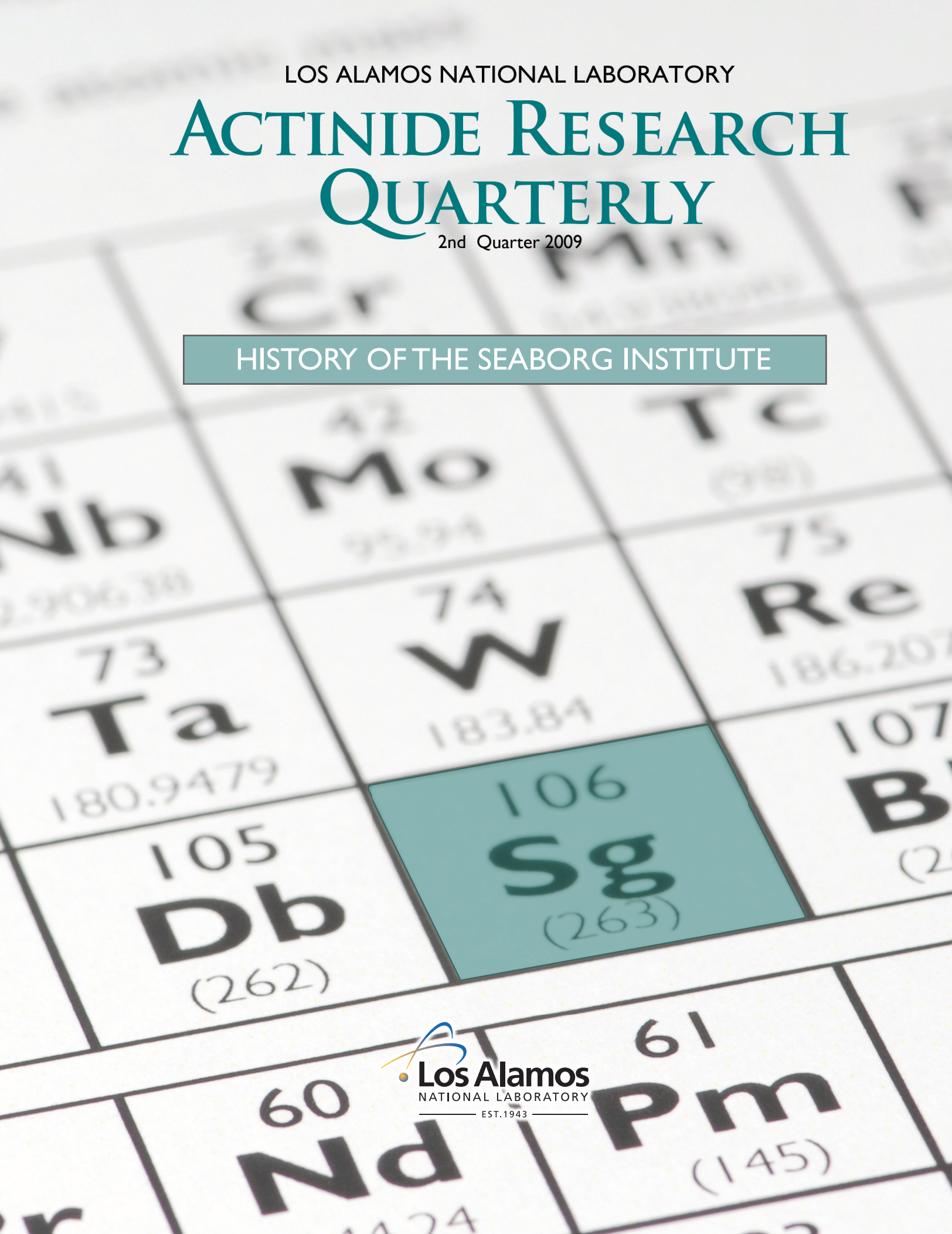
LOS ALAMOS NATIONAL LABORATORY

ACTINIDE RESEARCH QUARTERLY

2nd Quarter 2009

HISTORY OF THE SEABORG INSTITUTE



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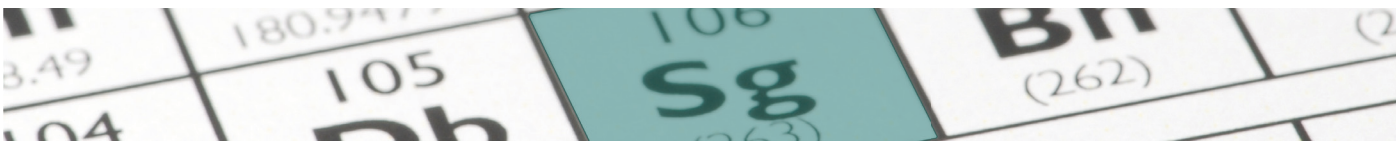


