Commentary

# Professor John Roderick Cameron's Influence on Radiation Safety in Terrestrial and Space Environments

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## ABSTRACT

Professor John Roderick Cameron (1922–2005) stands out as a trailblazer in the field of medical physics, whose innovative work has deeply influenced radiation protection and the broader medical radiation field through sound technical judgment and insight. Best known for inventing the bone densitometry device, his pioneering efforts have reshaped modern medical practices far beyond his initial breakthroughs. Cameron's explorations extended into the realms of space biomedical science and models of terrestrial radiation, areas where his insights continue to resonate today. As the Emeritus Professor of Medical Physics at the University of Wisconsin-Madison and a founding member of the American Association of Physicists in Medicine, Cameron laid crucial groundwork for safety standards in environments with high natural radiation levels. His leadership was instrumental in advancing thermoluminescence dosimetry, radiation measurement, and image quality assurance, driving progress in both academia and clinical practices. Moreover, through establishing Medical Physics Publishing, Cameron played a pivotal role in spreading vital research and educational materials across the fields of health physics and medical physics. This commentary reflects on Cameron's far-reaching contributions, highlighting his critical work in space radiation research and terrestrial radiation models-key to the future of interplanetary travel and potential human settlement on planets like Mars. His research in areas of high background radiation, like Ramsar, Iran, has been fundamental in developing strategies for biological protection in space, which are essential for ensuring astronaut safety during long-duration space missions. We honor Professor Cameron's profound legacy, celebrating his visionary spirit and the lasting impact of his contributions on generations of scientists in radiation science.

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## Keywords

JR Cameron; Radiation Protection, Background Radiation, Space Radiation, Astronauts

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## Introduction

This commentary addresses the scientific achievevments of John Roderick Cameron (1922–2005), as a true pioneer in medical physics. Although Cameron's work has had a significant influence on how medicine is currently practiced and state that millions of people throughout the world have benefited from his remarkable achievements such as the invention of the bone densitometry device, they simply ignored his contribution to some rapidly growing fields of science such as space biomedical science and terrestrial models for journeys to Mars or human colonization on the red planet [1, 2].

In 2005, the health physics and medical physics community lost a notable scholar, Professor John R. Cameron, at the age of 82. An Emeritus Professor of Medical Physics at the University of Wisconsin (UW)-Madison, Cameron left an indelible mark on the field with his pioneering contributions. A founding member and the 10th president of the American Association of Physicists in Medicine (AAPM), Cameron's legacy extends beyond his presidency. He was renowned for his innovative work in thermoluminescence dosimetry [3], bone densitometry [4, 5], and radiation measurement [5-8] and image quality assurance [9, 10]

Moreover, Cameron's impact resonates through the establishment of Medical Physics Publishing, a nonprofit organization dedicated to disseminating original books on health physics and medical physics. Beyond his professional accomplishments, Cameron was an advocate for reducing diagnostic radiation exposures, emphasizing accurate public education about the benefits and risks of medical radiation [11]. As illustrated in Figure 1, Cameron authored several books, including "Physics of the Body" (Medical Physics Series) and "Medical Physics".

Acknowledging Professor John Cameron as the second most Influential Medical Physicist globally, after Marie Curie, is a fitting tribute to his remarkable career. Some of his colleagues including SMJ Mortazavi are honored to have collaborated with him on influential publications in the fields of space biomedical sciences and background radiation. Their joint work, including studies like "Adaptive response studies may help choose astronauts for long-term space travel", [12] has had a meaningful impact on the field.

Cameron's visionary leadership extended to his role as the founding chair of the Department of Medical Physics at UW-Madison. He expanded the scope of physics in patient care, encouraging research in unconventional areas. His program for radiation physics measurement, funded federally, evolved into the Midwest Center for Radiation Physics. Under his guidance, numerous students completed advanced degrees, contributing to the advancement of physics in medicine.

Cameron's commitment to the marriage of medicine and physics was evident in his inventions, such as devices to check X-ray machine output [10], and the establishment of Radiation Measurements, Inc. He recognized the paramount importance of addressing exposure to high levels of space radiation and microgravity, as indicated in studies like "The life-saving role of radioadaptive responses in long-term interplanetary space journeys" [13].

The article by James S. Welsh, published in Radiology [14], discusses the significant influence of his mentor and friend, John Cameron, on his research into the historical levels of radiation and its effects on biological evolution. Cameron encouraged Welsh to explore the idea that radiation levels were higher in the distant past, which likely influenced the evolution of animals, plants, and microorganisms. This research challenges the current Linear No-Threshold (LNT) model, suggesting that modern biology may have overlooked its ancient radiological history. Welsh highlights a specific project and letter he wrote, emphasizing how ancient higher radiation levels would have impacted evolution.

