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# John C.H. Spence – friend, teacher, mentor, scientific pioneer and visionary

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John Spence was born in Australia, and his life was full of adventure and the no-nonsense "let's do it" spirit that abounds "down under". He had a magic combination of sharp eyesight, quickness of mind and fleetness of foot – a modern day Achilles. His many passions included science, music, literature, sailing and flying, and he excelled in all of them. He was at the center of his research fields from early on (Fig. 1), and he never slowed down, producing cutting-edge work prolifically throughout his career.

John was also a talented musician, both classical and popular, accomplished on the piano, flute and guitar, and a singer from an early age. He was very well read, and in his seventies he authored two outstanding popular books himself. Lightspeed [1] is a riveting tale about our understanding of light, from classical Greece to modern research on quantum entanglement, via Roemer's measurement of the speed of light and Einstein's theory of relativity. Spitfire Pilot [2] is a heartfelt account of his father's life as a fighter pilot in WWII. He built a sailboat as a teenager, had a side job as a radio announcer when he was a student at the University of Melbourne, and drove a 1923 Rolls–Royce Silver Ghost, lovingly restored, in his university days. He co-owned a house near Australia's famed Great Ocean Road, in the middle of the bush, where I once stayed and was woken up by kangaroos thumping by noisily. His maternal grandfather was also a fighter pilot, with a distinguished flying career in WWI. John's house in Arizona had the propeller of his grandfather's airplane at the entrance, and he flew gliders himself, earning his pilot's license at 62. He was also a keen sailor: first on the sailboat he built himself, in Sydney Harbour, and later on a Flying Dutchman on Lake Pleasant in Arizona, and larger boats on the Pacific Ocean, the Puget Sound and the Adriatic.

In science, he started with a slightly obscure subject for his Physics Ph.D. – the double plasmon in metals, but he quickly pivoted to the development of the Fourier-log single-scattering recovery method that became widely used. He then gravitated to various "hot subjects": dynamical diffraction, high resolution electron microscopy, about which he wrote a major textbook, defects in semiconductors, channelling of the electron beam and its practical use for determining the location of impurities in crystals, and convergent beam electron diffraction, with a book on the subject written jointly with J.-M. Zuo. Inversion of dynamical diffraction was especially important to him. He returned to it in 2020 with a complete solution [3], and later said that this was the paper he was the most proud of. He was also a keen builder of pioneering instruments: an early CCD camera, a cathodoluminescence system for a scanning transmission electron microscope (STEM), a side entry holder with an STM built into it, a field emission apparatus for lens-less imaging. There were many subjects that looked important, interesting and doable to him, and he embarked on a large number of them with contagious enthusiasm.

During a sabbatical at the Lawrence Berkeley Laboratory in 1997–1998, he started to focus on coherent diffractive imaging. He initiated a series of "International Workshops on Phase Retrieval and Coherent Scattering", with the first one taking place in Berkeley in 2001, and the series continuing bi-annually since. He wrote major articles on the subject in Science of Microscopy and the Springer Handbook of

Microscopy, which he co-edited with Peter Hawkes. He then joined forces with Henry Chapman, Petra Fromme, Janos Hajdu, Uwe Weierstall, and many others to develop diffractive imaging at the first X-ray Free-Electron Laser (XFEL) at the Stanford Linear Accelerator Laboratory, and later at DESY in Hamburg, Germany. He became a co-founding editor of the Journal of the International Union of Crystallography (IUCrJ) that focused on this field, served on committees responsible for the field's direction, and he co-founded the NSF 'BioXFEL' Science and Technology Center, which now consists of 13 partner institutions, and became its Director of Science.

BioXFEL in able to image biological particles such as viruses at about 1 nm spatial resolution, and achieves femtosecond-level time resolution. This is a powerful combination for studying fast biological processes. It also allows structures to be determined before the particles fly apart due to the intense X-ray pulse that hit them. John coined the name "diffract and destroy" for the technique, and it also goes by "serial femtosecond crystallography". It has produced many remarkable results, and it has led to John being a co-author on a large number of high visibility publications: 19 in Nature and 7 in Science. This part of his research is covered in greater depth by Henry Chapman at this meeting.

John's many passions and achievements have been summarized more thoroughly by Chapman et al. [4] and Hawkes et al. [5], and there are many loving tributes on a Kudo board dedicated to him [6]. His irrepressible vitality, contagious enthusiasm, and sincere concern for other human beings come through brightly in these accounts. We were truly lucky to have him as a friend, teacher, mentor and colleague, and his influence on the many things he touched will persist for a very, very long time.


**Figure 1.** Participants of the first Castle Hot Springs Workshop organized by the High Resolution Electron Microscopy Facility of Arizona State University (ASU) in 1981. This small group of people has had an outsized influence on microscopy, and John Spence was very much at the forefront of the group.

References:

[1] J.C.H. Spence, *Lightspeed: The Ghostly Aether and…* Oxford University Press, 2019.
[2] J.C.H. Spence, *Spitfire Pilot: Lou Spence*, Brolga Publishing Pty Ltd., 2021.
[3] J.J. Donatelli, J.C.H. Spence, Phys. Rev. Lett. **125** (2020) 065502.
[4] H.N. Chapman, S.S. Hasnainb, U. Weierstall, *John C.H. Spence (1946–2021)*, IUCrJ **8,** (2021) 705.
[5] P.W. Hawkes et al., *John C.H. Spence (1946–2021)*, Ultramicroscopy **229** (2021) 113367.
[6] https://www.kudoboard.com/boards/89L2L9xB

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