The Seaborg Institute for Transactinium Science

Established to educate the next generation of nuclear scientists

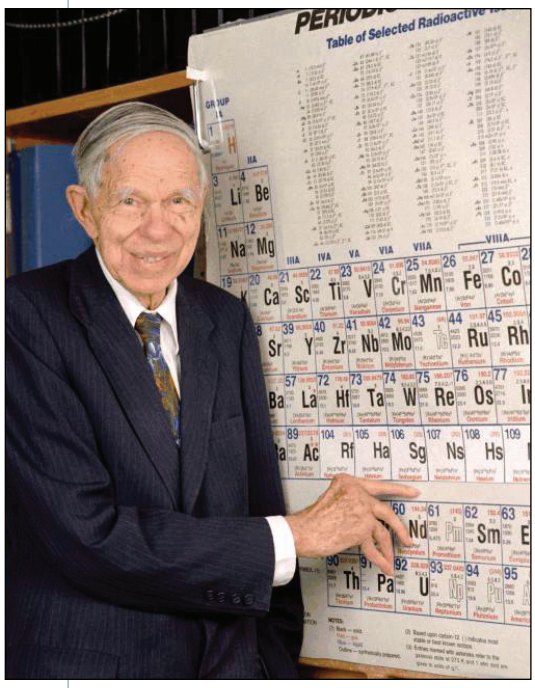
This article was contributed by Darleane C. Hoffman, professor emerita, Graduate School, Department of Chemistry, UC Berkeley, faculty senior scientist, Lawrence Berkeley National Laboratory, and charter director, Seaborg Institute, Lawrence Livermore National Laboratory; and Christopher Gatrousis, former associate director of Chemistry and Materials Science, Lawrence Livermore National Laboratory.

In the late 1970s and early 1980s, research opportunities in heavy element science and engineering were seldom found in university settings, and the supply of professionals in those fields was diminishing to the detriment of national goals. In response to these concerns, national studies were conducted and panels and committees were formed to assess the status of training and education in the nuclear sciences. The studies in particular addressed the future need for scientists trained in the areas of nuclear waste management and disposal, environmental remediation, nuclear fuel processing, and nuclear safety analysis.

Unfortunately, with the exception of the American Chemical Society's Division of Nuclear Chemistry and Technology summer schools for undergraduates in nuclear and radiochemistry established in 1984, the studies did not lead to any new or innovative solutions to the critical issue of the dwindling numbers of nuclear scientists.

The two national defense laboratories, Los Alamos (LANL) and Lawrence Livermore (LLNL), together with the University of California, Berkeley (UCB), had an historical commitment and tradition of leadership in actinide research. But with the decreasing academic component, the projected need for professionals in the field could not be met through existing mechanisms. With nuclear weapons technology continuing to play a central role in defense policy, knowledge and expertise in the production, processing, purification, characterization, analysis, and disposal of actinides were also deemed to be essential.

The concern that the field was becoming subcritical at a time when its core competence was crucial to our nation's industrial, environmental, and scientific survival led to the establishment of a center for education and research: The Seaborg Institute for Transactinium Science.



Ernest Orlando Lawrence Berkeley National Laboratory

Glenn Seaborg helped spearhead the establishment of the actinide-transactinide research institute that now bears his name.

The beginning

The establishment of an actinide-transactinide research institute was spearheaded by Christopher Gatrousis, Glenn Seaborg, Tom Sugihara, and Darleane Hoffman in October 1989. Gatrousis was associate director for Livermore's Chemistry and Material Sciences Directorate. Seaborg, codiscoverer of numerous elements including plutonium and the one that bears his name—seaborgium, was a former chancellor and professor at UCB as well as associate director at large at Lawrence Berkeley National Laboratory (LBNL). (See sidebar, "Seaborg the scientist," on page 7.) Sugihara was deputy for research in Livermore's Chemistry and Material Sciences Directorate. Hoffman, a professor of nuclear chemistry at UCB and a faculty senior scientist at Berkeley Lab, was leader of Berkeley Lab's Heavy Element Nuclear and Radiochemistry Group.

Darleane Hoffman, who would be named the Seaborg Institute's charter director, talks with Dana Christensen, formerly of Los Alamos National Laboratory, during a break at the Workshop on Transactinium Science held in June 1990. The workshop, which attracted scientists from around the world, was organized to address establishment of the institute. A 119-page summary of the workshop published later that year stated: "There was unanimous agreement that education and training should be ranked as the [institute's] first priority."

Photos on pages 2–6 courtesy of Christopher Gatrousis

Gatrousis had previously discussed the idea of an actinide-transactinide research institute with Livermore Director John Nuckolls, who was enthusiastic. It was proposed that the institute should be part of the UC system (with Berkeley as the primary campus), use laboratory space at Berkeley Lab, and be a joint institute with Livermore. A steering committee or governing board with experts from a broad range of institutions was suggested, and Seaborg agreed to chair the group. Gatrousis was to talk with cognizant associate directors at Livermore, and Seaborg was to acquaint UC President David Gardner with the plans. By April 1990, Nuckolls and Seaborg had sent a letter to the DOE's Secretary of Energy proposing the establishment of the institute.

Seaborg came up with the name "Institute for Research on Transactinium Elements" so that it would not be limited in scope or use words such as "transplutonium" or "transuranium." Using transactinium in the name would also cover all the known elements heavier than actinium as well as all that might be discovered in the future. The institute would eventually be dubbed "ITS."

The planners envisioned that the institute would have a permanent staff as well as rotating members from around the world. A strong faculty/student component would be essential to be effective in educating the next generation of scientists in pertinent fields. A vigorous applied component as well as fundamental research was to be fostered.

Funding would be sought from defense programs for the education and training of the next generation of nuclear and radiochemists required for the nation's national security programs in the broadest sense—both defense and energy. Research on actinide processing, radionuclide migration, fundamental chemistry of the transactinium elements, and complexing agents, to name but a few, would be encouraged. It was also envisioned that the unique facilities of the national laboratories would be made available to university students and professors to perform collaborative research in relevant fields.

