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EDITORIAL

John Roderick Cameron (1922–2005): Scientist, teacher, mentor, inventor, and philanthropist extraordinaire

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1 Introduction

"If anything is worth doing, it is worth doing badly." This is Professor John Cameron's well-known philosophical catchphrase. He was saying, "It doesn't have to be perfect; just get it to work!". [1]Because they could fine-tune and perfect the task at hand, this has frequently inspired his students to "just do it" as some progress is better than none.

Professor Cameron spent his whole life working to advance the field of medical physics in the US and other developing countries, particularly in Latin America and Asia. He is adored by many for his generous spirit, commitment to education and humanity, and excellent sense of humor. He is well renowned for his creative, progressive, and thought-provoking ideas on scientific matters. Figure 1 shows a vintage photo of Professor John Cameron.

Professor Cameron is a distinguished physicist and pioneer in the field of medical physics. He earned the title "father of bone densitometry" for his groundbreaking work in inventing the dual-energy X-ray absorptiometry device, which completely changed how bone density was measured and how osteoporosis was diagnosed and treated. He was also credited as the 'father of thermoluminesce dosimetry' for developing this as a reliable and practical radiation detector that has been extensively used all over the world.

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2 Early life and education

John was born on a farm in Chippewa County, Wisconsin, USA, on 21 April, 1922 and he was raised during the Great Depression. His parents relocated to Superior in 1937 so that he and his seven siblings could pursue higher education. After enrolling at the University of Wisconsin-Superior, John's education was interrupted by service in the U.S. Army Signal Corps from 1941 to 1946. He studied at the University of Chicago following the war, where he earned a BS in mathematics in 1947. After moving to Madison, Wisconsin, John completed his PhD in physics there in 1952. His thesis was titled "Elastic Scattering of Alpha Particles by Oxygen." It's interesting to note that the cross sections data he measured is still used in ion beam implantation research [1–3]. Figure 2 shows John working in his laboratory in his younger days.

3 Academic and scientific career

John's first academic position was as an assistant professor at the University of Sao Paulo (USP), Brazil, in 1952. He spent two years working with Professor Oscar Sala building a 4 MeV electrostatic accelerator. As an assistant professor at the USP, John established many lifelong friendships. After a brief stint of post-doctoral work at the University of Wisconsin-Madison, he became an assistant professor at the University of Pittsburgh (1956–1958). Finally, in 1958, John joined the faculty of the Department of Radiology at Madison as an assistant professor, with a joint appointment in the Department of Physics. Professors Ray Herb and Jerry Nickles were John Cameron's mentors. He quickly established himself as a leader in the field of medical physics and immediately began attracting graduate students and faculty to the new field of medical physics. Those whom John

[1] This quotation was adopted from G K Chesterton, an English writer, philosopher, and journalist.

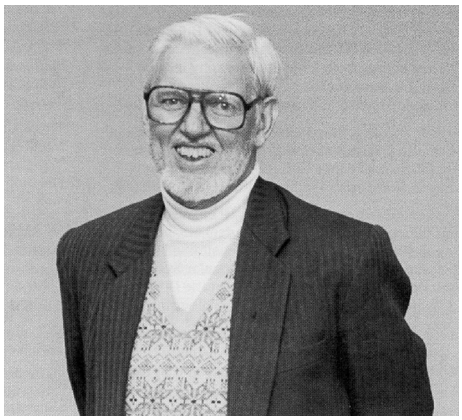

Fig. 1 A vintage photo of Professor John Cameron. Courtesy of the Department of Medical Physics, University of Wisconsin, USA

Fig. 2 The young John Cameron working in the laboratory. Courtesy of the Department of Medical Physics, University of Wisconsin, USA

recruited include, amongst others, Herb Attix, Paul DeLuca, Jerry Nickles, Charles Kelsey, and Charles Mistretta.

Over the following three decades, under his leadership, the UW medical physics department expanded from a "one-man" operation to one of the biggest and most successful in the world. In 1981, the program became the first US department of medical physics, and John served as chair from its beginning until his retirement in 1986. He took considerable personal delight in the fact that many of the department's graduates had achieved significant success as top medical physicists in their respective fields.

