

NATIONAL ACADEMY OF SCIENCES

N O R R I S E . B R A D B U R Y

1909—1996

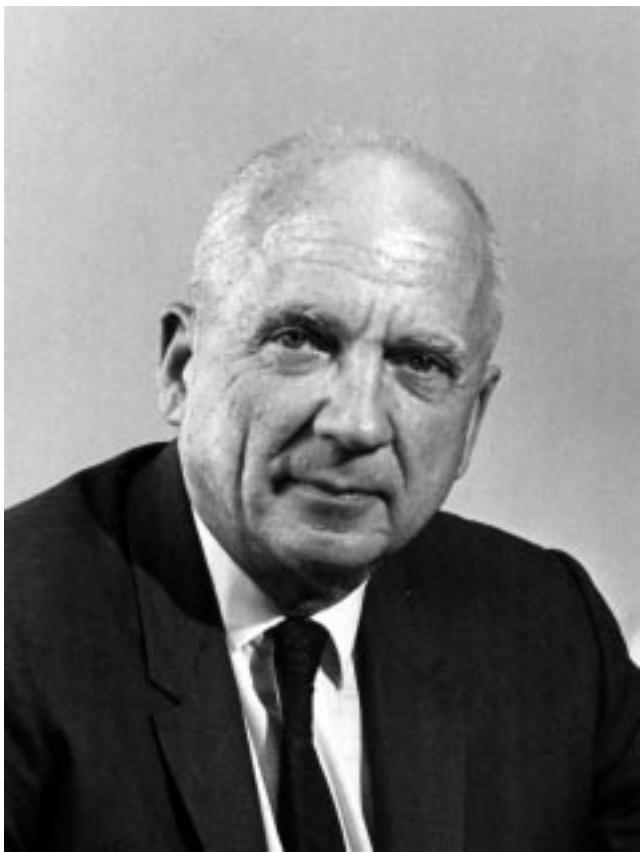
A Biographical Memoir by

HAROLD M. AGNEW AND RAEMER E. SCHREIBER

*Any opinions expressed in this memoir are those of the author(s)
and do not necessarily reflect the views of the
National Academy of Sciences.*

Biographical Memoir

COPYRIGHT 1998
NATIONAL ACADEMIES PRESS
WASHINGTON D.C.



Courtesy of Los Alamos Scientific Laboratory



A handwritten signature in black ink, appearing to read "McNamee". The signature is fluid and cursive, with a large, sweeping flourish at the end.

NORRIS E. BRADBURY

May 30, 1909–August 20, 1997

BY HAROLD M. AGNEW AND RAEMER E. SCHREIBER

NORRIS E. (EDWIN) BRADBURY died August 20, 1997, at the age of eighty-eight. He succeeded J. Robert Oppenheimer as director of the Los Alamos Laboratory in October 1945 with the understanding that his appointment was an interim one, perhaps only for six months. Instead, he held the position of laboratory director for twenty-five years before retiring. Under his leadership, the laboratory recovered from the postwar doldrums and became internationally renowned for advanced research and development in a variety of fields. Much of the work was aimed at understanding the use of nuclear energy, but important work was also done in related fields, such as computing, biosciences, and space technology.

Norris Bradbury was born May 30, 1909, in Santa Barbara, California, one of four children of Edwin Pearly and Elvira (Clausen) Bradbury. He grew up in southern California and attended Hollywood High School and then Chaffey Union High School in Ontario, California, where he graduated at the age of sixteen. His early interest was chemistry, but while at Pomona College in Claremont, California, he became intrigued with physics. He graduated from Pomona summa cum laude in 1929 with a B.A. in chemistry. His scholarship at Pomona earned him a Phi Beta Kappa key.

Norris did his graduate work at the University of California, where he served as a teaching fellow from 1929 to 1931 and a Whiting fellow during 1931-1932. In 1932 he received his Ph.D. in physics for work on the mobility of ions in gases. That same year he was awarded a National Research Council Fellowship in physics. He spent the next two years doing research at the Massachusetts Institute of Technology. In 1935, at the age of twenty-six, he became an assistant professor of physics at Stanford University. He was promoted to an associate professorship in 1938 and became a full professor in 1943.

During the 1930s, Bradbury established a reputation as an expert on conduction of electricity in gases, properties of ions, and atmospheric electricity. He published numerous technical articles on these subjects in journals such as *Physical Review*, *Journal of Applied Physics*, *Journal of Chemical Physics*, and *Journal of Atmospheric Electricity and Terrestrial Magnetism*.

