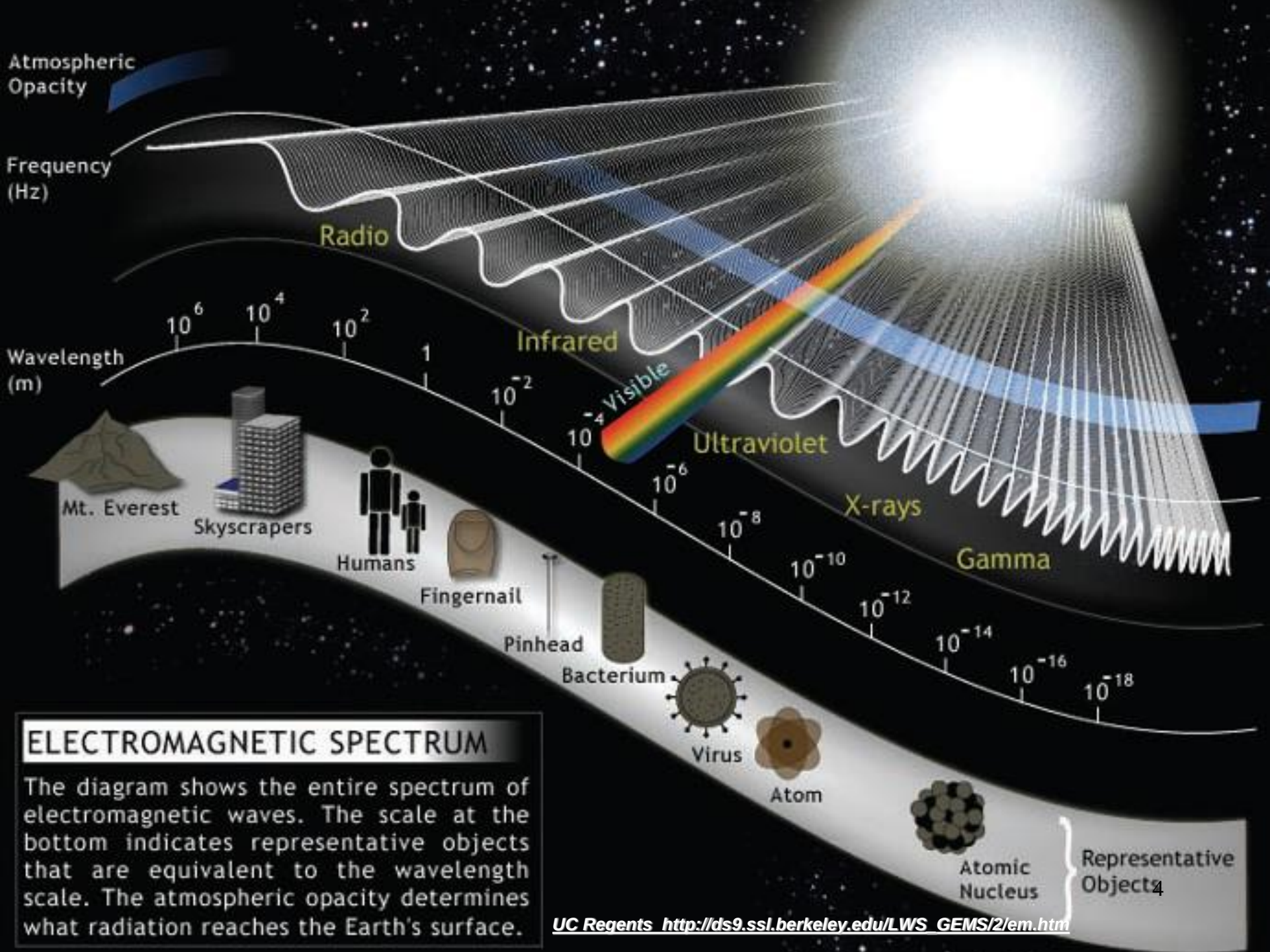
PRINCIPLES OF RADIOBIOLOGY by mohsen mohammadi

RADIATION

RADIATION

Energy traveling through space or matter, ultimately to be absorbed by another body.

Marchiori, Dennis (2005). *Clinical Imaging*. St. Louis, MO: Elsevier Mosby.



