Fridtjof Kavli FREE

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Marilyn Esther Jacox

Marilyn Esther Jacox, scientist emeritus at NIST, died on 30 October 2013 in Rockville, Maryland, of a respiratory infection. A physical chemist, she was known internationally for her discoveries of the structure and bonding properties of free radicals and molecular ions and for greatly expanding the field of cryogenic matrix isolation spectroscopy.

Marilyn was born on 26 April 1929 in Utica, New York, and at an early age developed a fascination with astronomy and light. In 1951 she received a BA in chemistry from Utica College of Syracuse University. She moved to Cornell University to work with Simon Bauer and received her PhD in 1956 with the thesis "Collisional energy exchange in gases: Use of the spectrophone for studying relaxation processes in carbon dioxide." For the next two years she carried out postdoctoral research with Oscar Rice at the University of North Carolina at Chapel Hill.

In 1958 Marilyn joined the Mellon Institute of Industrial Research (later merged into Carnegie Mellon University) in Pittsburgh, Pennsylvania, as an independent researcher. There she became acquainted with Dolphus Milligan and his IR studies of free radicals. Milligan was using a technique, matrix isolation, for trapping reactive species in frozen inert gases; he had brought the method from George Pimentel's group at the University of California, Berkeley. The pair began collaborating in those studies at Mellon and continued at the National Bureau of Standards (NBS, now NIST), where both received appointments, Marilyn in 1962 and Milligan a year later.

Despite the extra obstacles facing a woman and an African American man at that time, the two scientists achieved great success in producing and trapping numerous free radicals and molecular ions by using the low-temperature matrix isolation technique. They probed the trapped species using IR spectroscopy and were adept at using isotopic substitution to support sometimes bold assignments of molecular spectra. Many of their publications were landmark studies and became standard reading for graduate students.

Colleagues at NBS were supportive against prejudicial obstacles. In the early 1960s, NBS moved from Washington, DC, to new laboratories at the present site in Gaithersburg, Maryland. Bureau scientists were required to inspect the buildings and provide instructions for the layout of utilities, but a strict rule prohibited women from the construction site. Marilyn hid under the dashboard of a pickup truck while two colleagues signed her in as "Dr. Jacox." She performed her inspection covered by a lab coat, with her hair and face concealed by a hard hat.

Marilyn Esther Jacox

Milligan died, tragically, in 1973. Marilyn succeeded him as chief of the photochemistry section and the next year was appointed chief of the environmental chemical processes section, where she served until 1978. Though saddened by the loss of her colleague, Marilyn continued the work they had begun together. She developed a novel neon discharge technique, involving both photoionization and Penning ionization, that greatly expanded her portfolio of ions available to study. Photolysis within the matrix, controlled using cutoff filters, was another powerful innovation of Marilyn's for assigning spectra. She was soon established as a world leader in molecular spectroscopy. Some of her studies brought her into vigorous competition with other scientists, but she was consistently objective, honest, and constructive. Her critical comments on manuscripts during peer review will be missed; they yielded more improvements than reports from most other referees.

Concurrently with her research projects, Marilyn maintained an ever-growing bibliography of published spectroscopic data on small transient molecules. She issued a series of critically evaluated tabulations that culminated in 1994 in a thick book entitled *Vibrational and Electronic Energy Levels of Polyatomic Transient Molecules*. She updated the database regularly, and it has been available online since 1998. The compilation stands as a monument to Marilyn's determination, which is legendary at NIST. One colleague called her "unstoppable" after she missed only two and a half days of work following major surgery for breast cancer. Although nominally retired in 1996, she maintained a full research program until her final illness.

Catherine Lugez, a former postdoctoral researcher with Marilyn, regards her with great affection and respect. "For a lot of people, Marilyn was a giant in the world of spectroscopy. For me, she was a giant in the world of mentoring and supporting young scientists and women." Marilyn received many awards and honors, including a festschrift in 2000, but she never gained patience for declarations that gender bias in science has disappeared.

An avid world traveler, Marilyn would return home with copious photos and video to share with friends. (One of us has a family photo, taken by Marilyn at a conference, that was shared in a year-end letter to friends.) She participated in piano, book, and photography clubs; published genealogical books; was active in her church; and favored red, sporty cars. Marilyn earned great respect for her scientific contributions, and she will be fondly remembered for her adventurous spirit, her work ethic, and the warmth of her personality.

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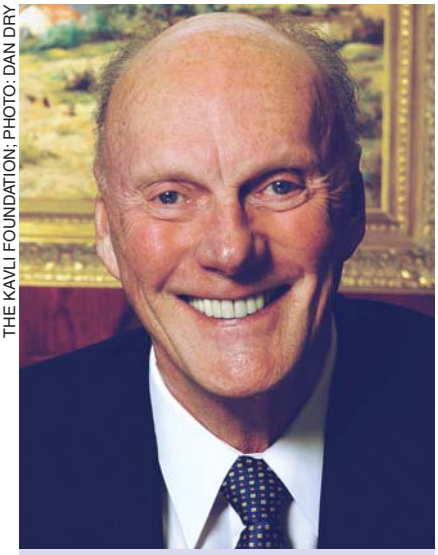
Fridtjof Kavli

Fridtjof "Fred" Kavli died in Santa Barbara, California, on 21 November 2013 of a rare form of cancer (cholangiocarcinoma) that he had been battling for about a year. Trained as a physicist, Kavli made his living as an entrepreneur and engineer. He later realized his lifelong passion for science by supporting basic research in astrophysics, nanoscience, and neuroscience, the fields he called the most exciting of the 21st century. With Kavli's enduring belief in the transformational power of science, the foundation he established



THE KAVLI FOUNDATION; PHOTO: DAN DRY

Fridtjof Kavli

endowed 17 institutes, created three prizes, funded seven professorships, and supported many programs around the world that live on as his legacy.

