Glenn Seaborg 1912 - 1999

Gregory J Butera

Seaborg was one of the most revered chemists in the world. He was a beloved Professor of Chemistry at UC Berkeley for nearly 60 years, discoverer of plutonium and 10 other elements, former chairman of the Atomic Energy Commission and one of the last survivors of the Manhattan Project, former chancellor of UC Berkeley and namesake of element 106, seaborgium.

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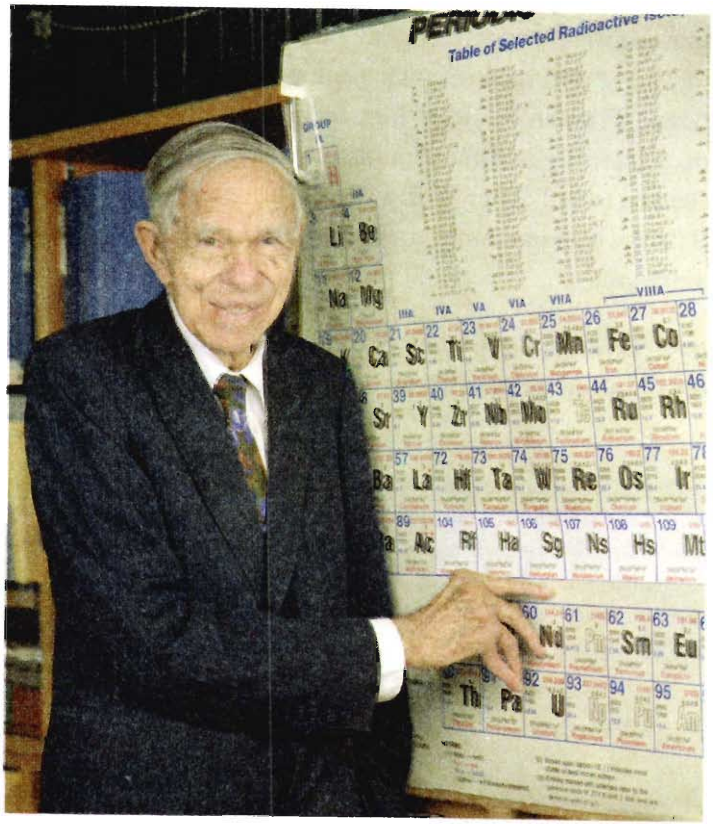
His major contributions to the field include: co-discovery of plutonium-238 and -239, plus nine other transuranium elements – elements beyond uranium in the periodic table. Among these was seaborgium. He also led the Manhattan Project group that devised the chemical extraction processes used in plutonium



Seaborg receiving his PhD in 1937.

production during World War II. His work with transuranium elements and a revision of the periodic table he proposed to account for them won him in 1951 the Nobel Prize in Chemistry, which he shared with UC Berkeley colleague Edwin M McMillan.

Seaborg had a long and distinguished career in science, education and public service. His career encapsulated the history of nuclear science in this country. From early studies of naturally radioactive elements, he quickly moved to exploit new techniques to create artificially radioactive elements. Principal among these was the cyclotron, invented at UC Berkeley by Ernest Lawrence. Soon, however, he was drawn into an unprecedented national project to turn the tremendous energy of fissioning nuclei into a bomb whose destructive power dwarfed that of any previous weapon.

"Seaborg was a true giant of the 20^{h} century, a legend in the annals of scientific discovery".

– Charles Shank
Lawrence Berkeley National Laboratory
Director

Although Seaborg was the first to discover and isolate appreciable amounts of plutonium for use in atomic weapons, he became an ardent proponent of nuclear disarmament. As a member of the seven-man Franck Committee, Seaborg wrote to President Truman to deter him from dropping the bomb on Japan, suggesting he first demonstrate the weapon to the world on a barren island. After World War II, he championed efforts to regulate the uses of atomic energy as head of the Atomic Energy Commission.

