physicist, with seminal contributions in solar and interplanetary physics, Earth and planetary magnetospheres, and space science instrumentation." Russell, according to the citation, is "well recognized scientifically for his seminal contributions to understandings of plasma waves in the Earth's and other planets' magnetospheres, for his contributions to new observational understandings in magnetic field reconnection, for his insightful observational studies of solar wind–magnetosphere coupling, and for many additional contributions over a wide range of space plasma subjects. . . ." He holds joint appointments in the Institute of Geophysics and Planetary Physics at UCLA and in the university's Earth and space sciences department.

Andrea Bertozzi, professor of mathematics and physics at Duke University, will join the UCLA faculty in July as professor of mathematics.

Obituaries

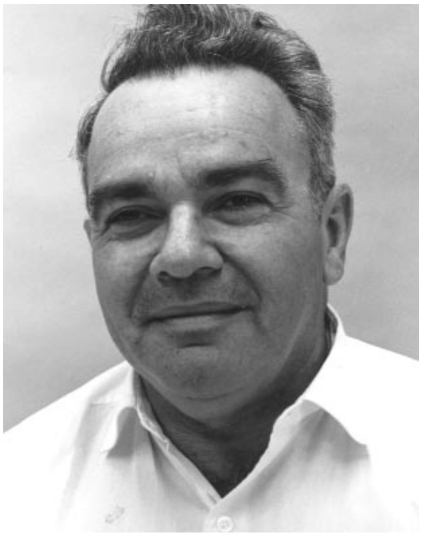
Martin David Kamen

Martin David Kamen, codiscoverer of carbon-14, died in Santa Barbara, California, on 31 August 2002.

Kamen was born in Toronto, Ontario, Canada, on 27 August 1913. In his youth, he was primarily interested in classical music, and started out majoring in music at the University of Chicago. He changed his major to chemistry, however—for economic reasons, he said. He continued, though, to play the viola at a high professional level throughout his life. He earned his PhD in physical chemistry in 1936 under adviser William D. Harkins. His thesis was entitled, "Neutron–Proton Inter-action: The Scattering of Neutrons by Protons."

In 1936, Kamen joined the University of California, Berkeley, first as an unpaid volunteer in Ernest O. Lawrence's research group. He soon became the group's radiochemist and isolated radioactive isotopes from various elements exposed to the cyclotron beam. He did not confine himself to a supporting role, though. Along with his frequent collaborator Samuel Ruben, he was among the early leaders to use radioactive isotopes in the study of the paths followed by important chemical reactions. Both Kamen and Ruben were drawn to research on biological topics, which were not a widely recognized part of chemistry in the 1930s.

The two were a priceless asset at the Berkeley cyclotron, where a few useful tracer isotopes, such as 14-day phosphorus-32 and 88-day sulfur-35, were already available for such studies. Both elements are important in biology, but the central element is carbon. When Kamen and Ruben began, carbon's only available radioisotope was ^{11}C, with a halflife of only 21 minutes. The good news was that the cyclotron could make a lot of that isotope; the bad news was that it would be gone in a few hours at most.



ANNUAL REVIEWS

Martin David Kamen

But the two collaborators were young and unafraid. With much effort and little sleep, they produced results showing that the technique had promise. Still, the short time scale was a straitjacket. By 1939, several researchers had hints of the possible existence of radioactive ^{14}C, which might have a longer halflife—guessed to be days or even months! Lawrence gave Kamen the go-ahead to bombard graphite with beams of neutrons in the hope of converting stable ^{13}C to ^{14}C—the wrong reaction as it turned out. By early 1940, the two researchers had achieved a positive result using one of Willard Libby's screen-wall counters. The isotope existed and the sample showed no decay as they waited. It took a few years for them to realize that ^{14}C was made by neutron bombardment of nitrogen, not ^{13}C. They were pleasantly surprised that the isotope's halflife turned out to be more than 5000 years.

