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Conference Provides International Forum on Plutonium Science

The 300 participants registered for the international conference "Plutonium Futures—The Science" represented 14 countries* as well as Department of Energy national laboratories and other federal and international institutions, universities, and industries. Among the attendees were 20 students and 17 faculty members, representing 14 universities from the USA, France, and Sweden. Los Alamos National Laboratory in cooperation with the American Nuclear Society sponsored the conference to discuss the current state of plutonium and actinide sciences and to rejuvenate the science needed to solve the international issues surrounding these materials.

The conference, which ran from August 25 through 27, 1997, at the Hilton Hotel in Santa Fe, New Mexico, began with a welcoming message by Laboratory Director Sig Hecker followed by five plenary lectures. In a videotaped presentation Dr. Glenn Seaborg, awarded a 1951 Nobel Prize in chemistry for his discovery of plutonium, talked about the history of the discovery of the element and his personal perspective on the evolving use of plutonium in our society. Dr. Seaborg, in a classroom setting at the University of California, Berkeley, emphasized the importance of attracting young researchers to the field.

"A great deal of modern life revolves around science. We need scientists and engineers to make the discoveries and developments necessary to compete in a highly technological world...We need a higher level of science literacy in the general population in order that its members may perform adequately in a technological society."
Dr. Glenn Seaborg

*Austria, Australia, Belgium, Canada, France, Germany, Japan, Kazakhstan, Korea, Russia, Spain, Sweden, UK, USA

A Web page has been established for suggestions and comments concerning the conference: see http://www.lanl.gov/puconf97/

This article was contributed by Ann Mauzy, CIC-1, who covered the conference for *Actinide Research Quarterly.*

Dr. Seaborg set in motion another theme of the conference, that of the utility and importance of plutonium and other transuranic elements in medical applications and energy and the need to better educate the public about the risks and benefits of these elements. He characterized nuclear energy as a rational approach to the dangers of various other energy sources and predicted that the depletion of those other sources will mean an eventual return to breeder reactors and nuclear energy using both plutonium and the most abundant isotope of uranium, ^{238}U.

Other plenary speakers included Dr. Victor Mourogov of the International Atomic Energy Agency, Dr. Alan Waltar, Dr. Daniel Kerlinsky, and Dr. Darleane Hoffman. The speakers addressed the core science issues associated with nuclear proliferation and nuclear energy: the safe storage and ultimate disposal of surplus weapons material and management of large inventories of actinides from civilian nuclear power generation. Representing the "loyal opposition," Daniel Kerlinsky, Physicians for Social Responsibility, agreed that these were the basic science issues and also urged international cooperation. The final plenary speaker, Dr. Darleane Hoffman, echoed Dr. Seaborg's message emphasizing the challenges and opportunities for basic research that plutonium and the other actinides present.

The five technical sessions that followed during the two and a half days covered topics under the broad categories of materials science, transuranic waste forms, nuclear fuels and isotopes, separations, actinides in the environment, detection and analysis, plutonium, and actinide compounds and complexes. The papers within these areas spanned an extremely wide range of technical topics and gave attendees a chance to learn about current research outside of their particular specialties. There were more than 100 papers presented at the conference. Among those were 12 in materials science, 26 in transuranic waste forms, 5 in nuclear fuels and isotopes, 19 in separations, 12 in actinides in the environment, 9 in detection and analysis, and 13 in plutonium and actinide compounds and complexes.

Topics covered the entire gamut from the general, e.g., overview of work at the V. G. Khlopin Radium Institute, to the specific, e.g., specific separations techniques for specific types of mixed wastes, material and thermodynamic properties, and spectroscopic studies of actinides.

In the discussions of nuclear fuels, Dr. Seaborg and a number of other speakers noted that nearly 20% of the electricity generated around the world presently comes from fission energy of plutonium in nuclear reactors. Others noted that about 60 metric tons of excess plutonium will be recovered from warheads being dismantled under the START I and II agreements. The central question is, "What is the best way to use/dispose of this plutonium?"

The need for international cooperation in answering this question was nicely summed up by Richard Rhodes, the banquet speaker (see inset). Rhodes sees plutonium as an essential resource to ensure humankind's right to live without starvation. He sees nuclear energy and nuclear proliferation as global problems that can only be solved with global solutions.