The UW in Madison is located about three hours driving distance from the University of Chicago in Chicago, and thus John Cameron frequently visited Chicago for his lectures at seminars in Graduate Programs in Medical Physics. Professor Kunio Doi (one of the authors of this manuscript) was also able to give a talk on radiographic image analysis and magnification techniques during his stay in Madison, Wisconsin. Hence, Kunio and John had known each other,

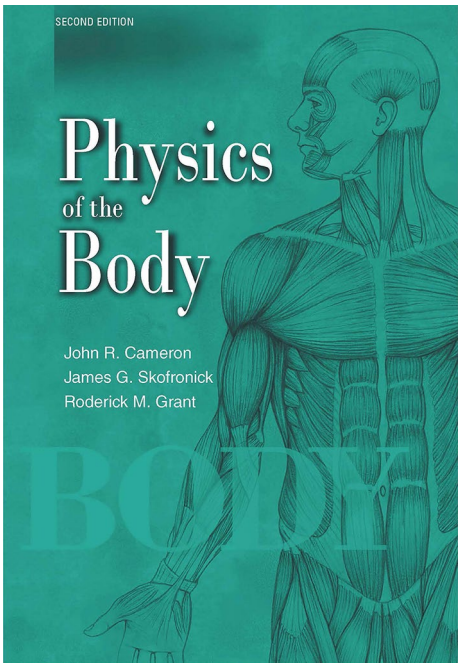

Fig. 3 'Physics of the Body' 2017, 2nd Edition eBook, published by Medical Physics Publishing, Wisconsin, USA. Courtesy of Medical Physics Publishing

although John was a very senior physicist while Kunio was very young.

John also encouraged Professor Larry DeWerd to start the Accredited Radiation Calibration Laboratory (ARCL) in 1981, which provides comprehensive calibration services for diagnostic and therapeutic measurement devices and sources. Since then, ARCL has been serving medical facilities nationwide, providing radiation dosimetry services, and training a large number of graduate students.

In 1963, John was appointed as a professor of medical physics and became the founding director of the Medical Physics Department at UW. Since its inception, under the stewardship of John and his successors, the department has flourished and became one of the leading medical physics departments in the world [4].

At UW John focused on the application of physics to medicine, emphasizing on the development of new technologies and techniques for diagnosis and treatment of human diseases. He was a prolific researcher and published more than 200 scientific papers during his career. One of his most popular books is 'Physics of the Body', coauthored with James Skofronick and Roderick Grant, published by Medical Physics Publishing, Wisconsin, USA (Fig. 3) that has stimulated lots of interest in appreciating the physical basis of the human body [5].

In his later years, from 1992 onwards, John's research interests turned to hormesis. He made a good argument,

Fig. 4 The senior John Cameron in the laboratory. Courtesy of the Department of Medical Physics, University of Wisconsin, USA

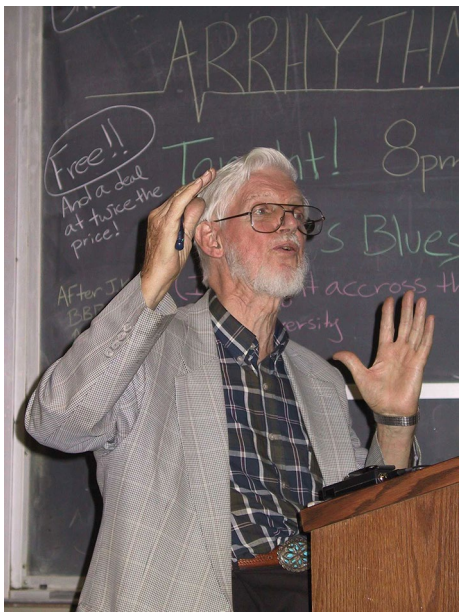

Fig. 5 The enthusiastic John Cameron giving a lecture. Courtesy of the Department of Medical Physics, University of Wisconsin, USA

albeit controversial, that we all need more radiation to be healthy. He published the article "Is radiation an essential trace energy" [6]. He volunteered, but no one dare to do it! Figs. 4 and 5 show senior John working in his laboratory and giving a lecture respectively.

4 Invention and innovation

John has a lot of original ideas in applying physics to solve human health problems. His most significant inventions are bone densitometry and thermoluminescence dosimetry.

4.1 Bone densitometry

John's invention of the single photon absorptiometry (SPA) to assess bone mineral content was one of his greatest contributions to medicine [7–10]. This technique was further developed into dual-energy X-ray absorptiometry (DXA) which is a main method to quantify bone mineral content. DXA quickly became the gold standard for measuring bone density and diagnosing osteoporosis, a condition that causes bone fragility and increases the risk of fractures, particularly in older adults. Two historical documents on the SPA are shown in Figs. 6 and 7.

John's DXA device was the first to use two different X-ray energies to measure bone density, which allowed for more accurate and precise measurements than previous techniques. The device was also capable of measuring bone density at various sites in the body, including the hip and spine, which are the most common sites of osteoporotic fractures.

