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X -RaysOn November 8th, 1895, in his laboratory in Würzburg University in Germany, professor Wilhelm Conrad Röentgen noticed a fluorescent glow of crystals kept near a cathode ray tube. The fluorescence continued even after he covered the tube with black paper. Röentgen concluded that the cathode ray tube was emitting an unknown radiation, which could penetrate through paper and excite fluorescent materials. Further study showed that the energy emission could pass through most opaque objects, including soft tissue of humans, but not highly dense materials like bones and metal objects.

One of the initial experiments performed to study X Rays was actually a radiograph of Röentgen’s wife’s hand, who, on seeing the film, declared “ I have seen my death!” Röentgen called the energy emission “ X-Radiation”, where ‘ X’ refers to the unknown variable used in mathematics. This Radiation is today known as X-Ray, an electromagnetic emission which has redefined medical diagnostics and found various industrial applications. The discovery created a frenzy in the scientific world and media alike. Scientists were fascinated by the possibilities opened up by the discovery of an electromagnetic emission with a shorter wavelength than light, and its implications for understanding the structure of matter.

The public was enthralled by the idea of an invisible ray which could give pictures of bones and body parts. World War I saw the use of X-Rays on the battlefield to locate bullet wounds in soldiers as early as June 1896, only six months after Röentgen’s discovery. His discovery was highly acclaimed and he was awarded the first Nobel Prize in Physics in 1901. With increasing prevalence due to diagnostic X-Rays and Radiotherapy to treat cancers, the various side effects of X-Rays also started to come to light. The most common symptoms were hair loss, skin lesions and reddening of skin. Clarence Madison Dally, an assistant to Thomas Edison, died as a result of direct X-Ray exposure, leading to cancer of the hand. The event led to Edison abandoning all his research into X-Rays and claiming, “ Don’t talk to me about X-Rays. I’m afraid of them.

“ X-Rays grew beyond the medical world with the advent of Coolidge tubes, which were high vacuum X-Ray tubes. These tubes were reliable sources of X-Rays, operating at upto 100, 000 volts, and allowed for industrial use of X-Rays. The X-Ray tubes developed also allowed for faster and safer exposure. However, with the masses still largely unaware of the dangers of radiation, X-Rays found applications in various avenues which fascinated and enchanted the people. Some used it for ‘ artistic photography’, while others used it in shoe shops as ‘ Shoe Fitting Fluoroscopes’. Charlatans and quacks used the fluorescence created to mesmerize their audience and even carry out radiotherapy to cure all sorts of ailmentsNuclear Magnetic ResonanceNuclear magnetic resonance spectroscopy explores the magnetic properties of the nuclei of certain atoms. From an instrumental point of view, it relies on the phenomenon of nuclear magnetic resonance, which can provide a wide range of information, including structure, reaction state, and chemical environment. Molecules containing at least one atom with a nonzero magnetic moment are potentially detectable by NMR, such isotopes including 1H, 13C, 14N, 15N, and 31 P.

These signals are characterized by their frequency (chemical shift), intensity, fine structure, and magnetic relaxation properties, all of which reflect the environment of the detected nucleus. NMR is the analytical method that provides the most comprehensive structural information, including stereochemical detail. Nuclear magnetic resonance spectroscopy (NMR) has a long history that reaches back to 1945 when the phenomenon of nuclear magnetic resonance was experimentally verified in condensed matter for the first time. After successful applications of NMR in analytical chemistry, structural biology, and initial magnetic resonance imaging (MRI) trials, localized in vivo magnetic resonance spectroscopy (MRS) was finally introduced during the 1980s. It has evolved during the past 25 years in terms of localization quality, spatial resolution, acquisition speed, number of detectable metabolites, and quantification precision, and has profited especially from the significant increase of magnetic field strength that recently became available for in vivo investigations. Today it allows for non-invasive determination of tissue concentrations of various metabolites and compounds in animals or humans and is applied for clinical diagnostics as well as physiological research.   NMR in diagnosis of EpilepsyNuclear magnetic resonance spectroscopy (MRS) is a non-invasive method for detecting brain metabolites. MRS has been applied to the study of human disease for several decades.

It has advanced the study of neurological disorders by providing a metabolic biopsy of the living brain. Although a large number of metabolites and enzymatic pathways can be studied with MRS, two main techniques have been applied to study epilepsy. The most common one is 1H-MRS, in which compounds such as N-acetyl aspartate (NAA), choline (Cho), creatine (Cr), myoinositol, ?-aminobutyric acid (GABA), and glutamate are detected. The second technique employs phosphorus (31P), which provides information about the energetics of human tissue. Today, clinical 1 H-MRS can be carried out in routine MR scanners and at high field in research settings.