NATIONAL ACADEMY OF SCIENCES

ROBERT BIGHAM BRODE

1900—1986

A Biographical Memoir by

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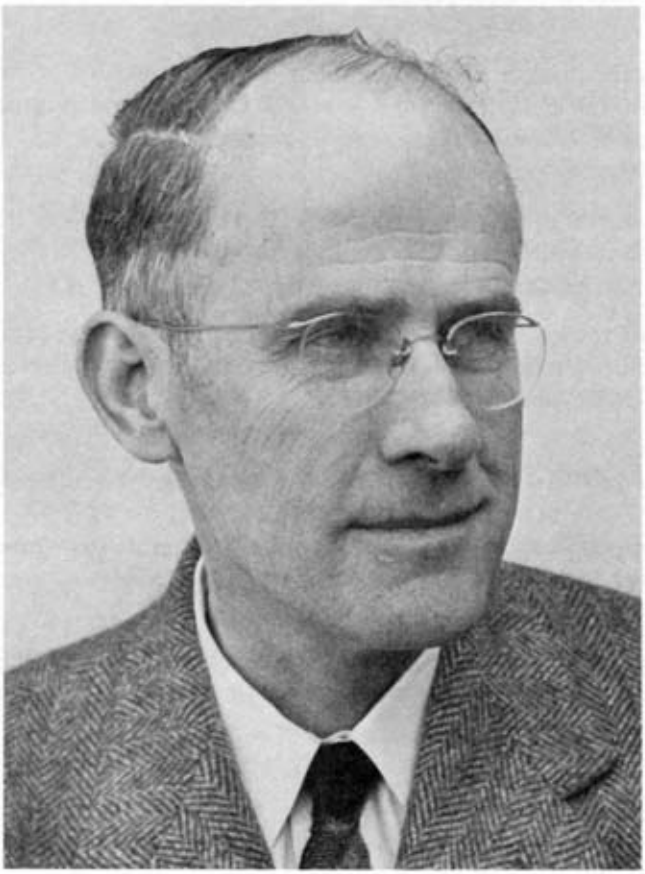

Robert B. Brode

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June 12, 1900–February 19, 1986

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THE EMINENT PHYSICIST, distinguished educator, public servant, academic statesman, and professor emeritus of the University of California, Robert Bigham Brode, died February 19, 1986, at his home in Berkeley, California. Robert was one of triplets born June 12, 1900, in Walla Walla, Washington. Following the example of their father, professor of biology at Whitman College, Robert and his brothers, Wallace and Malcolm, all became distinguished scientists.

EDUCATION

Bob Brode's young life included not only science but also a general cultural education. During those early years he became a proficient flute player, contributing enjoyment to others and gaining personal pleasure for many years.

Leaving Whitman with a bachelor's degree in 1921, Brode went to the California Institute of Technology, where he earned the Ph.D. degree in physics in 1924. By so doing he took his place at the head of a long line; 1924 was the very first year in which this degree was awarded by Caltech, which was then, under the direction of Robert A. Millikan, developing its scientific program.

PREWAR RESEARCH AND TEACHING

Brode's first research, published in 1925, showed that molecules such as nitrogen and carbon monoxide, or methane and argon—having similar arrangements of their external electrons—have very similar cross-sections for collisions with slow electrons, leading to results that are difficult to explain using classical physics. Not until 1966, when modern computers to evaluate numerically the wave-mechanical analysis became available, were his results completely understood. From then on his early work was widely used in analysis of data concerning the scattering of charged particles at low energies.

Brode started his professional experience as an associate physicist in the Bureau of Standards. He held a Rhodes Scholarship at Oxford in 1924–25, a National Research Fellowship at Göttingen in 1925–26, and a research appointment at Princeton in 1926–27. He married Bernice Hedley Bidwell on September 16, 1926.

Brode came to the University of California at Berkeley in 1927 as an assistant professor of physics and rose very rapidly to the rank of full professor in 1932. During these years he was energetically establishing his program of research in the growing department, continuing his work on interactions of slow electrons in various gases, a field now important in research on plasma physics. Workers at several European laboratories, in particular Dr. L. LePrince-Ringuet and Dr. P. Auger in Paris, were involved in similar research.

Brode was especially pleased to be awarded a Guggenheim Fellowship for study in Cambridge and London in 1934–35, as he had developed a great affection for England from his rewarding stay in Oxford as a Rhodes scholar ten years earlier. He, his wife, and their two small sons also enjoyed a warm friendship with the family of P. M. S. Blackett of Birkbeck College, London.

During this period Brode transferred his activity from very slow electrons to very fast particles, the heavy components of cosmic radiation. He became enthusiastic about the scientific results that could be obtained by applying Blackett's techniques involving counter-controlled cloud chambers to study the specific ionization and momentum of these particles.

