In Memoriam Glenn T. Seaborg (1912–1999): Nuclear Pioneer, Educator, and Public Servant

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Chemistry and History: In this section we present articles by leading scientific historians that chronicle the important events, persons, and publications that make up the rich history of chemical science. The history of chemistry, of course, has taken place against the background of world history, and the articles in this section often make that very clear. Chemists and their research are always influenced by current events. These articles are intended to describe the setting in which important discoveries occurred and to humanize their discoverers.

—Clifford LeMaster, Editor in Chief

Glenn T. Seaborg died in his home in Lafayette, California, near Berkeley, on Thursday, February 25, 1999, at the age of 86, while convalescing from a massive stroke that he suffered while exercising on a flight of stairs at the Boston meeting of the American Chemical Society last August. He had fallen down the stairs and for several hours lay seriously injured, helpless, and paralyzed until he was discovered. He is survived by his wife, the former Helen L. Griggs, who had been cyclotron inventor Ernest O. Lawrence's secretary; three sons: David Seaborg of Walnut Creek, California, Stephen Seaborg of La Mesa, California, and John Eric Seaborg of Free Union, Virginia; and two daughters: Lynne Annette Seaborg Cobb of Grand Junction, Colorado and Dianne Karole Seaborg of Lafayette. The Seaborgs' eldest son Peter Glenn died in 1997.

A University of California, Berkeley faculty member since 1939, University Professor of Chemistry since 1971, Associate Director-at-Large of the Lawrence Berkeley Laboratory (LBL), and Chairman of the Lawrence Hall of Science, Seaborg (Figure 1) was a legend in his own time. Last year he received the largest number of votes from his American Chemical Society colleagues for *C&EN*'s "Top 75 Distinguished Contributors to the Chemical Enterprise" (Only deceased chemists Linus Pauling and Robert B. Woodward received more votes). His long, distinguished career in science, education, and public service includes the Nobel Prize in chemistry for the discovery of the transuranium elements (with Edwin M. Macmillan, 1951), the University of California, Berkeley chancellorship (1958–61), and other important academic and governmental posts. His numerous honors include the Enrico Fermi Award of the U.S. Atomic Energy Commission (1957), the Priestley Medal of the American Chemical Society (its highest award, 1979), the Henry De Wolf Smyth Award of the American Nuclear Society (1982), and the Actinide Award (1984). He served as president of the American Chemical Society (1976), the American Association for the Advancement of Science (1972), and Science Service since 1966. His activities were so multifaceted and prolific that he was cited in the *Guinness Book of World Records* for having the longest entry in *Who's Who in America*.

Glenn Theodore Seaborg was born on April 19, 1912, in the small, iron-mining town of Ishpeming on Michigan's Upper Peninsula, the son of Herman Theodore Seaborg (originally Sjöberg), who had been born in Ishpeming of Swedish immigrant parents, and Selma O. Seaborg (née Erickson), a Swedish immigrant who had come to the United States in 1904 at the age of seventeen. Swedish was Glenn's first language, and he gave the first paragraph of his Nobel address in that tongue. Active in a number of Swedish-American and Swedish organizations, he was chosen Swedish-American of the Year in 1962, and in 1984 he was corecipient of the Swedish Great Heritage Award with actress-dancer-singer, Ann-Margret.

When Seaborg was ten, the family moved to Home Gardens (now South Gate), a new subdivision near Los Angeles, where his father was unable to find permanent employment. Glenn and his younger sister Jeanette first attended grammar school in Watts but completed their primary education in Home Gardens. He attended high school in Watts where in his junior year he took his first science course—chemistry—and decided to become a scientist.

