Rethinking a tenet of cancer risk assessment for low radiation doses

Science isn’t perfect, but it does theoretically correct itself, and in the process even overturns keystones to fields of knowledge. However, such shifts don’t occur without pushback, especially from individuals and organisations with something to protect. The Health Physics Society, which is dedicated to radiation safety, produced a documentary that exposes a history of scientific errors, fundamental self-correction. Einstein unwound Newton’s clockwork theory of the universe; Barry J Marshall and J Robin Warren found friends in pharmaceutical companies selling chronic medication to people with stomach ulcers, and the powerful National Football League (NFL) almost destroyed Omalu’s career.

Scientists develop a clearer understanding of radiation biology. Notably, such self-correcting significant advances wouldn’t be easy and involved considerable scorn and rebuke from academic circles. Influential companies and organisations with financial interests in retaining the status quo ensured extra inertia. Marshall and Warren found few friends in pharmaceutical companies selling chronic medication to people with stomach ulcers, and the powerful National Football League (NFL) almost destroyed Omalu’s career.

Such fights for the soul of science continue. In the United States, food multinationals that influence federal dietary regulatory committees are pushing back against growing scientific evidence that the nutritional guidelines could be feeding the obesity epidemic. And leadership within the US-based HPS – a professional organisation dedicated to radiation safety – is strongly encouraging a re-examining of one of the fundamentals of radiation risk assessment they claim should never have seen the light of day.

WHERE IT STARTED

If you’re looking for a player at the LNT Model’s genesis, it’s Hermann J Muller. Muller was a leading American geneticist who, during the 1920s and 1930s, performed, at the time, groundbreaking research into radiation on fruit flies. He believed his work proved a link between radiation exposure and genetic mutations. His work, published in the eminent journal Science, helped establish his reputation as a specialist in the nascent field of radiation genetics. However, as Calabrese points out, Muller did not include his data in the publication. There are a couple of other unfortunate facts: Muller received the Nobel Prize in Physiology or Medicine in 1946 for showing a link between radiation exposure and genetic mutations, but, according to Calabrese, Muller confused a mutation (e.g., gene mutation) with a transgenerational phenotype change, a mistake he admitted ten years after receiving his Nobel Prize. Also, his experiments focused primarily on the effects of massively high doses and high dose-rates of radiation, over 100-million-fold dose-rates more than background radiation, and he assumed that the concept of genetic repair mechanisms did not exist. The concept of genetic repair mechanisms in mice was first suggested in 1958 by
Behind the Research

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radiation geneticist William Russell, a colleague of Muller. There's more: the focus of Muller's research — fruit flies — may share many fundamental genetic and biological characteristics with other organisms, but they're certainly not humans. At the end of the Second World War, as America entered a protracted nuclear race with the Soviet Union, it needed a clearer picture of the possible genetic effects of radiation on humans. However, the American human-population geneticist, James V Neel, published research showing no significant increase in birth defects or other genetic damage in the offspring of Japanese survivors of the Hiroshima and Nagasaki bombs, effectively challenging Muller's risk assessment interpretations. Muller, nonetheless, used his influence to prevent Neel's study from being reviewed. Russell's written reason for not publishing his findings was 'It was, therefore, something of a surprise not to obtain a positive result in the experiment described here, and it was feared that publication of a negative finding could mislead the public into a false feeling of safety.'

A FLAWED PERSPECTIVE Hermann J Muller and William and Liane Russell are just two of the players in the illuminating HPS interviews with Calabrese that come to light as having shaped our understanding of heredity and cancer risk assessment. There are many others, and in the interviews, drawing on the vast troves of correspondence between them and other original documentation, Calabrese untangles the web of decisions and consequences he believes happened at the intersection of progress and regulatory agency public health and cancer risk assessment policies.

As the HPS stresses, generations of radiation geneticists, health physicists, nuclear engineers, and others have been incorrectly brought up to accept the LNT Model as an unassailable keystone of their discipline and to believe all genetic damage is cumulative, irreversible, and irreversible. The HPS says this flawed perspective transformed the field of radiation protection and, in their words, 'created a vehicle for an ideology of radiation protection that was feared that publication of a negative finding could mislead the public into a false feeling of safety.'

The RUSSELLS AND THE MICE Other highly significant players in this scientific drama are William L Russell, a geneticist and radiation biologist who worked at Oak Ridge National Laboratory, part of the US Atomic Energy Commission, from the 1940s through 1950s, and his wife and fellow geneticist, Liane. The Russells attracted generous government funding to investigate the genetic effects of radiation exposure on mice, specifically focusing on the inheritance of mutations caused by massive doses and dose-rates of radiation. Their published research helped support Muller's LNT model and its adoption by central scientific and regulatory advisory committees. However, according to Calabrese, the Russells failed to report numerous control-group mutations which lead to a gross overestimate of hereditary risk. This failure ultimately influenced the US NAS to formally adopt the LNT model for hereditary risk in 1956 and cancer risks in 1972.

Another serious deception by William Russell has been recently revealed. In a major study ending in 1959, William Russell exposed male mice to a very high (near death-threatening) acute dose of radiation while observing health and longevity in the offspring. He concluded that the offspring of the mice exposed to this extremely high dose of radiation didn't experience any adverse effects. This outcome challenged the LNT model that predicts low-dose radiation would lead to negative findings in offspring. Despite the obvious importance of this finding, Russell did not publish his data for over thirty years until 1993, in order to help win a court case for the British nuclear industry by which time Muller's LNT Model was considered untouchable. Russell's written reason for not publishing his findings was 'It was, therefore, something of a surprise not to obtain a positive result in the experiment described here, and it was feared that publication of a negative finding could mislead the public into a false feeling of safety.'

References
• Calabrese, EI, Seely, RS, (2002), Cover up and cancer risk assessment: Prominent US scientists suppressed evidence to promote adoption of LNT. Environmental Research, 102: doi.org/10.1016/s0013-9351(02)01293-7

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