In 1941, prior to the U.S. entry into World War II, Bradbury was commissioned in the Naval Reserve and assigned to the Naval Proving Ground at Dahlgren, Virginia. There he remained until the summer of 1944, when he was asked to transfer to the Manhattan Project's top-secret Los Alamos Laboratory. He arrived at Los Alamos in July 1944 to head the implosion field test program. He was soon placed in charge of the assembly of all non-nuclear components of Fat Man, the plutonium implosion weapon, which was successfully detonated near Alamogordo, New Mexico, on July 16, 1945.

On August 14, 1945, the war ended and shortly thereafter J. Robert Oppenheimer resigned as director of the weapons laboratory at Los Alamos. In mid-October 1945, on Oppenheimer's recommendation, Commander Norris Bradbury, U.S. Naval Reserve, was released from active duty

to become the second director of the Los Alamos Laboratory. At the time he accepted the post, there were numerous indications that he might well be the last director of the laboratory. With the war over, the scientists who had labored so diligently and fruitfully to produce the atomic bomb were impatient to return to their laboratories and universities. There was no certainty as to what the future of Los Alamos would be, and there was even a considerable outcry that the laboratory would be completely abolished.

During this period of uncertainty Commander Bradbury became Director Bradbury, interim (at least so he thought) head of Los Alamos Laboratory—"Scientific" was not added to the laboratory's name until 1947. He accepted the directorship with the proviso that he would hold it only for six months or until atomic energy legislation determining the future of Los Alamos was passed, whichever came first. He soon found that the six months would be up long before such legislation was passed and put into effect. The MacMahon Act creating the Atomic Energy Commission was signed into law on August 1, 1946, and became effective January 1, 1947, with the transfer of the Manhattan District to the Atomic Energy Commission.

Bradbury recalled the first few months of 1946 as being undoubtedly the most difficult he experienced as director. The main water line into Los Alamos froze and for many weeks, tank trucks had to haul water from the Rio Grande Valley. Utilities, housing, and community facilities were temporary or non-existent. The war had been over for six months, but both the laboratory and the staff were housed in make-shift buildings inside a military post.

The laboratory staff was reduced from a wartime high of 1,400 civilian employees and 1,600 military technicians in July 1945 to about 1,000 people in January 1946. The military technicians were granted honorable discharges; the ci-

vilian staff was honor bound only for the duration of the war, and many were returning to their home assignments. In December 1945, against this background of reduced staff, the laboratory was informed that it was assigned the responsibility for providing the bombs and technical direction for Operation Crossroads, a massive test of atomic bombs against warships. This operation was conducted successfully in the summer of 1946.

In the meantime, Bradbury had the formidable task of establishing the laboratory as a continuing and reliable research organization. This involved selection of research and development priorities that would be of national interest, hiring competent people to carry out these objectives, replacing the inadequate temporary buildings, and providing new houses, schools, and other infrastructures needed to make Los Alamos an attractive place to live.

Under Bradbury's leadership, Los Alamos Laboratory expanded its objectives to include basic nuclear research, exploring nuclear applications and cooperation with universities through vigorous consultant agreements, postdoctoral appointments, and student fellowships. Weapons development was to continue but with an admixture of relevant basic research that would attract top-notch scientists and engineers.

The debate at the Washington level on the future of nuclear energy finally led to the creation of the Atomic Energy Commission, which took over in January 1947. In the meantime, General Leslie R. Groves, as commander of the Manhattan District, advised Bradbury that, "The Los Alamos site must remain active for a considerable period. . . ." This letter, dated January 4, 1946, set the pattern for the rebuilding of the laboratory and town site that was later implemented by the Atomic Energy Commission.

The University of California, which had contracted to

operate the Los Alamos Laboratory for the Manhattan District as a wartime obligation, agreed to continue in this role. The fact that staff members of the laboratory were University of California employees was an aid in recruiting competent scientists and engineers. Additionally, an extensive consulting program enabled the laboratory to recapture much of the knowledge accumulated by the wartime staff members who left at the end of the war. These consultant agreements made it possible to obtain the services of former staff for days or even weeks as needed.

Bradbury believed that laboratory management was responsible for encouraging scientific creativity by offering an environment in which scientists could work without interruption, shielded from budget worries and bureaucratic regulations. This philosophy translated into considerable freedom to initiate new projects. For many years of Bradbury's tenure, the Los Alamos Scientific Laboratory was able to choose its own priorities. The Atomic Energy Commission was still establishing itself as a federal organization and was dominated by the Senate/House Joint Committee for Atomic Energy. Bradbury and his staff made frequent trips to Washington, and it was not unusual for the visits to result in support from both of these groups for new laboratory programs.

