Bryan and Cherry Alexander Photography

Jill Sutcliffe

A reindeer digging through snow to graze on lichen. But is it radioactive?

Radioactivity and wildlife

Early in 2003, researchers in the Arctic reported that radioactivity was being spread among wildlife species in ways that no one had detected before. Where does this radioactive contamination come from?

Radioactive contamination in the Arctic was discovered by researchers collecting samples of seabird guano (droppings). The team, from the Norwegian Radiation Protection Authority, found that some samples contained ten times as much radioactive material as other samples from the area. From this they worked out that the seabirds must be eating radioactive fish and crustaceans. There was a chance that plants growing in the fertile guano might concentrate the radioactivity it contained, and become a hazard to plant-eating animals.

Where does it come from?

In the 1950s and early 1960s, nuclear weapons were regularly tested in the air at island sites in the Pacific Ocean and in the Russian Arctic. It was soon shown that, as a result of the testing, places far away from the test sites had become contaminated. Radioactive substances were carried high into the atmosphere, and spread by the jet-stream winds. This information contributed to the political pressures which led to the Partial Nuclear Test Ban Treaty, signed in 1963. It also led to the setting up of groups which measure information about radioactivity in the environment.

In 1986 the Chernobyl accident occurred. A fire which got out of control at a nuclear power station in Ukraine resulted in radioactivity getting into the air. Wind movements in the upper atmosphere transported this radioactive material over much of Europe.

Radioactive materials have also sometimes been released into or dumped at sea, where they can move around unpredictably.

What happens to it?

Nuclear testing, Chernobyl and radioactive dumping at sea have all contributed to the spread of radioactive

Even now some sheep movements in the UK are restricted because of the Chernobyl accident in 1986. Rain brought radioactive materials to ground in the uplands of Wales and Cumbria where the sheep were feeding.

GCSE key words

Half-life
Isotope
Ecosystem
Mutation
Food web
Bioaccumulation

Pascal Goetgheluck/SPL

This scientist is using a Geiger counter to check moss samples collected from a mountainside

Box 1 Radioactive detectives

It is relatively easy to detect radioactive materials. As they decay they give off radiation which can be detected using a Geiger counter or other detector. When an individual atom decays, it emits either an alpha particle or a beta particle. It may also emit a gamma ray. Each click of a Geiger counter records the decay of a single atom. There are few techniques which are as sensitive as that!

In addition it is possible to determine which radioactive isotopes are present by studying the gamma radiation. Each isotope gives out gamma rays with a particular energy or wavelength. The Norwegian researchers used this to show that their seabird guano samples contained unusually high concentrations of uranium-238 and radium-226, two naturally-occurring isotopes. They also found a lot of caesium-137, which does not occur naturally. They guessed that it came from nuclear weapons tests 40 or 50 years ago.

A total of 520 atmospheric nuclear explosions were set off in the years up to 1980.

materials in the environment. In the Arctic, algae in the sea take up radioactive ions, fish eat the algae, and birds eat the fish. On land, lichens take in radioactive substances from the air and are then eaten by reindeer. The reindeer eat a lot of lichen and therefore accumulate radioactive substances in their bodies. High levels also build up in other arctic animals as radioactive substances are passed up the food chain — an example of **bioaccumulation**.

Why should we worry about what's going on up in the Arctic? Environments in the Arctic are fragile because their ecology is highly specialised. There are relatively few species of plants and animals, and when one species in a food web is harmed, the others are also likely to suffer. This means that damage to the environment shows up quickly, and it can be an early indicator of what is going on elsewhere in the world.

• Find out more about nuclear weapons testing using a search engine.

Long-lived isotopes

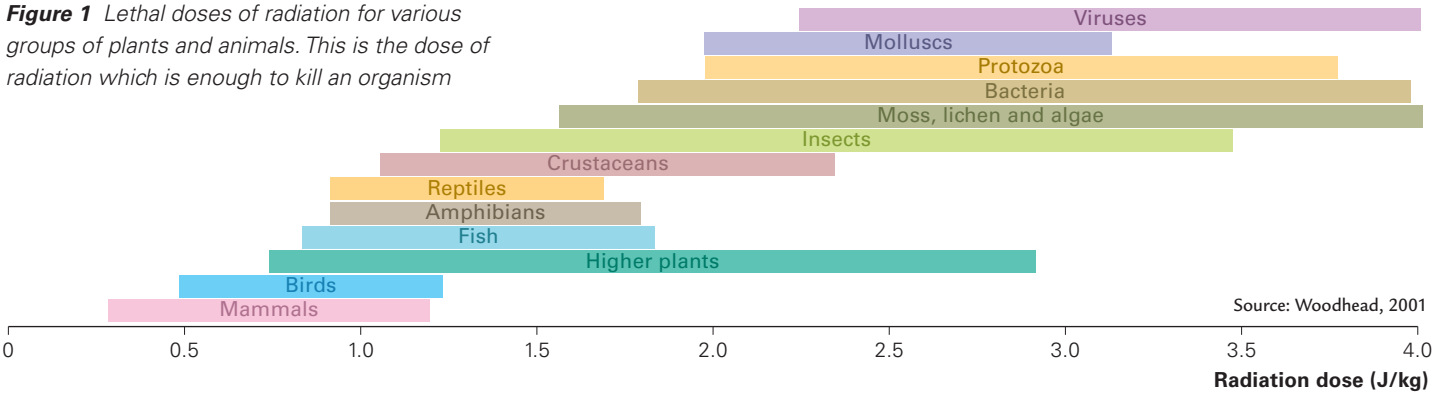
It is only just over 100 years since Henri Becquerel discovered the phenomenon of radioactivity and Marie Curie named it. However, radioactive materials, such as uranium, thorium and the isotope potassium-40, have been present since the formation of the Earth some 4500 million years ago. They have very long half-lives and are known as **primordial elements** (Table 1).

Effects of radioactivity on human health were seen soon after its discovery. People using radioactive materials were exposed to a lot of radiation. There was no means of measuring these invisible rays, and so radiographers (people working with X-rays) measured the standard dose by putting their hands in the path of the rays until they went red.

Table 1 *Many radioactive elements were present in the Earth when it formed, 4500 million years ago. Those with long half-lives are still present, as they decay very slowly*

Radioactive isotope	Half-life
Uranium-238	4500 million years
Thorium-232	14 000 million years
Potassium-40	1300 million years

Figure 1 *Lethal doses of radiation for various groups of plants and animals. This is the dose of radiation which is enough to kill an organism*



Source: Woodhead, 2001

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