



In Memoriam

BADER, Richard Frederick William (1931 - 2012) Age: 80

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Richard F. W. Bader (October 15, 1931 – January 15, 2012) was a Canadian quantum chemist, noted for his work on the Atoms in molecules theory. This theory attempts to establish a physical basis for many of the working concepts of chemistry, such as atoms in molecules and bonding, in terms of the topology of the electron density function in three-dimensional space.

He was born in 1931 in Kitchener, Ontario, Canada. He obtained a BSc (1953) and a MSc (1955) from McMaster University, Hamilton, Ontario, Canada and a PhD (1958) from the Massachusetts Institute of Technology (MIT). He did postdoctoral work at MIT and the University of Cambridge. He was appointed Assistant Professor in the Department of Chemistry at the University of Ottawa in 1959 and promoted to Associate Professor in 1962. He moved to McMaster University as Associate Professor in 1963, became full Professor in 1966 and had been Emeritus Professor since 1996.[2] He was elected a Fellow of the Royal Society of Canada in 1980.

Bader was elected a Grand Fellow of the MIRCE Academy, Exeter, UK, in 2010

His work on atoms in molecules is the subject of his book, *Atoms in Molecules: A Quantum Theory*.

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Scientist had the proof his thinking was correct

Work was referenced more than 26,000 times when 3,000 would be considered respectable

SUSAN FERRIER MACKAY

Special to The Globe and Mail

A nomination for the 2011 Nobel Prize in chemistry speaks volumes about the work of Richard Bader. His *Quantum Theory of Atoms in Molecules (QTAIM)* is arcane to most but, in the world of science, it could be one of the most important contributions to chemistry theory since the discovery of quantum mechanics. Bader's theory cast new light on the understanding of atoms and bonding in molecules. It's being usefully applied in the field of drug development, the design of new materials, and crystallography, the science of the arrangement of atoms in solids.

Prior to Bader's work, phrases such as "molecular structure" or "chemical bond" were routinely used in the world of chemistry but without precise agreement on their meaning. Bader likened the situation to a common language in which everyone had a dictionary of personal interpretation. Based on his observation of electron density, Bader created a new standard by proving a unique link between physics and chemistry. Not everyone in the scientific community agreed or was happy about it because it went against established modes of thinking. Bader didn't care. He knew he was right because he had proof.

"Richard was a brilliant defender of his work against critics because he understood, not only his work but the critics' point of view usually better than they did," says friend Todd Keith, one of Bader's grad students in the early 1990s. Immutable facts lay at the heart of Bader's passion.

At McMaster University, where he became Professor Emeritus in 1996, a sign on his door proclaimed, "If you cannot measure it or define it from physics I do not want to discuss it."

Richard William Frederick Bader was born on Oct. 15, 1931, in Kitchener, Ont. He was the second son of Albert and Alvina Bader, both immigrants from Switzerland. Albert Bader worked at Burns Pride of Canada as a butcher. Alvina worked in housekeeping at Kitchener Waterloo Hospital. Interested in science, and the natural world around him, their younger son enjoyed mixing chemicals and performing experiments in the basement of their house. Once, he almost blew it up.

When Bader was a teen his father helped him get summer employment at a slaughterhouse where he removed the toenails from dead pigs. Understandably, it was not a job he relished but his father insisted it was not permissible to quit. His father also gave him the happy news that he had won a scholarship to nearby McMaster University. Bader majored in chemistry but was equally interested in physics. After obtaining his master's, he was accepted at MIT to work on his PhD. Bader said, "I decided that when I left I would make it my goal to find the physical basis of chemistry."

After earning his doctorate in 1958 Bader won an international fellowship to Cambridge where he studied under Christopher Longuet-Higgins, a theoretical chemist whom Bader said, "could reduce people to tears in 30 seconds and who had no time for 'fuzzy thinking.'" Reading books that Longuet-Higgins assigned, Bader became convinced that electron density was the basis for carrying chemical information.

But, his mentor disagreed, saying it would never amount to anything. It was a refrain Bader would hear many times. His theory went against accepted notions of how chemistry worked; consequently, he had difficulty getting his papers published. According to his daughter Suzanne, it was a source of great frustration to him.

"His most cited papers were often met with fierce resistance," says associate chemistry professor Chérif Matta, a former PhD student of Bader's. "Richard was exceptionally knowledgeable and innovative, contagiously passionate about his science, and extremely deep and rigorous. Richard was ahead of his time."

After Cambridge, Bader returned to Canada as an associate professor at the University of Ottawa. In 1966, he became a full professor at McMaster. By this time he had a young family. While in Boston, attending a dance, Bader had met twin sisters Pamela and Patricia Kozenof, both nurses from New Zealand. A man who could be forceful and persuasive, Bader persuaded Pamela to stay in Canada and marry him.

The ceremony took place in September, 1958. Three daughters duly arrived: Carolyn in 1961, Kimberley in 1964 and Suzanne in 1966. The family built a house on the shores of Lake Ontario in Burlington, and rescued a shell of a cottage in the northern area of Tobermory. Pamela Bader took plumbing and wiring courses and the couple spent summers renovating together. Suzanne Bader recalls her father's love of nature, particularly trees. "He would transplant trees from our home in Burlington to the cottage where the terrain was vastly different. This was an experiment for him to observe. Dad would walk around the property inspecting them. I think he named them all 'Charlie'."

Enamoured of astronomy, Bader encouraged imagination in his children and taught them how to wish upon a star. He also left mathematical problems at the foot of their beds during the night and signed them "the secret writer."

The whole family travelled together when Bader went on sabbatical trips. Daughter Suzanne remembers their travels fondly. "The adventures never ended. Climbing hills to explore castles in England, roaming the Louvre to appreciate the arts, attending local operas. Dad loved different culture, experimenting, observing and absorbing all of it."

During his career, Bader helped create a software program called AIMPAC widely used in universities to help with the analysis of atoms in molecules. Among other honours, he received the Alfred P. Sloan Research Fellowship, the John Simon Guggenheim Memorial Fellowship and he was elected a Fellow of the Royal Society of Canada.

In 1990, at the age of 59, Bader outlined his QAIM Theory in his book *Atoms In Molecules: A Quantum Theory* published by Oxford University Press. Bader's work has since been referenced more than 26,000 times in other scientists' publications (2,000-3,000 citations in a lifetime is considered respectable). Bader said, "In the end I knew I would win and now I have won and I am one of the most widely quoted chemists in the world. It has been a long, hard fight. I've had a hell of a life, but it's been really great."

The 2011 Nobel Prize for chemistry was awarded to an Israeli scientist for his work on quasi crystals. Canadian Richard Bader was disappointed when he didn't win, but not entirely surprised. The nomination however confirmed he was one of the greats in his field. He died of lung disease on Jan. 15 at Joseph Brant Memorial Hospital in Burlington. He was 80.

WAC
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