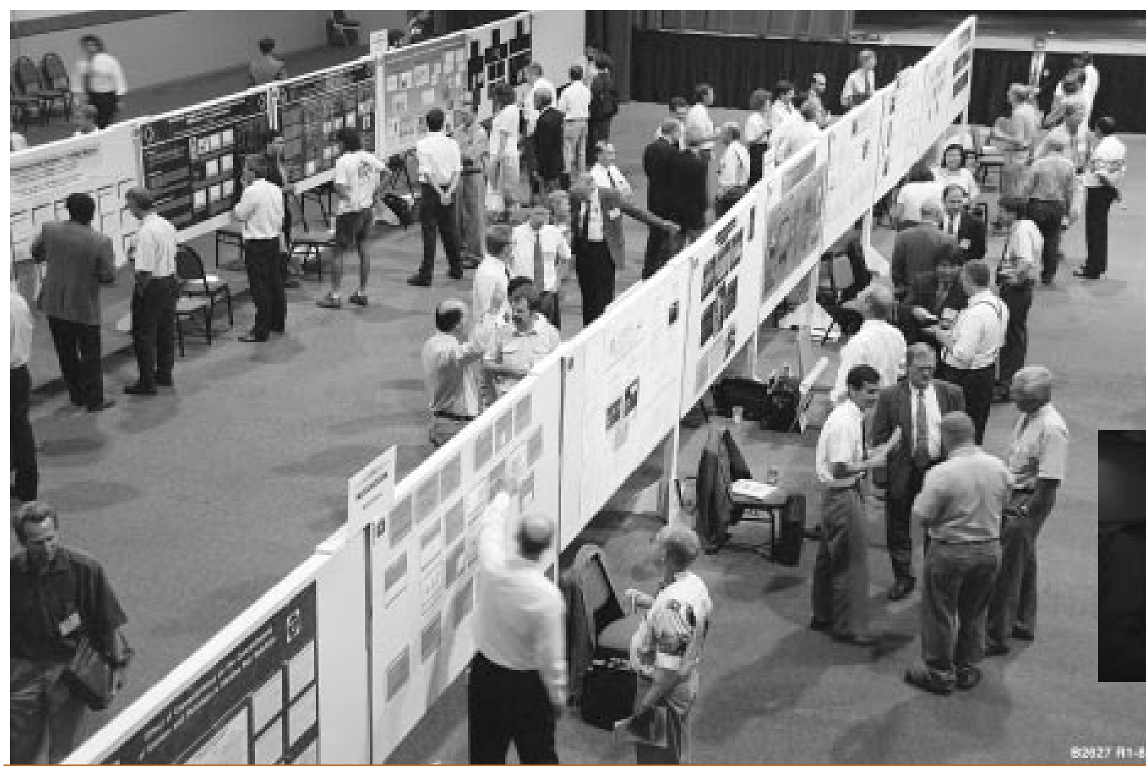
Rhodes Challenges Plutonium Scientists

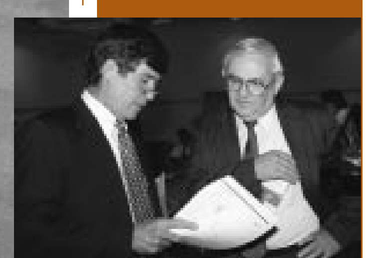
Pulitzer Prize-winning author (*The Making of the Atomic Bomb)* Richard Rhodes challenged the conference attendees to use the public health model, the one that has eradicated smallpox from the earth, in solving problems of nuclear proliferation and nuclear energy. In his talk entitled "Public Health, Public Knowledge, Public Peace" he pointed out, "Moralizing about subjects that are essentially technical (disease was once considered a punishment from God) blocks the path to finding solutions." He placed the ban on reprocessing of spent nuclear fuel in this category and pointed out that this decision ignored the fact that there are much easier routes for proliferation.

In furthering the metaphor, he urged declassification of necessary facts, shared open knowledge, committed individuals, and an international, nonpoliticized regime of nongovernmental agencies to enable a nuclear materials management system to oversee retrievable storage of plutonium, its separation, and its burnup in power reactors. In working together, he concluded, we will be furthering the greater good: the prevention of nuclear weapons proliferation and the production of electrical power necessary for civilization.

