

Robert Fox Bacher

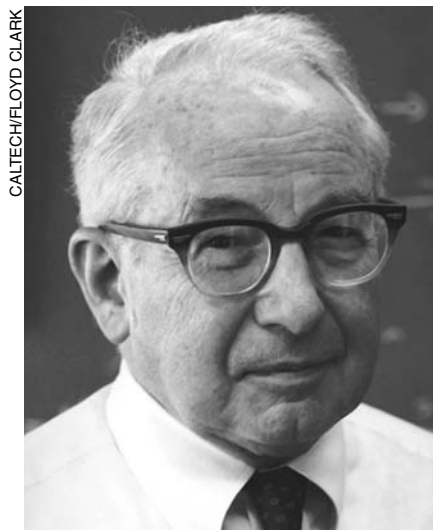
Robert Fox Bacher, widely known for his leadership at the Radiation Laboratory at MIT and the experimental physics and bomb physics divisions at Los Alamos, died on 18 November 2004 at a retirement community near Santa Barbara, California. He is also remembered for his membership in the Atomic Energy Commission (AEC); his longtime chairmanship of Caltech's division of physics, mathematics, and astronomy; and his service as the university's provost.

Born on 31 August 1905 in Loudonville, Ohio, Bob grew up in Ann Arbor, Michigan, where he attended the University of Michigan. He was fortunate to have as a summer neighbor Harrison Randall, chairman of physics at Michigan, who steered him into physics at a time when Randall was transforming the department into one of the US leaders. Samuel Goudsmit and George Uhlenbeck had arrived at Michigan from the Netherlands and the university had just established the renowned summer school attended by Niels Bohr, Enrico Fermi, J. Robert Oppenheimer, and many others.

Bob studied engineering physics and then did a graduate thesis under Goudsmit in theoretical work on hyperfine structure in 1930. He pursued a two-year National Research Council fellowship at Caltech (1930–31) and at MIT (1931–32). While at MIT, he had occasion to report on the recent discovery of the neutron, which may have raised his interest in nuclear physics.

He returned to Ann Arbor in 1932, stayed on without an appointment because of the Depression, and began experimental work in hyperfine structure. In 1934 he became an instructor at Columbia University, where he met and became friendly with I. I. Rabi. He left in 1935 for Ithaca, New York, where he joined Cornell University as an instructor. Three years later, Bob initiated a program on slow-neutron cross sections using a time-of-flight apparatus and a 15-inch (!) cyclotron built by M. Stanley Livingston. He collaborated with Hans Bethe on an encyclopedic review article on nuclear physics, one in a series of three articles that were published in *Reviews of Modern Physics* in 1936 and 1937.

In the fall of 1940, while the neutron work was still active, Bob went to MIT's Radiation Laboratory, where he headed the indicator group under the overall direction of Lee A. DuBridge and later led the radar receiver group. Bob was



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persuaded by Oppenheimer, though, to join Los Alamos in early 1943 as chairman of the experimental physics division and, later, the bomb physics division. At the time, there were plans to convert Los Alamos to a military lab, but Bob made it clear that he would resign if that happened. It never did.

After World War II, Bob returned to Cornell as director of the nuclear lab but was called away to advise the US delegation to the United Nations on international control of nuclear energy. After the failure of the Baruch Plan, the early attempt to give the UN oversight of nuclear power and atomic weapons, Bob joined the AEC as its only scientist member. He led AEC efforts to restart the production of atomic weapons and to support research, and helped found Brookhaven National Laboratory. He also pursued efforts to design breeder reactors. In 1949 Bob resigned with the intention of returning to Cornell.

Dubridge, however, had accepted the presidency of Caltech in 1946 and asked Bob to join him as chairman of the division of physics, mathematics, and astronomy. After some arm-twisting by Dubridge, Bob reconciled himself to a career in administration and accepted the position. One of his first moves as chairman was to talk to Richard Feynman, who Bob knew was thinking of leaving Cornell. After complicated negotiations—Bob encouraged Feynman to borrow his car and explore Hollywood—Feynman was persuaded to come to Caltech. Bob also initiated a high-energy physics program at Caltech by arranging to build a 600-MeV electron synchrotron.

CALTECH/FLOYD CLARK

In 1955 Bob brought Murray Gell-Mann to Caltech to cement the university's outstanding position in elementary particle theory. At about the same time, together with Dubridge and Jesse Greenstein, he initiated a radio astronomy program establishing the Owens Valley Radio Observatory, and thus added to Caltech's leading position in observational astronomy.

Bob continued as an adviser to the AEC and as a member of President Dwight D. Eisenhower's Science Advisory Committee. In 1959 he was a member of the US delegation on nuclear test ban negotiations. He stepped down as Caltech's division chairman in 1962 to become the university's first provost, a position he held until 1970. He remained on the faculty until his retirement in 1976. He and his wife, Jean, moved in the late 1980s to a retirement community.

