Introduction to the Special Issue in honour of George Simms Hammond

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The articles in this issue of *Photochemical and Photobiological Sciences* are a celebration of the legacy of our friend, mentor, and colleague, George Simms Hammond, who passed away on October 5, 2005. The contributors are members of those groups, and they span three generations of his scientific progeny. All are members of the same family, affectionately referred to as "The Hammond Mafia."

Since the time of his death, there have been several memorials, some focusing on George as a person and others concentrating on his scientific contributions.[1] A *festschrift* that appeared in 2003[2] includes an extensive list of his scientific accomplishments. An ongoing website is available with extensive information about George's publications, career, and hobbies, as well as contact information for students and collaborators.[3]

George Hammond was multidimensional in many respects. His life combined interests in theater (as an amateur actor), poker, and international affairs with (what sometimes appeared to others to be) eclectic interests even within science. Although his contributions to physical organic chemistry during the decade of the '50s and mechanistic photochemistry, especially during the decades of the '60s and '70s, are where his long term legacy may lie, he was also very instrumental in the development of materials science as a multidisciplinary "art" form during the '70s and '80s, in educational innovation throughout his career, and in making those around him aware of the frontiers of science and challenging the dogma that bordered those frontiers.

George Hammond's life is a celebration of the macroscopic manifestation of the Heisenberg Uncertainty Principle and the American dream. He started his life on May 22, 1921 on a dairy farm in Auburn, Maine, was taught by his grandmother initially, and eventually received a BS degree from Bates College (*magna cum laude*) in 1943. His doctoral thesis at Harvard in 1947, under the mentorship of Paul D. Bartlett, focused on free-radical initiated polymerization processes and led to two of his more than 300 peer-reviewed publications.[4] After a postdoctoral year with Saul Winstein at UCLA, he joined Iowa State University in 1948. His first article from there demonstrated his ability to use principles of physical organic chemistry to solve complicated scientific problems.[5]

The influence of Bartlett, allowing his graduate students to try new ideas, even those arousing his skepticism, had a lifelong impact on how George mentored his own students and postdoctoral fellows. He encouraged them to develop their own projects and, when presented with the ideas, usually exclaimed, "Gee, that's great!", even when he found some errors. He treated those in his group as peers; symbolically, he asked that all his students and postdocs call him "George", and those with sufficient courage and confidence did. His science was about nature *and* the people investigating nature: "It is good to have new scientific puzzles to think about and it is good to interact with the people. When I think about the matter I see that a great deal of the pleasure that I have extracted from a scientific life is actually social."[6]

He defied attempts to define who he was or where his scientific interests would lead. He changed career paths on several occasions, and he made seminal contributions in virtually each new field he entered. For instance, the "Hammond–Gray Curriculum" was considered too radical for adoption by many because the categorizations of chemistry as structure, dynamics, and synthesis deemphasized the traditional subdisciplines of physical, organic, inorganic, analytical, and biochemistry. Yet, its impact is still important in the United States and elsewhere. For instance, the program offices of the U.S. National Science Foundation are organized along lines that mirror Hammond's views. In addition, his textbook, *Organic Chemistry*, written with Donald Cram,[7] was revolutionary because it approached the teaching of the subject according those same three major concepts—structure, dynamics, and synthesis—rather than by functional groups.

George's most famous non-photochemistry article, on the "Hammond Postulate", was written at Iowa State in 1955.[8] In it, he described a proposed relationship between structures of transition states and either their reactants or products, based on the relative energies of each species. Later, he mentioned that the basic concepts came to him during a dream, and he complained that the postulate had been applied in ways he never intended and then was criticized for reasons that had nothing to do with his intent. Still, the basic ideas in the paper have become an icon for structure–reactivity relationships; it is the 15th most cited article in the history of the *Journal of the American Chemical Society*.[9]

Although the first of his seminal photochemistry articles appeared in 1959,[10] the year after he moved to Caltech in Pasadena, he admitted that he had tried for several years, with limited success, before making notable progress in deciphering the chemistry of excited states. The road leading to the successes of the '60s and '70s was not smooth. However, the explosion of creativity, insight, and discovery that began at Caltech resulted in the development of modern mechanistic photochemistry.

After serving as the Chair of the Division of Chemistry and Chemical Engineering at Caltech, George moved to UC Santa Cruz as Vice-Chancellor for Natural Sciences in 1972, and he remained there until 1978. During 1974–78, he was also Foreign Secretary of the U. S. National Academy of Sciences where he was instrumental in increasing international contacts between the Academy and scientists in then Soviet block countries and in ensuring the success of a novel science and education development program with Brazil.

