weekly newspaper *Tal e Qual*. An official with the Egas Moniz hospital said the X-ray equipment it owned could not hold people who weighed more than 140 kg. (308 pounds, or 22 stone). Obesity has been gradually rising in Portugal as dietary habits have changed.

Continue to: Sources and Uses