obituaries

M. Stanley Livingston

M. Stanley Livingston, one of the pioneers in nuclear physics and a prolific contributor to the accelerator art, died on 25 August 1986 in Santa Fe, New Mexico, at the age of 81. High points in his eventful career included construction of the first cyclotron and inspiration of the invention of alternating-gradient focusing.

Livingston's family moved from his birthplace in Wisconsin to California when he was five years old. He grew up in a series of small towns where he acquired basic mechanical skills and an interest in technology from acquaintance with farm machinery and automobile engines. He entered Pomona College, intending to specialize in chemistry. His roommate, however, was Victor Neher (later well known for his work as an associate of Robert A. Millikan) whose infectious enthusiasm for physics induced young Livingston to change his goal to a career in physics. After graduating from Pomona in 1926 he spent two years at Dartmouth where he earned an MA working on x-ray diffraction studies.

His next move was to the University of California where he asked Ernest Lawrence, then a young assistant professor, to suggest a PhD thesis topic. Lawrence suggested his recent idea of possible resonant acceleration of ions in a magnetic field using radio frequency electric fields (the word "cyclotron" had yet to be invented). Livingston proceeded with enthsiasm to assemble the components for a test of the idea and within a year was accelerating hydrogen ions to 80 keV with alternating fields adding only 1 keV per revolution of the ions. In 1931 he published his thesis "Acceleration of particles to high energies without the use of high voltage." Lawrence and Livingston apparatus, the first cyclotron, now a museum piece, can be seen in the Lawrence Hall of Science at the University of California (Berkeley).

The importance of the new principle was evident; Lawrence and Livingston's next energy goal was a million volts, which they achieved in the spring of 1932. By the summer of that year nuclear disintegrations were observed and the pioneering nuclear physics program of the University of California was under way. In Lawrence's words "We're making history."

The pressures for aid from the new cyclotron expert were intense and continuous; to free himself to study and to catch up on the progress of nuclear

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physics Livingston accepted an instructorship at Cornell in 1934. There he speedily brought his knowledge of nuclear physics up to date. Hans Bethe and Robert Bacher came to Cornell at about the same time and the three assembled the first comprehensive survey of nuclear physics. It was published in three papers in the *Reviews of Modern Physics* in 1936–37 and became the students' "bible" during the decades that followed.

In 1938 a project was afoot at The Massachusetts Institute of Technology to build a large (for that time) cyclotron and Livingston was persuaded to move to Cambridge to take charge of its construction. Thus began a long-lasting and happy association with MIT. The 42-inch cyclotron was completed in 1940 and had a long and honorable career.

One of the cyclotron's primary applications was to be medical. Soon the war effort was demanding radioactive tracers for blood studies and radiation for sterlization of blood, and the cyclotron was brought into 24-hour service.

Midway through the war, Livingston had reduced the cyclotron operation to routine and he joined the Office of Naval Research to apply radar and radar countermeasures to the antisubmarine effort. After two years in Washington and six months in London he completed this assignment and was able to return to MIT and to resume work on particle accelerators.

Soon after the war, Brookhaven National Laboratory was formed and Livingston was invited to take charge of construction of the laboratory's first major particle accelerator. He began with a design study of what he concluded was the largest practical synchrocyclotron, 700 MeV. Shortly, however, he was persuaded by I. I. Rabi that the goal must be a billion volts or higher. It was evident that the machine must be a

proton synchrotron—a machine for which no prototye had yet been built. It was at this time that we first worked closely with Stan. It was a very happy association as we faced the multitude of new problems that had to be solved. He assembled and smoothly coordinated a thoroughly capable group. Where experience was lacking, he called on previous associates from MIT and elsewhere, and within a year all problems were under control. After two years Livingston's leave from MIT ran out and he returned to Cambridge. But he left a group so well organized that it virtually ran itself. In 1952 construction of the "Cosmotron" was completed. It reached and passed a billion volts, eventually attaining 3 GeV.

During the summer of 1952 Livingston paid us a visit. In preparation for a visit by members of the newly formed CERN European group who planned to build a scaled-up Cosmotron, he suggested a study of possible improvements in the Cosmotron's design. One of his suggestions, worked out in collaboration with Courant and Hartland Snyder, resulted in the discovery of the alternating-gradient or "strong focusing" principle, published in 1952. (This principle had been discovered earlier by Nicholas C. Christofilos but had not been published and was unknown to the Brookhaven group.) Strong focusing has resulted in major improvements in design of accelerators, in order of magnitude increases in achievable energy and in design contributions for many other scientific instruments. This achievement, with the construction of the first cyclotron must certainly assure for Livingston an honored place in the history of physics.