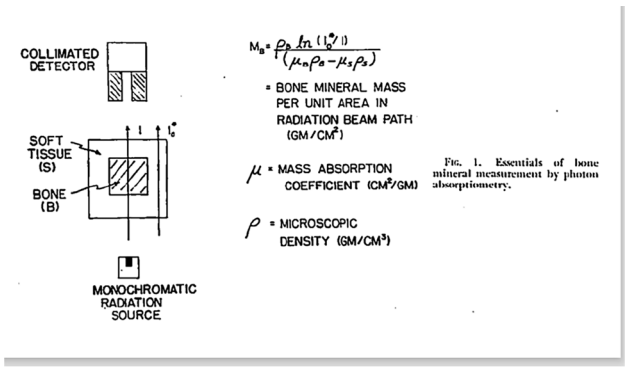

Fig. 6 Schematic showing the principle of single photon absorptiometry. Reproduced with permission from Investigative Radiology [9]

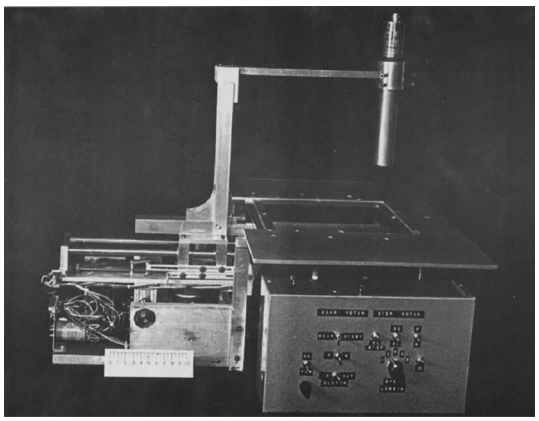

Fig. 7 Photograph of the prototype rectilinear scanner for the determination of bone mineral content. Reproduced from the Progress Report NASA Grant [10]

John's contributions to the field of bone densitometry have had a significant impact on the early detection, treatment and monitoring of osteoporosis, helping to prevent fractures and improve the quality of life for millions of people around the world. DXA is now used in clinical practice worldwide [11].

4.2 Thermoluminescence dosimetry (TLD)

Professor Farrington Daniels of the University of Wisconsin had invented thermoluminescence dosimetry (TLD) in 1954, but he did not develop it for commercial use. John and his colleagues made significant contributions to the understanding and application of TLD in the field of radiation dosimetry [12, 13]. In 1968 Cameron, Suntharalingam and Kenney published a book on the thermoluminescence phenomenon that is still regarded as an excellent reference work on the practical aspects of thermoluminescence [14]. Their research focused on improving the accuracy and reliability of TLD systems for various applications, including radiation therapy, occupational radiation monitoring, patient dose monitoring, and environmental radiation monitoring. Figure 8 shows John holding a TL dosimeter.

TLD technology has been widely employed in many different fields and applications for decades, it has proven to be an effective instrument for ensuring radiation safety. In many countries, TLD is still the dosimeter of choice, but newer dosimeters, such as optically stimulated luminescence dosimetry (OSLD) [15] and radiophotoluminescence dosimetry (RPLD), are gaining popularity [16].

5 Entrepreneurship

5.1 Radiation Measurements Incorporated (RMI)

In the late 1960s or early 1970s, John formed the Radiation Measurements Incorporated, or RMI, primarily to produce test tools for X-ray quality control testing to support the international community. Shortly after John retired in 1985, Gammex bought RMI. It continued until Peggy Lescrenier, in about 2014, sold it to Sun Nuclear. Mirion Technology most recently bought Sun Nuclear. As a result, the company has undergone a lot of transformation.

Fig. 8 John holding a TL dosimeter. Courtesy of the Department of Medical Physics, University of Wisconsin, USA

5.2 Medical Physics Publishing

John started the Medical Physics Publishing as his second venture to support the medical physics community. He launched this after leaving the university in 1985. Reprinting essential but out-of-print publications was one of the initial goals of Medical Physics Publishing, a nonprofit organization. The company now produces a wide range of original books and is a significant source of information on medical and health physics. His objective was to make books accessible to medical physicists and other scientists working in related fields.

6 International outreach

6.1 Latin America

Since John held his first academic appointment in Brazil in 1952, he had helped to forge a close relationship between UW and Brazil. Oswaldo Baffa Filho, Thomaz Guillardi, Paulo Costa, Emico Okuno, Alinka Lepine, and Cecil Chow Robilotta are a few of the physicists John had contact with. Through his extensive lecturing and encouragement, John has spearheaded the growth of medical physics in Brazil and other Latin American countries [17]. Figure 9 shows John with his Brazilian colleagues.