Born in 1912, Seaborg grew up in Ishpeming, Michigan, and moved to Los Angeles when he was ten years old. He received his

It is hard to imagine a scientist who had a greater impact then Glenn Seaborg – not just for his discoveries but for his contributions to education, through his leadership in the University, and for his wisdom in helping to steer this country and the world in the right direction. And yet he was still accessible and engaged in departmental affairs until his unfortunate illness. He is very much missed. The day he passed away, we found his graduate file in the department office and looked with some awe at his first letter to Berkeley, 65 years ago, inquiring about graduate scholarships. He said, 'I am particularly interested in chemistry.' Amen."

— Paul Bartlett
Chairman, Department of Chemistry

A.B. in Chemistry from UCLA in 1934 and his Ph.D. in Chemistry from Berkeley in 1937. He stayed on as a researcher working under G N Lewis, joining the faculty full time in 1939. Much of his work was done at the University of California Radiation Laboratory, now the Lawrence Berkeley National Laboratory.

His work in radiochemistry tackled the pure scientific challenge of isolating new chemical isotopes. In 1941, a mere four years after completing his Ph.D., he and UC Berkeley colleagues bombarded uranium with deuterons from an atom-smasher and isolated from the product an unstable element with 94 protons in the nucleus. He later proposed to name the new element after the planet Pluto–plutonium. One isotope of plutonium, plutonium-239, which Seaborg and colleague Emilio Segré discovered a month later, turned out to split or fission when hit with slow neutrons, and this characteristic attracted the attention of scientists developing an atomic bomb from fissionable uranium. In 1942, at the age of 30, Seaborg was appointed head of the plutonium chemistry group of the Manhattan Project, and he moved to the University of Chicago Metallurgical Laboratory to develop techniques for chemically separating plutonium from the other debris created in a nuclear pile.

During his four years in Chicago he continued to collaborate with Berkeley colleagues, adding two other elements to his list of discoveries: curium (element 96) in 1944 and americium (element 95) in 1944-45. While there, Seaborg formulated the actinide concept of heavy element electronic structure. Proposed in 1944, it accurately predicted that the heaviest, naturally-occurring elements, together with the synthetic transuranium elements, would form a transition series of 'actinide' elements in a manner analogous to the rare earth series of 'lanthanide' elements. This concept, one of the most significant changes to the periodic table since Mendeleev's 19th century design, shows how the transuranium elements fit into the periodic table and thus demonstrates their relationships to other elements. The concept was key to Seaborg's success in chemi-

At the controls of a Geiger counter in 1941.

"He always had his eye on the ball and knew what he was doing. He had amazing energy and he was very meticulous about details. Glenn did a lot where a lot of people wouldn't or couldn't. Seaborg had a phenomenal career.

– Albert Ghiorso
Friend and collaborator, and one of the discoverers of seaborgium.

Seaborg and Edwin Mc Millan shared the 1951 Nobel Prize in Chemistry.

Seaborg with Quiz Kids Sheila Conlon and Bob Burke. Seaborg accidentally announced the discovery of elements 95 and 96 on this radio talk show in 1945.

> *"He was always ready to give time to education. Glenn took more seriously a freshman chemistry talk than a convocation of the world's eminent scientists."*
>
> *— Darleane Hoffman*
> *Professor of Chemistry*

Seaborg receiving the Nobel Prize for Chemistry in 1987.

cally isolating many other transuranium elements. Also, in 1942, during a brief stop in Nevada on his way to Chicago, he married Helen Lucille Griggs, who worked as a secretary at UC Berkeley.

Back at Berkeley in 1946, now a full professor of chemistry, Seaborg returned to pure research. Several of the elements he discovered or co-discovered when he returned to academia were named in tribute to UC Berkeley, the university he called home for more than 60 years, since his years as a graduate student. Element 97, discovered in 1949, was named berkelium, while element 98, discovered in 1950, was named californium.

Over the years he was involved in the discovery of all but one of the man-made elements up to element 102: einsteinium in 1952, fermium in 1953, mendelevium in 1955 and nobelium in 1958. These transuranium elements were created artificially in particle accelerators.

In 1974 he was part of the team that discovered element 106. After much wrangling, the element was named seaborgium, in his honor, in 1997. He was the only scientist to have an element named after him while still alive.

"That's a great honor because that lasts forever," he once told a reporter. "One hundred years from now, or a thousand years from now, it'll still be seaborgium when you'd probably have to look in obscure books to find any references to what I had done."

