



Alan Carrington

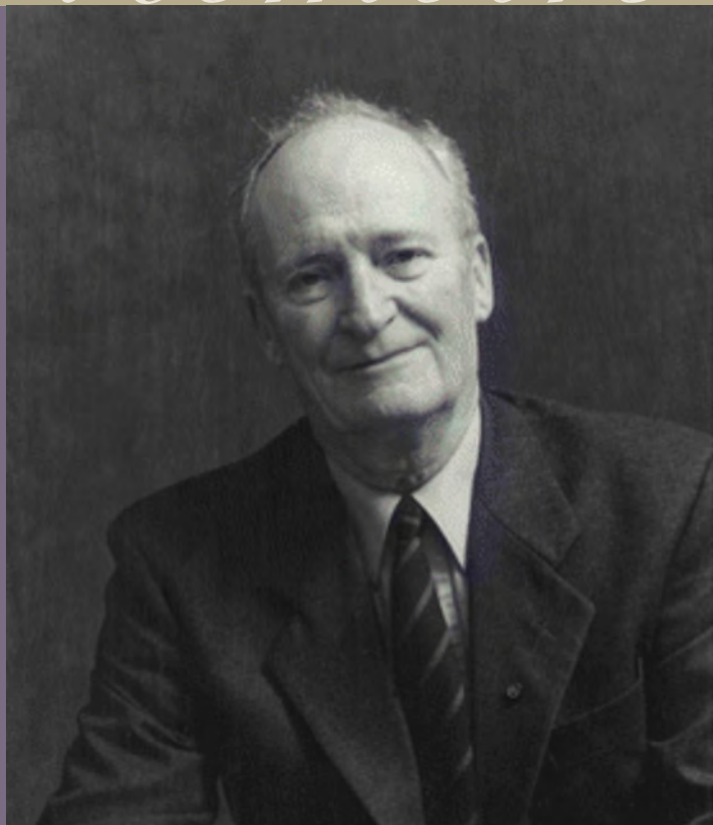
1934–2013

BIOGRAPHICAL

*Memoirs*

*A Biographical Memoir by  
Richard J. Saykally*

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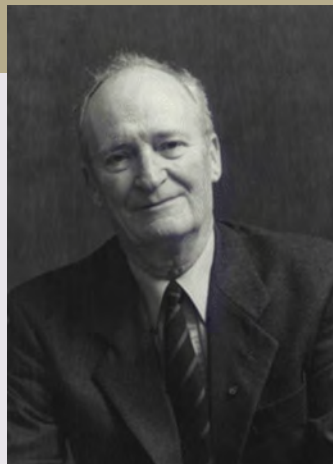
# ALAN CARRINGTON

January 6, 1934–August 31, 2013

Elected to the NAS, 1994 as a Foreign Associate.

## Pioneering advances in the spectroscopy and theory of radicals and molecular ions

It was in the late spring of 1979 when I first met Alan Carrington. Carl Lineberger, the distinguished chemistry professor at the University of Colorado, had arranged a dinner party at the Flagstaff House following Alan's characteristically elegant seminar on his brand new experiments in molecular ion beam infrared predissociation spectroscopy, which had opened up an exciting new arena for study. Largely due to advances made in atmospheric chemistry and molecular astrophysics, molecular ion chemistry and spectroscopy had become all the rage in the previous several years, and Boulder was at the center of it. Alan's new work had everyone there excited. Lineberger invited me to join the dinner group, along with Boulder "ion guys" Fred Fehsenfeld, Eldon Ferguson, and Gordon Dunn.



By Richard J. Saykally

I was an NRC postdoctoral fellow at the National Bureau of Standards (now called National Institute of Standards and Technology), working with Ken Evenson, mastermind of the ultimate speed of light measurement achieved in the Bureau's Time and Frequency Division, and I had just accepted a professorship at Berkeley. As a graduate student with Claude Woods at the University of Wisconsin-Madison, I had done a research proposal on an elegant new technique invented by Bell Labs scientist Terry Miller, "Microwave Optical Magnetic Resonance Induced by Electrons," as part of my doctoral requirements. This led me into the world of magnetic resonance microwave spectroscopy of free radicals that Alan Carrington and his group had pioneered a decade earlier. In addition to studying his first book, *Introduction to Magnetic Resonance* (with Andrew McLachlan), I had digested most of the dozen or so papers written by Alan, with Miller, his graduate student, and postdoc Don Levy. That experience changed my life.

Alan said, “That is the WORST reason I can think of for designing your laboratory projects! As spectroscopists, we should do things that advance our understanding of molecular physics!”

Lineberger generously positioned me right next to Alan at the table. Alan’s compelling warmth and energetic kindness helped me transcend my inhibitions toward actually having a conversation with this personal hero of mine, and we found a mutual resonance. He greatly admired the revolutionary ion microwave spectroscopy experiments that Claude Woods had pioneered at Wisconsin, and he quizzed me extensively about them. But he also unveiled another Carrington characteristic—honest,

straightforward, and downright blunt criticism, when appropriate. He asked me about my research plans for Berkeley, which, uncreatively, involved rotational spectroscopy of several molecular ions, like  $\text{HCl}^+$ . When I answered, he remarked scornfully, “Why do you want to do that?” I innocently replied, “Because they might exist in interstellar clouds!” Alan said, “That is the WORST reason I can think of for designing your laboratory projects! As spectroscopists, we should do things that advance our understanding of molecular physics!”