Fig. 9 John's visit to Sao Paulo, Brazil. (*From left*) Pio, Marilena, Von, Graeff, Cameron, Baffa, and Thomaz. Courtesy of Oswaldo Baffa Filho, University of Sao Paulo, Brazil

Sometime during the 1980's, John was able to make an arrangement for Kunio to visit Brazil for a series of seminars on radiographic image analysis with a group (Director, Professor Sergio Mascarenhas de Oliveira) in the physics department at the University of São Paulo in San Carlos, Brazil. This contact was very useful, since close collaboration between the University of Chicago and physicists in Brazil has continued even to the year 2010, with Regina Medeiros, Paulo Azevedo Marques, and Robert Pereira for their extended stay at the University of Chicago, as well as Kunio's frequent visits to Brazil.

6.2 Abdus Salam International Centre of Theoretical Physics (ICTP)

John co-organized the first workshop on medical physics at the Abdus Salam International Centre of Theoretical Physics (ICTP) in Trieste, Italy, 1988. Physicists and graduate students from less developed countries attended this workshop, and several American and Italian medical physicists were lecturing. When Kunio arrived in Trieste with the same flight with John, Kunio had to ask John some Italian money since he did not have a chance to exchange Italian money at that time. When Kunio returned the money to John later, he asked Kunio, 'How about the interests?' This was one of his typical jokes! Fig. 10 shows John with the Director of ICTP and other participants.

Professor Kwan Hoong Ng (the other author of this manuscript) had the chance to get to know John while he participated in the workshop. He still recalls clearly helping John carry copies of the hardcover book "The Physics of Radiology" by Johns and Cunningham from his room to the lecture hall across the picturesque Strada Costiera. John actually carried them all the way from the USA to ICTP and gave each participant a copy of the book.

Fig. 10 John (*second from right*) with Professor Abdus Salam (*center*), director of the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy. Courtesy of Oswaldo Baffa Filho, University of Sao Paulo, Brazil

Fig. 11 Kwan Hoong and John. Photo taken at John's summer house at Lone Rock, Wisconsin, summer of 1996. Courtesy of Kwan Hoong Ng, Universiti Malaya, Malaysia

Their friendship continued to grow as both were interested in the advancement of medical physics in less developed countries. In 1995, Kwan Hoong, as a visiting scientist, and his family (wife Leng Suan, and children Wei Lin and Wei Ren) spent two years with John at UW (Fig. 11). One of the projects was to promote radiology quality control by manufacturing simple QC test tools and sending them to physicists in developing countries. Together, they started the Electronic Medical Physics World (EMPW) and 'Ask Your Medical Physicists' [18].

6.3 Asia and the United Kingdom

John had traveled and delivered lectures at various national and regional conferences at the invitation of Kwan Hoong and other enthusiastic physicists, and he had sparked the development of medical physics throughout Southeast Asia [19]. Since 2004, the South East Asian Federation of Organizations for Medical Physics (SEAFOMP) has dedicated a lecture named after him at the annual conference to honor his tremendous contribution to the advancement of medical physics in the region [20]. Willi Kalender, Kwan Hoong Ng, Barry Allen, Gary Fullerton, Brian Thomas, Joel Gray, Tomas Kron, David Townsend, Kunio Doi, Geoffrey Ibbott, Anchali Krisanachinda, Colin Martin, Hilde Bosman, Slavik Tabakov, Peter Homolka, Cynthia McCullough, and James Lee are the former lecturers.

Professor John Cameron was invited by Dr. Masahiro Endo of the National Institute of Radiological Sciences (NIRS) in Japan to present a lecture titled "Longevity is the best measure of low dose radiation exposure" at the 87th Japan Society of Medical Physics (JSMP) Scientific Meeting in Yokohama in April 2004. His visit was

Fig. 12 John giving a lecture at the Niigata University, Japan. Courtesy of Shinichi Wada, Niigata University, Japan

arranged by Niigata University Professor Shinichi Wada. The content of the lecture was related to John's special interest in the beneficial effects of low dose radiation [21–23]. Following his visit to Yokoyama, John also spoke at Niigata University on the topic of "Is radiation as dangerous as they say?" (Fig. 12) and subsequently paid a visit to the NIRS, where he gave a lecture on a similar topic and discussed the effects of low-dose exposure.

