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## The Computer Tomographic Scanner: How Solving a Mathematical Algorithm Won a Nobel Prize in Medicine

### Content

In November 1895 Wilhelm Röntgen performed an experiment in which invisible cathode rays, generated by electrostatic discharges from within an evacuated glass tube, caused a cardboard screen to fluoresce. He called them X-rays, using the mathematical description for something unknown. Röntgen's discovery revolutionised medical diagnosis. Within a few weeks of the appearance of an X-ray image of his wife's hand, the technology was being used by clinicians all over the world. In 1901 he was awarded the Nobel Prize in Physics for his discovery of X-rays. If we then fast forward 50 years to Groote Schuur Hospital, and ten years before before Christiaan Barnard performed the world's first heart transplant, a far more momentous project in medical science took place in Cape Town. It is the story of the computer tomographic (CT) scanner.

Allan MacLeod Cormack was born in Johannesburg on 23 February 1924 and died in Boston on 7 May 1998. He was educated at Rondebosch Boys High School and then studied physics at the University of Cape Town and the Cavendish Laboratory at Cambridge University. In 1955 he was seconded to Groote Schuur Hospital as a nuclear physicist. As he later stated: "It was immediately obvious that the problem was a mathematical one. If a fine beam of X rays of intensity  $I_0$  is incident on the body and the emerging intensity is  $I$ , then the measurable quantity

$$g = \ln(I_0 / I) = \int_L f \cdot ds$$

where  $f$  is the variable absorption coefficient along the line  $L$ . Hence, if  $f$  is a function in two dimensions, and  $g$  is known for all lines intersecting the body, the question is: Can  $f$  be determined if  $g$  is known?" Cormack was indeed able to solve this problem which he described in his seminal paper published in 1963 [1]. There was virtually no response to his paper, with the most interesting request for a reprint (there was one other) coming from the Swiss Centre for Avalanche Research who thought the method could be used to find skiers buried under the snow! Allan MacLeod Cormack and Godfrey Newbold Hounsfield were joint winners of the Nobel Prize for Medicine in 1979 for their pioneering work in "the development of computer assisted tomography."

The second half of my presentation will focus on the anatomy of writing a book about Allan Cormack [2]. In this personal odyssey, I will explore 12 topics, including the idea for the book, arranging my materials, securing a publisher, travelling to conduct background research, writing long hand or typing, importance of an editor, role of illustrations, selecting a title for the book, the cover design, enjoyment of the book launches, reviews of the book, and finally I will read two of my favourite passages.

[1] Cormack AM, 'Representation of a function by its line integrals, with some radiological applications', Journal of Applied Physics, 34(9): 2722-2727, 1963.

[2] Vaughan CL, Imagining the Elephant: A Biography of Allan MacLeod Cormack, ISBN 978-1-86094-988-3, Imperial College Press, London, 304 pages, 2008.

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