During various periods with Allied-Signal Corporation, from 1978 until his mandatory retirement at the end of 1987, George was Associate Director of Research, Physical & Organic Chemistry, Director of Chemical Dynamics, Energy & Chemical Process Laboratory, and Integrated Chemical Systems Laboratory, and Executive Director of Integrated Chemical Systems, Molecular & Applied Genetics, Biosciences, and Metals and Ceramics Laboratories.

In fact, George Hammond never retired spiritually, physically, or philosophically. He was affiliated with and held formal positions at Georgetown University, Portland State University, and Bowling Green State University. He continued to promote in words and deeds the interdisciplinary nature of the photosciences until the end. After listening to a particularly uninspiring oral presentation, he opined, "Any scientific (or other) discipline when put into a small rigid box will surely shrivel and die."[11] In 1996, at the age of 75, he presented a plenary lecture entitled, "Where has photochemistry come in 35 years? Where is it now?", at the I-APS Photochemistry Conference in Foz de Iguaçu, Brazil. The last sentence of the abstract for that lecture reads: "The growth and melding of all of the photochemical and optical sciences places us in a position to tackle important problems of a complexity which have made them untouchable 35 years ago." His name appears on 19 peer-reviewed articles that postdate his "retirement". The last,[12] co-written with a former student and published shortly before his death, demonstrates how he was able to breathe new life into old subjects.

Many honours have been bestowed on George Hammond in formal recognition of his contributions to the field of science, especially the photosciences and science education. They include the Award in Petroleum Chemistry, the James Flack Norris Award in Physical Organic Chemistry, the Award in Chemical Education, and the Priestley and Seaborg Medals from the American Chemical Society, the E. Harris Harbison Award for Gifted Teaching by the Danforth Foundation, and honorary doctoral degrees from Wittenberg University (Ohio), University of Ghent (Belgium), Bates College (Maine), Georgetown University (Washington, DC), Bowling Green State University (Ohio), and the Weizmann Institute of Science (Israel). He also received the National Medal of Science from President Clinton in 1994 and the Othmer Gold Medal from the Chemical Heritage Foundation in 2003. He was the organizer of the first IUPAC Symposium on Photochemistry in 1964 and was an Editor of the series *Advances in Photochemistry* for many years.

Those of us who were fortunate to be able to interact extensively with George Simms Hammond know that the scientific world and the larger world outside of science have lost one of our true "luminaries". Through this issue and what it represents, we hope to keep the spirit of George's lamp burning brightly.

Richard G. Weiss
Georgetown University, Washington, DC, USA

Carl C. Wamser
Portland State University, Portland, OR, USA

References

1 See for instance: (*a*) *Chem. Eng. News*, 28 November 2005, p. 46; (*b*) N. J. Turro and H. Gray, *Angew. Chem., Int. Ed.*, 2006, **45**, 1018.
2 (*a*) J. Saltiel and R. S. H. Liu, *J. Phys. Chem. A*, 2003, **107**, 3147–3148; (*b*) C. C. Wamser, *J. Phys. Chem. A*, 2003, **107**, 3149–3150.
3 http://chem.pdx.edu/~wamserc/Hammond/default.htm.
4 (*a*) P. D. Bartlett, G. S. Hammond and H. Kwart, The Inhibition and Retardation by Certain Quinones of the Peroxide-Induced Polymerization of Allyl Acetate and Vinyl Acetate, *Discuss. Faraday Soc.*, 1947, **2**, 342–352; (*b*) G. S. Hammond and P. D. Bartlett, The Polymerization of Allyl Compounds. V. Inhibition, by Nitro Compounds, *J. Polymer Sci.*, 1951, **6**, 617–624.
5 G. S. Hammond and H. J. Shine, The Mechanism of the Benzidene Rearrangement. I. The Effect of Acid Concentration on Rate, *J. Am. Chem. Soc.*, 1950, **72**, 220–221.
6 G. S. Hammond, *My Story, Thus Far. An Autobiography*, 1996, unpublished.
7 G. S. Hammond and D. J. Cram, *Organic Chemistry*, McGraw Hill, New York, 1959.
8 G. S. Hammond, A Correlation of Reaction Rates, *J. Am. Chem. Soc.*, 1955, **77**, 334–348.
9 *Chem. Eng. News*, 19 May 2003, p. 42.
10 G. S. Hammond and W. M. Moore, The Role of a Triplet State in the Photoreduction of Benzophenone, *J. Am. Chem. Soc.*, 1959, **81**, 6334.
11 Note passed from GSH to RGW at an American Chemical Society Meeting, 1998.
12 R. S. H. Liu, G. S. Hammond and T. Mirzadegan, On a Possible Role of 11-*cis*-Retinal Conformation in Controlling the Dual Decay Processes of Excited Rhodopsin, *Proc. Natl. Acad. Sci. U. S. A.*, 2005, **102**, 10783–10787.

