Nuclear Medicine Pioneer: Glenn T. Seaborg

Explorer of the Mysteries of the Atom

Photos courtesy of Lawrence Berkeley National Laboratory.

(Left) Glenn T. Seaborg and Edwin McMillan on the day they were notified they had won the Nobel Prize (October 1951). (Right) Glenn T. Seaborg and Emilio Segrè presenting a sample of plutonium to the Museum of History and Technology, Smithsonian Institution, Washington, DC, March 28, 1966.

As codiscoverer of one of the most frequently used radionuclides in nuclear medicine, ^{99m}Tc, Nobel laureate Glenn T. Seaborg, PhD, has contributed enormously to the specialty of nuclear medicine and created a firm foundation for the development of nuclear chemistry. The discoverer of ten elements, including one that bears his name, Seaborg continues to draw on a lifetime of experience to advocate the safe uses of nuclear power and the need to invest in education and support of basic research and to pass on to future generations the excitement of scientific discovery.

Early Interests

Seaborg was born in Ishpeming, MI, in 1912. He moved with his family to southern California when he was 10 years old. His interest in chemistry and physics was whetted while he was in high school. He was influenced by Dwight L. Reid, his teacher, who had enthusiasm and passion for these subjects. Following his graduation from high school, Seaborg began undergraduate work at the University of California Los Angeles (UCLA), from which he received his A.B. in chemistry in 1934. During his final year of study at UCLA, Seaborg became interested in the new developments occurring in nuclear science. That interest led him to pursue graduate studies at the University of California Berkeley (UCB), where he received his doctorate in chemistry in 1937. He joined the UCB faculty in 1939 and served in various capacities, including as the campus's second chancellor (1958–1961).

Seaborg's period of graduate study was an exciting and stimulating time. Some of the leading and emerging figures in chemistry and physics were at UCB. Highlights of the curriculum featured weekly conferences and seminars with presentations from the faculty and graduate students on the latest research. Seaborg's colleagues and future friends included cyclotron inventor and future Nobel laureate Ernest O. Lawrence, Robert Oppenheimer and future collaborators John (Jack) Livingood and Edwin McMillan.

Radioisotope Discoveries

After completing his graduate studies, Seaborg became the personal research assistant Gilbert N. Lewis, UCB's dean of the college of chemistry. While Seaborg assisted Lewis with his research on generalized acids and bases, during his spare time, generally at night, he continued his own investigations. His research was spurred when Livingood, his codiscoverer of ^{131}I, handed him a "hot" target and asked him to chemically identify the radioisotopes it contained. This initial foray was the launching point for Seaborg's life work and was the start of a 5-year collaboration with Livingood. In addition to ^{131}I, the Seaborg-Livingood team also discovered ^{59}Fe and ^{60}Co. The development of ^{131}I occurred when noted nuclear physician Joseph G. Hamilton, MD, complained of the insufficient half-life (25 min) of the tracer he was using, ^{128}I, in his thyroid metabolism studies. Hamilton wanted a tracer with a half-life of about "a week." Seaborg and Livingood synthesized ^{131}I, which has a half-life of 8 days. During this time, Seaborg also collaborated with another future Nobel laureate, Emilio Segrè, and developed ^{99m}Tc.

Transuranium Elements and the Discovery of Plutonium

Seaborg's initial experiments with radioisotopes were the catalyst for his research with transuranium elements, so named because they extend beyond uranium on the periodic table. Uranium is the heaviest known naturally occurring element, but transuranium elements can be artificially created in particle accelerators. Seaborg had been following the work of several investigators, including that of McMillan with Philip H. Aldeson, who identified the first transuranium element, neptunium (No. 93 on the periodic table). In 1940, when he was only 28 years old, Seaborg began working with McMillan to identify the next transuranium element, plutonium (No. 94). Using the 60-in. cyclotron

developed by Lawrence, Seaborg, McMillan and their colleagues discovered plutonium by bombarding a sample of uranium with deuterons.

Two years later, after the Japanese attack on Pearl Harbor, Seaborg headed to Chicago to work on the Manhattan Project. His duties there included directing the research activities for transuranium elements and the chemical extraction of plutonium from uranium. In 1942, Seaborg and his associates created an additional source of nuclear power with the identification of ^{233}U, which established the use of thorium as a nuclear fuel. The discovery of plutonium was the starting point for the development of nine other transuranium elements: americium and curium in 1944 (Nos. 95 and 96, respectively), berkelium (No. 97) in 1949, californium (No. 98) in 1950, einsteinium (No. 99) in 1952, fermium (No. 100) in 1953, mendelevium (No. 101) in 1955, nobelium (No. 102) in 1958, and seaborgium (No. 106), which was identified in 1974 and confirmed in 1993 at Lawrence Berkeley National Laboratory. According to Seaborg, the naming of Element No.106 for him "was the greatest honor ever bestowed upon me."