"Moralizing about subjects that are essentially technical (disease was once considered a punishment from God) blocks the path to finding solutions."

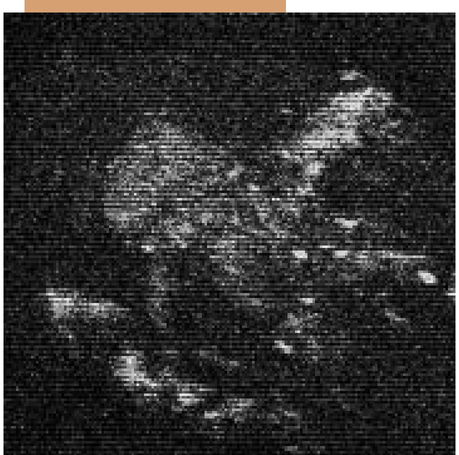
Richard Rhodes

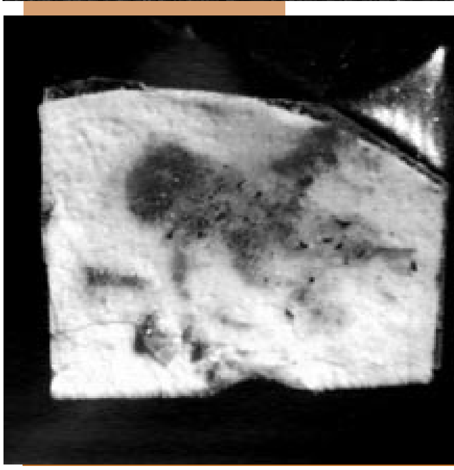




X-Ray Fluorescence Is Useful for Actinide Characterization

At the bottom is a sample of process residue from Rocky Flats in the form of ash, placed on a piece of tape. At the top is an elemental map of the plutonium distribution within the ash sample using x-ray microfluorescence. The elemental map was acquired with a 100-micron aperture.





Although there is no "silver bullet" analytical method that can answer all questions about all actinide sample types and problems, x-ray fluorescence (XRF) spectrometry is one of the myriad of analytical methods that are available to answer such questions. X-ray fluorescence spectrometry is a mature analytical method used to determine elemental composition in a wide range of sample types.

The fundamental process is based upon the removal of a core electron from the sample by x-rays from an x-ray tube. The resulting core electron vacancy is filled by an outer-shell electron, which emits an x-ray that is characteristic of the element. This provides the qualitative part of the analysis or answers the question, "what elements are present?" The intensity of the x-ray fluorescence detected is directly proportional to the concentration of the element in the specimen. This value gives the quantitative part of the analysis or answers the question, "how much of the element is present?" This relatively simple process is used throughout the world in analytical laboratories and plants to monitor processes, identify contaminants, and solve problems. At Los Alamos, XRF is an important tool in providing characterization information on a wide variety of samples and supporting a number of different programs.

Although the fundamental process is simple, the instrumentation used in XRF is neither simple nor inexpensive. The basic instrumentation of power supply, excitation source, and detector is universally similar, but the hardware details are sufficiently complex to push instrument base prices over \$100K. There are two types of XRF instruments available, wavelength-dispersive XRF (WDXRF) and energy-dispersive XRF (EDXRF). While x-ray tubes are common to all XRF instruments, they vary in output depending upon the instrumentation. Most WDXRF systems have high-power tubes, typically 3 kW–4 kW and use crystals for diffracting the emitted x-rays before they are detected. The WDXRF instrument thus detects elements sequentially, one at a time. There are simultaneous instruments; however, these simply have separate detector channels for each element. The WDXRF instruments offer sensitivity, resolution, and both long- and short-term stability.

The EDXRF instruments utilize a solid-state detector that captures all elemental x-rays simultaneously. Their rapid analysis is offered at the expense of spectral resolution and ultimate sensitivity. In general, both instruments can handle solid and liquid samples with sensitivities in the tens of parts per million. The detection limits vary by element as well as by the matrix.

The routine samples we analyze by XRF include gallium and trace uranium in plutonium and plutonium oxide samples. Although other elemental methods are capable of detecting these elements, the nature of the plutonium matrix creates additional challenges that affect the accuracy, precision, and speed of the analysis in these other methods.