Returning to Berkeley, Brode continued these studies with a succession of students, starting with M. A. Starr. He reported on the design and characteristics of a magnet for cosmic ray cloud chamber studies in which the mass of the mesotron was measured by using a drop-counting technique in the magnetic field. With his student, Dale Corson, he was able to separate electrons, protons, and mesons and to measure their masses. In 1938, Corson applied the drop-counting technique to confirm the theoretical prediction that specific ionization for electrons should increase with increasing energy for relativistic mass above about four times the rest mass.

Brode was always interested in teaching both undergraduates and graduates. He was well remembered by many students as the instructor in the upper-division course on electricity and magnetism. He participated regularly in the Monday Night Journal Club started by Ernest Lawrence in the 1930s, often contributing reports of his own research and keen comments on the work of others. In the years 1930–43 fifteen graduate students conducted their research under his direction. During the intensely active period of research and development before World War II, this work resulted in improved equipment and analysis, contributing substantially to the development at Berkeley of a world-class physics department.

WAR SERVICE

Brode's work with cosmic rays was interrupted by the war. Going first to the Applied Physics Laboratory at Johns

Hopkins, he played a leading role in the successful research and development effort on the amplitude-operated radio proximity fuse. When the Los Alamos project was established in 1943, among its many problems was the development of a fusing mechanism to detonate a bomb at a specific height above the terrain. New methods were needed because of the size of the explosion and the unprecedented level of reliability required, but the proximity-fuse problem had elements of similarity, so the project's leaders—many of whom had been Brode's colleagues at Berkeley before the war—sought his talents. Thus it happened that he joined the project at the start, and his wife and sons arrived a few months later. During his entire period "on the mesa" from 1943 until he returned to Berkeley in 1946, Bob Brode was in charge of the "fusing group."

Their early work was directed toward adapting proximity fuses and developing barometric-pressure switches. The latter program led to creation of a sizable organization that, in cooperation with the Air Force at distant air bases, used elaborate instrumentation to collect and interpret data on the evolving designs. Early in 1944 it became evident that the range of proximity fuses was inadequate for the increased estimate of detonation height, and that barometric switches were incapable of the required precision. Brode and his group then focused their efforts on a newly developed simple radar, which was tested extensively, using the experience and the organization from the earlier field tests. A large number of systems were dropped from barrage balloons in New Jersey and on dummy bombs from aircraft based at Wendover Field, Utah. An elaborate design evolved using several radars, together with banks of clocks with pull switches and barometric switches to arm the system after leaving its aircraft, all in series-parallel

arrays to guard against trouble from premature operation or failure of any individual component.

The planning and design began in August 1944 and resulted in production of operating units almost a year later. The pace of the work, like every other activity at Los Alamos, was limited chiefly by the number of hours each leader was able to drive himself and his team. Brode had recruited a mixed group of fourteen civilians, twelve reserve military officers, and thirty-seven special-detachment army privates recently drafted after obtaining college degrees in the sciences. In most accounts of the Manhattan Project the work of this group has received little attention, yet it was essential. The quality of its field work was praised by the commanding officers at each of the four sites involved, and the fusing systems on both bombs used to end the war operated perfectly. The group's dedication and skill reflected Bob Brode's leadership and the example he set. One of its members wrote, "No one could have had a more inspiring, demanding, and sympathetic boss under those remarkable conditions. Bob and Bernice were outgoing and hospitable to young people. They enjoyed the New Mexico ambience when time allowed, folk-dancing to all hours on occasion. Bob played the flute in the local amateur symphony. They were a sincere, sophisticated but unaffected couple doing all they could to help others and to maintain a civilized environment during times of great stress."

POSTWAR TEACHING AND RESEARCH

After the war, Brode resumed his teaching and research on measurements of momentum, specific ionization, and range of cosmic ray mesons. Using a cloud chamber in the field of a permanent magnet, he made observations of cosmic radiation particles in a B-29 aircraft at 30,000 feet. He also returned to guiding the research of graduate students,

supervising another twenty-two of them between 1946 and 1957, for a total of thirty-seven students, who have made significant scientific, academic, and administrative contributions. They included Dale R. Corson, president and chancellor of Cornell University (1969–79) and William B. Fretter, vice-president of the University of California (1978–83).

He continued to be active in undergraduate education; in the middle 1960s he assisted the U.S. Educational Commission in its mission to many European countries, and took particular interest in the awards of Hayes-Fulbright fellowships. From 1962 to 1965 he was the chairman of the Committee on Physics Faculties in Colleges (COPFIC) formed by the American Association of Physics Teachers and the American Institute of Physics, which reported on methods for improving the teaching of physics in colleges.