ELECTROMAGNETIC SPECTRUM

The diagram shows the entire spectrum of electromagnetic waves. The scale at the bottom indicates representative objects that are equivalent to the wavelength scale. The atmospheric opacity determines what radiation reaches the Earth's surface.

UC Regents http://ds9.ssl.berkeley.edu/LWS_GEMS/2/em.htm

History of Radiology

- November 11, 1895, Wilhelm Conrad Roentgen
- Roentgen the first Nobel prize in physics in 1901

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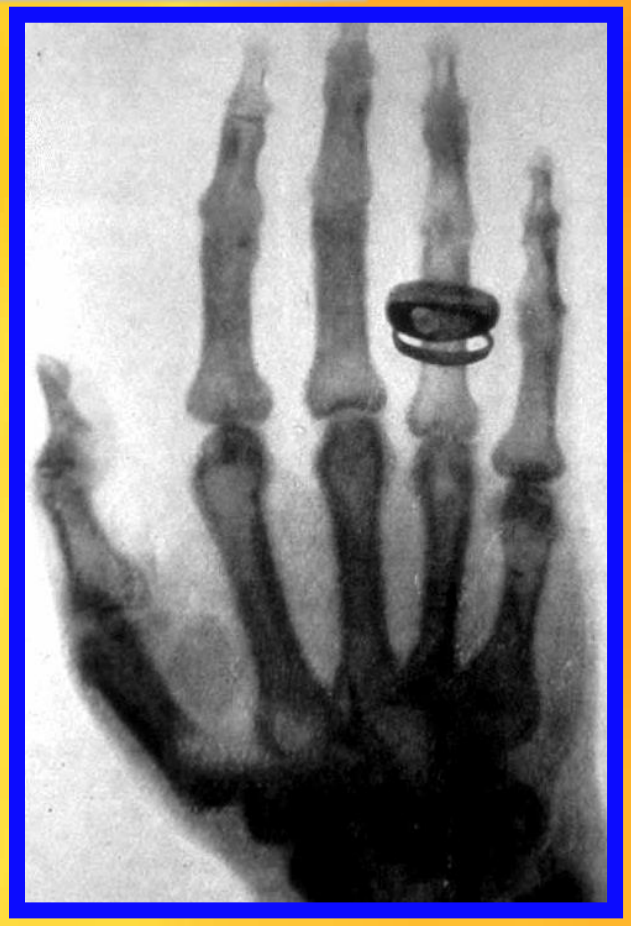
www.fortbend.k12.tx.us/campuses/documents/Teacher/2008%5Cteacher_20081121_1142_2.ppt

History of Radiology

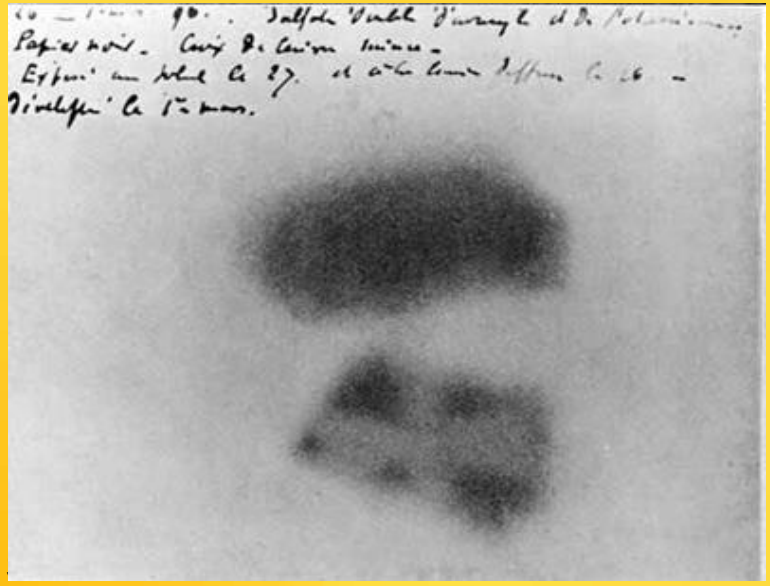
1st X-ray?
Roentgen's Wife's Hand



X-ray of a colleagues hand after presenting the"new ray" to the Physics – Medical Association