The gallium and uranium analyses begin the same with sample dissolution, followed by removal of the plutonium matrix with ion exchange resins. The gallium is eluted from the ion exchange column and collected in a beaker. Then a zinc internal standard is added, and the sample is analyzed directly. This process can provide precision with values approaching $\pm$ 0.1%. The trace uranium, on the other hand, is collected and then concentrated on a resin-impregnated filter paper. This offers us sensitivities in the low parts-per-million range. While precision is not an issue, this method avoids the isotopic interference from the plutonium matrix. Both of these analyses support such programs as pit rebuilding, surveillance, and development of mixed-oxide (MOX) fuels.

Other analyses involving actinide materials are applied to samples from Hanford and Rocky Flats. In these analyses, the sludge or ash particles are analyzed directly to provide a qualitative identification of the elements

Joel Dahlby, CST-8, operates an x-ray microfluorescence instrument, an innovative use of XRF to excite a specific location on a specimen. The technique can be used to perform spatially resolved elemental analysis for concentrations of 10 ppm to weight percent levels.

present. We are currently developing a semiquantitative method that will provide both qualitative identification and relative quantitative values of the detected elements. Although this analysis will not provide absolute concentrations, the values will be referenced to known standards for lot-to-lot comparisons. This procedure takes advantage of the rapid sample analysis and minimum sample preparation requirements, keeps the per sample costs low, yet still provides the needed composition information on the sample.

The Source Term Testing Program (STTP) project is another area where XRF is providing qualitative and quantitative data. In STTP brine samples are withdrawn from test containers and filtered. The XRF team receives both the brine and filters for analysis. The XRF results give a picture of what is dissolved in the brine and what is suspended within the liquid phase of the test material. Both sample types offer challenges in analysis since calibration standards that match the matrix of the unknowns must be fabricated. Although these analyses are not absolute because of the widely varying test container compositions, the values provide a relative scale for comparing the effects of the brine interactions with the different waste forms being tested.

In addition to these routine methods, we are actively pursuing new and innovative ways to use XRF so we can meet future characterization needs. One area of research is the use of x-ray microfluorescence (XRMF), which utilizes a spatially restricted x-ray beam to excite a specific location on a specimen. The detected x-rays are localized and can provide information on heterogeneity, inclusions, thin films, and interfaces. Our current program has several thrusts that offer new approaches to actinide characterization. The dried spot method has the potential for rapid, multielemental analysis on small masses of volumes of material. The method utilizes 10-ml to 50-ml drops of solution, which are dried. The resulting dried residue, which is mere micrograms of material, is analyzed with sensitivities approaching less than 1 part per billion. This is 3 orders of magnitude better than conventional, bulk XRF. The primary advantage lies in the small sample size, which also helps to keep exposures to personnel as low as reasonably achievable in sample handling and analysis.

Rapid, spatially resolved analysis of MOX surrogates is providing insights into the evolution of gallium from potential MOX reactor fuel pellets. The presence of gallium is a critical issue for disposing of weapons plutonium in MOX fuel. Although most of the gallium can be removed, the mechanism of the removal process and behavior of the residual gallium need to be studied. The capabilities of XRMF allow us to study the gallium behavior on a scale that does not require the high resolution of a scanning electron microscope.

Finally, the ultimate goal is to develop an instrument that uses chemical images to provide both elemental and molecular information simultaneously. These chemical images will rapidly transmit both qualitative and quantitative, spatially resolved information on the elemental and molecular composition of the sample. This vision is based on integrating elemental and molecular spectroscopic data from XRMF, micro-Raman, micro-FTIR (Fourier transform infrared spectroscopy) and x-ray microdiffraction. The principal advantage of this integrated approach is the nondestructive, comprehensive chemical information on either small samples or spatially resolved images of macroscale specimens. This multiplexing of spectroscopic information would improve characterization accuracy and minimize multiple sample preparations to solve analytical problems.

This is just a snapshot of the importance of only one analytical method and how analytical chemistry as a whole underpins actinide science and actinide production efforts and how analytical science impacts all of the scientific efforts at Los Alamos.

