The realities of radium

Vikki Cantrill tells the story of element 88's discovery and how its glowing reputation eventually faded.

In a report describing a new substance, Marie and Pierre Curie noted¹ on 26 December 1898: "This radioactive substance contains a large proportion of barium; despite this, the radioactivity is considerable. The radioactivity of radium must therefore be huge". The finding came as part of their studies into the mineral ore pitchblende (now known as uraninite), from which they had discovered polonium just a few months before. The substance contained a new element; chemically very close to barium, it glowed with a faint blue light, which earned it the name radium from the Latin 'radius' that means ray.

The Curies extracted a few milligrams of highly radioactive radium chloride from several tonnes of pitchblende. It was not until 1910 that Marie Curie and André-Louis Debierne isolated the pure metal by electrolysis of its chloride salt with a mercury cathode. The procedure — which produced a radium–mercury mixture — involved distillation of the mercury that would require quite the risk assessment today. In the same year, the importance of element 88 was set when it was chosen as the benchmark to define the original unit of radioactivity: the curie, with 1 Ci being equivalent to the decay activity of one gram of pure ²²⁶Ra. The SI unit, the becquerel, was introduced in 1975. One Bq corresponds to one disintegration per second, and 1 Ci is equivalent to 37 GBq.

Only one year after the successful isolation of elemental radium, Marie Curie was awarded the Nobel Prize in Chemistry for her discoveries of both polonium and radium. Element 88 sits beneath barium in the periodic table, and like the other members of Group 2 it is a soft, shiny, silvery-white metal. A decay product of uranium, it has over 30 isotopes, all of which are radioactive with half-lives that range from mere nanoseconds to 1,600 years.

Entrepreneurs were quick to cash in on the glowing element. Radium soon became hailed as an all-around health and beauty elixir, and added to everyday items such as

Credit: Musée Curie (Coll. imprimées)

water, coffee, beer, chocolate, toothpaste, face creams (pictured) and suppositories. It was also used as a treatment for male impotence — through the careful, and presumably eye-watering, insertion of radioactive wax rods (bougies) into the urethra — and was even added to chicken feed to try to obtain self-incubating eggs.

By 1921 the price of radium was so high (US\$100,000 per gram) that Curie could no longer afford to purchase it for her research at the Institut du Radium in Paris. Fortunately, Mrs Marie Mattingly Meloney, an American editor, heard about the situation and raised the necessary funds to buy one gram of pure radium, which was presented to Curie during a visit to the USA — cautiously housed in a lead-lined mahogany box, as by then some suspected it to have harmful effects, even in small doses that had been deemed safe.

Most notoriously², radium was widely used in paints for clock and watch dials to make them glow in the dark. The women employed to do this detail work had to regularly shape their brushes to a sharp point by using their

lips. The small amount of radium that they ingested each time caused severe anaemia, tooth loss, jaw decay, bone cancer and ultimately death. Although their deteriorating health was disregarded for far too long, the Radium Girls, as they became known, brought a lawsuit against the dial manufacturers in 1927 and settled out of court; eventually radium's popularity declined.

Radium's current annual production — by extraction of spent nuclear fuel rods — is less than 100 grams. Element 88 has become a focus in environmental monitoring, in which its contamination levels in soil are quantified and its radiation levels in watercourses assessed. In medical treatments its use has mostly been superseded by safer alternatives, such as ⁶⁰Co, although ²²³Ra is still used in radiotherapy to treat prostate cancer that has spread to the bone^{3,4}. It acts as a calcium mimic and is incorporated into the bone matrix at sites of active mineralization. Once inside the bone, the α-particles emitted can kill cancerous cells.

Today, the thought of Marie Curie with radium vials in her pocket is terrifying. The warming blue glow she liked to watch at night turned out to be a warning about radium's intense radioactivity. □

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Competing interests

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