In spite of the fact that the major mission of the Los Alamos Scientific Laboratory was the development and testing of nuclear weapons, Bradbury hoped they would never be used in war. He expressed these views in a number of speeches and papers, which briefly may be paraphrased as follows: The role of the laboratory was to help provide the United States with an arsenal of nuclear weapons that would discourage any enemy nation from attacking it. Nuclear disarmament was the ultimate goal, but it could only be accomplished through international agreements, and hostile

nations would only enter into such agreements if convinced that they could not win a nuclear war.

Although a firm supporter of the country's nuclear deterrent, Bradbury was a strong proponent of the 1963 Limited Nuclear Test Ban Treaty. He expressed the feelings of the entire nation when he closed his testimony before the Senate hearing on the nuclear test ban treaty by saying, "I, myself, with considerable knowledge of nuclear things, with some knowledge of their military use, but with only a plain citizen's feelings about people and nations and hopes and fears, would prefer to follow the path of hope."

Under the pressures of the Cold War, the Los Alamos Scientific Laboratory was assigned a key role in designing and testing a variety of nuclear bombs and warheads, including thermonuclear devices. Tests were conducted at the Pacific Proving Grounds and the Nevada Test Site. Other major projects included the development of a nuclear propulsion reactor, a project known as Rover. Although the reactor never flew, Rover's technical feasibility was demonstrated by ground tests at thrust levels of 50,000 to 150,000 pounds. Laboratory staff also tested several exploratory reactor designs, including solid and liquid plutonium fuels and gas-cooled uranium reactors; performed basic research in the areas of physics, chemistry, and metallurgy; and established a large program in biological and medical health research.

Norris Bradbury took an active interest in Los Alamos, both in his capacity as director of the Los Alamos Scientific Laboratory and as a member of the community. He was involved in developing the entire community, including housing, hospital facilities, community services, and schools. Prior to his retirement from the Navy in 1961, he served as commander of the local Naval Reserve unit. He participated in organizing the first Cub Scout pack in Los Alamos

and was a charter member of the YMCA. He served as a trustee, president, and vice president of the Board of Education, and was a member of the Board of Regents of the University of New Mexico. He also served on the Board of Regents of the Museum of New Mexico and was president of the New Mexico Archaeological Society. Under Bradbury's leadership, Los Alamos developed and still has one of the finest hospitals and school systems in the Southwest.

Bradbury remained a professor of physics in absentia at Stanford until 1951, when he was appointed a professor of physics at the University of California, the operator of the Los Alamos Scientific Laboratory for the Atomic Energy Commission. However, he remained on leave from the university's Berkeley campus to conduct his work at the laboratory. He also held honorary doctor of science degrees from Pomona College and Case Institute of Technology and an honorary doctor of law degree from the University of New Mexico. In 1960 he received a certificate of appreciation from the University of California "for the great contribution he has made in research and development in nuclear and thermonuclear science, and for the prestige he has brought upon the laboratory and the university." This presentation was made on the anniversary of Bradbury's fifteenth year as laboratory director.

Among the honors and awards presented Bradbury was the Navy's Legion of Merit awarded in 1945. In 1964 he received the annual New Mexico Academy of Science Achievement Award. In April 1966 he accepted the Department of Defense's Distinguished Public Service Medal presented for "exceptionally meritorious civilian service to the Armed Forces and the United States of America in a position of great responsibility as director, Los Alamos Scientific Laboratory . . . The outstanding international reputation of the Los Alamos Laboratory is directly attributable to his exceptional

leadership. The United States is indebted to Dr. Bradbury and his laboratory, to a very large degree, for our present nuclear capability."

The Atomic Energy Commission's citation was presented to Bradbury in February 1968 as part of the ceremonies observing the laboratory's twenty-fifth anniversary. The citation reads:

Norris Edwin Bradbury: For his contributions as director of the Los Alamos Scientific Laboratory to the defense of the United Sates; for his accomplishments as a scientist and administrator in translating basic concepts into practical instruments of national security and peacetime national goals; for his courageous and imaginative leadership after World War II in transforming a temporary wartime installation into an outstanding modern center for research and development; and for his dedicated service both as a Laboratory director and as a private citizen to the Los Alamos community.

The citation is the highest award given by the Atomic Energy Commission to contractors who have made especially meritorious contributions to or have been clearly outstanding in the nuclear energy program.