Nothing of its kind existed in the United States, and it was hoped that the institute would become the nucleus for such research as well as for collaboration with international transuranium programs.

A Workshop on Transactinium Science was convened in June 1990 in Oakland, California, to address establishment of the institute. The workshop created interest throughout the transactinium science community. More than 90 scientists from various national laboratories, universities, and research institutes in the United States, Europe, Japan, and elsewhere participated.

The workshop's findings and recommendations were published in September 1990 as "Report of a Workshop on Transactinium Science." Quoting from the workshop summary: "There was unanimous agreement that education and training should be ranked as the first priority. Thus, the primary objective of the Institute is to train the next generations of Ph.D. scientists and engineers for transactinium research positions. However, other educational activities intended to build up the supply pipeline of nuclear science and engineering candidates for B.S. and graduate degrees are likewise considered essential."

INSTITUTE FOR TRANSACTINIUM SCIENCE ESTABLISHED

The Glenn T. Seaborg Institute

The Lawrence Livermore National Laboratory and the Lawrence Berkeley Laboratory, in collaboration with the University of California/Berkeley, are pleased to announce the establishment of an Institute for Transactinium Science. The Institute, to be centered in Livermore, will be devoted to the study of the transactinium elements with special emphasis on education and training of the future generation of scientists in heavy-element research.

The Institute will provide a unique focus and mechanism for cooperation and collaboration between the system-wide campuses and laboratories of the University of California and with the transactinium community world-wide. Institute facilities will be made available to students, visiting faculty and others for the specialized experimental programs characteristic of this field.

In recognition of the enormous contributions that Professor Glenn Seaborg has made to the field and to science education in his many years of affiliation with the University, the Institute is named in his honor and will be known as *The Glenn T. Seaborg Institute.*

Professor Darleane C. Hoffman of UC Berkeley and LBL will serve as the Institute's first Director.

John H. Nuckolls
Director, LLNL

Charles V. Shank
Director, LBL

On Feb. 22, 1991, at the Symposium Commemorating the 50th Anniversary of the Discovery of Plutonium, former Lawrence Livermore Director Roger Batzel read an announcement (a copy is shown at left) from John Nuckolls and Charles Shank formally establishing the Glenn T. Seaborg Institute for Transactinium Science.

The institute takes shape

In November 1990, a joint LLNL/LBNL Institute Charter was prepared and submitted to UC President Gardner. The charter—as well as a proposal to name the institute in honor of Glenn Seaborg—was approved in February 1991. Formal establishment of the Glenn T. Seaborg Institute for Transactinium Science was announced at the Symposium Commemorating the 50th Anniversary of the Discovery of Plutonium held in February 1991. Hoffman was named director, and Patricia Baisden and Lawrence Newkirk of Livermore were appointed deputy directors.

The primary goal of the institute as originally stated in the 1991 proposal was "to create a focus for transactinium science at LLNL and LBNL, and nationally, in order to foster and develop U.S. pre-eminence in the science of the chemical, physical, nuclear, and metallurgical properties of the transactinium elements with a major emphasis on helping to provide scientists and engineers with the knowledge and expertise required to meet the changing needs of the

Chris Gatrousis presents Glenn Seaborg with the Institute for Transactinium Science Plaque during the Symposium Commemorating the 50th Anniversary of the Discovery of Plutonium.

U.S. in national security and energy policy, environmental studies, medicine, waste minimization and processing, etc. that are vital to the U.S. Department of Energy."

The proposal further stated, "Transactinium science is inherently a multidisciplinary field and its progress cannot be achieved by scientists working alone. Stable support, complex and specialized equipment, diverse expertise, participation by a major research university or universities, and physically secure facilities are necessary for a research center in heavy element science to flourish."

Initial funding for the institute was received in April 1991 from LLNL Weapons Supporting Research. An advisory council was appointed in May 1991. (See sidebar, "ITS Advisory Council," on page 5.) Members came from Livermore and other national laboratories, UC and other universities, the Electric Power Research Institute, Germany, and Japan. The first newsletter, authored by Deputy Director Baisden, of the Glenn T. Seaborg Institute for Transactinium Science, was also published in July 1991.

The institute would make available unique facilities, complex and specialized equipment, and diverse expertise not commonly found in university settings for students at the undergraduate, graduate, and postdoctoral levels, as well as for collaborative research with university programs. Postdocs and students are shown with members of the ITS Advisory Council at Livermore in March 1994. Glenn Seaborg is standing at far right.

Accomplishments

From the beginning, scientists from LBNL, UCB, and LLNL were involved with the Glenn T. Seaborg Institute for Transactinium Science. Early participation from other UC campuses and with UC–system organizations, including Los Alamos, was solicited. It was also hoped that other DOE laboratories—including Oak Ridge and Argonne, which had expressed early interest—would be involved. Foreign scientists, especially from Japan, were very interested in participating, but unfortunately this Japanese interest was never formalized with Livermore because of intellectual property issues.

The accomplishments of the ITS to date were summarized by Hoffman in a presentation to the Council in August 1995. New initiatives, goals, and strategic plans were presented as were seven core competencies: expertise in actinide science, applications to environmental problems, special instrumentation, chemical properties, solid-state properties, determination of nuclear properties, and synthesis of new nuclides.

ITS Advisory Council

The first Advisory Council for the Lawrence Livermore National Laboratory Institute for Transactinium Science (ITS) met July 11-12, 1991. The list of members reads like an international "Who's Who" in nuclear and radiochemistry and relevant applications.

