The X-ray

A look inside—the X-ray illuminates a world never seen before

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A potentially broken arm, a toothache that just won't quit, structural soundness of a bridge or a building, and even security on the world's airplanes. All of this depends on one ubiquitous tool—the X-ray. In fact, X marks the spot in so many places in today's world that we take the innovative scan for granted, forgetting the X-ray's origins. It goes back more than a century.

The X-ray has been a part of the vernacular since its 1895 discovery by German physicist Wilhelm Röntgen. For some 20 years prior to Röntgen's discovery, his fellow scientists had been experimenting with energy and the light it produces. Johann Hittorf had, in 1876, discovered a fluorescence emanating from glass electron tubes, and named that light "cathode rays." Later, William Crookes created a glass vacuum cylinder containing electrons that discharged a high electric current. In his laboratory, Röntgen combined Hittorf's cathode rays with Crookes' tubes and got an unexpected result.

The enlightening combination of these two inventions produced a faint green light against the lab's far wall—and, to Röntgen's astonishment, traveled on its way through books and other objects. While switching the items in the ray's path, Röntgen saw the outline of his hand bones projected on the wall. He called this strange, new ray "X" for "unknown."

Röntgen hurriedly published a report titled "On a New Kind of Ray: A Preliminary Communication" in a German medical journal and was awarded the first Nobel Prize for Physics.

X-rays (or "Röntgen rays," as they are known in some parts of the world) are, like normal light rays, produced by atomic activity. Wavelike forms of electromagnetic energy are released at varying speeds by atoms in the form of light photons. While normal, visible light travels on a long wavelength of low energy, X-rays travel on a short wavelength of incredibly high energy. Items constructed of large, high-energy atoms, such as bone, are easily illuminated by X-rays, whereas skin, which is composed of small, low-energy atoms, allows X-rays to pass through.

Röntgen's discovery wowed the scientific world, and soon his peers were working to develop new uses and technologies for the X-ray. The public was wowed, as well. Scores turned out as audiences for X-ray exhibitions, where the machine's capabilities were displayed on stage. But as one scientist after another suffered arm amputations as a result of "radiation sickness"—it would later be known as a form of cancer—it became clear that the intensity of X-rays was harmful to humans. Despite the hazards, the potential benefits of Röntgen's new invention could not be ignored.

Doctors could now diagnose broken bones without having to resort to surgery as they had before, and dentists had been given perhaps their most valuable tool for identifying cavities and other dental problems. Another early use of X-rays was in fitting shoes; many shoe stores in the 1940s and 1950s had machines in which customers could confirm that shoes fit their feet. As many as 10,000 machines were thought to be in use and the practice continued for years until the danger of exposure was considered unacceptable.

Precautions including the protective aprons worn during many types of X-rays have reduced risks to patients, and continued developments in the scientific community have created uses for the X-ray that Röntgen never could have imagined.

X-rays are now used to determine the authenticity of works of art and museum artifacts and for art restoration. They also can detect fake gems, smuggled goods at customs, and were an integral part of former President Ronald Reagan's Cold War defense planning strategy. Reagan's Strategic Defense Initiative included the use of an X-ray laser device; a blaster of sorts powered by a thermonuclear explosion. In recent years, the widespread use of X-rays has also contributed to airport security, slowing down lines but (hopefully) making airports more safe.

Röntgen's accidental discovery continues to illuminate and reveal secrets that would otherwise be hidden.