According to Leslie Roberts in *Science* (**248**, 24; April 6, 1990), debate is raging over Gardner's study, because, if Gardner is right, radiation safety standards may have to be changed. In the dispute over the Sellafield study, one fact appears clear—there is an unexpectedly high incidence of childhood leukaemia in the village of Seascale in northwestern England, where the Sellafield nuclear reprocessing plant is located. Similar leukaemia clusters have been found near the Dounreay reprocessing plant in Scotland and the Ministry of Defence weapons labs at Aldermaston and Burghfield.

Gardner and his colleagues culled birth and medical records, and, when possible, reanalysed pathological specimen. They identified 74 cases of childhood leukaemia and non-Hodgkin's lymphoma, diagnosed between 1950 and 1985, in the country of West Cumbria, and matched them with 1001 controls. They then investigated four possible causes—prenatal X-rays, viral illness in the mother, anything that might enhance environmental radiation exposures, and parental occupation and exposure to radiation. The only one that stood out strongly was the father's employment at the plant, and, especially, his radiation dose before his child's conception. Children whose fathers were exposed to the highest levels of external radiation—either a total dose of 100 millisieverts, typically accumulated over about 6 or 7 years, or 10 millisieverts in the 6 months before conception—were six to eight times more likely to develop leukaemia than were the controls.

Researchers ask why genetic effects should show up in the children of the Sellafield workers, whose highest doses were about 10 or 20 millisieverts, when they don't show up in the children of Japanese survivors, whose average exposure was 450 millisieverts. Gardner's view is that the Japanese exposure was very different from a work situation. He speculates that perhaps DNA can repair itself after an instantaneous exposure, like that in Japan, but not in the face of continuous, low-level exposure.

According to the article in *Science*, Warren Sinclair, director of the US National Council on Radiation Protection and Measurements, does not propose to take any hasty action until more data are collected.

Meanwhile, at the Sellafield plant, British Nuclear Fuels, which runs the plant, has announced that any worker who is alarmed about his exposure can, after counselling, be transferred to another job. Several have talked to the managers about the risk, but none has decided to be transferred.

Measuring radiation doses

The effect of radiation is described in terms of two quantities. The **absorbed dose** is the amount of radiation energy that is absorbed per unit mass (gram) of body tissue. The SI unit of absorbed dose is the **gray** (Gy). This replaces the earlier rad (for radiation absorbed dose, 1 Gy=100 rad). The **dose equivalent** is a physiological quantity depending on a biological weighting factor. The weighting takes into account different types of ionizing radiation and their energies, because these may have very different biological effects. The SI unit of dose equivalent is the **sievert** (Sv). It replaces the earlier rem (for Röntgen equivalent of man, 1 Sv=100 rem). The gray and the sievert are dimensionally equivalent and are both equal to joule per kilogram. Although, for most practical applications, the weighting is unity, two separate measures are used in order to emphasize the distinction between absorbed dose and dose equivalent.

Sometimes the dose equivalent is weighted to take into account the sensitivity of different human organs/tissues to radiation exposure. This is called **effective dose equivalent** and is also expressed in sievert, or its submultiples, such as the **millisievert** (mSv).

The effective dose equivalent to a group of persons from a source of radiation is called **collective effective dose equivalent.** It is expressed in a unit called **person-sievert.** In practice, it is usually expressed as a rate, e.g. person-sieverts per year.

Dental identification disks

Forensic dentistry has developed into a reliable scientific system as an aid in identification. Among the organs of the body, teeth are the last to be destroyed under any adverse circumstances since they are highly calcified to resist putrefaction. In many criminal assault cases, evidence based on correlation of the arrangement of teeth in suspect/victim with bite marks has been produced and accepted. Availability of dental records of individuals has greatly aided identification of disaster victims. The age of an individual can be computed from an examination of the teeth.

Very recently personalized identification disks were developed, which, when bonded to teeth, help in the identification of individuals in case of disaster or mishap. The disk carries a number, which, when referred to a data bank, can provide details about the individual. The identification disk is bonded to the buccal surface of the maxillary first or second molar. It is placed above the height of contour toward the midline of the tooth; this places the disk in a stress-free area of the mouth. The selected tooth is first isolated for etching. The entire buccal surface is etched for 60 seconds with etching gel containing 30% phosphoric acid. It is then washed for 15 seconds. A small amount of a resin is applied on the etched surface, which looks chalky white in colour. The resin is also applied on the back of the disk, which is then placed on the prepared tooth surface. The disk is completely covered with the transparent resin, which is then polymerized to harden it.

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