Glenn T. Seaborg, Nobel laureate professor, *University of California (chairman)*
Roger Batzel, director emeritus, *Lawrence Livermore National Laboratory*
Gregory R. Choppin, professor, *Florida State University, Tallahassee*
Floyd Culler, corporate president, *Electric Power Research Institute*
Jean Fuger, professor, *Commission of European Communities*
Gerhardt Friedlander, Ph.D., *Brookhaven National Laboratory*
Dieter Gruen, Ph.D., *Argonne National Laboratory*
Günter Herrmann, professor, *GSI, Darmstadt; Nuclear Chemistry Institute, University of Mainz, Germany*
John Huizenga, professor, *University of Rochester, New York*
Brian Maple, professor, *University of California, San Diego*
Don Olander, professor, *University of California, Berkeley*
H. Umezawa, professor, *Japan Atomic Energy Research Institute*
Gene Wewerka, Ph.D., *Los Alamos National Laboratory*
Ray E. Wildung, Ph.D., *Battelle Pacific Northwest Laboratories*
Ray Wymer, Ph.D., *Oak Ridge National Laboratory*

The ITS Advisory Council met for the first time in July 1991. Chris Gatrousis, Glenn Seaborg, and Darleane Hoffman are seated in the front row (third, fourth, and fifth from left, respectively). The distinguished group in this photo includes all members of the advisory council (except for Brian Maple) as well as Tom Sugihara (standing, far left), Patricia Baisden (standing, third from left), and Larry Newkirk (standing, far right).

Four of the codiscovers of element 106 posed for this photo at the March 1994 annual meeting of the ITS Advisory Council. From left to right are Kenneth Hulet, Carol Alonso, Glenn Seaborg, and Albert Ghiorso. It was announced at this meeting that seaborgium would be formally proposed to the ACS Nomenclature Committee as the name of element 106.

Seaborg Institute Charter Director Darleane Hoffman is flanked by well wishers at her retirement party. From left to right are Roger Batzel, former LLNL director; Duane Sewell, former LLNL deputy director; Hoffman; Glenn Seaborg; and Chris Gatrousis. Hoffman continued to serve as acting director until 1998.

The institute has sponsored many workshops over the years. The most notable was the United States–Former Soviet Union (FSU) workshop on Actinides in the Environment, held in August 1995. It was hosted by the Seaborg Institute in cooperation with more than 20 scientists from Livermore, Los Alamos, and Berkeley and 15 scientists from the FSU, and involved nearly a year of planning. Representatives from federal and industrial funding agencies were invited. The goal of the workshop was to forge new collaborative research proposals to encourage future scientific cooperation between the United States and the FSU in addressing the international problems of actinides and other radionuclides in the environment.

The Seaborg Institute has served as a focal point for technical advice to the DOE and other organizations on environmental, proliferation, and disposal issues involving plutonium and other transactinium elements. ITS personnel authored or coauthored a host of publications, presentations, seminars, and invited talks. The review book *Advances in Plutonium Chemistry 1967-2000* was prepared under ITS auspices with Hoffman as senior editor. The book comprised 12 chapters written by eminent scientists on experimental and theoretical accomplishments in plutonium chemistry and the outlook for future advances.

Hoffman retired as director of the Seaborg Institute at Livermore in 1996 but continued as acting director until 1998 when she was succeeded by Louis J. Terminello. During this period, the Actinide Science Summer School was established. After Terminello joined the LLNL Weapons Program Office in 2000, Patrick G. Allen served as acting director until Christine L. Hartmann-Siantar became Director in 2001. She added new core capabilities to the ITS portfolio with a biomedical program in collaboration with the UC Davis Cancer Research Center and an emphasis on radiation detection.

In 2004, Annie Kersting was named director and restructured the Actinide Summer School program into the current eight-week Nuclear Science Summer Internship Program for both undergraduate and graduate students. Under her leadership, the Glenn T. Seaborg Institute at Livermore has broadened its program and is now the center of education in nuclear science for the Physical and Life Sciences Directorate.

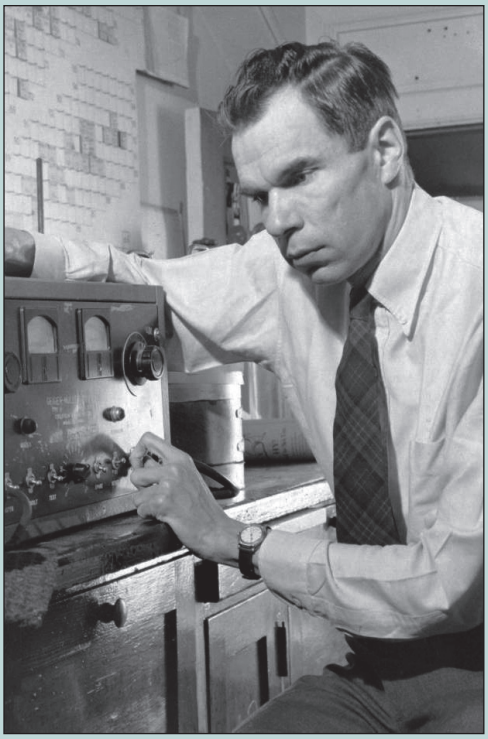
Further reading:

"Report of a Workshop on Transactinium Science," Lawrence Livermore National Laboratory Report, UCRL-LR-104538, September 1990.

