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Linear Non-Threshold (LNT) historical discovery milestones[1]

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Abstract

The present paper provides a summarized identification of critical historical milestones in the discovery of the flawed and corrupt foundations of cancer risk assessment, with particular focus on the LNT Dose Response model. The milestone sequence presented herein is based on a large body of published findings by the author. The history of LNT and cancer response represents what may be the most significant case of scientific misconduct reported in the US, with its revelation severely damaging the scientific credibility and moral authority of leading US regulatory agencies and organizations such as the National Academy of Sciences (NAS) and the journal Science. The consequences of this corrupt history are substantial, affecting cancer risk assessment throughout the world, critical aspects of national economies, the development of critical technologies and public health practices.

1. Introduction

In recent years there has been a reawakening of interest to document and clarify the historical foundations of cancer risk assessment. While this has typically been based on peer-reviewed literature, it misses essential historical foundational elements preserved in original documents such as letters, memos, meeting transcripts, unpublished dissertations and theses, research proposals, and other types of communications that may offer unique insights into underlying reasons for critical scientific and policy decisions. Over the past fifteen years, I have attempted to integrate such original documentation while expanding its scope and reframing it within a more technically rigorous, and challenging science focus. These assessments represent a novel hybrid historical-scientific analysis designed to integrate the strengths of both approaches.

New insights have emerged concerning the historical foundations of LNT and cancer risk assessment from these analyses that have challenged, and, perhaps have shaken, some of the core historical beliefs of health physics and chemical toxicology. These findings have revealed that critical foundations of cancer risk assessment were based on fundamental errors, profound institutional and personal bias, unethical editorial practices by *Science* journal, and deliberate misrepresentations of the scientific record by leaders of the radiation genetics community as members of the NAS Biological Effects of Atomic Radiation (BEAR) 1 Genetics Panel and

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the NAS leadership itself. This body of work has also revealed that some of these leading radiation scientists suppressed cancer study findings to ensure their biased cancer risk assessment views would be adopted.

Never in the historical foundations of modern science has such a long series of linked episodes of fraud and corruption overtaken a leading scientific disciple (i.e., radiation genetics), and organizations granted special status of public trust, such as the journal *Science*, the NAS and the US Environmental Protection Agency (EPA). The present paper provides a "brief" listing of historical milestones in the LNT historical fraud discovery process. It is recommended that the reader watch the documentary of the Health Physics Society on the historical foundation of cancer risk assessment and the LNT The History of the LNT Episode Guide (hps.org).

2. Milestones

2.1. PART 1: Muller-Establishing the LNT Concept and Single-Hit Model

1. **Hermann J. Muller based the linear dose response concept for radiation induced gene mutations on the assumption that repair of genetic damage did not occur.** This mistaken interpretation was based on observations that visual background mutations in fruit flies were uncommon, suggesting that the genome was extremely stable [1].
2. **Muller neglected to propose alternative hypothetical evolutionary mechanisms that included a repair feature**. Failure to do so became an overriding conceptual error that lead other radiation geneticists to adopt LNT [1].
3. **Muller's Nobel Prize Research induced transgenerational genetic changes using a massive dose rate that exceeded background by 100 million-fold** [2, 3]. Failure to recognize this dosage disconnect between his massive exposure rate and background radiation lead to improper application of these findings for human risk assessment policies and exposure standards.
4. **A major development was that Muller did not induce gene mutation despite getting the Nobel Prize for this "discovery"**. While Muller was soon challenged that he did not induce gene mutations but mostly gene deletions, a significant discrediting occurred only after Muller achieved the dose response revolution by getting the NAS to recommend the switch from a threshold to LNT for radiation risk assessment [4].
5. Muller used his novel genetic damage findings and newly acquired status to encourage collaboration between radiation geneticists and leading physicists in the mid-1930s to create the LNT single-hit model. **This mechanism based LNT model excluded repair of genetic damage** [5, 6].
6. While Muller's radiation induced gene mutation and LNT hypotheses [7] were largely discredited by the late 1930's [4, 8, 9], these were revived by the Ray-Chaudhuri's [10] research [11, 12], solidifying his **chances for the Nobel Prize** [11].

2.2. PART 2: The Manhattan Project and LNT Muller-Establishing the LNT Concept and Single-Hit Model

7. Muller convinced Manhattan Project (MP) researcher leader Curt Stern to replicate and strengthen the findings of Ray-Chaudhuri [5, 12].
8. **During the MP the chronic exposure experiments of Ernst Caspari failed to support the Ray-Chaudhuri LNT hypothesis but rather supported a threshold dose response model** [11].
9. Stern refused to accept the threshold findings of Caspari, claiming his control values were aberrantly elevated leading to the threshold observations [12].
10. Caspari rebutted Stern based on peer-reviewed literature by radiation geneticists [5, 12, 13].
11. **Caspari and Stern wrote a manuscript claiming that their threshold findings should not be accepted until it was**

determined why Caspari showed a threshold while the earlier acute exposure study by Warren Spencer showed a linear response. This effectively marginalized the impact of the Caspari findings on the field of radiation risk assessment [14-16].

