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BRUCE HERBERT MAHAN

1930—1982

A Biographical Memoir by
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Biographical Memoir

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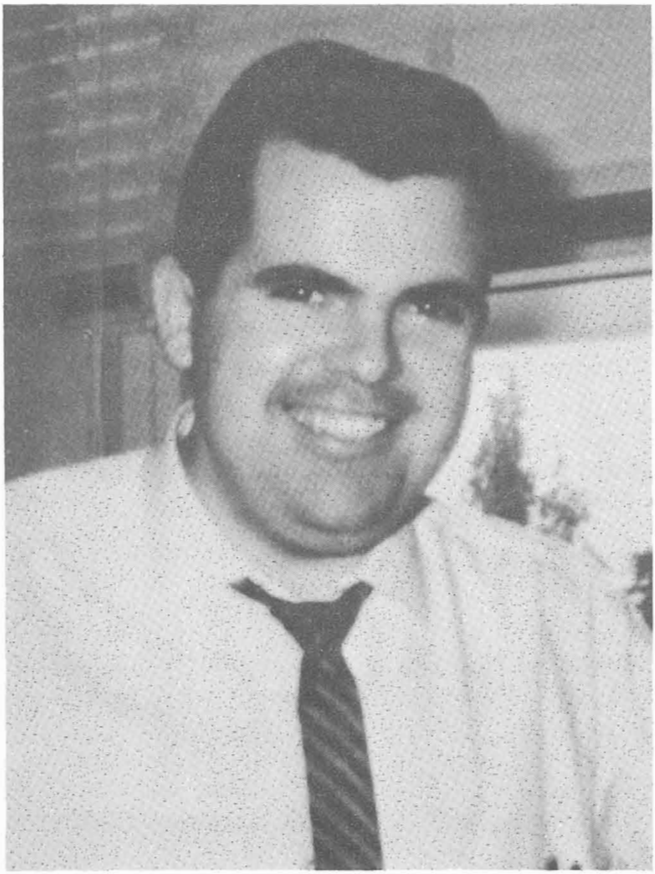

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Bruce H. Mahan

BRUCE HERBERT MAHAN

August 17, 1930–October 12, 1982

BY IGNACIO TINOCO, JR.

BRUCE MAHAN was born on August 17, 1930, in New Britain, Connecticut, the youngest of three children born to Arthur E. Mahan and Clara Blanche Gray Mahan. He did not reveal much about himself to his colleagues or his students, so there is little information about his early life. It is clear that he did very well in school. His mother told one story about his youth that explains a great deal about his character. His elementary school teacher had told him that his parents must be very proud of him for his good grades. When he said "Not particularly," the teacher called his mother to say that she did Bruce a disservice by not praising him. His mother replied, "I'm happy he is doing well, but it is not necessary to praise him simply for using his God-given gifts to good advantage."

In 1948 he entered Harvard College on a fellowship. He was attracted to chemistry and he distinguished himself rapidly in that subject. He received an A.B. in chemistry in 1952 and as one of the top students he was encouraged to remain there for his graduate work. He decided to carry out his doctoral studies with George Kistiakowsky in physical chemistry. Kistiakowsky had trained with Bodenstein in Berlin, and it was in that tradition that Mahan set out to

pursue his research. It was a pivotal decision, starting him on the track of research in gas phase kinetics that occupied all of his scientific career. He received an A.M. in 1954 and a Ph.D. in 1956. His Ph.D. thesis research was on the photolysis of methyl ketene.

He came to Berkeley as an instructor in 1956 directly from Harvard; his entire career and future life were centered at Berkeley. He immediately started building a vacuum line to continue his research on gas phase photolyses. He was a competent glass blower and as beginning instructors were not allowed to train graduate students, he did all the work himself. This meant he spent long hours in the laboratory. He was very helpful to graduate students in adjoining laboratories, because of his knowledge of physical chemistry and his practical experience with vacuum pumps, seals, and gauges. However, his presence was sometimes inhibiting, as he discouraged the practice of dumping liquid oxygen in the sinks. It seems he had practical experience with an explosion once when liquid oxygen found organic material in the drain trap.

In 1959, three years after arriving at Berkeley, now an assistant professor, he volunteered to teach a new freshman chemistry course described in the catalog as "Lecture and laboratory for students of superior facility and preparation." It ended a long Berkeley tradition of having only one freshman course for all entering students, and it established one of the first beginning chemistry courses that used calculus and the quantitative application of thermodynamics. The course he established and the textbooks he wrote to support it became models for the modern teaching of freshman chemistry in this country. In 1963 *Elementary Chemical Thermodynamics* was published in a general chemistry monograph series; it provides a very clear de-

scription of the subject at an elementary level. In 1965 *University Chemistry* was published; this textbook (and its more elementary version *College Chemistry*) was the model for all high-level freshman texts used today. The fact that it was written by a single author instead of the multiauthor texts now common makes it even more impressive. The book went through three editions and sold over half a million copies during Mahan's lifetime. It is now in its fourth edition with Rollie J. Myers as a coauthor. The book has been translated into eight other languages; it has truly had a worldwide impact. Professor Mahan's direct impact on the Berkeley students was also very effective. The students admired and respected him as a demanding, but fair teacher with a very deep understanding of chemistry. He received one of the first campus distinguished teaching awards in 1961.