Although retired from teaching since 1979, Seaborg had continued to search for the 'superheavy' elements until his illness, and in 1994 was involved in the discovery of the currently unnamed element 110. Seaborg held over 40 patents, including those on elements americium and curium, making him the only person ever to hold a patent on a chemical element.

His co-discoveries include many isotopes which have practical applications in research, medicine and industry. Among these are iodine-131, technetium-99m, cobalt-57, cobalt-60, iron-55, iron-59, zinc-65, cesium-137, manganese-54, antimony-124, californium-252, americium-241, plutonium-238, as well as the fissile isotopes plutonium-239 and uranium-233. Iodine-131, still widely used for diagnosis and treatment of diseases, prolonged the life of Seaborg's own mother.

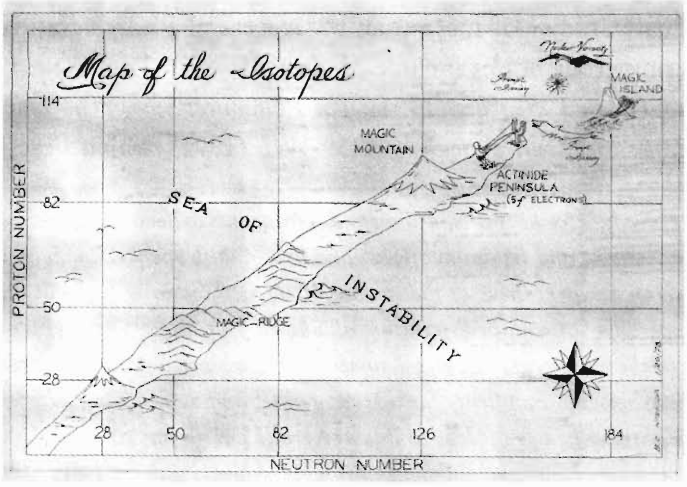
Bronze Plaque commemorating the discovery of plutonium in 307 Gilman Hall being presented by Under Secretary of the Interior John A Carver, Jr to three of the men who participated in the historic discovery: Glenn Seaborg, Arthur Wahl and Edwin McMillan.

Besides the Nobel prize, Seaborg received the National Medal of Science (1991), UCLA's Glenn T Seaborg Medal (1988), the Priestley Medal (1979), and the American Chemical Society's George C Pimentel Award (1994) for his "outstanding contributions to the education of the world's citizens." He also served as president of both the American Association for the Advancement of Science and the American Chemical Society.

He stayed close to his Swedish roots, and counted among his major awards the Great Swedish Heritage Award from the Swedish Council of America, and the John Ericsson Gold Medal from the American Society of Swedish Engineers.

"Glenn had four rules for success: Don't procrastinate, do it now. Do the most unpleasant task first. Talk to the person you dislike the most first. And keep everyone informed. Good communication was always important to him."

— Darleane Hoffman
Professor of Chemistry



This illustration playfully shows the 'Island of Stability' Seaborg predicted would be found beyond the Actinides.

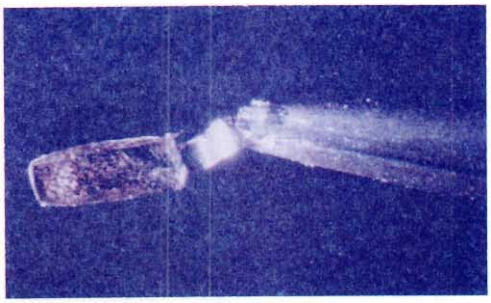


Photo of the first plutonium sample, one of the first few micrograms of plutonium oxide.

In 1995, Seaborg also had an asteroid named after him by its discoverers, astronomers Caroline and Eugene Shoemaker.

Seaborg's commitment to science education and public service was demonstrated through his work with the Lawrence Hall of Science as well as his involvement in science policy. He was a member of the National Commission on Excellence in Education, which published the much-publicized A Nation at Risk in 1983, addressing the crisis in mathematics and science education. Seaborg also served as chairman of the board of Science Service, which publishes the magazine *Science News* and conducts the Intel (formerly Westinghouse) national science talent search.