After the US entered World War II, Lawrence's group was increasingly drawn into war work. In 1943, Ruben died tragically in an accident involving the poison gas phosgene. Kamen, who worked mainly on the Manhattan Project, carried on an effort to produce useful quantities of ^{14}C. Then came an unexpected blow. Kamen's skill and passion for classical music had strengthened over the years, and he was now part of a circle of talented musicians in the San Francisco area. Through these friends, he met the Soviet consul in the city and was incautious enough to have lunch with a member of the consul's staff to talk about music. The Soviets were our allies, but that alliance did not extend to nuclear weapons research. FBI agents sitting at an adjacent table were ready to believe the worst. Almost immediately, Kamen was summoned to the office of an administrator in Lawrence's research group and informed that he was fired, with no notice or chance of a hearing. He found himself blacklisted beyond any chance of either a university or industry research position—the FBI was watchful and energetic. Through a neighbor, he found a job at last as an inspector in a San Francisco shipyard. For the codiscoverer of long-lived ^{14}C, a man with a finite chance of a Nobel Prize, this was a violent shock indeed.

There was no relief until near the end of the war in 1945. The offer of rescue came from physicist Arthur Compton, himself a senior figure on the Manhattan Project and president of Washington University at St. Louis, in Missouri. After receiving some positive words about Kamen from Lawrence, Compton offered Kamen a tenured faculty position in the university's medical school. Kamen's new task was to lead his colleagues there into the world of radioactive tracers for diagnosis and research. This position did not end his problems, but it made them bearable.

He achieved one important step forward in 1947 with the publication of his pioneering text, *Radioactive Tracers in Biology: An Introduction to Tracer Methodology* (Academic Press). Decades later, that text and its succeeding editions have been the bible for many young investigators, a group not limited to those working in the biological sciences.

The shared discovery of ^{14}C is the work for which Kamen is best known. Carbon-14 was, and is, the most important tracer isotope. However, the body of his later work includes many biochemical discoveries, most of them related to photosynthesis. A few examples from a career lasting almost half a century must suffice. A 1941 paper he wrote with Ruben and other coworkers about using stable oxygen-18 overturned a widely held view that

O_2 produced in photosynthesis came from carbon dioxide. He and his colleagues, in fact, proved that O_2 comes from water. Kamen, his students, and his collaborators also did groundbreaking research on the mechanisms of photosynthesis in bacteria and on bacterial cytochromes.

A new chapter of Kamen's political problems opened in 1948. He received an invitation to attend an isotope symposium in Paris, and another for a visit to Israel. As his tickets were being written, federal agents moved in and, on instructions from the State Department's passport office, confiscated his passport. At first it was even difficult to discover the cause of this action. It proved to be the same dossier, with embellishments, that had produced his instant dismissal at Berkeley. The country was entering its infamous McCarthy period, when accusations were increasingly accepted as proof.

He was fortunate in the continued support of Compton and other university officials in the legal battles that followed. Still, he had to fight on two fronts with very limited financial resources. The passport office maintained its right to withhold his passport at will, although President Dwight D. Eisenhower had directed that a review board be established to ensure due process. Meanwhile, the *Chicago Tribune* and its Washington, DC, affiliate published stories, complete with pictures, that said Kamen had passed secret documents to Soviet agents. As time passed, the number of individuals who spoke and acted in his behalf increased. The American Civil Liberties Union and the Federation of American Scientists eventually took up the case. Finally, after seven years, the courts ruled in Kamen's favor in both matters. He received a new passport and the ordeal was over.

His scientific career carried him to two more universities before his retirement. He joined Brandeis University in 1957, where he helped Nathan Kaplan create a department of biochemistry that was not tied to a medical school. Four years later, he was recruited to join the young University of California, San Diego. In the newly formed department of chemistry, he founded a biochemistry group, which developed so well that the department was later renamed the department of chemistry and biochemistry.

Kamen's highly readable autobiography *Radiant Science, Dark Politics: A Memoir of the Nuclear Age* (U. of California Press, 1985) offers a fuller picture of this remarkable man.

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