obituaries

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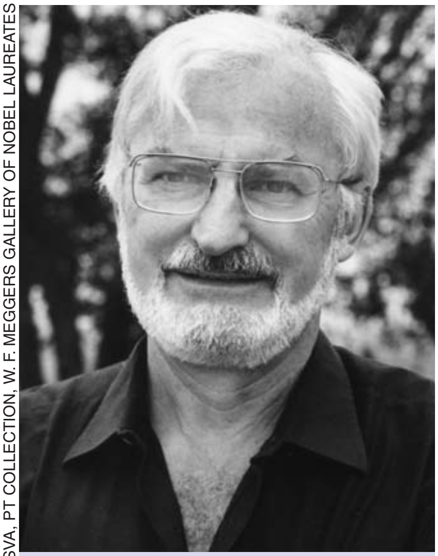
Heinrich Rohrer

Heinrich Rohrer, Heini to his friends, passed away in Wollerau, Switzerland, on 16 May 2013, three weeks short of his 80th birthday. He has been called the father of nanotechnology, and he helped establish the field with the invention, along with Gerd Binnig and Christoph Gerber, of the scanning tunneling microscope (STM). For their work, Heini and Binnig shared half the 1986 Nobel Prize in Physics. The other half went to Ernst Ruska for the much earlier invention of the electron microscope.

Heini inspired many of us to get into nanotechnology. Perhaps most important, he guided the nascent field with his extraordinary wisdom. I remember him telling a group of us working on scanning probe microscopy that we could praise our own inventions to the high heavens, but that the trouble starts if we bad-mouth someone else's inventions! In particular, he advised us to stay away from comparisons of our new scanning probe microscopes (SPMs) with electron microscopes. He said the problem is the temptation to compare our new, state-of-the-art instrument to an existing commercial one that may be using 20-year-old technology rather than what's state of the art in that field.

To those of us entering nanotech, Heini gave advice freely and provided substantial assistance. He helped the biophysics lab at the University of California, Santa Barbara, get started by sending it his first STM postdoc, Othmar Marti, for a year at the expense of IBM, Heini's employer. He strongly encouraged innovation and the development of other SPMs. He frequently noted that as long as an SPM was different enough from existing ones, a use would be found for it. That has proved true: For example, even though scanning capacitance microscopes and scanning ion conductance microscopes have very poor resolution compared with the STM, they are useful because they are sensitive to things beyond topography.

Heini was born on 6 June 1933 in the small town of Buchs in Switzerland. He studied physics at ETH Zürich, where he was an undergraduate under Wolfgang Pauli and Paul Scherrer. He stayed



AIP/ESVA, PT COLLECTION, W. F. MEGGERS GALLERY OF NOBEL LAUREATES

Heinrich Rohrer

on to obtain his PhD, on the length changes of superconductors at the magnetic-field-induced superconducting transition, with Jørgen Lykke Olsen. As Heini wrote in his Nobel Prize biography, "Following in [Olsen's] footsteps, I lost all respect for angstroms. The mechanical transducers were very vibration sensitive, and I learned to work after midnight, when the town was asleep." That was important background for the invention of the STM, since measuring small distances in the presence of vibrations is crucial.

In the summer of 1963, Ambros Speiser, director of the newly founded IBM Research Laboratory in Rüschlikon, Switzerland, invited Heini to join the physics effort there. Heini first worked on Kondo systems with magnetoresistance in pulsed magnetic fields and then on other magnetic systems. The real excitement started in 1978 when he hired Binnig, a genius who soon began work on what would become the STM. Heini had the good sense to give Binnig the freedom he needed to explore an area that was new to them both and totally unproven.

Later Heini had the foresight to foster the transition of STM technology beyond IBM into the world. At first it seemed to many others that it would be impossible to enter that area. After all, the creative minds working at IBM had a budget in the millions for making complex devices that depended on magnetic levitation in ultrahigh vacuum at cryogenic temperatures. What academic researcher could hope to compete? But Heini was persistent in encouraging others to join the field. And, as it turned out, useful STMs could be made without magnetic levitation, without ultrahigh vacuum, and at room temperature.

Although STMs in ultrahigh vacuum at cryogenic temperatures continue to give spectacular results, other SPMs have proved useful for technological and medical research in air or fluids at room temperature. The rapid and friendly spread of the technology is due in large part to the spirit of the field established by Heini: collaboration, cooperation, and mutual respect.

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Kenneth Geddes Wilson

Physics lost a creative genius on 15 June 2013, when Kenneth Geddes Wilson died at age 77 in Saco, Maine, of complications from lymphoma.

Leo Kadanoff, one of many physicists who inspired Ken, wrote after his death, "Ever since the early 1970s, the tools and concepts put forward by Wilson have formed the very basis of particle physics, field theory, and condensed matter physics. These concepts included fixed points, couplings that vary with scale, variation of physical properties with spatial dimension, description of couplings via anomalous dimension, qualitative variation in properties as a consequence of phase transitions, and topological descriptions of excitations."