12. Muller reviewed the Caspari findings prior to giving his Nobel Prize Lecture on December 12, 1946. [17]. However, during the Nobel Prize Lecture **Muller failed to acknowledge the threshold findings of Caspari, despite its being the largest chronic exposure study to date and having no criticisms** [18].
13. **In contrast, Muller praised the seriously flawed Ray-Chaudhuri dissertation, inexplicably using it to claim that this research discredited the threshold model** [14].
14. Follow up MP research by Uphoff and Stern to replicate the Caspari study never yielded a peer-reviewed research paper, only a one-page summary in *Science*. No data have ever been reported for the two chronic exposure Uphoff experiments [19]. **Lacking any published papers by Uphoff in the peer-reviewed literature on these matters makes the issue of Uphoff study weaknesses and their scientific and policy relevance mute. Nonetheless, due to the influence of Stern and Muller, the radiation genetics community and the NAS BEAR 1 Genetics Panel inappropriately gave credence to the unpublished and unavailable Uphoff data** [5].
15. Control group research by Muller at the University of Indiana from 1946 to the mid-1950s confirmed the Caspari control data [5, 12].
16. Muller contradicted himself in reports in the 1950s that Caspari's control was aberrantly high and Uphoff's data were acceptable. Muller failed to report past communications with Stern supporting Caspari showing profound bias [12, 20-22].
17. In 1949, the prominent MIT health physicist Robley Evans strongly endorsed the threshold conclusions of Caspari [23]. Evans initiated communication with leading radiation geneticists and he was being successful in persuading many to his view [24]. Muller became concerned and needed to discredit the threshold supporting Caspari findings. This led to his dishonest published papers.

2.3. PART 3: The NAS BEAR 1 Genetics Panel-Recommends LNT

18. In 1955 the US NAS created the BEAR 1 Genetics Panel, funded by the Rockefeller Foundation (RF). The President of the Rockefeller Institute for Medical Research and the President of the NAS was the same person, Detlev Bronk who also was on the Board of Directors of the RF [5].
19. **Bronk appointed Warren Weaver, the director of the RF, to chair the NAS Genetics Panel, though not a geneticist. All the geneticists selected were strongly supportive of the LNT view.** The Panel proclaimed the belief that all radiation doses, no matter how low, induced gene mutation, that the genetic damage was cumulative, irreversible and not reparable, leading to a linear dose response [5, 13].
20. **The Panel, based on Muller's leadership, refused to give scientific standing to the ten-year study of the transgenerational genetic effects of the atomic bombs** since it showed no treatment related effects, supporting a threshold [14].
21. In light of this decision, Neal "quietly" shared his study with a UK genetics committee [25].
22. **The BEAR 1 Genetics Panel commits scientific misconduct:** Weaver assigned the geneticists of the Panel to estimate the number of genetic defects induced in offspring of US adults, given a specific gonadal exposure to ionizing radiation, assuming a linear dose response. There was enormous uncertainty and variation for genetic damage estimates among the panel geneticists, causing concern that Panel recommendations (e.g., linearity) may not be accepted. In response, the Panel hid the disagreement/uncertainty in its *Science* journal paper and committed scientific misconduct [5, 13, 26].

23. The Panel refused to provide written documentation of the scientific foundations of their report with the approval of the President of the NAS, Brock [13].
24. The BEAR 1 Genetics Panel produced two reports: one in *Science* and a "Report to the Public". The "Report" document had a major impact upon the leading mainstream media. **The Genetics Panel did not write, review or approve the "Report". The NAS represented the "Report" as the work and opinions of the Panel, deceiving the public** [27].
25. Neel presented his Atomic Bomb genetic data in August, 1956 in international settings with considerable publicity, creating controversy with Muller who was concerned that such human population studies, such as Neel's, would redirect funding from his laboratory efforts to field studies [28].
26. Muller tried to prevent the research paper of Neel from being published in a World Health Organization (WHO) conference report. This created further hostilities, requiring the intervention of UK scientists to protect Neel's position [28].

2.4. PART 4: The Lewis Impact on LNT

27. George Beadle, the chair of Biology at Cal Tech, refocused the BEAR Genetics Panel on the capacity of mutations to induce cancer, encouraging Edward Lewis to develop a paper on radiation and cancer risk. The Panel reviewed the manuscript prior to its publication in *Science*. [5].
28. **The Lewis paper received an endorsement by the editor of *Science*; he was featured in *Life* magazine and testified before Congress and appointed to National Committee for Radiation Protection and Measurement (NCRPM)** [29-32].
29. **In 1958 Lewis led NCRPM to recommend LNT for radiation induced cancer based on the Precautionary Principle** [30, 33].
30. In 1959, Congressional testimony by Lewis contained either multiple blatant errors or deliberate misrepresentations of the research record to support adoption of LNT [29].
31. The findings of Lewis have been criticized for strong bias and lack of adequate expertise. Numerous flaws were exposed, discrediting its application to the human risk assessment [29, 30].
32. **In 1959, President Eisenhower created the Federal Radiation Council (FRC) to undertake human health risk assessment, as the President lost confidence in the threshold supporting Atomic Energy Commission (AEC) based on the reports of the BEAR 1 Genetics Panel. The FRC became advised by LNT supporting BEAR radiation geneticists to guide their decisions. The staff of the now LNT supporting FRC became incorporated into the EPA, with its LNT philosophy** [5].