After his lecture in Japan, John took part in a debate on the motion ''There is no radiation risk to health at low doses'' at the UK Radiological Congress in Manchester in June (UKRC 2004)'. He spoke on "Moderate dose rate radiation is good for your health" [22] which was reported, along with other speakers: Ludwig Feinendegen, Ken Chadwick, and Colin Martin, in an editorial by Philip Dendy, published by the British Journal of Radiology [24]. This debate had stirred up considerable interest in the biological effects of low dose radiation and had improved our understanding of the issues involved.

7 International Professional Recognition

Throughout his career, John has received numerous honors and awards for his outstanding contributions to medical physics. He was elected to the National Academy of Sciences in 1972, and received the National Medal of Science from President George H.W. Bush in 1989. He was also awarded the Gold Medal from the International Society for Clinical Densitometry in 2002 in recognition of his pioneering work in bone densitometry. He was an AAPM founding member and its 10th president. In 1980, he was awarded the Coolidge Award. In 2000, he was awarded the inaugural International Organization for Medical Physics (IOMP) prestigious Marie Sklodowska-Curie Award.

7.1 American Association of Physicists in Medicine (AAPM)

John often wore a "visible" red jacket to the American Association of Physicists in Medicine (AAPM) annual meetings. This jacket was quite conspicuous to all attendees, and it has generated a lot of conversations and laughter. He also adorned other eye-catching attire (Fig. 13). Readers are encouraged to view a series of AAPM—three interviews conducted with John [25].

Each year, AAPM conducts an Early-Career Investigators' Competition for the Annual Meeting since 2001. The ten highest-scoring Early-Career Investigator abstract submissions determined by reviewers are selected to be presented in a special symposium in honor of University of Wisconsin Professor Emeritus John R. Cameron. The top three recipients are recognized at the Awards and Honors Ceremony [26].

8 Afterword

Generations of medical physicists, scientists, and clinicians have been inspired by John, who was a much-loved mentor and educator. He was renowned for his love for science and medicine as well as his ability to succinctly and clearly convey difficult ideas to the uninitiated.

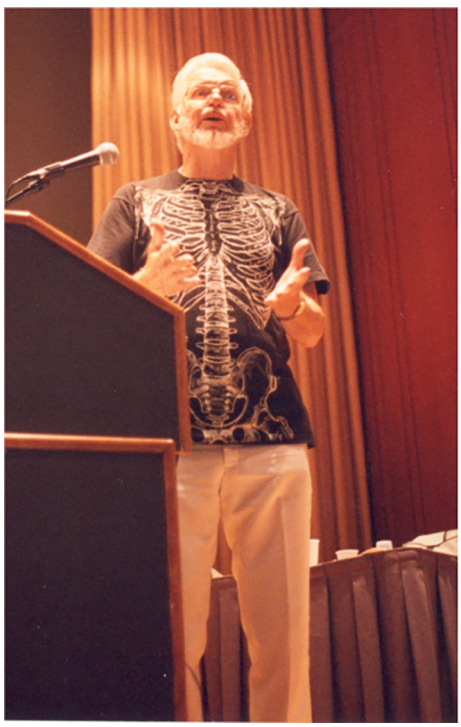

Fig. 13 John in his 'humorous' outfit delivering a lecture. Courtesy of the Department of Medical Physics, University of Wisconsin, USA

Fig. 14 John with his beloved wife, Lavonda, 2005. Courtesy of the Department of Medical Physics, University of Wisconsin, USA

John Cameron was a true pioneer in medical physics, and his work has had a significant influence on how medicine is currently practiced. Millions of people throughout the world have benefited from his invention of the bone densitometry device.

Beyond his scientific achievements, John was also known for his kindness, humor, humility, and generosity. He constantly donated quality control tools, books, and journals to the needy physicists residing in developing countries. John's legacy lives on through his contributions to science and medicine, and through the many students and colleagues who were fortunate enough to be mentored and inspired by him.

Up until his death at the age of 83 in 2005, he still kept up his teaching and research activities. A fond memory (Fig. 14) John with his beloved wife, Lavonda, six months before he left us.

Acknowledgements We thank our colleagues for providing historical accounts, documents and photographs: Larry DeWerd, Brian Pogue, James Zagzebski, Alyssa Mohr, and Frank Ranallo from the University of Wisconsin, USA; Steve Goetsch, USA; Oswaldo Baffa Filho, Paulo Costa, Emico Okuno, Alinka Lepine, Cecil Chow Robilotta, Victor Lago do Nascimento, Brazil.

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