In 1968 Bruce Mahan became chairman of the chemistry department; he was chairman for three years, from 1968 to 1971. The faculty found him to be a tough but fair administrator. He actually read, understood, and evaluated their publications before making recommendations for promotions and advancements. In a department with more than fifty members, this requires a great deal of knowledge and dedication. Some of the younger faculty found him somewhat intimidating. He was sometimes gruff; he was often abrupt. He expected a great deal and he did not give out a lot of praise; his mother must have taught him this attitude.

Mahan's research interests were on gas phase kinetics and photolysis. He concentrated on molecular collisional processes, especially collisional energy transfers and ion-molecule reactions. He was the first to recognize that the efficient energy transfer from excited polyatomic molecules

was due to frequent events with a small amount of energy transfer rather than from rare events with large amounts of energy transfer. His first independent publication, *The Nature of Collisional Processes in Unimolecular Reactions,* described this theoretical work. His penetrating observation treated the impulsive translational-vibrational energy transfer process correctly for the first time.

State-selective kinetic studies are common now using molecular beams and lasers. However, in the early 1960s Bruce Mahan did pioneering experiments using arc lamps and vacuum systems in the spirit of modern kinetics. By the proper choice of photolyzing wavelengths and reactants, he produced molecules in different electronic states and measured their different reactivities. He was among the first to apply molecular beam systems that provided velocity selection of reactants, and angular and energy analysis of products. Yuan T. Lee, who received his Ph.D. from Mahan in 1965, shared the Nobel Prize in 1986 with Dudley Herschbach for their molecular beam work.

Mahan's main research applications of molecular beams was to reactions of molecules, ion, and electrons. The enormous contributions he made in the field of ion recombination and the dynamics of ion-molecule reactions established him as a world leader in molecular reaction dynamics. His experimental work on angular and energy distributions of the products of reactive ion-molecule reactions are classics. His discovery of specific electronic excitation in inelastic, nonreactive scattering and his original measurements of their angular distributions were a real breakthrough. The research provided direct information about potential energy surfaces not otherwise obtainable. His theoretical insight was of equal importance to his experimental results. He deduced several widely used mod-

els for understanding and predicting ion-molecule reactions. The most important are molecular orbital correlation diagrams and energy state correlation diagrams. His simple impulsive models for inelastic and reactive scattering were very helpful to the development of the field.

His research accomplishments were recognized by several awards. He was an Alfred P. Sloan Fellow in 1963–65. He received the gold medal California Section Award of the American Chemical Society in 1968. He was elected to membership in the National Academy of Sciences in 1976.

Professor Mahan provided thorough, sound training to twenty-four graduate students at Berkeley; the first, John Doering, received a Ph.D. in 1961, the last, Fred Grieman, in 1979. Mahan's scientific rigor and his serious personality kept many of his students at a distance. Perhaps this was partly due to his belief that graduate students should take the initiative in pursuing their Ph.D. thesis research and in developing themselves. He was not the type of research director who gave strong and dominating guidance. His way of guiding students during his daily visit to the laboratory always started with, "What's new?" and ended with "What do you plan to do next?" If the answers to these two questions were satisfactory, he would often just nod his head and leave without uttering a word. Many of his students appreciated the way Mahan allowed them to develop early into independent scientists. One of his former students, Yuan T. Lee, attributes his success to the way Bruce chose to train his students.

It was not all work for Bruce Mahan. He was a very shy person who never married, but he did enjoy the company of a few friends. As a graduate student at Harvard he and his housemates continuously renovated a model A to provide a distinguished means of transportation. He was a

very good cook who prided himself in preparing fancy meals for visitors. During his twenty-six years at Berkeley he liked to travel, to photograph, and to listen to opera. He also liked to share his experiences with the morning coffee group at the Faculty Club and with his colleagues at the chemists' table for lunch at the club. This was the family he used to validate his adventures and accomplishments. He would go to Death Valley or to the Arizona desert about once a year. He first drove his Mercedes, but after this car was sand-blasted once in a desert windstorm, he bought a four-wheel drive Bronco. He also bought some rugged land in Mendocino County in northern California and built a shelter on it. He liked to improve the dirt roads and clear brush on the land.

In 1975 Bruce Mahan learned that he had amyotrophic lateral sclerosis, a dreadful disease that slowly but inexorably causes paralysis starting from the periphery of the body and progressing to the center. He went from crutches to a wheelchair to bed and a respirator in about four years. During this time he always remained cheerful and active. He directed his graduate students, worked on the new edition of his book, wrote scientific manuscripts, and studied new areas of science. During the last months he required twenty–four–hour nursing care and could only communicate by his eyes. Even before he became ill he never wasted words; he could demolish a weak argument or explanation just by raising an eyebrow.

Once Mahan made a commitment he never wavered. He had the honesty and integrity and above all the ability to do whatever he said he would do. He would never quit and he would never give an excuse. He faced ALS as he would any other objective. He just kept fighting.

Bruce Mahan's father and older siblings had died long

before he became ill. At first he kept his disease a secret from his mother, but she was called when he contracted pneumonia and his doctor thought he would not last long. He survived for another two years.

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