In 1944, Seaborg developed the actinide concept, which identifies the position of the heaviest elements, including the first 11 transuranium elements, in the periodic table. The concept is considered to be one of the most significant changes in the periodic table since its early 19th century design by Mendeleyev.

In addition to ^{131}I, ^{99m}Tc and the transuranium elements, Seaborg was the codiscoverer of several other isotopes routinely used in nuclear medicine: ^{57}Co, ^{60}Co, ^{55}Fe, ^{59}Fe, ^{65}Zn and ^{137}Cs.

Nobel Prize and Other Activities

In 1951, Seaborg and McMillan were awarded the Nobel Prize for chemistry for their discoveries in the chemistry of transuranium elements. Undaunted by being one of the youngest recipients of the prestigious award (he was 39 years old at the time), Seaborg continued his research activities at UCB. As director of the nuclear chemistry division and in 1954 as the associate director of the radiation laboratory, Seaborg conducted studies on nuclear structure and reactions as well as alpha-particle radioactivity. In 1958, he was appointed UCB's second chancellor. During his tenure as chancellor (1958–1961), construction was begun on the Lawrence Hall of Science, in honor of Ernest O. Lawrence, who had died a few years earlier.

Seaborg's chancellorship was shortened by his appointment in 1961 as the chair of the Atomic Energy Commission (AEC; now the Nuclear Regulatory Commission) by President John F. Kennedy, a 10-year appointment that encompassed the terms of three presidents (Kennedy, Johnson and Nixon). As AEC chair, Seaborg was responsible for the management of a massive operation that included promoting the use of nuclear energy, developing and testing nuclear weapons, monitoring the production and sale of isotopes for medical and other uses and licensing of nuclear materials for power plant development. During his time as chair, Seaborg expanded the AEC's various programs. For example, there were 2 nuclear power plants in 1961 and 70-plus plants by 1971. Perturbed by and in disagreement with many Nixon administration policies, Seaborg resigned from the AEC and returned to UCB in 1971.

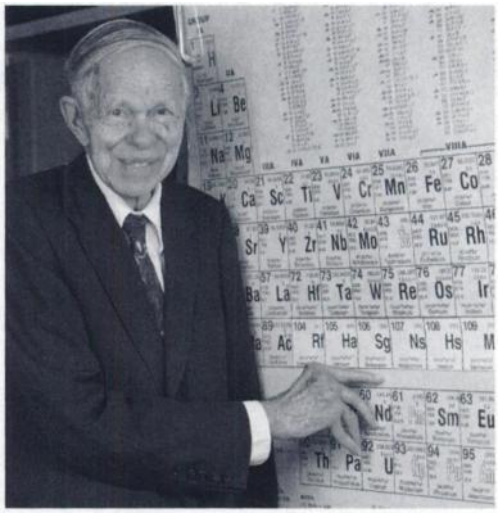

Photo courtesy of Lawrence Berkeley National Laboratory.

Glenn T. Seaborg points out seaborgium on the periodic table (February 1994).

Now in his 80s, Seaborg is still a familiar presence at UCB. He currently serves as the associate director at large of the Lawrence Berkeley National Laboratory and is chair of the Lawrence Hall of Science, a facility that provides educational opportunities for school-age children. Seaborg holds over 40 patents, including those for americium and curium. He has written numerous books and over 500 scientific articles. The recipient of 50 honorary doctorate degrees as well as honorary membership in 8 foreign academies of science, Seaborg also has served leadership roles in various domestic scientific and educational organizations, including as president of the American Association for the Advancement of Science and the American Chemical Society. In 1996, he participated as a guest lecturer at the centennial activities during the Society of Nuclear Medicine's Annual Meeting in Denver, CO.

Over the years, Seaborg has used his international reputation to promote the safe uses of nuclear energy, and he remains a proponent and champion of educational issues, particularly better instruction in math and sciences in American educational systems. In a recent biographical sketch, Seaborg noted that "education is the best investment we can make in the future."

Seaborg's numerous accomplishments, tireless energy and absolute joy in the thrill of discovery are surely inspiring to both current and future generations of scientists.

—Eleanore Tapscott