Applications of radioactivity

Although most atoms are stable, others change spontaneously and at the same time emit one or several types of radiation. These are unstable “radioactive” atoms. Radioactivity originating from these atoms occurs everywhere in nature (see *Alternatives* No. 2), but it can also be stimulated artificially. It is used in a large number of applications in sometimes surprising fields, apart from the generation of electricity, which is the best known.

MEDICINE 1

PREVENTION, RESEARCH

Radioisotopes like cobalt 60 and Iridium 192 are used in nuclear medicine services as radiation sources to produce images of internal organs (scintigraphy) by radiating the body from the outside. Short half-life radioisotopes can also be used as markers. A small quantity of products with a short half-life emitting gamma or beta radiation is then added into the body. The radioisotope (usually Potassium 40) replaces a stable atom is tracked. Its radiation from outside, using appropriate receivers to identify its path in the body. Radioisotopes are used in neurology to understand how cerebral areas function, and what happens in heart disorders. It is also helpful for the development of new medicines.

TREATMENTS

Other treatments are used in radiotherapy services. They consist of applying local radiation on a specific area of the human body, avoiding healthy tissues as much as possible. These rays may be generated externally (photons, neutrons, protons) or internally (curietherapy). In the latter case, a cesium source is placed in contact with the tumor, or metabolic irradiation is applied by injection of a radioactive substance (iodine or phosphorus) that fixes selectively onto some cells. The difficulty lies in finding the right doses to destroy a tumor without damaging the surrounding healthy tissues. Radioisotopes also provide a reliable cold sterilization method by destroying all micro-organisms. Throwaway syringes are now sterilized in this manner.

FOOD PROCESSING INDUSTRY 2

Micro-organisms, larva, insects, mould and fungi that damage foodstuffs can be eradicated by applying radiation to the food. This food ionization technique is perfectly safe since radiation deposits energy only and in no way modifies the nature of the products thus treated. It is now used routinely in the food processing industry.

INDUSTRY 3

Industrial radiography by X- or gamma rays is a means of displaying differences in the shape, density and structure through the material being studied, without destroying it. This method is used to make inspections of welds or sheet metal work, in aeronautical construction, ship building or nuclear construction, and even in buildings, using X- or gamma rays. Neutrons have the special property that they easily pass through high density materials such as steel or lead. Similarly, these radiation sources can be used as radioactive gauges for checking tanks: the filling level, the density of fluids in the tanks, or to measure the wall thickness.

ENVIRONMENT 4

Radioisotopes can also be used to study the environment, by continuously monitoring the content of suspended solids in water, for example. Similarly, sediments can be marked with radioactive elements to monitor their migration in the soil with time.

ART 5

As with food, gamma radiation may be used to clean and protect works of art from insects or fungi that attack them. Thus, an intense radioactive flux was applied to the famous Pharaoh Ramses II mummy to eliminate the bacteria that were threatening it. Note also the dating technique based on the natural disintegration of carbon 14 that can be used to date products to about 40,000 years, and identify the date of various archeological objects or cave paintings.