Robert Rathbun Wilson

March 4, 1914 — January 16, 2000

Robert Wilson was a central figure in the flowering of high-energy physics in the last fifty years. He was the driving force in the creation of two of the four world class high energy physics laboratories in the United States; the Laboratory of Nuclear Studies at Cornell and the Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois. His insistence on bolder, more economical design, seen clearly in the accelerators he built at Cornell, influenced the design of most modern accelerators. At Fermilab, first he built the world's highest energy accelerator, the 500 Gev (billion electron-volts) proton synchrotron, and later initiated the doubling of the energy by replacing the conventional magnets with super-conducting magnets. The latter technique made possible, both technically and financially, very high-energy accelerators. All subsequent and planned high-energy synchrotrons have used super-conducting magnets.

Wilson was born March 4, 1914, in Frontier Wyoming. He studied physics under E.O. Lawrence at the University of California at Berkeley, receiving a Ph.D. degree in 1940. He published his first paper while still an undergraduate, and as a graduate student, he published the first theoretical analysis of the stability of cyclotron orbits, and verified his analysis experimentally.

In 1940, he married Jane Inez Scheyer of San Francisco. They had three sons, Daniel R., Jonathon H., and Rand E. Wilson. In 1941, he accepted appointment as an Instructor at Princeton and was promoted the following year to Assistant Professor. In 1943, Wilson, together with his research group, joined the new Laboratory being set up at Los Alamos for the development of the "atomic" bomb. In 1944, he was chosen head of the Physics Research Division, which was responsible for the experimental nuclear physics research, and later for nuclear measurements that were made during the test of the first atomic bomb. Appalled by the destructive power of the bomb, Wilson worked effectively toward the end of World War II for civilian control of atomic energy. He was a leader in the formation of the Federation of Atomic Scientists, becoming its chairman in 1946.

After spending two years as an Associate Professor at Harvard University, Wilson moved, in 1947, to Cornell University, where he spent the next 20 years as the Director of the university's Laboratory of Nuclear Studies. At Cornell, he oversaw the construction of four successively more energetic electron synchrotrons. The second of these accelerators, a 1.2 GeV strong focussing synchrotron, was the first operating accelerator of this type. The following quotation from Wilson's 1953 report to the Office of Naval Research (ONR), describing the new project, tells us much about Bob as an accelerator builder:

> *"The Laboratory has indulged itself in some high adventure. A new synchrotron has been designed which is to give over a billion electron volts of energy. The design is highly controversial in that the new machine is exceedingly small and cheap for what it will do, hence there is considerable risk that it may not work at all. On the other hand, if we are successful, we shall have the largest electron accelerator in the world and new areas of research will be opened to us."*

And it was a great adventure. Despite Bob's warning to the ONR, the 1.2 GeV machine was very successful. Not only did it produce important physics, but its design paved the way to more compact, less expensive accelerators. What is also revealing is the candor of Bob's proposal to the ONR. There was no guarantee of success, only the guarantee of a scientifically exciting project worth the risk involved.

The Cornell facility, alone among university facilities, has endured as an important center of experimental high-energy research in this age of giant national or international laboratories because it has always had an accelerator with some unique physics capabilities, built for a modest price. Wilson insisted on this during his tenure as director. His inspiring leadership, inventiveness, can-do attitude and commitment to keeping the Lab at the forefront have carried through to the faculty, students, and staff to the present day. The three subsequent directors were colleagues or students of his.

During his 20 years at Cornell, Wilson remained deeply embedded in the physics program, as both mentor and experimentalist. He performed extensive measurements of kaon and pion photo-production in which he made the first observation of a new state of the nucleon, N(1440). In a series of elastic electron-nucleon scattering experiments, he extended the work of Robert Hofstadter on the structure of the nucleon.

In 1967, after completing the 10 GeV Cornell Synchrotron, the fourth machine, Wilson left Ithaca to assume the directorship of Fermilab. Starting on a virgin site with no staff, he began the job of building the most ambitious accelerator project ever undertaken up to that time. In addition to the challenge of building a cascade of large accelerators in less than five years, Wilson promised to double the 200 GeV energy of the originally proposed accelerator, a promise that he fulfilled, making it the highest-energy facility in the world. He accomplished that feat primarily by designing magnets that had a smaller aperture and higher magnetic fields, thereby increasing the energy of the protons, which could be circulating in the same-sized tunnel. The achievement of higher energy at the same cost was a hallmark of Wilson's career.