2.5. PART 5: William Russell and the LNT Story

33. In late 1950s, William Russell of the BEAR 1 Panel and Arthur Upton suppressed a negative lifetime radiation cancer study with mice. Thirty-five years later Upton used this data to win a litigation on radiation induced cancer in the UK [34, 35]. Russell wrote that he did not think that the public could place the findings in proper perspective. Upton continued to suppress the study as director of the US National Cancer Institute (NCI) and chair of Biological Effects of Ionizing Radiation (BEIR), 1990.
34. **In 1958 William Russell reported that mice display repair of radiation induced mutational damage. They showed the existence of a dose rate effect, which suggested DNA repair** [36].
35. After Muller died in 1967 Russell criticized the fundamental tenets of the Radiation Mantra based on his extensive studies with mice. Russell [37] showed that the Radiation Manta was not valid, since damage was not cumulative, could be repaired and did not lead to a linear dose response at low dose rates.

36. A new NAS committee was created in 1970 to update the work of the BEAR Panel. The Panel acknowledged repair but retained the LNT model and applied it to cancer risk assessment in 1972 [5]. While the Russell work had shown a threshold for female mice, males had not yet shown this, despite showing substantial repair capacity.
37. Nearly twenty-five years later Paul Selby found a significant error in the Russell data control group [38]. The Russells failed to report control group mutation cluster findings. Due to an external board review, the Russells corrected the record [39]. **If the 1972 estimates had the correct values, the findings would indicated a threshold for males and an hormetic effect for females, challenging the LNT conclusion of BEIR I and their adoption by EPA** [5].

3. Conclusions

The history of LNT and cancer response represents perhaps the most significant case of scientific misconduct ever uncovered in the US, spanning several generations, undercutting the scientific credibility and moral authority of leading US regulatory agencies, national standard bearer organizations such as the NAS, the journal *Science* and leading scientists. It also challenges the failure of the national media to investigate and report such information to the public.

The pattern is so extreme, pervasive and important since the collective actions result in the control and direction of cancer risk assessment principles and practices worldwide, affecting governments, economies, new technologies, medical successes, lifestyle choices, how parents raise their children and how one perceives the world. The LNT story is also more than science as it becomes inextricably entangled with controlling human activities from the individual to the largest corporations and national and international policies and actions.

Finally, of particular concern is that the US EPA was created fifty-two years ago, using massive financial and scientific resources to assess cancer risk evaluation concerns. However, the US EPA has not been involved in any of the above historical discoveries reported here. Rather, the history of the EPA has been one of accepting and integrating the numerous mistakes and misconduct derived information into the polices and practice, simply perpetuating the corrupt practices identified here.

4. Final Thoughts

Since the field of cancer risk assessment and its regulatory practices throughout the world are based on profoundly corrupt foundations, what should governments, regulatory agencies and society do? The most likely thing that government regulatory agencies will do is exactly what they have always done concerning such a challenging issue: NOTHING. They will ignore the issue, hoping that it will simply get buried and die. This is exactly what they have been doing since the present series of revelations started to be uncovered and reported. Such a conclusion is supported by the actions of establishment politicians, the leadership at *Science*, the NAS and a number of editors at other highly influential journals where they prevent publication and suppress these concepts and findings. Thus, there is a strong agenda to stop this issue from having an impact on regulatory agencies and many other areas within society. Unless there is an open and detailed scientifically based discussion on these matters nothing will change.

The most important practical change needed is the replacement of the public health philosophy based Precautionary Principle which is founded—not on science-but on fear, with an evolutionary biology based Precautionary Principle that acknowledges that all organisms, including humans, are not victims of environmental challenges and threats but incredibly resilient survivors that have been selected for over many millions of years to successfully deal with all sorts of anticipated and unanticipated physical, chemical, biological and social threats to health and life. These evolutionary processes occur in all living creatures, from bacteria to humans, each with their own selected versions of efficiency and redundant protective strategies. However, regulatory agencies such as EPA have decoupled evolutionary biology from their regulatory philosophy and practices. Yet,

as Theodosius Dobzhansky eloquently reminds us in this paraphrasing of his famous evolutionary dictum: Nothing in Life, including regulatory science and its underlying cancer risk assessment modeling makes sense without an evolutionary foundation. Regulatory agencies need to return to basics, that is, an evolutionary biology based Precautionary Principal framework. If this were achieved it would revolutionize and enlighten the regulatory process and environmental-public health philosophy and practices.

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