Need for protections from radiation at Rocky Flats supported by science
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The two biggest controversies at Rocky Flats in 2019 are the presence of radioactive plutonium in the Rocky Flats National Wildlife Refuge and the area proposed for the Jefferson Parkway. When the "cleanup" was done at Rocky Flats the official standard for nuclear waste in the top 3 feet of soil at the site was 50 pCi/g, Much higher amounts were allowed in soil at deeper levels. EPA and CDPHE call this "safe." But the National Academy of Sciences says any exposure is harmful. (See *Health Risks from Exposure to low Levels of Ionizing Radiation, BEIR VII, 2006)*

In 1943, for the Manhattan Project, Karl Z. Morgan accepted the task of determining how much ionizing radiation nuclear weapons workers could be exposed to without harm. Called the "father of health physics," he worked at Oak Ridge with specialists. "We all . . . adhered . . . to the so-called 'threshold hypothesis,' meaning that if a dose were low enough, cell repair would take place . . . and there would be no resultant damage. In other words, we believed there was a safe level of radiation." By 1949, however, "The majority of us realized that there really wasn't a so-called safe level of exposure." Convinced that risk increased in exact proportion to dose, Morgan and colleagues rejected the threshold model in favor of the "linear no-threshold" (LNT) hypothesis. (Morgan in Robert Del Tredici, *At Work in the Fields of the Bomb*, 1987, pp. 132-3.)

Morgan headed the Health Physics Division at the Oak Ridge National Laboratory from its creation in 1943 until his retirement in 1972. He influenced bodies that recommended exposure standards, including the National Council on Radiation Protection and Measurements (NCRP), which adopted the LNT approach for calculating risk, making it the orthodoxy of the nuclear establishment. In 1956 Lauriston Taylor, the NCRP's longest-serving member, said: "Any radiation exposure received by man must be accepted as harmful. Therefore, the objective should be to keep man's exposure as low as possible and yet, at the same time, not discontinue the use of radiation altogether." (Taylor in Catherine Caufield, *Multiple Exposures: Chronicles of the Radiation Age*, 1989, p.120.) Though belief that there is no safe level of exposure continues, it is not accepted for Rocky Flats, since DOE, EPA and CDPHE call exposure to 50 pCi/g "safe."

Morgan eventually rejected the LNT orthodoxy in favor of the more stringent "supralinear" approach, because it "fits the data more appropriately." He explained: "Down at the very low doses you actually get more cancers" from low doses "than you do at the high doses. Now, I'm not saying that you get more cancers at these low doses than at high doses. I'm saying that damage per unit dose is greater at these levels. And that's true in part because the high levels will more often kill cells outright, whereas low levels of exposure tend to injure cells rather than kill them, and it is the surviving, injured cells that are the cause for concern. . . . there's no question that the effects of fallout, the effects of handling radioactive materials, and

the effects of even a small medical exposure will be much more severe than had been anticipated." (Morgan, in Del Tredici, p. 133) Leading scientists accepted the supralinear approach, including Alice Stewart, England's foremost nuclear specialist.

Morgan understood that if low-dose exposure is more dangerous than previously realized, more stringent protective measures are needed. But once he rejected the LNT orthodoxy in favor of the supralinear approach, he had moved beyond the established paradigm, and the industry ostracized him. Until his death in 1999 he led an active campaign against exposure to low-dose radiation, testifying as an expert witness in lawsuits. (Karl Z. Morgan and Ken M. Peterson, *The Angry Genie: One Man's Walk through the Nuclear Age*, 1999, p. 145.)

The LNT approach of the nuclear establishment, with its recognition that any exposure to radiation is potentially harmful, is midway between the threshold view that there is a level of exposure below which harm does not occur and the supralinear view that low dose radiation is more harmful per unit dose than higher levels of exposure. Hormesis, a close cousin of the threshold view, assumes that a little radiation is good for you. Each of these views has supporters.

But what is best for public health, including offspring and future generations?

The answer is simple: That is best which is most protective. Obviously, this is the supralinear approach, with its concern to protect people from harmful effects from low-dose exposure. If people are protected at this level, they are protected at all levels. Clearly, anyone visiting the Rocky Flats National Wildlife Refuge or working at or living near the proposed Jefferson Parkway is not protected.