In addition to Principal Investigator **George J. Havrilla,** the XRF Team includes **Bill Hutchinson, Margie Moore, Lisa Colletti, Forrest Weesner,** and **Christopher Worley of** CST-8 and **Jon Schoonover** of CST-4.

LANL Faces Institutional Challenges in Its Nuclear Future

Todd LaPorte is a professor of Political Science at the University of California, Berkeley.

Dr. LaPorte was an "ex officio" member of the 1996 NMT Science and Technology Assessment Review Committee.

Social scientists rarely have the opportunity to become familiar with operations that combine demanding technologies, high national purpose, and extraordinary institutional challenges. Such an opportunity was afforded me this year by the Nuclear Material Technology (NMT) Division and the Nuclear Materials and Stockpile Management Program Office. The experience was at once engaging, informing, and unsettling. This editorial reflects my unusual view of LANL's evolution and could be seen, in part, as a letter to those who so graciously became my teachers.

As the readers of this quarterly know, LANL, especially its plutonium-handling facilities (Technical Area-55, managed by NMT), has been tasked to demonstrate its ability to become the nation's leading organization with the capacity for "pit remanufacture," i.e., periodic remanufacture of the plutonium components needed to maintain nuclear weapons in a state of highly reliable readiness. Since there is no other facility with sufficient capacity, TA-55 is, in effect, the U.S. plutonium fabricator of last resort, a facility that is likely to be required for the foreseeable future.

In taking up its expanded role, LANL has joined with DOE in using the metaphor of "stewardship" to focus on these responsibilities and public service. With regard to managing nuclear materials, especially in the coming era of regulatory transparency, the role of "institutional steward" is quite extraordinary. To the attentive public, "stewardship" is likely to imply that LANL and DOE are claiming they can assure highly reliable operations for many work and management generations, perhaps for hundreds of years, in a manner that evokes deep, sustained public trust and confidence. From an institutional perspective, these are very demanding goals to achieve and sustain. Indeed, the recent extension of LANL's mission challenges our capacity to maintain an organization's operational balance and to successfully navigate the turbulent waters of national politics.

The Lab and NMT already demonstrate an understanding of highly reliable operations. The requisites for evoking the public's trust and confidence are more problematic but have drawn a good deal of comment and some analysis. I leave this discussion for another venue. Assuring high performance in the spirit of stewardship for many generations, i.e., "institutional constancy," is another matter. It is an unexpected, unfamiliar, though apt challenge. Institutional constancy is a prime condition undergirding the exercise of honorable institutional stewardship. It is not well understood and is unexpected within an American political culture that lauds change and shrinks from continuities of power. Institutional constancy implies the faithful adherence to a mission and its operational imperatives in the face of a variety of social and institutional changes and requires adaptability to meet institutional and public commitments.

LANL already seeks to assure continuity of top technical talent in its recruiting and mentoring activities, key mechanisms in socializing and training generations of able professionals in the spirit of enterprise. But there are only meager analytical bases for achieving organizational qualities that address the challenge of constancy. What little that has been done suggests that these qualities require steadfast political will and what one might call the "organizational infrastructure of constancy."

Political will is likely to be enhanced by strong articulation of commitments by agency leaders to unswerving adherence to the spirit of the initial agreement as well as vigorous external reinforcement from regulatory agencies and public "watchdog groups." The organizational infrastructure of constancy is less familiar and includes

- administrative and technical capacities to carry out constancy-assuring activities reinforced by agency rewards for pursuing them;
- adequate resources and activities to assure the transfer of technical and institutional knowledge from one work and management generation to the next;
- analytical resources for future impact analyses; and
- capacities to detect and remedy the early onset of likely failure related to processes that threaten the future, as well as assurance of remediation if failures actually occur.

Institutional constancy must be seen in terms of the missions animating an institution—in the case of LANL and NMT—research and development goals. The challenge in the future will be to integrate R&D with excellence in specialty production, activities that some observers believe to be intrinsically at odds. The dimensions of this challenge are suggested by the objectives the U.S. seems to be pursuing, i.e., to manage nuclear materials in a manner that 1) emphasizes a self-conscious spirit of sustained institutional stewardship; 2) aims to be the best in the world, not only in the U.S.; and 3) equips technical and operational professionals to demonstrate, via their interactions with professional counterparts throughout the world, that the U.S. retains an effective nuclear weapons deterrent capacity for the indefinite future.