Ken was born on 8 June 1936 in Waltham, Massachusetts. His father, accomplished Harvard University chemist E. Bright Wilson, was a student of Linus Pauling; his father and Pauling coauthored an influential early text on quantum mechanics. His mother was a physics graduate student before marrying. Ken was a member of the first generation to grow up with quantum mechanics, and he had an exceptional perspective.

As an undergraduate at Harvard, Ken was a Putnam fellow in 1954 and 1956. He also ran the mile on the varsity track team. After receiving his BA in physics in 1956, he was advised by his father to study under Richard Feynman or Murray Gell-Mann in graduate school at Caltech. According to Ken, Feynman said he wasn't working on anything, so Ken began his effort to make sense of strongly interacting field theories under Gell-Mann and received a PhD in 1961.

Ken was a junior fellow of the Harvard Society of Fellows from 1959 to 1962. He spent a year at CERN and then in 1963 joined the faculty at Cornell University, where he spent 25 remarkable years. He famously obtained tenure in two years with virtually no real publication record. By his own account, he had sought problems so difficult that publications would be few. He proceeded to reshape our understanding of quantum field theories and to tremendously extend their utility.

For more than 10 years, Ken employed pion–nucleon scattering and fixed-source theory as paradigms for nonperturbative renormalization. He did not try to tailor his work to any specific problem but instead sought tools sufficiently powerful to solve whole classes of problems, and he took inspiration from nonrelativistic quantum mechanics, which offers reliable nonperturbative methods. In 1965 he introduced many key features of his renormalization group approach, but he did not solve the fixed-source problem. He realized that he must allow for an arbitrarily large number of couplings, the hallmark of the Wilsonian renormalization group. After another five years, during which he invented the operator product expansion, Ken solved a drastically truncated version of the problem numerically, with controlled errors. Few appreciated what he had accomplished, but he then made rapid progress on many fronts.

Ken continued to work on renormalization of the strong interaction throughout his career. He investigated almost all possible asymptotic scaling behavior of the strong coupling in 1971, but he missed asymptotic freedom because, by his account, he had not taken gauge invariance seriously enough. That work led him in 1974 to invent lattice gauge theory, which grew into a subfield in particle physics and has evolved to become the most reliable tool for nonperturbative calculations in quantum chromodynamics.

While Ken was working on his fixed-source calculations through the 1960s, the subject of phase transitions came to his attention. Inspired by Benjamin

Kenneth Geddes Wilson

Widom and Kadanoff, he realized that phase transitions require a large range of coupled length scales, exactly the sort of problem he was encountering in quantum field theory. He began an extremely fruitful collaboration with Michael Fisher at Cornell. Their seminal work on critical points and phase transitions revolutionized condensed-matter theory, especially after the epsilon expansion provided examples of Ken's ideas that could be computed analytically rather than numerically.

In 1975 he published his Kondo-problem solution, which exploited its similarity to the fixed-source problem he had solved. He included a lucid discussion of the deep connections between renormalization problems in condensed-matter physics and particle physics, a bridge that led to incredibly fruitful collaborations between the two fields. The reach of effective field theory grew to cover all scales.

In 1982 Ken received the Nobel Prize in Physics for his development of general and tractable renormalization group methods to handle widely different scales of length simultaneously. Such problems include some of the most difficult and important in physics, among them critical points and phase transitions.

Fascinated by computers as a graduate student, Ken soon considered them as essential as analytic techniques for his calculations. He became a champion of computational physics and supercomputers, with lattice gauge theory pushing their limits for decades. In 1985 he was appointed director of the Cornell Theory Center (now the Center for Advanced Computing), one of the first supercomputing centers created by NSF.

In 1988 Ken moved to the Ohio State University. His wife, Alison Brown, had been hired by Ohio State's supercomputer center; Ken liked to joke that he was a spousal hire. He wanted to turn his attention to education, and at Ohio State he could establish a physics education research group. He served as a codirector for Project Discovery, a statewide effort to improve science education, but his attention naturally drifted to education as a whole. Working with Constance Barsky, he mounted a monumental effort to find practical means to drastically improve the US educational system, including studying fields as disparate as geology and airplane engineering for productive analogues. His efforts were still nascent at the time of his death, but his 1994 book *Redesigning Education* (Holt), written with Bennett Daviss, outlined many of his basic ideas.

Ken continued to work on the strong interaction at Ohio State, and he developed a novel alternative to lattice gauge theory that employs Dirac's light-front formulation of field theory. In the process of developing renormalization group tools for that problem, Stanislaw Glazek and Ken invented the similarity renormalization group. Its transformations are designed to avoid problems in Ken's earlier transformations and hopefully extend the reach of the renormalization group.

Ken was generous with his time and his ideas. He delighted in helping students. At times, it seemed as if he thought in his own language, and when anyone had difficulty understanding his ideas, he would patiently translate them into a more accessible form.

No account of Ken should omit his other passions: hiking, kayaking, and folk dancing. And the gardens he grew with Alison were amazing.

Robert Perry
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Paul William Zitzewitz

Paul William Zitzewitz, a dedicated educator, noted textbook author, atomic physicist, and leader in the American Association of Physics Teachers (AAPT), passed away on 30 April 2013 in Northville, Michigan,