A Fulbright Fellow in 1951–52, Brode was again able to work in England, this time on research in Manchester, where he renewed ties with physicists he had known earlier.

Robert Brode was a member of a large number of scientific, academic, and honorary organizations; in many of them he was sought out for positions of service and leadership. These include the International Union for Pure and Applied Physics (vice-president); American Association for the Advancement of Science (president of the Pacific Division); National Research Council (chairman, Physics Division Executive Committee); American Association of University Professors (vice-president and other offices); American Physical Society (member of the Council); National Science Foundation(associate director for research); and International Council of Scientific Unions (U.S. delegate). He served on the board of editors of *Reviews of Modern Physics*, on selection panels for Rhodes Fellowships, John F. Kennedy Foreign Scholarships, and Fulbright Scholarships,

and on panels for awards by the U.S. State Department, the U.S. Atomic Energy Commission, and the Institute of International Education. He was also an associate of the Carnegie Institution and a member of the American Academy of Arts and Sciences, the Washington Academy of Sciences, the Optical Society of America, the American Association of Physics Teachers, the American Institute of Physics, Phi Beta Kappa, Sigma Xi, Delta Sigma Rho, and other groups. He was acting director of the Space Sciences Laboratory at Berkeley in 1964–65 and was director, in London, of the University's Education Abroad Program in the United Kingdom in 1965–67.

ACADEMIC STATESMANSHIP

After the war Brode was increasingly sought out by his professorial colleagues at Berkeley to become a leading member of the Academic Senate. Brode was a firm believer in faculty self-governance at the University of California. During the difficult era of McCarthyism, when the university was rent by the oath controversy, he was a vigorous leader of the faculty, serving as chairman or member of its most important committees; his integrity, forthrightness, and deep concern for the welfare of the entire university community were widely respected. In these roles, and through the American Association of University Professors, for which he served as vice-president and in a variety of other posts, he exerted strong and ultimately successful efforts to restore full academic freedom.

Brode rendered long service to the university as academic assistant to two of its presidents, Clark Kerr (1960–65) and Charles J. Hitch (1972–73), as well as to the vice-president for academic affairs, Angus E. Taylor (1967–72). In this capacity, his wise counsel covered a wide range of subjects, including academic freedom, reorganization of

the Academic Senate, admission and enrollment issues, standards of peer review for faculty, and the changing status of the ROTC programs on the campus. President-Emeritus Kerr has written of his service, "Bob Brode was one of the great statesmen of the Berkeley faculty. He gave me the best advice I got from anyone. He was always the wise, active, devoted, unselfish leader of faculty opinion. He had the rare ability to be, at one and the same time, both in and above the conflicts of the day. His only agenda was the welfare of the university and of its faculty and students. Might there be more like him!"

HONORS AND AWARDS

Robert Brode's talents and accomplishments were rewarded by a series of scholarships, fellowships, and honorary degrees:

Rhodes Scholarship, 1924–25
National Research Fellowship, 1925–26
Guggenheim Fellowship, 1934–35
Election to the National Academy of Sciences, 1949
Fulbright Fellowship, 1951–52
Honorary D.Sc. degree, Whitman College, 1955
Centennial Award, University of California, 1968
Honorary LL.D. degree, University of California, 1970

The citation for the final honor listed above serves to sum up his career:

Brilliant physicist, talented teacher, scientific statesman, creative administrator, for over four decades you have inspired countless students. Your interest has ranged from slow electrons in atoms to swift mesons in cosmic rays. You have been many times chosen to guide the affairs of your discipline and have lent your wise counsel to your nation and to the world. You

have given unflaggingly of yourself in service to your colleagues and to your University. You embody the best of your profession, and we salute you today in gratitude and affection, and confer upon you our highest honor.

Bob Brode had a great fondness for Christmas music. At this time of year he often invited students and others to his home for a sumptuous buffet, followed by singing from the Oxford Book of Carols. For over fifty years, beginning with his arrival at Berkeley in 1927, he was an enthusiastic singer in the Monks Chorus of the Faculty Club, a group of faculty members who gather each December to sing at the annual Christmas dinners of the club. He recruited several members from the physics department and elsewhere over the years, and enjoyed regaling the Monks with tales of the Christmas music at King's College at Cambridge.

This very tall, large-boned, gentle, modest, and considerate man was decidedly a presence—loved and respected by all who knew him. He and his diminutive wife Bernice resided happily for many years high in the Berkeley hills in a distinctive house of rustic redwood design, constructed in part by Bob with his own hands, and later in a similar house nearer the campus. These homes made perfect settings for their gracious and informal hospitality to an enormous circle of colleagues, visitors, students, and friends, who continue to cherish their memories.

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