These are as unusual and demanding a set of institutional goals as ever to be proposed for technical organizations and programs. Goals 1) and 3) above have rarely been sought, authorized, or supported by sponsors in the past, nor are they particularly honored by political, media, or economic leaders in our political culture. Yet the multigenerational demands of these goals raise the issue of "institutional honor," a topic almost absent from organizational studies and broached only hesitantly in technical professional conversation.

Our generation is, in effect, handing down undeniable demands to the fourth and fifth generations. Meeting these demands will be difficult, especially in view of the fact that the major benefits of nuclear deterrence have accrued to the present generation but with much of their cost deferred to future generations. Will these obligations requiring some of their generations' best and brightest be readily taken up by our descendants? Will it be an honorable and honored "taking up"? As the political situation that bolstered the dedication of national resources to nuclear stewardship attenuates with time, future generations without our frame of reference may find our "gift" increasingly onerous. The conditions necessary to nurture an honored institution within the society at large apply as well to according honor to technical production activities and research and development so that sustained, high-quality technical operations may be ensured.

In the context of LANL's past, this discussion may seem unduly alarming. After all, LANL, under the benign oversight of the University of California system, has repeatedly made unique and invaluable contributions to advance basic scientific knowledge and to overcome a vigorous adversary. Couldn't we expect the same "world class" performance in the new era? Perhaps, but to leave it there misses the emerging public skepticism regarding technical systems generally, a particularly

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"Indeed, the recent extension of LANL's mission challenges our capacity to maintain an organization's operational balance and to successfully navigate the turbulent waters of national politics."

LANL Faces Institutional Challenges in Its Nuclear Future *(continued)*

acerbic skepticism regarding the nuclear enterprise. It can be argued that those who are technically engaged in the various aspects of this enterprise have not been particularly well served by their governmental or commercial sponsors and promoters. Recent history suggests failures of institutional competence, policy determination, and public disclosure. The accumulation of these failures exhausts public patience, erodes confidence in technical professionals (and their overseers), and accretes layers of resentment harbored in the social psyches of a distracted and anxious public.

While the technical parameters of "science-based stockpile stewardship" may be in the process of becoming clarified, operational lineaments remain opaque and institutional imperatives illusive. This presents the current leadership not only with demanding technical obstacles, but with extraordinary institutional ones as well. The metaphor of stewardship is apt and warranted. Offered in the face of historical residues and evolving conditions, that stewardship lays demanding charges upon current leadership and taxes our institutional capacities. It also taxes our abilities to frame perspectives that acknowledge the political strain intrinsic to maintaining those technical capabilities that have been central to achieving global dominance.

It is possible, perhaps likely, that leaders in Washington have neither the capacity nor the full resolve to initiate the necessary stewardship-enhancing changes. To the degree this is so, developments in the relationships of LANL with the external world and changes within the weapons programs themselves must be initiated mostly from within the Lab, probably in the face of at least residual resistance from its overseers. But if stewardship-enhancing measures are broadly effective, technical and institutional leaders will recover the confidence of able Americans. This is a requisite to nurture a climate of understanding and honor in which each generation assumes the obligation of managing the burden of nuclear weapons and materials in such a way that their successors in the "fourth generation" will inherit a system at least no more difficult to manage than the one they received.

It will be a challenge. There is no credible basis for confidently selecting out those organizational solutions that will be suitable for the future on the basis of short-term managerial, economic, or political considerations. In effect, we could, in all good-hearted earnestness, start out wrong, as history would surely note.

Todd LaPorte

The ideas presented in this editorial are the author's and do not necessarily represent the opinion of Los Alamos National Laboratory, the University of California, the Department of Energy, or the U.S. government.

Publications, Presentations, and Reports (April 1997–September 1997)

Journal Publications

M. P. Neu, S. D. Reilly, and W. Runde, "Plutonium Solubility and Speciation to be Applied to the Separation of Hydrothermal Waste Treatment Effluent," *Materials Research Society Symposium Proceedings Series, II. Scientific Basis for Nuclear Waste Management XX*, Volume 465, in press.

