Father of crystallography

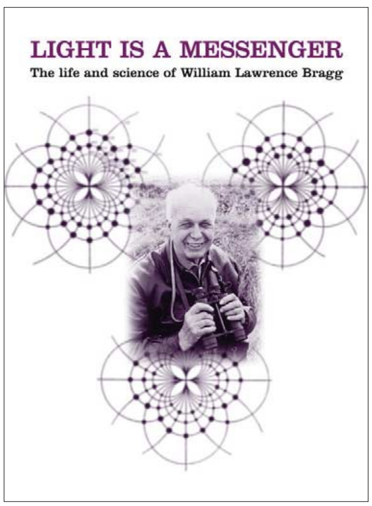
A new biography of William Lawrence Bragg tells a fascinating story, not only of the person but also of the science he initiated, says **Ron Lifshitz**.

William Lawrence Bragg was only 25 when he won the 1915 Nobel Prize in physics, and remains the youngest person ever to win the Nobel Prize. Considered the father of X-ray crystallography, he was the first (together with his father) to use X-rays to determine the arrangement of atoms in simple crystals. In the following years until his retirement in 1965, he was involved with almost all the major developments in X-ray crystallography. From his early solution of scores of inorganic crystals, through his study of metallic alloys, to the solution of complex biological macromolecules such as hemoglobin and DNA, Bragg's life story is also a personal history of the first 50 years of X-ray crystallography and the birth of modern materials science and molecular biology.

Graeme K. Hunter gives a detailed account of Bragg's personal life and numerous scientific accomplishments in *Light is a Messenger*. Bragg is described as a shy intellectual, a genius who used his understanding of optical diffraction to lay the foundations of X-ray crystallography one simple idea at a time. He was quick to realize that 'Bragg peaks', as we call them today, are formed by the interference of waves diffracted by planes of atoms in the crystal according to 'Bragg's law'. He was first to realize that the peak intensities, not only their positions, hold the information for unlocking the crystal structure, and recognized the importance of overcoming the 'phase problem', which he tackled using ingenious methods. In this context, it is surprising that Hunter mentions nothing of Karle and Hauptman's solution of the phase problem in 1953. Is it possible that Bragg had nothing to say about such a pivotal development?

An important lesson can be learned from Bragg's attitude to research. He approached the problem of crystal structure like solving a puzzle, and believed that all the information required was contained within the diffraction pattern. He didn't care to learn the detailed chemistry or biological function of the molecules, nor did he study quantum mechanics as did all his contemporaries. It seems that Bragg didn't believe in fancy theory but rather in simple logic, grounded in his fundamental grasp of physics. Bragg invented experimental devices for doing some of his theory. The 'fly's eye' used visible light to produce diffraction patterns from crystal models. The 'X-ray microscope' performed inverse Fourier transforms by diffracting light from diffraction patterns of real structures imprinted on glass plates, using 'half-wave plates' to produce the required phase differences. He also used bubbles in soap solution to simulate atomic dynamics and study dislocations in metals.

Hunter almost apologizes that Bragg led a conventional personal life and lacked the charisma of other Nobel laureates. Nevertheless, he manages to paint a complex and interesting portrait. Bragg's excellent relationship with his wife and children is contrasted with his less than perfect relationship with his mother and scientifically overshadowing father, William Henry Bragg. His lifelong difficulty in living up to the Nobel Prize, and his struggle in gaining the respect of colleagues when replacing Rutherford as Cavendish Professor in Cambridge are well depicted. Hunter also manages to convey Bragg's excitement of scientific discovery and agony of having been found wrong or beaten to the finish line. Altogether, this is a fascinating story for anyone curious about the process of scientific discovery.



Graeme K. Hunter
Light is a Messenger: The Life and Science of William Lawrence Bragg
Oxford University Press (2004), 322 pp., ISBN: 0-19-852921-X
$59.50 / £35

Light is a Messenger may be too technical for the general reader, but is highly recommended for readers of *Materials Today*. Personally, I wonder how Bragg would react to the recent discovery of quasicrystals. Would he approve of their artificial mathematical description using abstract high-dimensional spaces? I have a feeling that he would introduce a simple yet clever idea for describing quasicrystals as they are – three-dimensional physical objects.

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Nanoscale Science and Technology

Robert Kelsall *et al.* (eds.)
John Wiley & Sons (2005), 472 pp.
ISBN: 0-470-85086-8
$99.95 / £55 / €82.50

This edited volume includes contributions on the control, modification, and fabrication of materials at the nanoscale, as well as the assembly of these structures into devices. It begins with chapters on general methods for fabrication and characterization, followed by sections on semiconductor, magnetic, and molecular nanostructures.

Emerging Nanoelectronics: Life with and after CMOS

Adrian M. Ionescu and Kaustav Banerjee
Springer (2005), 1388 pp.
ISBN: 1-4020-7917-6
$350 / £230 / €299

The three volumes in this work explore future options for coping with the approaching limits to the scaling of complementary metal-oxide-semiconductor (CMOS) technology. Topics include single and few electron devices, nanoscale circuits and architectures, nanophotonics, and nanoelectromechanical systems.

Fast Light, Slow Light and Left-Handed Light

P. W. Milonni
Institute of Physics (2004), 261 pp.
ISBN: 0750309261
$105 / £70

The propagation of light in dispersive media is a subject of practical as well as fundamental importance. Refractive index can vary with frequency so that group velocities of optical pulses can be much greater or smaller than the speed of light in a vacuum. The refractive index of specially designed metamaterials can also be negative. These phenomena are introduced in this book, and the consequences of negative refractive index for 'perfect lenses' is discussed.

Expert (3)
Graduate (2)
Undergraduate (1)