In the fall of 1929 Seaborg entered the University of California, Los Angeles where he earned money by working as the lone control chemist on the graveyard shift at the Firestone Tire & Rubber Co., a stevedore, apricot picker, and apprentice linotype machinist for the *Los Angeles Herald*. Although he preferred to major in physics, he chose chemistry because he thought there were more job opportunities in the chemical industry during the Great Depression. Following his graduation in February 1934 he attended the University of California, Berkeley where he supported himself with a teaching assistantship ($50 per month). In 1936 nuclear physicist Jack Livingood asked Seaborg to separate and identify radioisotopes from a "hot" target that had been bombarded in the cyclotron, and during the next five years, the two isolated a number of radioisotopes useful in biology, nuclear and radiological medicine, and industry. One of these radioisotopes, iodine-131, now used more than half a million times per year in the United States for the diagnosis and treatment of thyroid diseases, later saved Seaborg's mother's life. After earning his Ph.D. in May 1937, Seaborg remained at Berkeley as Gilbert Newton "G. N. " Lewis' personal assistant.

In mid-May 1940 at Berkeley, physicists Edwin M. Macmillan and Philip H. Abelson produced the first transuranium element (atomic number 93), naming it neptunium because it was the next element beyond uranium, as

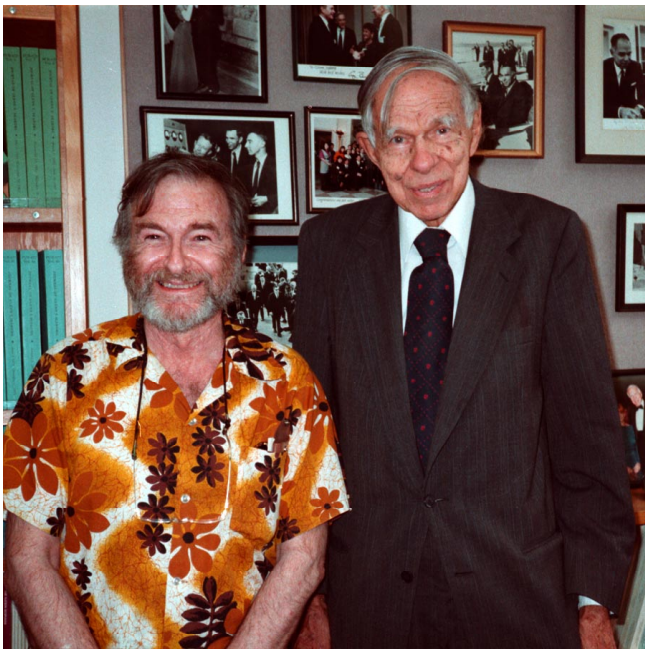

Figure 1. Nobel chemistry laureate Dr. Glenn T. Seaborg in his Lawrence Berkeley Laboratory office with Dr. George B. Kauffman. The walls are lined with photographs of Seaborg with all the U.S. presidents from Eisenhower to Clinton, foreign heads of state, other famous scientists, and celebrities (July 28, 1993) (courtesy, Dr. George B. Kauffman).

Neptune was the next planet beyond Uranus, for which uranium had been named. After Macmillan's search for the next transuranium element (atomic number 94) was interrupted by his sudden transfer to the Massachusetts Institute of Technology to work on radar, Seaborg, then an instructor, together with graduate student Arthur C. Wahl and instructor Joseph W. Kennedy, pursued the task and produced and identified the element, which they named plutonium, on February 23, 1941 in Room 307 of Gilman Hall (now a National Historic Landmark).

Because large amounts of the fissionable plutonium were needed for a nuclear bomb, a crash program was begun by the Manhattan Project with Seaborg, who arrived on his thirtieth birthday (April 19, 1942) at the University of Chicago Metallurgical Laboratory where the work took place, in charge. In what he described as "the most exciting and most challenging period of my life," Seaborg worked around the clock to develop the extraction process that was then used in what he called "surely the greatest scale-up factor [10 billion] ever attempted," at the newly constructed Hanford Engineer Works in the state of Washington to produce amounts of plutonium-239 large enough to construct a bomb ("Fat Man," dropped on Nagasaki, Japan on August 9, 1945). Seaborg was one of the six signatories of the Franck Report, urging that the bomb be demonstrated to the Japanese rather than used against a civilian population, but their recommendation was disregarded. Until his death, Seaborg considered the control of nuclear weapons the most critical problem of our time.