On his return to MIT Livingston began a study of possible applications of the new principle to an accelerator for the Cambridge area. After considering both proton and electron machines he settled on a 6-GeV electron accelerator. By this time many others at MIT and Harvard were interested and, in 1956, construction started on the Cambridge Electron Accelerator. Completed in 1962, this was the first multi-GeV electron synchrotron. It was built by an enthusiastic young group, inspired by Livingston, and included many important technical innovations.

He served as director of the CEA until 1967 when he became associate director of the Fermi National Accelerator Laboratory. In 1970 he retired and moved, with his wife Lois, to Santa Fe.

In Santa Fe he established a valued association with the Los Alamos Meson Physics Facility—his continuing interest in scientific history inspired him to

compose a comprehensive and definite history of the Los Alamos linear accelerator. At the same time, his manual dexterity found an outlet in the production of truly beautiful jewelry in the style of the local Indians.

He was the author or coauthor of several books on particle accelerators and their history. In 1970 he was elected to the National Academy of Sciences and in 1985 his contribution to the discovery of alternating-gradient focusing was recognized at a ceremony at Stanford at which he received an illuminated parchment signed by the directors of major high-energy laboratories throughout the world, recognizing the importance of this discovery. This was, perhaps, his most cherished honor. Posthumously he was named, together with Ernest D. Courant, for the Fermi Award (see page 83). This award, made by the President, was accepted by Livingston's wife on 18 December 1986.

During his long and productive career he made a great many friends, not only in the United States, but worldwide. They will miss him deeply.

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Hubert Maxwell James

Hubert Maxwell James, emeritus professor of physics at Purdue University, died 23 May 1986 in Lexington, Kentucky. James had a long and distinguished career as a scientist, educator and administrator. Born in Clarksburg, West Virginia, on 10 March 1908, he received his AB from Randolph–Macon College in 1928 and his AM and PhD from Harvard University in 1930 and 1934, respectively. His formative research career coincided with the period when quantum mechanics had been firmly established and important applications to molecular structure were just beginning. It was at this point James, in collaboration with A. S. Coolidge, attacked the problem of the binding energy of the H_2 molecule. In a classic paper they used the variational technique to find the binding energy of this molecule with an accuracy sufficient to verify the validity of the then new quantum mechanics in a new context. This, together with this work on the Li_2 molecule, represented a significant advance over the earlier Heitler–London calculations and established his reputation in chemical physics.

After a two-year period as a research fellow at Harvard, James joined the faculty of Purdue University as an assistant professor of physics in 1936 and rose to the rank of professor in 1944. The Purdue physics department was then being established as a strong research department under the guidance of Karl Lark-Horovitz. James's scholarship, his creative research program and his pleasure in teaching were crucial in this enterprise. The application of statistical mechanics to the problem of rubber elasticity was his next field of interest. Here again, in collaboration with Eugene Guth, he wrote some of the classic papers in this abstract yet practical field.

During World War II James was a part of the distinguished group of scientists and engineers forming the MIT Radiation Laboratory. He made many important contributions, such as work on the propagation of radar waves at long ranges, the stabilization of radar systems and problems in systems analysis. *Theory of Servo Mechanisms* in the MIT Radiation Laboratory Series documents part of his activity during this period.

After 1945 Purdue became a major center of semiconductor research, in which he was a prominent participant. His theoretical contributions to electronic states in perturbed systems are landmarks in the field. The James–Lark-Horovitz model for localized electronic states in bombarded semiconductors provided a guide for the interpretation of radiation damage in semiconductors. His interest in chemical physics continued in studies of molecular crystals such as methane and solid hydrogen.

He succeeded Lark-Horovitz as head of the Purdue physics department in 1958 and served in that capacity until 1966, when he returned to teaching and research. This period witnessed a significant growth in the activities of the deparment.

After his retirement in 1974, James continued to maintain a strong research interest and served as a consultant to the Center for Information and Data Analysis and Synthesis, a research center affiliated with Purdue.

James was an outstanding scholar, a creative scientist and an influential teacher. His devotion to science and to his colleagues and students, his unfailing courtesy in his personal relationships and his subtle sense of humor—all these will be mised by those who knew him.

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