

ing Super Collider Laboratory in Dallas, Texas. Dugan was previously head of Fermilab's antiproton source department.

Simon Foner, chief scientist at the MIT Francis Bitter National Magnet Laboratory, is now also associate director of the laboratory.

OBITUARIES

George Pimentel

Until his death on 18 June 1989, George Pimentel devoted his unbounded energy and passion to science, to his students and colleagues, to his family, and to an occasional ballgame.

George was born 2 May 1922 in California's Central Valley. He grew up in a poor section of Los Angeles, attended public schools and earned a bachelor's degree in chemistry from the University of California, Los Angeles, in 1943. Following a short stint at Berkeley working on the Manhattan Project, George trained for submarine duty in the Navy. At the close of the war he participated in the formation of the Office of Naval Research and in early consideration of nuclear-powered ships.

In 1946 George returned to Berkeley to do graduate work with Kenneth Pitzer on infrared spectroscopy. Three years later he had earned his PhD in chemistry and joined the faculty. During his career George developed methods of vibrational spectroscopy to study molecular bonding and chemical reactivity, to produce the first chemical lasers and to explore the planet Mars.

George attacked the important problems. During the 1950s he developed the matrix-isolation technique to trap free radicals, extremely reactive molecules that play a central role in chemical reactions. A solid matrix of inert gas molecules, cooled to the temperature of liquid hydrogen, prevented a free radical embedded inside it from reacting, thus allowing leisurely spectroscopic study of the radical. This method was used first to investigate the HCO radical and to record spectra of hydrogen-bonded species, and later to study rare gas compounds and many other interesting species. It is now employed routinely in most chemical laboratories. With Aubrey McClellan, George wrote *The Hydrogen Bond* (1960), the book on hydrogen bonding that guided the field for many years.

In the mid-sixties George's studies of fast reactions unlocked the secret to converting chemical energy direct-

ly into laser light. He and Jerry Kasper first discovered the iodine-atom photodissociation laser— $\text{CF}_3\text{I} + h\nu \rightarrow \text{CF}_3 + \text{I}(^2P_{1/2})$ —which lased on the $^2P_{1/2} \rightarrow ^2P_{3/2}$ transition, and then the $\text{H}_2 + \text{Cl}_2$ laser. After that, he and Karl Kompa developed the very practical HF chemical laser. This laser has since taught us much about chemical reactions and about the transfer of energy among molecules. It has also been developed into large and powerful laser systems.

George wanted to know whether there was life on Mars, and so he persuaded NASA to put one of his rapid-scan infrared spectrometers on a Mariner spacecraft to determine the chemical constituents of the Martian surface. His instrument was novel and clever, built from scratch on the Berkeley campus to NASA space flight standards. No evidence for biological material was observed, but much was learned about the planet's surface and atmosphere. George was chosen as a member of the first group of scientist-astronauts, but he withdrew when he learned that he would probably never get into space.

George was a national leader in science and science policy. He served as deputy director of the National Science Foundation from 1977 to 1980 and as president of the American Chemical Society in 1986. He organized and edited the National Academy of Sciences report *Opportunities in Chemistry*—often called the "Pimentel Report"—which was published in 1985 and later revised and released for use in high schools under the title *Opportunities in Chemistry: Today and Tomorrow*. In George's final lecture, the Priestley Medal Address given last April, he urged members of the scientific community to mount "a massive and ongoing campaign of public education," so that our society can sensibly weigh the risks and benefits of science and technology.

George loved to teach. He brought the significance of chemistry and the excitement of research to Berkeley freshmen, to his research students and collaborators, to national leaders and, through the CHEM study program, to secondary school teachers and students. He helped each of his research students attain a level of achievement well beyond reasonable expectations. Whether he was in the halls of Congress, in the classroom or eating a peanut butter sandwich, George's clear logic, his openness and candor and his concern for others always won his audience.

George Pimentel did everything with tremendous vigor, intensity, commitment and, above all, desire to

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George Pimentel

succeed. Squash partners and opposing softball teams quickly found this out. George's idea of relaxation was winning a ballgame, mixing concrete or having a hundred friends over for a party.

George Pimentel chose his own epitaph:

"He went to the ballpark every day/And he let them know he came to play."

C. BRADLEY MOORE

University of California, Berkeley

Michael J. Moravcsik

Michael J. Moravcsik died quite unexpectedly on 25 April 1989 in Turin, Italy. He was spending a term at the University of Turin, on leave from the University of Oregon.

Mike was a very active researcher in theoretical high- and intermediate-energy physics as well as in science policy, international scientific development and the "science of science." He was a dedicated teacher and a prolific writer on a broad range of topics.