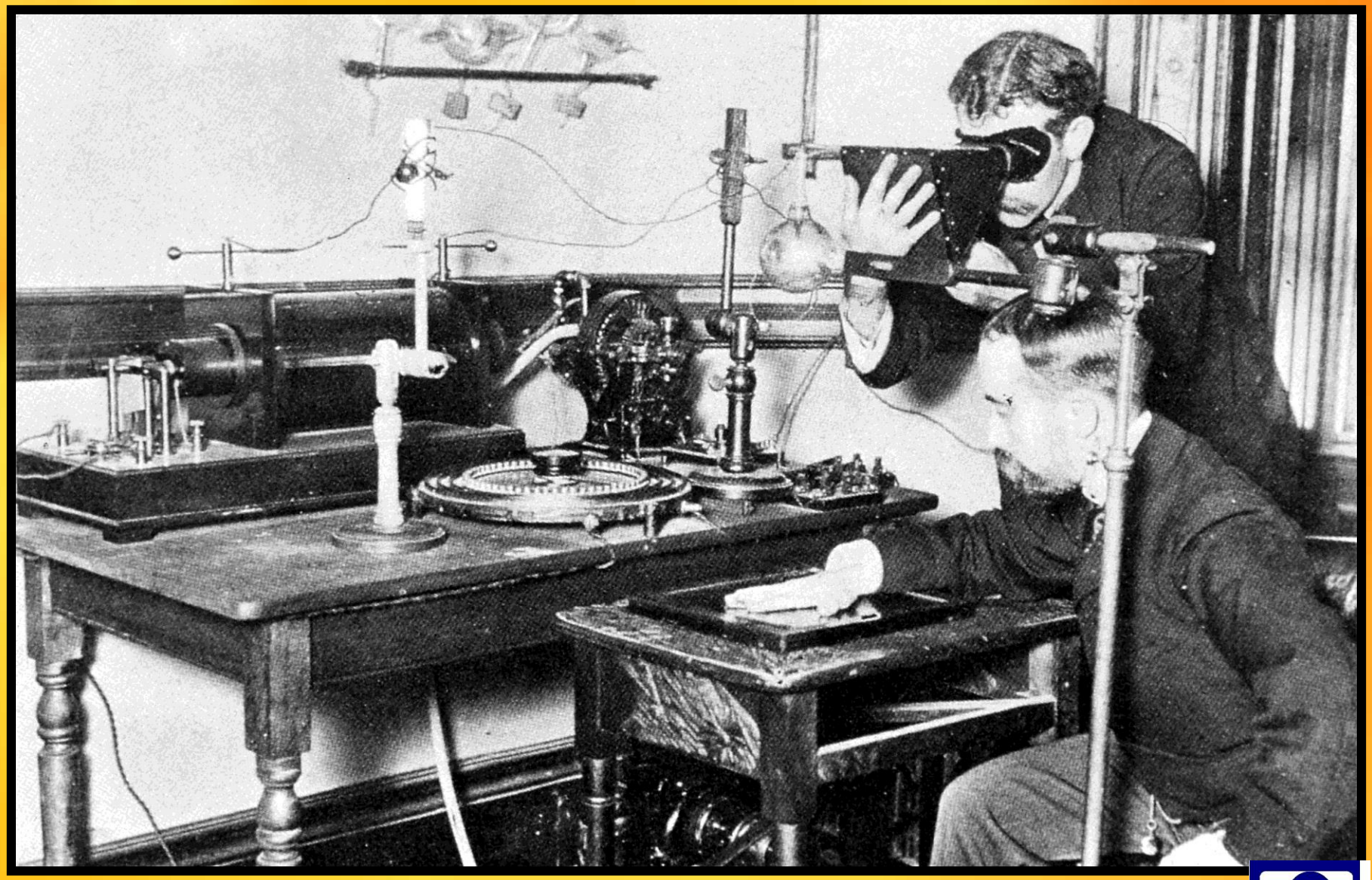
The discovery of radiation

- **Henri Becquerel discovered radioactivity on 26th Feb 1896.**



The discovery of radiation

- **In 1903 he shared the Nobel Prize for Physics with Pierre and Marie Curie who had refined Becquerel's work and discovered the existence of Radium.**