Advances in Plutonium Chemistry 1967-2000, Darleane Hoffman, senior editor, American Nuclear Society, La Grange Park, Ill., 2002.

Seaborg the scientist

The Seaborg Institute is a tribute to one of the world's greatest nuclear scientists, Glenn T. Seaborg (1912-1999). A few of his many accomplishments include winning a Nobel Prize before he was 40, codiscovering plutonium (and nine other elements), serving as a section head of the Manhattan Project, advising ten presidents, receiving the Enrico Fermi Award for work in nuclear chemistry and leadership in scientific and educational affairs, and serving as chairman of the Atomic Energy Commission from 1961 to 1971 under Presidents Kennedy, Johnson, and Nixon.



Glenn Seaborg at a Geiger-Muller counter and amplifier in Gilman Hall, University of California, Berkeley, 1941.

Photos on pages 7–11 courtesy of Ernest Orlando Lawrence Berkeley National Laboratory

When he was 28, Seaborg led the research team that discovered plutonium. Darleane Hoffman, charter director of the Seaborg Institute, describes the discovery this way:

> In late 1940, Seaborg assigned Arthur C. Wahl, one of his two graduate students, to investigate the tracer-scale chemistry of element 93, neptunium, as a possible thesis project. Joe Kennedy, a fellow instructor of Seaborg's in the Chemistry Department at the University of California, Berkeley, constructed the measuring equipment for the experiments.
>
> The short-lived isotope neptunium-239 had already been produced by Edwin McMillan and Philip Abelson in bombardments of uranium with neutrons; they had chemically separated it and reported the results in *Physical Review* in 1940 before the United States' entry into World War II. They also began deuteron bombardments at the 60-inch cyclotron on the Berkeley campus to try to find a shorter-lived element 94 daughter than the apparently long-lived 94-239 isotope.
>
> After McMillan suddenly departed for wartime work at MIT, he encouraged Seaborg to continue the deuteron bombardments. In a December 1940 deuteron bombardment, two different isotopes with nearly the same half lives, but with different beta energies, were identified in a

chemically separated neptunium fraction. Growth of an alpha activity of about 50 years was also observed, presumably element 94 with mass 238. The parent was the isotope neptunium-238, which decayed to 94-238 and the results formed the basis for a *Physical Review* paper published in 1946. A note describing these experiments was sent to Washington (January 1941) by Seaborg, McMillan, Kennedy, and Wahl, but they felt more definitive experiments were needed before they could claim discovery of the new element 94.

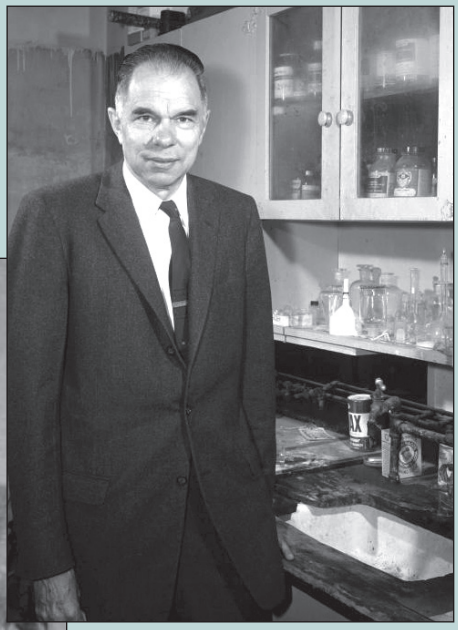
Element 94 was subsequently named plutonium after the planet Pluto, following McMillan's lead in naming element 93 after Neptune, the next planet after Uranus, for which uranium had been named nearly 150 years earlier.

The team chemically identified the element late on the night of Feb. 23, 1941, and well into the next morning, in Room 307 of Gilman Hall, which was designated a National Historic Landmark on the 25th anniversary of the discovery. (Hoffman, Albert Ghiorso, and Seaborg give a complete description of these events in their book, *The Transuranium People: The Inside Story*.)

Glenn Seaborg (left) and Edwin McMillan on the day they were notified they had won the Nobel Prize, October 1951.

Seaborg, Kennedy, Wahl, and physicist Emilio Segrè soon identified the plutonium-239 isotope and demonstrated that it released an enormous amount of energy when it underwent fission. This discovery was instrumental in the development of the atomic bomb during the Manhattan Project. The results were voluntarily withheld from publication but were communicated to Washington on May 29, 1941, and were the basis for a declassified version published by Kennedy, Seaborg, Segrè, and Wahl in 1946 in *Physical Review*.

"My section's mission seemed impossible: Design an automated process to mass-produce an element that existed in such small quantities that no one had ever even seen it," said Seaborg. "Three years of intense work produced just enough plutonium for two bombs—enough to end the war."



Above: Glenn Seaborg revisits the old laboratory in Gilman Hall on the 25th anniversary of the discovery of plutonium. Left: Seaborg, Arthur C. Wahl, and Edwin McMillan (standing in the background from left to right) attend the dedication of Room 307 of Gilman Hall as a National Historic Landmark.

Besides plutonium, Seaborg codiscovered nine other "transuranium" elements (i.e., artificially created elements beyond naturally occurring uranium) including americium (95), curium (96), berkelium (97), californium (98), einsteinium (99), fermium (100), mendelevium (101), and nobelium (102), and element 106—seaborgium—which was named in his honor. Seaborg and Edwin McMillan shared the 1951 Nobel Prize in chemistry for their discoveries in the chemistry of the transuranium elements.