A naturalized American, Kavli was born in 1927 in Eresfjord, a small town near the Norwegian Sea between Bergen and Trondheim. It was there, growing up on the family farm, that he discovered his love of science. As he would reminisce, "I used to ski across the vast white expanses of a quiet and lonely mountaintop. At times, the heavens would be aflame with the northern lights, shifting and dancing across the sky and down to the white-clad peaks. In the stillness and solitude, I pondered the mysteries of the universe, the planet, nature, and of man. I'm still pondering."

From a young age, Kavli was a sharp businessman. During and after World War II, when gasoline was scarce, the teenaged Kavli and his older brother, Aslak, manufactured and sold wood briquettes that could be used to power automobiles and buses. Their business was a success, and Kavli used the profits to finance his education at the Norwegian Institute of Technology (today the Norwegian University of Science and Technology) in Trondheim.

Three days after his graduation in 1955, Kavli left Norway for Canada on the SS *Stavangerfjord* with $300 in his pocket. After a year there, he headed for his real goal, California. "America was the land of opportunity, and California had the climate," he would say. He spent a year designing sensors for Atlas missiles for a small engineering firm in Los Angeles. Then, as he said, with "Viking courage and adventure in my blood," he decided to set out on his own.

His company, Kavlico, began in 1958 with a short ad in the *Los Angeles Times*: "Engineer seeking financial backing to start own business." Under Kavli's leadership, Kavlico developed a wide range of innovative sensors used on automobiles and on military and space vehicles. By the time Kavli sold it in 2000 for $340 million, the company had grown to 1500 employees and $80 million a year in business.

With the proceeds, he established the Kavli Foundation in December 2000 and began his "payback." Kavli was a strong believer in the importance of recycling wealth and in the power of science and technology to better humanity. His deliberate focus on long-term, basic research countered the prevailing trend in federal funding toward research with near-term returns centered on pressing problems. He and the Kavli Foundation have provided a strong, timely, and effective voice for long-term, basic research. He employed the same far-sighted approach to one of his deepest personal concerns—creating a sufficient and sustainable energy future while preserving the environment and confronting climate change.

The Kavli Foundation, guided by Kavli's vision and with the leadership of two effective presidents (David Auston, 2002–09, and Robert Conn, 2009–present) has achieved much in its first 13 years.

There are 17 Kavli Institutes—2 in theoretical physics, 4 in neuroscience, 5 in nanoscience, and 6 in astrophysics—at leading universities around the world, including one in Norway. As we two can testify from our work as institute directors, Kavli's formula was simple: "We don't try to tell the institutes what to do. We try to just select the very best science teams and institutions and support them in what they want to do, and we expect them to choose the very best course of action." His plan has worked extremely well.

The biennial awarding of Kavli Prizes in Astrophysics, Nanoscience, and Neuroscience began in 2008 with all the fanfare of that other Scandinavian prize: an announcement of the prize recipients in May, in Oslo and at the World Science Festival in New York; a prize week in September with a ceremony involving the king of Norway and Alan Alda; a lavish dinner in the Oslo Town Hall; and a medal slightly larger than the Nobel medal.

The Kavli Frontiers of Science symposia for young scientists, which he funded with the National Academy of Sciences, and the Kavli Futures meetings are symbolic of the long view he always took. He was enormously proud that one of the Futures meetings helped germinate the BRAIN (Brain Research through Advancing Innovative Neurotechnologies) Initiative announced by President Obama last year.

Kavli believed in—and lived—the American dream, saying, "In America, you don't have to know anything; you just have to ask the right question." He met with US presidents and world leaders and served on the President's Council of Advisors on Science and Technology. Among his many honors was the Royal Norwegian Order of Merit for Outstanding Service.

Above all, Kavli was an optimist and a believer in the power of science to do long-term good, and he took great joy in giving back. Basic research has lost a powerful voice and benefactor, Norway has lost one of its most famous sons, and we have lost a dear friend whose enthusiasm, wisdom, and broad smile will long be remembered. Fridtjof Kavli's generous legacy will live on in the institutes, professorships, and prizes he has created and in the future work of his foundation.

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Robert Resnick

Robert Resnick passed away quietly, surrounded by his family, on 29 January 2014 in Pittsburgh, Pennsylvania. Bob was suffering from the various maladies of an advanced age and from mourning the recent death of Mildred, his wife of 67 years.

Bob had a remarkable career as a physicist, physics educator, and author, and his textbooks became the gateway to physics for generations of scientists and engineers. *Physics for Students of Science and Engineering*, written with David Halliday, was released in 1960 by Wiley (see Halliday's obituary in PHYSICS TODAY, January 2011, page 66). The textbook is now in its 10th edition, under the title *Fundamentals of Physics*, and has had several additional coauthors. That classic and Bob's seven other physics textbooks have been translated into more than two dozen