Although radiation is often seen as a problem, some may be unaware of the fact that it plays an important role in our lives.

The History of Radioactivity

In 1896, natural radioactivity was first observed by Henri Becquerel. Marie and Pierre Curie continued to work on this area, discovering new elements which had strong radioactive properties. These three physicists shared the Nobel Prize for Physics in 1903 for their work on radioactivity. Ernest Rutherford also contributed to the related discoveries of alpha and beta radiation, and identified the phenomenon of radioactive “half-life”. The discoveries of radioactivity, both natural and artificial, have evolved to cure and create problems in human life [Figure 1].

When radioactivity was first discovered, it simply meant “related to rays”, although today when people hear of radioactivity, it is often something that is regarded with a certain fear. Radioactivity is a property of unstable nuclei, whereby they spontaneously decay into nuclei of other elements. This is usually accompanied by radiation; there are three types of radiation emitted from radioactive substances: alpha particles, beta particles and a high-energy electromagnetic wave called gamma rays. When a substance decays, it ejects these particles and energy is released. The danger is that gamma rays can cause radiation sickness and produce radioactive waste, which in the wrong hands could cause mass devastation. However, in highly controlled situations, radioactivity can be very useful. For example, the energy produced by radioactivity is important in industry and the military.

In 1896, Henri Becquerel’s previous work was overshadowed by his discovery of natural radioactivity; this work was sparked by fellow physicist Wilhelm Röntgen who had recently discovered X-rays [Figure 2]. Becquerel studied uranium salts and established that they had radioactive properties. He later found that the rays emitted made gas ionize and were different from X-rays because they could be deflected by magnetic and electric fields. In 1898, the Curies announced the discovery of radium and polonium by fractionation of pitchblende; they continued to work on the properties of these substances and their findings became the foundations of future research into nuclear physics. Marie Curie continued her work on radioactivity, and in World War I (WWI), she set up France’s first military radiology center. By October 1914, the first 20 radiology vehicles were equipped...
and ready to help injured soldiers. Marie knew that X-rays could save soldiers, as they could be used to see bullets, shrapnel and broken bones. In 1899, Ernest Rutherford discovered and named alpha and beta radiation, and in 1900, P. Villard identified gamma radiation. Finally, in 1934, Frédéric and Irène Joliot-Curie were the first to discover an example of artificial radioactivity by bombarding non-radioactive elements with alpha particles.

Effects of Nuclear Energy based on Radioactivity

Nuclear power is a controversial subject. It is one of the most efficient ways of creating power to use in our homes but it comes with expensive faults. Nuclear fission is the process in which an atom is split to release energy. Using this method in controlled chain reactions, a huge amount of energy can be produced. Even though it is a non-renewable source, it is clean, as it does not give off carbon dioxide or any other harmful gases, making it a strong possibility for future power generation. However, there are huge problems with this type of power. In an uncontrolled situation, nuclear bombs can be created and used with devastating effect. Unfortunately, we have experienced this before, when they were first developed and used in World War II (WWII) to destroy Hiroshima and Nagasaki [Figure 3].

Another disaster took place in the 1980s when a nuclear reactor blew up and ejected radioactive waste into the atmosphere. It was blown into Western Europe and we are still seeing the effects today. In the Ukraine, children were born with deformities and developed cancer; today, most children there still develop leukemia at an early age. The disaster also ruined livestock in the Welsh mountains; sheep were being born with their organs outside their body, which then went on and affected the livelihood of the farmers for a decade. Even today, that land is not for livestock. In another incident at Dounreay Nuclear Power Station in Scotland, radioactive waste leaked into the sea and was found washed up on nearby beaches. They still continue to scan the beach for metallic particles. Nuclear fission is very risky and can lead to distressing effects, meaning that nuclear power stations can take up to 50 years to decommission and the radioactive waste has to be buried deep underground to ensure the public’s safety. An alternative to nuclear fission is nuclear fusion.

Nuclear Fusion and the Atom

Nuclear fusion occurs when two nuclei collide to form a heavier nucleus, with a large amount of energy being released in the process. This is both a cleaner and less dangerous way of producing energy and scientists today see it as the future way of powering the world. It is the best method as the radioactive waste produced is not dangerous like that formed by nuclear fission, and there are no carbon emissions either. The two atoms used are isotopes of hydrogen: deuterium and tritium. Although hydrogen is technically a finite resource, it has been calculated that this would not be a significant factor against nuclear fusion. Scientists are currently creating energy in this way but it is not efficient or economical yet. It is estimated that within 50 years, it will have been perfected and will also help to combat global warming.
Other Uses of Radiation

Radioactivity can be put to many uses, particularly in the fields of medicine, industry and archaeological research. Radio-carbon dating is a way of calculating the time since living matter died [Figure 4]. All living things contain a small amount of carbon-14, a radionucleotide taken from the atmosphere, which continues to radiate after death. The emission gradually decreases; so, the age of the remains can be calculated from its radioactive strength. Textiles, leather, parchment, basketwork and wood carvings can all be dated using this method. Not only is carbon dating used to date organic material found at an archaeological site, but also it can be used in pathology to date dead bodies.

Treatment with Radiation

X-rays and gamma rays can also be used effectively to treat cancer. Between 50 and 60% of cancer patients are treated at some time using radiation, allowing some to undergo less drastic surgery. There are three techniques used to treat cancer or other diseases using radiation. Teletherapy applies radiation to the outside of the body and can treat cancer inside or on the skin. A radioactive source can also be put inside the body to irradiate tumors; this is used for the treatment of organ diseases. Radiation has to be applied using carefully controlled doses or it can have an opposite effect, worsening a patient’s condition.

Radiation in Our Everyday Lives

Radiation happens in our day-to-day lives without us even noticing. The universe is full of nuclear reactors more commonly called stars; our sun radiates light and heat to us, which we depend on [Figure 5]. Without radiation, there would be no life on Earth, and the universe would be a totally different place. The discovery of radioactivity is the basis of many of the scientific discoveries that have led us to develop further. Whether it is broken bones, wounded soldiers, cancer patients, carbon dating, the future of our power stations or trying to understand how the universe works, we use our knowledge of radioactivity to assist us. Though man has sometimes taken this knowledge and abused it with adverse effects, I believe that we should continue to develop the technology and that it can be successfully used as a help rather than a hindrance. The founding figures of radioactivity did not set out to achieve all of these things, but like almost every scientific discovery that started with a desire for knowledge, it led to remedies and opportunities. Whatever is the opinion on radioactivity, it has become an essential tool.

About the Author

Naomi Robertson studied Physics, Chemistry, Maths, History and English at Tobermory High School on the Isle of Mull. She enjoys studying astronomy by going out with her telescope at night, and reading scientific journals.