In 1980, the accelerator's capability was more than doubled again to reach 1000 GeV by adding a super-conducting magnet ring in the same tunnel. (With characteristic foresight, Wilson had the original tunnel built with space to spare.) Called the Tevatron, the accelerator was activated in 1980 and continues today to be the world's most energetic proton accelerator.

The Tevatron undertaking was vintage Wilson. To guide its circulating beams, the accelerator required about 1000 very accurate and reliable super-conducting magnets, which in turn, required an enormous leap forward in super-conducting technology. Wilson provided the project's vision and leadership and was devotedly and personally involved in the difficult R&D required to establish the mass production technology for bringing the project to a successful and low–cost conclusion. Without the technology, the capital and operating costs required for multi-TeV accelerators such as the Tevatron would be prohibitive.

Wilson built accelerators because they were the best instruments for doing the physics he wanted to do. He had very clear ideas of what the important physics problems were and these ideas had a strong impact on the experimental program. So far, the two most important physics results at Fermilab have been the discovery of the bottom quark (in 1977) and the top quark (in 1995). It was the redesign of the accelerator from 200 GeV to 400 GeV that made it possible to observe the bottom quark and the full energy of the Tevatron was necessary for the discovery of the much heavier top quark. The third and heaviest family of quarks "belongs" to Fermilab and to Bob Wilson.

Fermilab was an architectural, as well as scientific, triumph. With Wilson's involvement, the campus was designed with a grace and beauty rare in such facilities. The striking and memorable main building revealed another side of Wilson: the artist who believed that art and science should blend to form a harmonious whole. Wilson eloquently expressed this philosophy to Senator John Pastore on April 16, 1969 in testimony before the Joint Committee on Atomic Energy of the U.S. Congress:

> *Senator John Pastore: "Is there anything connected with the hopes of this accelerator that in any way involves the security of the country?"*
> *Robert Wilson: "No sir, I don't believe so."*
> *Pastore: "Nothing at all?"*
> *Wilson: "Nothing at all.*
> *Pastore: "It has no value in that respect?*
> *Wilson: "Only from a long-range point of view, of a developing technology. Otherwise, it has only to do with the respect with which we regard one another, the dignity of men, our love of culture. Otherwise, it has to do with are we good painters, good sculptors, great poets? I mean all the things we really venerate in our country and are patriotic about. It has nothing to do directly with defending our country except to make it worth defending."*

In 1946, noting that protons deposit most of their energy near the end of their path, Wilson proposed using proton beams for cancer therapy. By controlling its energy, most of the beam's energy could be deposited in a cancerous tumor inside the body with little damage to healthy cells. At his suggestion, the Harvard cyclotron was used for cancer therapy—the first successful demonstration of the technique. In recent years, the use of proton therapy has grown rapidly in many different cancer treatment centers around the world.

Wilson was awarded the National Medal of Science in 1973 and the Enrico Fermi Award in 1984. In 1995, the Andrew Gemant Award was given to Wilson for "his outstanding work linking physics to the arts and humanities". He was elected to the National Academy of Sciences, the American Academy of Science, and the American Philosophical Society. In 1985, he was elected to the presidency of the American Physical Society.

Wilson's effervescent personality came through in everything he did. He was a man filled with exciting ideas, inventions, and an array of interests in art, humanities, nature, and moral principles. These interests resulted in the restoration of the grasses of the Great Plains and the buffalo herds to the Fermilab site; his artistic stamp on the architecture at Fermilab; his personal sculptures at the laboratory, at other institutions, and in his own home; his civil rights efforts at Fermilab; his commitment to the Federation of Atomic Scientists (now the Federation of American Scientists) and American Physical Society; and his long-time work toward proton therapy.

Wilson's legacy to high-energy physics and the laboratories he built survives his death. This feeling was eloquently expressed by Judy Jackson, Director of Public Affairs at Fermilab, in a letter to Jonathon and Ann Wilson. She wrote:

> *"...it is probably impossible to overstate his (Bob's) influence on Fermilab. I think most of the time institutional memories are rather short: even people who play important roles are forgotten surprisingly quickly. That is emphatically not the case for Fermilab and your father. One cannot spend a day or an hour in the Laboratory without feeling his presence, in the architecture, the prairie, the accelerators and the attitude. For once, it is no cliché to say he lives on; he really does."*

And so he does, also at Cornell.

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