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BIOLOGICAL EFFECTS OF RADIATION

Mihran Kassabian (1870-1910)

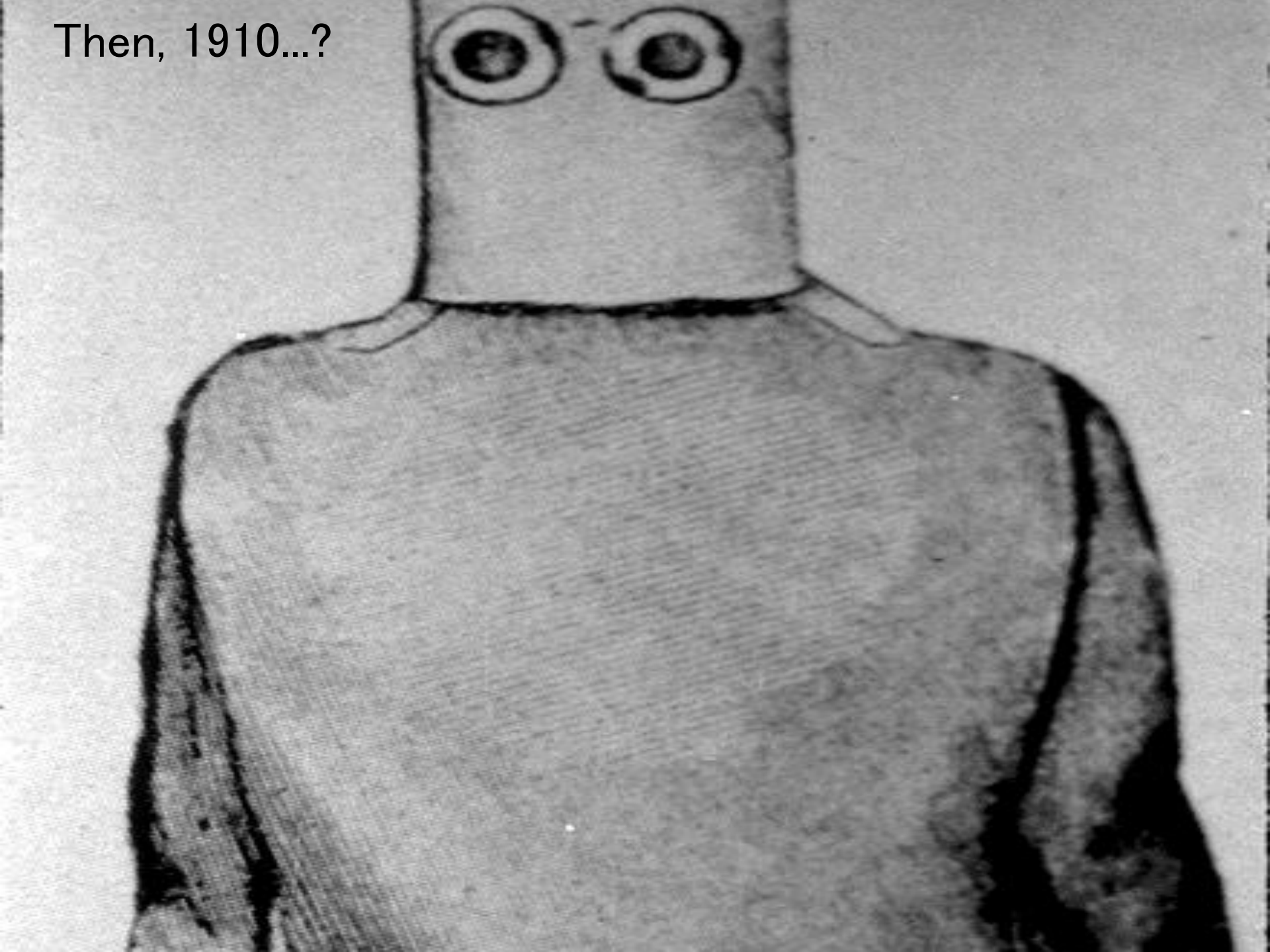
Sister Blandina (1871-1916)

- **1898 – Radiographer in Cologne.**
- **Held nervous patients & children with unprotected hands.**
- **6 months later had cancer of hand – arm amputated.**
- **1915 – severe breathing difficulties.**
- **Extensive shadow on the left side of thorax.**
- **Large wound on her whole front- and back-side.**
- **Died 22nd Oct 1916.**

Monument to radiation pioneers who died due to their exposures

Fig. 12-8. The stelae honoring the pioneers who died victims of their exposures to radiations (1935).