By the end of Seaborg's career, he had participated in the discovery of more than 100 isotopes of existing elements. To quote Seaborg: "There were no immediate uses for my discoveries—but today the radioisotopes are the workhorses of nuclear medicine, an isotope of plutonium is a major energy source in the

space program, and the element americium is critical to the smoke detectors in every house in the country." Perhaps his greatest contribution to science was the formulation in 1944 of the "actinide concept" of heavy element structure, which showed how the transuranium elements fit into the periodic table. Seaborg described the concept in the following excerpt from his 1979 Priestley Medal Address:

> In 1944, I conceived the idea that perhaps all the known elements heavier than actinium were misplaced on the periodic table. The theory advanced was that these elements heavier than actinium might constitute a second series similar to the series of 'rare-earth' or 'lanthanide' elements. The lanthanides are chemically very similar to each other and usually are listed in a separate row below the main part of the Periodic Table. This would mean that all these heavier elements really belong with actinium–directly after radium in the Periodic Table–just as the known 'lanthanides' fit in with lanthanum between barium and hafnium. [Seaborg's] revised Periodic Table listed the heaviest elements as a second 'rare-earth' series. These heaviest elements (including undiscovered elements), with the name 'actinide' elements, were paired off with those in the already-known lanthanide rare-earth series.

"This bold revision of the periodic table was a hard sell," Seaborg wrote in an article published in *Actinide Research Quarterly* in 1997. "When I showed it to some world-renowned inorganic chemists, I was advised not to publish it—such an act would 'ruin my scientific reputation.' However, I did publish it after the war, and it became a guide for the chemical identification of most of the subsequent members of the actinide series."

Seaborg mentored more than 65 successful Ph.D. candidates and authored hundreds of scientific papers. He also authored numerous books whose topics range from science to sports. Several years after publishing a memoir about his 50 years of service to U.S. presidents, Seaborg discussed the topic in a lecture at Lawrence Berkeley National Laboratory. "The point I want to make is to show what can happen to a fellow if he isn't careful," Seaborg quipped at the opening of the lecture.

Reminiscing in a 1996 interview about the discovery of plutonium, Seaborg said: "I was a 28-year-old kid and I didn't stop to ruminate about it. I didn't think, 'My God, we've changed the history of the world!' "

Naming seaborgium

you thought discovering the element was difficult?

Kenneth Hulet (left), Glenn Seaborg (center), and Albert Ghiorso peruse the evidence of the production of element 106.

Traditionally, an element's name is based on mythology, a mineral, a place, a property of the element, or a scientist (and, for consistency, the names of new elements end in "-ium"). Discoverers may suggest a name, but the final decision is made by the International Union of Pure and Applied Chemistry (IUPAC) after a review process by the Commission on Nomenclature of Inorganic Chemistry (CNIC).

Al Ghiorso, one of the codiscoverers of element 106, suggested "seaborgium" in honor of fellow codiscoverer Glenn T. Seaborg. Seaborg was a scientist—one of the traditional choices for naming elements—so what was the problem? According to the CNIC, it was because he was still alive.

Darleane Hoffman, Ghiorso, and Seaborg describe in the following excerpt from their book, *The Transuranium People: The Inside Story,* the maneuvering that took place over the naming of element 106:

> In August 31, 1994, The CNIC decided unanimously to continue the practice of naming elements after appropriate scientists, places, and properties but resolved specifically, 'an element should not be named after a living person.' This specifically excluded naming element 106 'seaborgium,' after Glenn T. Seaborg, as proposed by the undisputed discoverers, since Seaborg was obviously still alive and said 'I had no difficulty proving it!'
>
> [Decisions by the CNIC led to] scrambling the rest of the names in utter disregard of discoverers' suggestions or common usage by the heavy element nuclear chemistry community. For example, 'rutherfordium,' commonly used for 104, went to 106; 'hahnium' went to 108, replacing 'hassium,' which although chosen by the undisputed GSI discoverers was dropped entirely. Furthermore, names were picked that had never been in common usage, such as 'dubnium' for element 104 to replace 'rutherfordium,' and 'joliotium' for element 105, replacing 'hahnium.' The confusion was compounded by shifting the Berkeley names of 'rutherfordium' from element 104 to 106

and 'hahnium' from 105 to 108! Thus, 'hassium' and 'seaborgium,' both chosen by undisputed discoverers, were totally left out while the names 'dubnium' and 'joliotium,' both proposed by Dubna, were adopted for 104 and 105, respectively. During the comment period, there was an overwhelming swell of support for 'seaborgium' for element 106, especially since there was no real precedent for not naming a chemical element after a living person. There was little support for naming element 104 'dubnium' rather than 'rutherfordium'.

In August 1996, the CNIC proposed a compromise that was ratified by the IUPAC in August 1997. The slate of names first proposed in 1994 included mendelevium (101), nobelium (102), lawrencium (103), dubnium (104), joliotium (105), rutherfordium (106), bohrium (107), hahnium (108), and meitnerium (109). The final approved slate included mendelevium (101), nobelium (102), lawrencium (103), rutherfordium (104), dubnium (105), seaborgium (106), bohrium (107), hassium (108), and meitnerium (109).

"Thanks to support from the Chinese and Japanese Chemical and Nuclear Societies in particular, 'seaborgium' did prevail and there was confirmation of the historic right of discoverers to name the element they discovered and no retroactive rule against naming an element after a living person was adopted," said Hoffman in a recent interview with *ARQ*. To sum it up, she says: "The point of all this is to show how hard we had to work to get seaborgium approved while he was still alive—and in the end we were held 'hostage' and forced to accept 'dubnium' for element 105."