Seaborg's actinide concept, that the elements beyond actinium constitute a second actinide series analogous to the lanthanide (rare earth) series, is regarded as the most significant change in the periodic table since Mendeleev's original design. Seaborg recalled, "I showed my new table to the two leading inorganic chemists in the world before publishing it. The idea went over like a lead balloon. 'Don't do it, Glenn,' they warned me, 'it would ruin your scientific reputation.' It was just so hard to conceive that the periodic table had been this wrong. I didn't have any scientific reputation, so I published it anyway." According to Seaborg, it was "the key to the subsequent discovery of a number of transuranium elements." During the postwar years with the aid of this concept and the technique of ion exchange, he and his co-workers discovered and characterized nine additional transuranium elements. He held patents on elements 95 and 96 (americium and curium), making him the only person to hold a patent on a chemical element. He was also the only living person for whom a chemical element was named during his lifetime (seaborgium, atomic number 106).

Following the unexpected launch of Sputnik, Seaborg became chairman of the steering committee for the Chemical Education Material (CHEM) Study, which revolutionized high school curricula in the United States and other countries. In 1959 President Dwight D. Eisenhower appointed him to the President's Science Advisory Committee where he served as chairman of the panel on basic research and graduate education. In following years he served on a number of national and state educational studies, such as the National Commission on Excellence in Education, which produced the much publicized 1983 report, *A Nation at Risk*.

In 1961 President John F. Kennedy appointed Seaborg to a two-year term to head the Atomic Energy Commission, the first scientist to chair the AEC. Although this agency had a history of feuds and factional strife, Seaborg remained on good terms with his colleagues, managing not to be identified with the "bombardiers," who favored more weapons or with the "dreamers," who favored unilateral disarmament. He held the chairmanship for ten years (1961–71), throughout the Kennedy, Johnson, and part of the Nixon administrations, and he visited more than sixty countries in his efforts to promote international scientific cooperation and arms control agreements.

In various capacities Seaborg served as an adviser to ten U.S. presidents from Roosevelt to Bush, whom he served as advisor, and all of whom (except Roosevelt) he knew personally. Because he met Herbert Hoover and was consulted by Bill Clinton, he met almost a third of all U.S. presidents (He also knew all twelve vice presidents since Henry Wallace). He was an active participant in national and international policy-making at the highest levels of government and was involved in many of the most crucial and historically significant scientific, political, and educational events of the last six decades of the twentieth century, such as the Cuban missile crisis and the Limited Test Ban and Comprehensive Test Ban treaties, both of which he strongly favored. On May 29, 1963, he became the first non-Communist American to meet U.S.S.R. President Leonid Brezhnev, a meeting that "played a role in setting the stage for successful negotiations that led to an agreement on the [LTBT]...some two months later," one of Seaborg's many mitigating influences on the Cold War.

Seaborg described himself as "antibomb" but not "antinuclear," and he was careful to distinguish between his personal views and those of his government. Thus, although he had always been in favor of a test ban, he favored nuclear testing because it was national policy and because the U.S.S.R.

was conducting tests. He was personally opposed, however, to deployment of anti-ballistic missiles (ABMs), which was being debated by the U.S. Congress, and he ignored requests by the Nixon White House to make public pronouncements in favor of their deployment.

In spite of his numerous award-winning accomplishments Seaborg, a frequent flyer on Air Force One, never forgot his humble origins. A kind, modest man with a highly developed sense of humor, who wore his honors lightly, he was unsparing of his valuable time in helping others. In my own case, which could be echoed by the experiences of others, he wrote the introductions to two of my books and nominated me for a number of ACS awards. No longer shall we see his lanky (6 foot, 3 inch), Lincolnesque frame so familiar at national and international meetings where he was invariably the tallest person in the crowd (In the many formal photographs with the world's scientific and political leaders he was always placed in the back row because of his height). He will be sorely missed. *Requiescat in pace.*