GENETIC HARM FROM VERY LOW-DOSE PLUTONIUM EXPOSURE

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Plutonium-239 (Pu) is present in the soil of the DOE portion of the Rocky Flats site.[1] Some of this Pu can be expected to move onto the Refuge. Some will be moved by water in subsurface soil.[2] Some will be brought to the surface by burrowing animals or plant uptake and moved onto the Refuge by wind, water or human activity.[3] Because of its 24,110 year half-life, there is no question about whether Pu will be in the environment at the Refuge. This poses a danger to humans who enter the Refuge. The greatest threat is genetic.

Scientists at Columbia University found that a single plutonium alpha particle induces mutations in mammal cells. In a follow-up study, they found that a single plutonium alpha particle can induce mutations in bystander cells that received no direct radiation exposure.[4]

Hermann J. Muller, who received the 1946 Nobel Prize for his discovery of mutations in fruit flies exposed to radiation, in 1964 wrote that the genetic effect of radiation exposure of humans may not be apparent until the passage of several generations, when a person in the family chain of genetic harm will suddenly lose the ability to reproduce, bringing that family line to "genetic death." Thus, he said, "the hereditary damage should be the chief touchstone in the setting of 'permissible' or 'acceptable' dose limits."[5]

Genetic specialist Diethard Tautz said in 2000 that the very same hidden genetic effect can happen with wildlife exposed to radiation. He calls this a "genetic uncertainty problem."[6]

Colorado has the strictest standard for plutonium in surface water in the country. This is good, but it isn't good enough. Even with this standard some – especially children – will be harmed if the public is allowed access to the Rocky Flats National Wildlife Refuge. The Refuge should remain closed to the public.

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[1] The cleanup standard for the top 3 feet was 50 picocuries per gram of soil (50 pCi/g), which is 1,250 x the 0.04 pCi/g local level of Pu from global fallout. Pu in soil at a depth of 3 to 6 feet can be 25,000 to 175,000 x the 0.04 pCi/g global fallout level, while below 6 feet there is no limit on the amount allowed to remain in the soil.

[2] In the unusually wet spring of 1995 environmental engineer M. Iggy Litaor with instruments set up in the soil at Rocky Flats detected rapid migration of Pu. Similar movements have been detected elsewhere. See Arnie Heller, "Plutonium Hitches a Ride on Subsurface Particles," *Science & Technology Review*, Lawrence Livermore National Laboratory, October/November 2011, pp. 16-18.

[3] Shawn Smallwood, "Soil Bioturbation and Wind Affect Fate of Hazardous Materials that Were Released at the Rocky Flats Plant, Colorado" (November 23, 1996), Report submitted for plaintiff's counsel in Cook v. Rockwell International, United States District Court, District of Colorado, No. 90-CV-00181; Smallwood et al., "Animal Burrowing Attributes Affecting Hazardous Waste Management," *Environmental Management*, vol. 22, no. 6, 1998, pp. 831–847; D. I. Kaplan et al., "Upward Movement of Plutonium to Surface Sediments During an 11-Year Field Study, SRNL-STI-2010-00029, January 25, 2010. http://sti.srs.gov/fulltext/SRNL-STI-2010-00029.pdf.

[4] Tom K. Hei et al., "Mutagenic effects of a single and exact number of particles in mammalian cells," *Proceedings of the National Academy of Sciences*, vol. 94 (Apr. 1s allowed various amounts of plutonium (Pu) to remain in the soil: 997), pp. 3765-3770; and Hongning Zhou et al., "Radiation risk to low fluences of α particles may be greater than we thought," *Proceedings of the National Academy of Sciences*, vol. 98 (Dec. 2001), pp. 14410-14415.

[5] Herman J. Muller, "Radiation and Heredity," *American Journal of Public Health and the Nation's Health*, vol. 54, January 1964. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1254569/?page=9

[6] Diethard Tautz, "Genetic Uncertainty Problem," *Trends in Genetics*, vol. 16 (November 2000), pp. 475-477.