Further reading:

Editor's note: It would take an entire issue of *Actinide Research Quarterly* to list all of the articles and books written on the people and subjects discussed in the preceding two sidebars. We offer the following references to help you get started on your quest for further enlightenment:

"Radioactive Element 93," Edwin McMillan and Philip Abelson, *Physical Review* 57, 1940.

"Properties of 94 (239)," Joseph W. Kennedy, Glenn T. Seaborg, Emilio Segrè, and Arthur C. Wahl, *Physical Review* 70, 1946.

"My Service with Ten Presidents of the United States," transcript of a lecture delivered by Glenn Seaborg at Lawrence Berkeley National Laboratory on Oct. 28, 1995, http://acs.lbl.gov/Seaborg.talks/presidents/start.html

"Seaborg by Seaborg," from the Lawrence Berkeley National Laboratory website *Glenn Seaborg: His life and contributions,* http://isswprod.lbl.gov/Seaborg/

The Transuranium People: The Inside Story, Darleane C. Hoffman, Albert Ghiorso, and Glenn. T. Seaborg, Imperial College Press, London, 2000

Actinide Research Quarterly

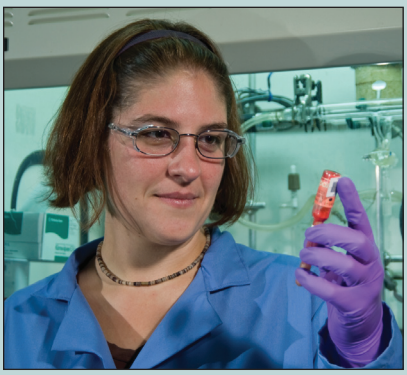
Branching out

Institutes established at Los Alamos and Berkeley Lab

In the late 1990s, institutes were established at Los Alamos and Lawrence Berkeley National Laboratories, fulfilling the original vision of expanding the Seaborg Institute to other sites. Today the three institute branches continue to promote actinide science but with different areas of emphasis: Livermore's is nuclear and bionuclear science and a Summer School for undergraduate and graduate students; Berkeley Lab's is fundamental actinide chemistry, student training, and the impact of radionuclides in the environment; and Los Alamos' is nuclear science studies of plutonium and the other early actinides (thorium through curium).

The Los Alamos Seaborg Institute was chartered in 1997 with goals similar to the original ITS at Lawrence Livermore National Laboratory: to provide a focus for actinide science, to help maintain U.S. preeminence in actinide science and technology, and to recruit and educate new scientists and engineers. Since its creation, the Los Alamos Seaborg Institute has been successful in encompassing both the areas of actinide science and all aspects of plutonium science. It has helped to unite segments of plutonium science scattered throughout Los Alamos and has been invaluable in recruiting outstanding young people to the Laboratory.

A two-year project that began in 1998 with *Los Alamos Science* magazine resulted in the production of two volumes concentrating on plutonium science at Los Alamos. This project was the driving force behind a plutonium science renaissance at Los Alamos that spawned new LDRD-Directed Research



The three branches of the Seaborg Institute are committed to fostering the education of the next generation of scientists through their graduate and postdoc programs and summer institutes. Left: Robyn Gdula (Los Alamos) probes the nature of uranium-ligand multiple bonds at Los Alamos. Center: Travis Bray (Berkeley Lab) analyzes data from the electrospray mass spectrometer in the Heavy Elements Research Laboratory. Right: Lindsay Shuller (Lawrence Livermore) uses a scanning electron microscope.

projects, an expansion of the Office of Basic Energy Sciences' actinide support, and a substantial increase in Los Alamos actinide science publications. *Actinide Research Quarterly* is published under the guidance of scientific advisors from the Seaborg Institute.

David L. Clark, a former Oppenheimer Fellow and Nobel Laureate Signature Award winner (synthetic and physical inorganic chemistry), was chosen as the director of the LANL Seaborg Institute. Two scientifically active deputies with complementary skills, Gordon D. Jarvinen (separations science) and Albert Migliori (solid-state physics), make up the current leadership team.

The Glenn T. Seaborg Center (GTSC) at Lawrence Berkeley National Laboratory was founded in the spring of 1999 with a mission similar to the other two institutes: scientific research and education. The scientific goal is to understand fundamental heavy element chemical interactions in complex systems at a molecular level. The GTSC seeks knowledge on the important system-controlling processes and materials related to fundamental actinide science, actinides and the environment, and to nuclear chemistry and materials.

Equally important is the GTSC mission of educating and training the current and the next generation of scientists with proficiency in actinide chemistry. The GTSC's dual mission supports the U.S. Department of Energy's critical role as the provider of fundamental science and trained personnel to meet national needs in environmental restoration and stockpile stewardship.

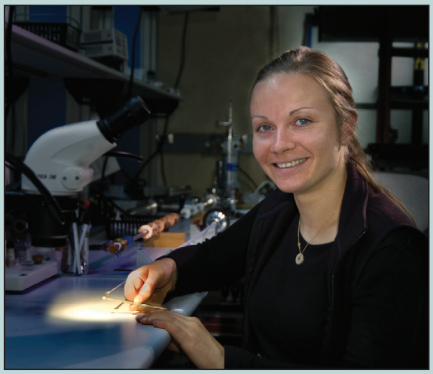
Left: Eric Bauer (Los Alamos) removes a polycrystalline sample from a furnace as part of his research on plutonium superconductors. Center: Kristina Pohaku (Lawrence Livermore) prepares samples in the chemical biology and nuclear sciences program. Right: Roy Copping (Berkeley Lab) prepares novel uranium complexes in an inert atmosphere glovebox.