Born in Budapest, Hungary, in 1928, Mike emigrated to the United States in 1948. He continued his education in physics and mathematics, receiving his AB from Harvard in 1951 and his PhD in theoretical physics from Cornell in 1956 under the supervision of Hans Bethe.

In 1958, after two years as a research associate at Brookhaven National Laboratory, he joined the theoretical physics division of the Lawrence Radiation Laboratory of the University of California, where he became head of the elementary-particle and nuclear physics group. In

1967 Mike left for the University of Oregon. For the rest of his life he was a professor in the Oregon physics department and in the university's Institute of Theoretical Science, which he directed from 1969 to 1972.

Mike's most notable contributions in physics always centered on strong-interaction theory. He began by studying the dynamics of pion photo-production in field theory models. In the middle 1960s, a shift of focus to partial-wave analyses and particle exchanges led him into the study of the nucleon-nucleon interaction. His collaborators in that work included Henry Stapp, Malcolm MacGregor and H. Pierre Noyes. This research produced the determination of the pion-nucleon coupling constant (the famous $g^2/4\pi \approx 15$), and progress in the particle-exchange model of the strong interaction. Their work also gave rise to Mike's influential book *The Two-Nucleon Interaction* (1963) and motivated the organization of the first Few-Body Conferences.

At the end of Mike's time at the Lawrence Radiation Lab his interests turned to the symmetries and spin properties of particle interactions. With Paul Csonka and Mike Scadron, he explored the rich formal structure of spin-dependent amplitudes, properties that were expected to be independent of particular dynamical models. Based on those studies, tests of symmetry laws could be formulated for reactions involving particles with any spins.

With the growing interest in the structure of spin amplitudes in the 1970s, Mike began to apply formal relations involving spin, symmetries and observables to actual experimental data. Mike and I proposed a more direct connection between theoretical amplitude structures and real data, and we applied this idea to data analysis. Our work resulted in the

discovery of simple relations among the phases of spin amplitudes for many processes and for a wide range of kinematic variables. Interpreting those simple patterns was the object of Mike's last research efforts.

While at the Lawrence Radiation Lab Mike developed a strong interest in science policy, particularly as it applies to third world countries. He deeply believed that understanding and applying science was crucial to economic development and modernization. His trenchant opinions and sensible advice on this subject were highly valued and were sought by individuals and organizations supporting science development, such as the Ford Foundation, UNESCO, AAAS and NSF. Some of his writings on science development are collected in three books: *Science Development* (1975), *How to Grow Science* (1980), and *On the Road to Worldwide Science* (1989).

Because Mike was dissatisfied with anecdotal reports and value judgments regarding the scientific progress of third world countries, he became active in developing quantitative indicators of scientific growth, effectiveness and productivity. His contributions to this nascent field were notable.

Mike also wrote about better ways to disseminate research results and to facilitate international participation in basic science projects. In 1969 he originated the Physics Interviewing Project, which biennially sends two physicists to third world countries to interview prospective students for American graduate schools. This program has benefited hundreds of students.

Mike thrived on discussing and finding practical remedies for daunting problems in science and the larger world. Believing in the beneficence of scientific progress, he sought to nurture it and foster its appreciation. Mike loved hiking, travel and music. He wrote music reviews for a Eugene, Oregon, newspaper, sang in choruses and wrote a textbook on the physics of music (*Musical Sound*, 1987). Mike's integrity, forthrightness and enthusiasm always guided his research, writing and teaching. To all his endeavors he brought a remarkable energy and commitment.

Mike's influence on how people think about physics, and about science in general, will continue, although his humor, warmth, casual style, common sense and penetrating insights will surely be missed.

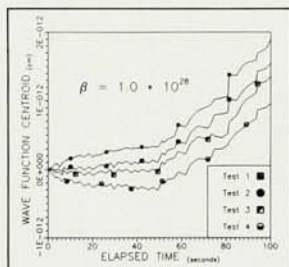
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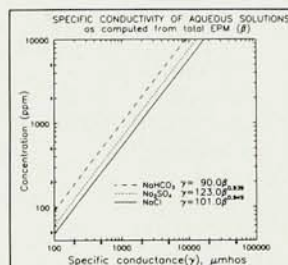


Michael J. Moravcsik

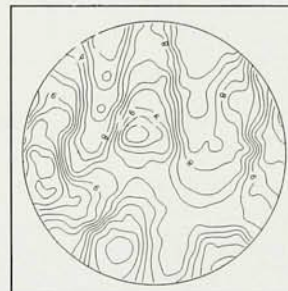
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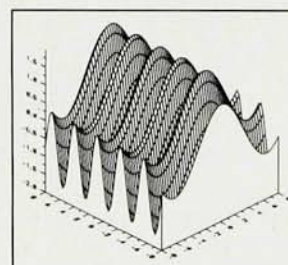
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