His efforts as a national spokesman on education were honored with the establishment in 1987 of the Glenn T Seaborg Center for Teaching Science and Mathematics at Northern Michigan University, which prepares educators to teach science in secondary schools. Last year, his efforts in education and chemistry research were recognized by the Glenn T Seaborg Chair in Physical Chemistry at UC Berkeley, created through a generous endowment in tribute to Seaborg and the College of Chemistry.

Seaborg authored over 500 scientific articles and guided the graduate studies of more than 65 successful Ph.D. candidates. His numerous books include *Modern Alchemy: The Selected Papers of Glenn T Seaborg* (1994); *The Plutonium Story: The Journals of Professor Glenn T Seaborg* 1939-1946 (1994), which describes

Seaborg helped discover most of the elements on this list. He was actively pursuing research until shortly before his illness.

TRANSURANIUM ELEMENTS

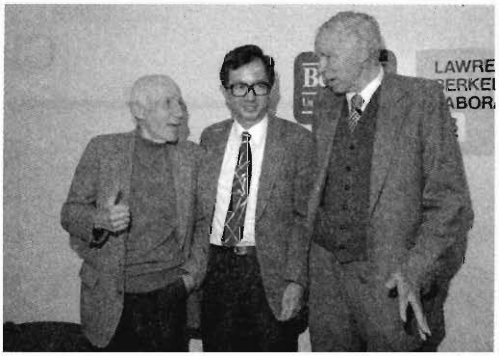
93	NEPTUNIUM	Np
94	PLUTONIUM	Pu
95	AMERICIUM	Am
96	CURIUM	Cm
97	BERKELIUM	Bk
98	CALIFORNIUM	Cf
99	EINSTEINIUM	Es
100	FERMIUM	Fm
101	MENDELEVIUM	Md
102	NOBELIUM	No
103	LAWRENCIUM	Lr
104	RUTHERFORDIUM	Rf
105	DUBNIUM	Db
106	SEABORGIUM	Sg
107	BOHRIUM	Bh
108	HASSIUM	Hs
109	MEITNERIUM	Mt
110		
111		
112		

"As an educator he inspired thousands of students to become interested in chemistry and its applications, and as a public speaker he helped develop an awareness of the impact of science on daily life and the importance of non-proliferation of nuclear weapons. He will be remembered as a brilliant scientist, an inspiring teacher, a devoted public servant, and lastly, as a kind, gentle, and unassuming person. His passing is a great loss to this university and to our country."

— Alexis T Bell

Dean of the College of Chemistry

his discovery of plutonium and work on the Manhattan Project; *Elements Beyond Uranium* (1990), a comprehensive summary of all aspects of transuranium elements; and an autobiography entitled *A Chemist in the White House: From the Manhattan Project to the End of the Cold War* (1998). Soon to be published is a book coauthored with nuclear chemists Darleane Hoffman and Albert Ghiorso entitled *The Transuranium People: The Inside Story*.



Melvin Calvin, Y T Lee and Seaborg, three Nobel Laureates celebrating Lee's award in 1987.

He is survived by his wife, Helen, of Lafayette, California, and five of his six children.

Acknowledgements

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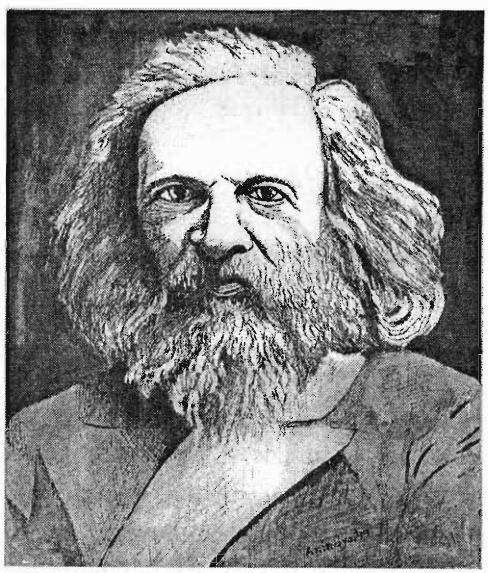
http://www.cchem.berkeley.edu/Publications/Seaborg/seaborgtrib.html



Anindya Das

Dimitrii Mendeleev (1834–1907)