Louise Johnson

(1940–2012)

Biophysicist who helped to establish the field of structural biology.

Louise Johnson transformed our understanding of how complex enzymes and other proteins work. By combining her in-depth knowledge of X-ray crystallography with a long-standing interest in biochemistry, she helped to launch structural biology as a new discipline.

Johnson, who died on 25 September, was born on 26 September 1940 in Worcester, UK. She attended Wimbledon High School for Girls in London and then completed a degree in physics at University College London.

In 1962, Johnson started a PhD at London's Royal Institution — working under David Phillips, a pioneer of protein crystallography. There she contributed to studies on lysozyme, an enzyme that is abundant in various substances, such as tears and egg whites, and which breaks down the cell walls of bacteria. Even at this early stage in her career, Johnson was not interested in just working out structures, but wanted to use an understanding of structure to uncover fundamental biochemical mechanisms.

By firing X-rays at the crystallized protein and studying the angles and intensities of the diffracted beams, Phillips established lysozyme's structure in 1965. This was the second protein structure to be solved by X-ray crystallography (the first was myoglobin, found in muscle). Johnson's contribution was to work out what lysozyme looked like when it was bound to *N*-acetyl-glucosamine, a component of bacterial cell walls. Johnson and Phillips's work led to the first structural evidence that a substrate slots into an enzyme, much as a key fits into a lock.

After her PhD, Johnson spent a year at Yale University in New Haven, Connecticut, where she worked as a postdoc with biophysicist Fred Richards. Here she uncovered the structure of the enzyme ribonuclease S, showing that X-ray crystallography could be applied to proteins that were more complex than lysozyme. In 1967, she returned to the United Kingdom and rejoined Phillips in the

Laboratory of Molecular Biophysics at the University of Oxford.

I first encountered Johnson about ten years later. I was a first-year undergraduate at Oxford studying biochemistry, and my tutor sent me to her to learn the basics

of how protein structures are determined. Instead of providing me with a standard textbook description, Johnson threw me in at the deep end. I was soon working through Fourier transforms — mathematical descriptions of what happens when X-rays are scattered by protein molecules.

In 1990, Johnson was made the David Phillips Professor of Molecular Biophysics, and she remained in this post until her retirement. By this time, the Laboratory of Molecular Biophysics had become part of Oxford's biochemistry department.

From 2003, Johnson combined her position at Oxford with leading the development of the UK national synchrotron, the Diamond Light Source near Didcot. The largest science facility to have been built in the country for more than 40 years, the synchrotron produces beams of light that can be used to investigate the structure and properties of materials including proteins. I recall accompanying her (both of us wearing hard hats and boots) as she showed me the nascent facility with evident pride.

Johnson's many achievements included establishing the structure of a large and complex enzyme called glycogen phosphorylase. Present in muscle, this enzyme turns inert glycogen into the sugar needed to power physical activity. Johnson showed

how the addition or removal of phosphate groups from the protein regulates its activity. (Phosphorylation has since turned out to be a key form of regulation in all sorts of cellular processes.) She subsequently carried out a set of groundbreaking studies on proteins that have key roles in the regulation of cell division.

In all this work, Johnson demonstrated that X-ray crystallography could reveal detailed catalytic and regulatory mechanisms, and can potentially unmask how large proteins work as complex biochemical machines. Her 1976 book *Protein Crystallography* (co-authored with Tom Blundell) was for many years the classic textbook on the topic.

Johnson received many honours in recognition of her work, including being made a fellow of the British Royal Society in 1990 and a foreign associate of the US National Academy of Sciences in 2011.

Louise was very supportive of young scientists, particularly women. Married, with two children, to physicist and Nobel laureate Abdus Salam, she understood the challenges of juggling a scientific career with looking after a family. A quiet and kind person, she directed her students and fellow researchers carefully but gently. The harshest comment I remember receiving from her — on my hastily written grant proposal — was “perhaps a little nebulous”. She was a source of inspiration to all around her, and will be greatly missed. ■

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