Bob served the US and international communities well. He was president of the American Physical Society (1964–65), chair of the International Union of Pure and Applied Physics (1969–72), and chair of the Universities Research Association (1970–73).

A strong administrator with firm views and clear principles, Bob defended academic freedom when Linus Pauling was severely criticized by some university trustees. He insisted that Caltech retain ties to Pauling after Pauling resigned. He oversaw the university's conversion to coed status. And he had a clear idea of how he expected the university to operate. He always consulted widely with senior colleagues before acting on academic matters, but then was decisive.

Bob had many friends at Caltech and nationally who greatly miss his wise counsel.

Robert Christy

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Clayton Hamilton Allen

Clayton Hamilton Allen, an acoustician who clearly enjoyed his work and offered an innovative approach to acoustical tasks, died on 25 August 2004 at Chebeague Island, Maine.

Born in Whitinsville, Massachusetts, on 2 June 1918, Clay received a BS in physics in 1940 from Worcester Polytechnic Institute. He entered Pennsylvania State College (now University) and earned an MS in physics in 1942. After three years at Wright-Patterson Air Force Base in Dayton, Ohio, where he worked on military communications gear, Clay resumed graduate work at Penn State.

Under the supervision of H. K. Schilling and Isadore Rudnick, Clay made significant contributions to high-intensity sound. Well known is his development of high-power sirens for use in air. He and Rudnick presented a paper on that topic at the May 1947 Acoustical Society of America (ASA) meeting and followed with an article in the September issue of the *Journal of the Acoustical Society of America (JASA)*. The siren reports caused quite a public stir and led to articles in *Life* magazine and *Popular Science*, and to a news short in movie theaters. Novel demonstrations included suspending marbles in a standing-wave field, heating a cup of coffee, and lighting a pipe. One of their sirens was used to study the biological effects of high-intensity sound. Clay received his PhD in physics in 1950.

Less well known is Clay's experimental study of finite-amplitude propagation. Using a baffled-piston source vibrating at 14.6 kHz, he discovered nonlinear acoustical saturation, or limiting sound-pressure level, as he called it. Saturation is the maximum sound pressure level achieved at a given distance at a given source frequency. Clay correctly explained it as caused by nonlinear distortion of the propagating wave. Distortion causes the transfer of energy to higher harmonics, where it is more efficiently absorbed. At saturation, any further increase in source level is accompanied only by an equal increase in absorption. Clay also discovered the blunting effect, and decreased side-lobe suppression, that increased absorption has on the directivity pattern of the radiation. Unfortunately, he reported his work only in his thesis (1950), in part of the Penn State Sig-

nal Corps report *Atmospheric Physics and Sound Propagation, Final Report for Period July 1, 1945 to May 20, 1950*, and in two papers presented at the June 1950 ASA meeting. As a result, his pioneering work is not widely appreciated even today.

After receiving his PhD, Clay immediately began working for Corning Glass Works in Corning, New York, where he directed sonic and ultrasonic research. In 1954 he joined the technology firm Bolt Beranek & Newman (BBN) in Cambridge, Massachusetts, to start what became a productive career as a consultant in acoustics. His early work was on the noise of components in the relatively new field of air conditioning, and a paper by Leo L. Beranek, George Kamperman, and Clay about that field was published in *JASA* in 1955. Clay's more complete work is reported in chapter 21, which he wrote for *Noise Reduction* (McGraw-Hill, 1960), edited by Beranek. In later work primarily for the textile, metal, and foundry industries, Clay applied his physics insight to machine design to reduce noise at the source.

At BBN, Clay's knowledge and experience set him apart from others. His physical intuition in high-amplitude sound, his expertise in design of high-power sources, and his uncanny ability to make complicated machinery work enabled the company to design outstanding test facilities. In 1958 he designed a powerful siren to be used in a high-intensity sound facility at BBN to measure the potential for failure of electronic and metal components. The siren operated over a frequency range of 50–10 000 Hz and had a maximum acoustic output of 1100 W. Besides periodic tones, it produced amplitude-modulated tones that simulated band-limited noise. Clay, with B. G. Watters, described the siren development in two *JASA* papers published in 1959.

Clay then designed a siren having an acoustic power of 25 kW as the basis for a full-scale, 25-siren research facility for the US Air Force. The facility was intended for research on noise-induced failure of jet aircraft and space vehicle structures during launch. Clay's leadership was essential to BBN in that and similar efforts. He left BBN in 1974 to establish the Clayton H. Allen Corp, which was formed a year later.

Clay's approach to noise control often led to patents. His first, in 1950, was with Rudnick for a siren. He also held four patents for earmuffs—including two for a design that provided a level-dependent attenuation for



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