But the most memorable aspect of Alan’s character that emerged from that exciting spring evening was the irrepressible pride he exuded for his family and for his British culture. The Carringtons were first and foremost a loving, close-knit clan of immensely talented musicians. Alan had met Hilary Taylor while in graduate school at Southampton University in 1956, while he was the accompanying pianist for a performance of Gilbert and Sullivan’s opera “Patience.” Hilary had the lead role. The handsome couple bonded quickly and permanently. They married three years later.

Their first child, Sarah, became a cellist, then came Rebecca, who played the viola, followed by Simon, who became a percussionist. Music dominated the Carrington family atmosphere. They played together almost daily when Alan wasn’t off lecturing on his latest experiments. Rebecca and Simon eventually toured the world (and still do) as members of England’s most prestigious orchestras. Both Alan and Hilary devoted their lives to the family, at considerable professional sacrifice. “Nothing is more important than one’s family,” Alan later remarked to me.

Alan was born in Greenwich, England, on January 6, 1934, the only child of Albert and Constance Carrington. His childhood was dominated by the harsh reality of war, his

father being deployed to several battlefronts, and Alan himself being transported with thousands of other children out of London to remote locations during the bombing sieges. By good fortune, he lived for the six years of war with a loving family in a small village not too far from Cambridge. His mother was eventually able to join him there. He was educated in the village school until 1945, managing his early education quite well despite the dire circumstances. His mother was fond of remarking that his teacher, Miss Harbor, told her that “Alan definitely has a brain!” The rustication brought on by these war years had another lifelong effect on Alan—his love of fishing and of the countryside, which never left him.



Alan Carrington (on far right) with friends in Libya, 1964.

Alan completed his elementary education at Colfe's Grammar School in London in 1952 and enrolled in Southampton University as a chemistry major, subtly developing an interest in spectroscopy. Upon entering his graduate career there, he joined Martyn Symons and David Ingram in the study of paramagnetic solids by EPR, the technique that was to raise Alan to the apex of physical chemistry when he decided to apply it to highly reactive gas phase free radicals.

After a year in the EPR laboratory of John Wertz at the University of Minnesota, where he began his independent career by

studying free radicals in solution, Alan returned to Southampton and finished his Ph.D. in the summer of 1959. His thesis was entitled *The Electronic Structure, Spectra, And Properties Of Transition Metal Oxyanions* and his External Examiner was Jack Linnett, FRS, and professor of physical chemistry at Cambridge. Alan was then invited by Christopher Longuet-Higgins to join him in Cambridge during the next year as a research fellow, funded by General Electric.

Alan and Hilary married that November, and their joy was compounded by the award to Alan of a research grant for the purchase of a Varian EPR (electron paramagnetic resonance) spectrometer, and subsequently by his appointments as a research assistant in the Chemistry Department and research fellow in Downing College. He assembled a

small research group and began publishing the results on free radicals that gained him widespread acclaim. Alan received the first of his many science honors, the Harrison Memorial Prize, in 1962. Several notable arrivals to the Carrington domain appeared soon thereafter, viz., their first two children, followed by two enthusiastic researchers—postdoctoral fellow Don Levy, who had just received his Ph.D. from Berkeley, and Terry Miller, who came from the University of Kansas to work on his Ph.D. with Alan.

Up to that time, Alan's famed free radical studies had been exclusively performed in the liquid state. With Don and Terry on board, Alan and his group successfully transplanted those studies into the gas phase. Thus began another Carrington legend, augmented by the recruitment of other top scientists, including John Brown, Brian Howard, Peter Sarre, and Tim Softley, to the group. The many papers published during this era led to the definitive understanding of the intricacies of open-shell molecules that we have today, and played a salient role in the explosive development of quantum chemistry that was occurring at that time. Alan's second book, *Microwave Spectroscopy of Free Radicals*, summarized much of that knowledge.

Major recognition greeted Alan in 1970, in the form of the Royal Society of Chemistry's Award in Structural Chemistry, followed by election as Fellow of the Society in 1971, the youngest such up to that time. Other awards included the Tilden Medal in 1972, a prestigious Royal Society Research Professorship in 1979, the Faraday Lectureship Prize in 1986, the Davy Medal in 1992, and in 1994, election to the U.S. National Academy of Sciences.

Characteristically eschewing the routine, Alan turned his ion spectroscopy studies toward precise measurement of ion beam spectra of highly excited electronic states of  $\text{HD}^+$ , excited vibrational states of  $\text{H}_3^+$ , and ultra-high resolution spectra of other simple ions. These efforts presented a daunting challenge to theorists at the time, requiring the abandonment of all the usual simplifying approximations.

The Royal Society Research Professorship included the freedom to move one's research to whatever university the awardee chooses, and in 1984 Alan was induced to move to the Physical Chemistry Laboratory at Oxford. He was appointed a Fellow of Jesus College, and took a small flat in town, where he lived in from Monday to Friday, commuting from his home in Chandler's Ford. As it turned out, the timing of this move was improptious, as Hilary had just secured an excellent position in the Southampton library, and

moving to Oxford would have been adverse to her career. Hence, after more than three years of this commuting bachelorhood, which he thoroughly despised, Alan decided to return to Southampton. He remained there for the rest of his career, officially retiring in 1999, after receiving the title of Commander of the British Empire, bestowed by the Queen. Thereafter, he wrote his third book, *Rotational Spectroscopy of Diatomic Molecules* (with the late John Brown).

The deep understanding that we now possess of the properties and chemistry of open-shell molecules and non-adiabatic effects in simple benchmark molecules was borne to us in no small measure on the shoulders of Alan Carrington and his talented collaborators. To Alan and those colleagues, science is forever indebted.

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