Bradbury also received the Enrico Fermi Award in 1970, presented by Glenn T. Seaborg. The citation reads:

For his inspiring leadership and superb direction of the Los Alamos Scientific Laboratory throughout one quarter of a century, and for his great contributions to the national security and to the peaceful applications of atomic energy.

Bradbury was a member of the National Academy of Sciences, a fellow of the American Physical Society, and a member of Phi Beta Kappa and Sigma Xi. He served as a member of the U.S. Air Force's Scientific Advisory Board and on the Science Advisory Committee in the Office of Defense Mobilization.

In spite of a busy schedule, Bradbury found time for his family and for a variety of interests. One of his hobbies was

woodworking in the shop of his home. He was interested in archaeology and geology and traveled in his pickup to isolated regions of the state. Many of his vacations were spent on extensive foreign travel.

He had little patience for the perks of top management. His office was strictly functional; no carpeting, no lounge chairs, simply GI office furniture. There were no reserved parking areas for individuals. His usual attire was casual; in fact, if he appeared for work in a business suit, it meant he was expecting VIPs or that he was about to leave on official business. His office door was open all day, except when he was in conference. He answered his phone himself unless he was already on the line. For a number of years he drove a battered Model A Ford coupe with a rumble seat, and warned passengers to beware of the insecure door locks and the holes in the floorboards. He eventually donated the car to the high school student shop to use for repair practice.

Bradbury continued to live in Los Alamos after his retirement. His wife Lois passed away in January of 1998. Three sons, James, John, and David, and their families survive him.

THE AUTHORS WISH to thank Roger A. Meade, archivist of the Los Alamos National Laboratory, for his assistance in preparing this manuscript.

SELECTED BIBLIOGRAPHY

1930

With O. Luhr. The mobility of aged ions in air. *Phys. Rev.* 36:1394-97.

1931

The mobility of aged ions in air. *Phys. Rev.* 37:230-31.

With O. Luhr. Corrected values for the coefficients of recombination of gaseous ions. *Phys. Rev.* 37:998-1000.

The mobility of aged ions in air in relation to the nature of gaseous ions. *Phys. Rev.* 37:1311-19.

With L. Loeb. The velocity spectrum of normal gaseous ions in air and the problem of ionic structure. *Phys. Rev.* 38:1716-29.

Absolute values of the mobilities of gaseous ions. *Phys. Rev.* 38:1905-1906.

1932

Mobility experiments in gaseous mixtures and aging experiments in pure gases. *Phys. Rev.* 40:524-28.

Photoelectric currents in gases between parallel plates as a function of the potential difference. *Phys. Rev.* 40:980-87.

The absolute values of the mobility of gaseous ions in pure gases. *Phys. Rev.* 40:508-23.

With L. Loeb. The effect of electron attachment on the ion-mobility curves in the Zeleny air-blast. *J. Franklin Inst.* 213:181-94.

1933

With L. A. Young. Photoelectric currents in gases between parallel plate electrodes. *Phys. Rev.* 43:34-37.

With L. A. Young. The passage of photoelectrons through mica. *Phys. Rev.* 43:84-85.

Energy distribution of photoelectrons from zinc surfaces. *Phys. Rev.* 43:502

Electron attachment and negative-ion formation in oxygen and oxygen mixtures. *Phys. Rev.* 44:883-90.

1934

Negative ion formation by electron attachment. *Phys. Rev.* 45:287.
Formation of negative ions in gases by electron attachment. I. Ammonia, carbon monoxide, nitric oxidehydrochloric acid, and chlorine. *J. Chem. Phys.* 2:827-34.

With H. E. Tatel. Formation of negative ions in gases by electron attachment. II. Carbon dioxide, nitrous oxide, sulfur dioxide, hydrogen sulfide, and water. *J. Chem. Phys.* 2:835-39.

Electronic configuration of molecule and their electron affinity. *J. Chem. Phys.* 2:840.

1936

With R. A. Nielsen. Absolute values of the electron mobility in hydrogen. *Phys. Rev.* 49:388-93.

1937

With F. Bloch. A deuteron source for nuclear research. *Phys. Rev.* 52:256.

With F. Bloch, H. Tatel, and P. A. Ross. Scattering and absorption cross sections of neutrons in cobalt. *Phys. Rev.* 52:1023-26.

1938

Ionization, negative-ion formation and recombination in the ionosphere. *Phys. Rev.* 53:210.

1939

Nocturnal E-layer ionization. *Phys. Rev.* 55:423.

1940

Preferential and initial ionic recombination in gases. *J. Appl. Phys.* 11:267-73.