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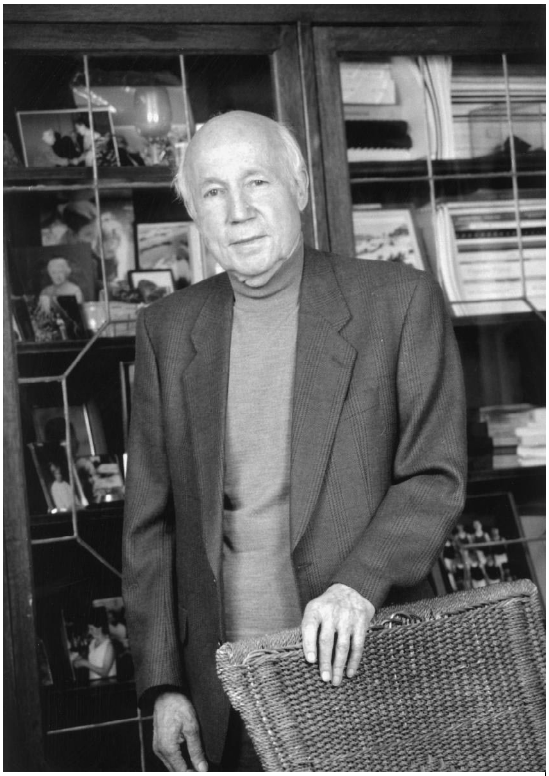
Obituary: A remembrance of Melvin Calvin



Melvin Calvin (1911–1997)

After a distinguished career of research and teaching, Melvin Calvin died in Berkeley, California on 8 January 1997, at the age of 85. Throughout his life, Calvin exhibited an intense curiosity that drove his scientific research. Although he may be best known for his contributions to our knowledge of photosynthetic carbon dioxide fixation and reduction, for which he was awarded the Nobel Prize in Chemistry in 1961, his interests were much broader and included investigations on chemical evolution, brain chemistry, oncology and solar energy conversion (Calvin 1989; Bassham 1997).

Calvin's inquiries into CO_2 fixation began in the mid-1940s. When radiocarbon, ^{14}C, became available at the University of California Radiation Laboratory, Calvin's laboratory developed methodology for feeding algae $^{14}CO_2$ and analyzing radioactive products formed as a function of time. The small amounts of labeled intermediates were detected and their concentration determined using two-dimensional paper chromatography. Similar methodologies were subsequently adapted by other biochemists and applied to the study of many metabolic systems. From the labeling patterns observed, the CO_2 fixation and reduction pathway was delineated by Calvin and coworkers, especially Andrew A. Benson and James A. Bassham.

Calvin's interest in photosynthesis extended to all aspects of the phenomenon and in the time period from 1956 to 1970, many pioneering experiments were conducted to characterize the primary photochemical events. His laboratory was one of two that first applied the new method of electron paramagnetic resonance (EPR) to photosynthetic systems (Sogo et al. 1957). These measurements showed there were two kinds of organic free radicals produced as a result of light-absorption, one of which appeared to be either an one-electron reduced or oxidized chlorophyll species. Pursuit of such studies eventually led to the assignment of one of these signals to a pair of chlorophyll molecules which served as the primary electron donor in Photosystem I (Norris et al. 1971), and the second signal was eventually assigned to an oxidized tyrosine side chain in the reaction center protein of Photosystem II (Barry and Babcock 1987).

Also developed in Calvin's laboratory during this period was the extension of the redox buffering method, initially introduced by Bessel Kok (Kok 1961), as a general method for the discovery and characterization of electron transport components in their in vivo state. These studies led to the measurement of the midpoint potential of both the primary electron donor (Loach et al. 1963) and the first stable electron acceptor (Loach 1966) in bacterial photosynthesis.

As was characteristic of Calvin's laboratory, newly developing spectroscopies and methodologies were quickly adapted to the study photosynthetic systems. In addition to the two examples given above, one further example of a spectroscopic method first applied to photosynthetic systems in Calvin's laboratory was that of circular dichroism (CD). Measurements of CD spectra of material from photosynthetic bacteria, as well as from oxygenic organisms, provided new insights into the organization of chlorophyll in reaction center and light-harvesting complexes (Sauer et al. 1968).

Stemming from Calvin's early training and research (some of which was involved with the Manhattan Project) was a strong interest in chelate complexes, metalloporphyrins and the development of model systems. We would probably now refer to this area of research as one focusing on biomimetic models or on biotechnology. Whether this work was driven by the desire to understand the role of manganese in oxygen evolution or to develop new catalysts and photocells, his research career is sprinkled with many projects involved in studying metalloporphyrins and their derivatives. Many people trained in his laboratory in these areas have continued to develop and extend these fields.

Even though achievements such as those cited above would seem to be of great significance, perhaps the most important legacy from Calvin is in the way he organized his research endeavors and trained and stimulated the people with whom he worked. Calvin was one of the first (if not the first) proponents of providing a working environment to enhance communication between a diverse group of scientists. This was achieved by utilizing large research laboratories in which individual work areas were on the periphery, but key supplies and refreshments were located in the middle. The idea was that people should frequently talk about their research and be informed about the activity of others in the lab. The second component was that the people Calvin recruited into his laboratory came with diverse training from all over the world – physicists, chemists, biologists, theorists, instrument engineers, etc. The concept of the cross-fertilization of ideas was a daily expectation in Calvin's group. This concept worked so well that many new laboratories and buildings are now being constructed in ways that are strikingly similar to Calvin's early model.

Also contributing to the dynamics of his laboratory was his direct interaction with the group. Although it was a large group, whenever one was getting new results, you could expect to see a lot of Calvin. His excitement, enthusiasm and endless questions provided much stimulation. During my tenure in his laboratory, I learned many things from him. One lesson I learned, he probably didn't know he was teaching. As is probably true of most people, I have always been very afraid of appearing stupid in front of groups of people – so much so, that I would seldom ask questions. Once a week, the entire biodynamics laboratory group met for discussion of an appropriate topic of research. At these meetings, I was at first astonished at some of what I considered to be 'really dumb questions' that Calvin would ask. Just about the time I was beginning to wonder how he ever got to the position he held, he would make a deeply insightful observation or comment. He gave me permission to show my ignorance, and therefore, to learn and to contribute.

Perhaps the best measure of the impact a person has had on a field is to examine the contributions made by people who were trained in their laboratory. In the case of Calvin, if one listed independent investigators who were trained, or whose mentors were trained, in Calvin's laboratory and who have made important contributions to an area of Calvin's interests, for example the primary photochemical events of photosynthesis, this list would likely include about one-fourth of the active people in the area.

I received several gifts and have many fond memories from my two years in Calvin's laboratory. These include many long-lasting friendships, as well as experiencing the fun and excitement of research. Perhaps the image of Calvin that is most appropriate was best expressed by a colleague. He described Calvin as a veritable bouncing ball, full of energy and new ideas – perhaps a super ball!

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