Kenneth N. Raymond, UC Berkeley chancellor's professor, senior scientist in LBNL's Chemical Sciences Division, and Actinide Chemistry Group program leader, heads the Berkeley Lab branch of the Seaborg Institute. David K. Shuh, senior scientist in LBNL's Chemical Sciences Division and Actinide Chemistry Group principal investigator, is the associate director.

Additional information on each of the three Seaborg Institutes can be found on their websites:

- Livermore: *https://www-pls.llnl.gov/?url=about_pls-centers_and_institutes-glenn_t_seaborg_institute*
- Los Alamos: *http://seaborg.lanl.gov/*
- Berkeley Lab: *http://actinide.lbl.gov/gtsc/*

Annie Kersting (front row left), director of Lawrence Livermore's Seaborg Institute, is shown with staff and students of the 2006 Nuclear Science Summer Internship Program.



Left: Sonia Francoual (Los Alamos) researches the effects of rhenium doping on a uranium-ruthenium-silicon compound at the National High Magnetic Field Laboratory. Center: Greg Brennecka (Lawrence Livermore), at right, discusses a poster detailing his comprehensive database of uranium mines. Right: Dan Schwarz (Los Alamos) studies structure and bonding in actinide complexes.

IGCAR honors Seaborg's contributions to actinide science

As the discoverer of the actinide elements, Dr. Glenn T. Seaborg occupies a special place in the minds of the chemistry community at the Radiochemistry Laboratory of the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam. Studies on the chemical aspects of plutonium-based fuels are an important element of the chemistry program at IGCAR, which focuses on the development of fast-reactor science and technology.

Dr. Seaborg's extraordinary vision, precise and detailed experimentation, and passion for research and education have always inspired us at IGCAR. Our direct relationship with Dr. Seaborg began in 1995 at a symposium on nuclear and radiochemistry. Dr. Seaborg provided a thought-provoking message to the participants, and what was most heartening was that he continued to feel the excitement of actinide chemistry in 1995 as strongly as he had many years before in the early years of actinide chemistry.

"The chemistry and investigation of the atomic nucleus still offer much exciting knowledge," Seaborg wrote symposium participants. "Like a buried old treasure chest, the deeper we dig, the more sparkling and valuable gems we will find." The message—typical of a visionary—has continued to attract the attention of visitors to my office and has served as a great source of inspiration. Dr. Seaborg also kindly sent a photo of himself at our request; it now adorns the entrance to the Radiochemistry Laboratory.

Sig Hecker (left), director emeritus of Los Alamos National Laboratory; Gordon Jarvinen (center), associate director of Los Alamos' Seaborg Institute; and P.R. Vasudeva Rao of the Indira Gandhi Centre for Atomic Research are shown in front of the photograph of Glenn Seaborg (on the left) that adorns the entrance to the Radiochemistry Laboratory at IGCAR. The photo on the panel on the right is of Homi Bhaba, the driving force behind India's atomic energy program.

In 1995 a debate was going on in the international community as to whether it was appropriate to name an element after a living person—in this case, Dr. Seaborg. The chemists who had gathered at the IGCAR symposium strongly believed that an opportunity for naming an element after an eminent person like Dr. Seaborg should not be missed merely because he was still alive.

As a result, the nuclear chemists at the symposium passed a resolution supporting the naming of element 106 "seaborgium," and this resolution was sent to the International Union of Pure and Applied Chemistry. We shared the elation of actinide researchers throughout the world when the international community accorded its approval for immortalizing Dr. Seaborg with an element bearing his name.

For more than 25 years, the Indian Association of Nuclear Chemists and Allied Scientists (IANCAS) has brought together radio- and nuclear chemists throughout India to promote nuclear sciences, especially the application of radioisotopes in various domains. The Southern Regional Chapter of IANCAS was formed at Kalpakkam in 2002. In 2003 the chapter chose to honor Dr. Seaborg's legacy by establishing the Seaborg Memorial Lecture series, held every April (Seaborg's birth month).

Eminent researchers working on subjects related to actinide sciences deliver the Seaborg Memorial Lectures. Topics have included applications of radioisotopes in medicine, super-heavy elements and the dynamics of nuclear fission, the history of plutonium, condensed matter physics of actinides, thermodynamic measurements and structural characterization of actinides in solution, and uranium mining in India.

The Seaborg Memorial Lectures have provided a great opportunity for the scientists at our Centre to appreciate the contributions of Dr. Seaborg and share their excitement about actinide science. A presentation prepared by our colleagues on the life and achievements of Dr. Seaborg is screened yearly; it has inspired many of our younger colleagues and serves as an important attraction to the lecture series.

—P.R. Vasudeva Rao
Director, Chemistry Group
Indira Gandhi Centre for Atomic Research, Kalpakkam

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Errata

In the last issue of ARQ, we gave the incorrect affiliation for a group of authors. Clemens Walther, Jörg Rothe, Markus Fuss, and Sebastian Büchner are with the Institut für Nukleare Entsorgung (INE), Forschungszentrum Karlsruhe.

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