Then, 1910...?



RADIATION HAZARD SIGN

- **INDICATES A RADIATION HAZARD**

Protective Effects of IMOD and Cimetidine against Radiation-induced Cellular Damage

Rahgoshai S.[1], Mohammadi M.[1]*, Refahi S.[2], Oladghaffari M.[3], Aghamiri S. M. R.[4]

ABSTRACT

Radiation damage is to a large extent caused by overproduction of reactive oxygen species (ROS). Radioprotectors are agents or substances that reduce the effects of radiation in healthy normal tissues while maintaining the sensitivity to radiation damage in tumor cells.

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Cimetidine was found more effective when used in vivo; this effect might be due to the augmentation of the presence of Sulphur atom in the compound which is important for their scavenging activity.

Recently, a new herbal-based medicine with immunomodulatory capacities, Setarud (IMOD), was introduced as an additional therapy in various inflammatory diseases and HIV infection.

IMOD is a mixture of herbal extracts enriched with selenium. Selenium confers protection by inducing or activating cellular free-radical scavenging systems and by enhancing peroxide breakdown. This article suggests that nontoxic amount of IMOD and cimetidine have radioprotective properties and could reduce cytotoxic effects of radiation.

Keywords

Radioprotection, Cimetidine, IMOD, Immunomodulator, Free Radical

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RADIOSENSITIVITY

LEAST SENSITIVE

MOST SENSITIVE

MATURE RED CELLS
LIVER CELLS
NERVE CELLS
PITUITARY
THYROID
MUSCLE
BONE AND CARTILAGE
SKIN EPITHELIUM
CORNEA
SQUAMOUS MUCOUS EPITHELIUM
LUNG TISSUE
LENS OF THE EYE
GONADAL GERM CELLS
BONE MARROW
LYMPHOCYTES

BIOLOGICAL EFECTS

- **THE OVERALL EFECTS ARE DIVIDED INTO TWO MAIN GROUPS:-**

1. **SOMATIC EFFECTS**

2. **GENETIC EFFECTS**

- **<u>LATE EFFECTS</u> –**

- **DUE TO CHROMOSOMAL DAMAGE**
- **MAY TAKE UP TO 20 YEARS TO OCCUR**
- **MOST COMMON LATE EFFECTS ARE CANCER AND LEUKAEMIA**

cancer for a 5 year old child from common procedures

This does not mean that any one child will get cancer from a single X-ray. It applies to populations of patients.

5 year old child		
Natural incidence	**1 in 5**	
Radiography	Effective dose (mSv)	Risk
Chest (PA)	**0.01**	**1 in 1 million**
Abdomen (AP)	**0.12**	**1 in 80 000**
Pelvis (AP)	**0.08**	**1 in 120 000**

Martin CJ and Sutton DG (2002), Practical Radiation Protection In Health Care, Oxford Press

Risk Benefit Ratio of Diagnostic Imaging

Amount of Radiation Resulting From CT

Examination	Effective Dose (mSv)	Chest X-ray Equivalents
3-view ankle radiography	0.0015	0.07
2-view chest radiography	0.02	1
Radionuclide cystogram	0.18	9
Flouroscopic cystogram	~0.33	~16
Radionuclide bone scan	~5	~250
Brain CT	2	100
Chest CT	up to 3	up to 150
Abdominal CT	up to 5	up to 250

Frush D, et al, CT and Radiation Safety: Content for Community Radiologists
www.imagegently.org

ALARA "As Low As Reasonably Achievable"

The ALARA philosophy and its guidelines are what help to keep the risk of radiation exposure down. The ALARA guidelines are limits established to ensure that safety is maintained. We know that lower doses carry lower risk, and this concept helps to maintain cost effective safety.