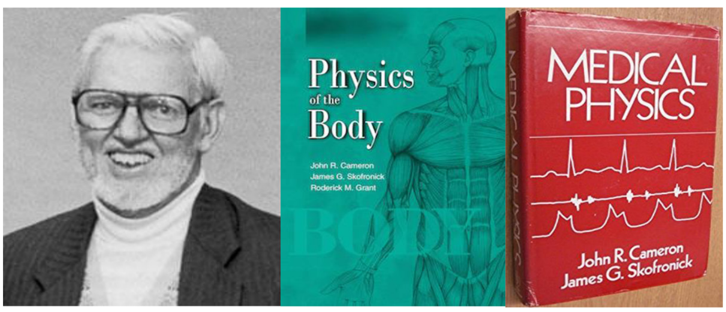


**Figure 1:** John R Cameron, a great leader and founding father of the health physics and medical physics communities, Emeritus Professor of Medical Physics at the University of Wisconsin (UW)-Madison (1922-2005).

Notably, Cameron's work on the "Very high background radiation areas of Ramsar, Iran" [15] has been pivotal in biological protection in space. This study, cited over 500 times, provides crucial insights into the biological effects of high radiation exposure, influencing strategies for protecting astronauts during space missions. As shown in Figure 2, the annual radiation dose in Ramsar, Iran, is higher than that of the Martian surface. While Ramsar experiences naturally high background radiation, the maximum recorded dose (260 mSv/year). This dose is comparable to the estimated dose equivalent rate on the surface of Mars that ranges from 156.4 mSv/year (at solar maximum) to 273.8 mSv/year (at solar minimum).

The research conducted by Cameron and his colleagues Mortazavi and Niroomand-Rad, titled "Potential Benefits of Adaptive Response Studies in Selecting Astronauts for Extended Space Journeys", [12] indicates that selecting astronauts with the most pronounced adaptive responses is advisable for prolonged space travel or colonization on Mars (Figure 3). This strategy aims to mitigate the risk of exposure to unforeseeable and substantial solar particle events, consequently minimizing the necessity for extensive shielding. The study recommends employing adaptive response studies as a criterion for the selection of astronauts for extended space missions, emphasizing the crucial need to address the challenges posed by elevated levels of space radiation and microgravity before embarking on any long-term manned space expedition.

Two decades after loosing Cameron (his death), the research on the cognitive effects of long-term exposure to alpha particles, mirroring conditions in Mars missions, further expanded our understanding. This study, focused on residents with high radium ingestion, revealed increased reaction times, highlighting potential challenges in deep space travel [16-19]. While more studies are required for direct applicability, this research contributes significantly to our knowledge of potential cognitive effects of space radiation exposure.

## Conclusion

In summary, the legacy of Professor John R. Cameron has profoundly influenced the fields of health physics, medical physics, and space radiation research. His innovative perspective and dedication to the progression of these

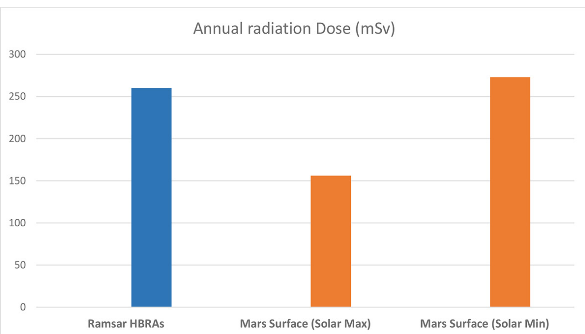


**Figure 2:** This bar chart compares the annual radiation dose in Ramsar, Iran, with that of the Martian surface. While Ramsar experiences naturally high background radiation, the maximum recorded dose (260 mSv/year) is comparable to the estimated dose equivalent rate on the surface of Mars that ranges from 156.4 mSv/year (at solar maximum) to 273.8 mSv/year (at solar minimum).

**Figure 3:** A Vision of human colonization on Mars. (Figure credit: https://copilot.microsoft.com/ created on Feb 25, 2024).

disciplines continue to motivate and guide new generations of physicists and researchers. His spirit, sound judgment, and technical expertise are greatly missed.

## Authors' Contribution

SMJ. Mortazavi conceived the main idea. JJ. Bevelacqua, SAR. Mortazavi and J. Welsh drafted the manuscript. All authors were involved in reviewing and finalizing the manuscript.

## Conflict of Interest

SMJ. Mortazavi and J. Welsh, as the Editorial Board Members, were not involved in the peer-review and decision-making processes for this manuscript.

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