H. T. Hawkins, B. E. Scheetz, and G. D. Guthrie, Jr., "Preparation of Monophasic (NZP) Radiophases: Potential Host Matrices for the Immobilization of Reprocessed Commercial High-Level Wastes," *Materials Research Society Symposium Proceedings Series, II. Scientific Basis for Nuclear Waste Management XX*, Volume 465, W. J. Gray and I. R. Triay eds., 387-394, Materials Research Society, Pittsburgh, PA (1997).

M. D. Diener, C. A. Smith, and D. K. Veirs, "Anaerobic Preparation and Solvent Free Separation of Uranium Endohedral Metallofullerenes," *J. Chem. of Materials*, **9**(#8), 1773–1777, (1997).

D. G. Kolman and J. R. Scully, "On the Requirement for a Sharp Notch or Precrack to Cause Environmentally Assisted Crack Initiation of Beta-Titanium Alloys Exposed to Aqueous Chloride Environments," to be published in *Effects of the Environment on the Initiation of Crack Growth, ASTM STP 1298*, (W. A. Van der Sluys, R. S. Piascik, and R. Zawierucha, Eds., American Society for Testing and Materials, Philadelphia, PA 1997).

D. G. Kolman and J. R. Scully, "An Explanation for the pH and Potential Dependency of b-Titanium Alloy EAC Initiation in Aqueous Chloride Environments Based on an Investigation of Crack Tip Electrode Kinetics," *Metallurgical Transactions A*, in press.

D. G. Kolman and J. R. Scully, "Comparison of Anodic Current Transients Resulting from Film Rupture on a Dynamically Strained Metastable b-Titanium Electrode to Those Observed Following Fractured Thin Film and Scratch Depassivation," *J. Electrochem. Soc*., in review.

Conference Presentations

The following papers were presented at the American Chemical Society National Meeting, San Francisco, CA, April 13–17, 1997: U. F. Gallegos and M. A. Williamson, "Molten Salt Electrochemistry"; R. R. Salazar, B. J. Griego, L. D. Schulte, S. D. McKee, W. B. Smith, M. J. Palmer, and V. A. Hatler, "Oxalate Precipitation of Pu(III) from Very Dilute HCl Solutions"; G. M. Purdy, G. D. Jarvinen, B. F. Smith, M. Cournoyer, and R. R. Gibson, "Polymer Filteration: An Emerging Technology for Selective Metals Recovery" (Division of Chemical Technicians); J. L. Lugo, D. E. Wedman, and T. O. Nelson, "Electrochemical Decontamination of Actinide Processing Gloveboxes"; R. B. Vaughn, J. M. Berg, and M. R. Cisneros, "The Use of Absorption Spectroscopy of Plutonium to Minimize Waste Streams"; L. A. Worl, D. D. Padilla, D. K. Veirs, S. J. Buelow, L. A. Le, and J. H. Roberts, "Hydrothermal Processing of Actinide Contaminated Organic Wastes," LA-UR-96-3796; M. Barr, G. Jarvinen, S. F. Marsh, and R. Bartsch, "Development of Anion-Exchange Resins for Separations of Actinides," LA-UR-96-3933; D. K. Ford, R. Scott Lillard, and D. P. Butt, "Corrosion Study of Candidate APT Engineering Materials," LA-UR-96-4078; and J. M. Berg, R. B. Vaughn, M. R. Cisneros, D. K. Veirs, and C. A. Smith, "Optical Studies of the Stoichiometry and Thermodynamics of Plutonium (IV) Nitrate Complexes in High Ionic Strength Acidic Solutions," LA-UR-96-4537.

The following papers were presented at the ANS Topical Conference on Methods and Applications of Radioanalytical Chemistry, Kailua-Kona, Hawaii, April 6–11, 1997: K. W. Fife, "A Kinetic Study of Plutonium Dioxide Dissolution in Hydrochloric Acid Using Iron(II) as an Electron Transfer Catalyst"; S. L. Yarbro, S. B. Schreiber, E. A. Ortiz, and R. L. Ames, "Reducing Pu(IV) to Pu(III) with Hydroxylamine in Nitric Acid Solutions"; G. D. Jarvinen, M. E. Barr, S. F. Marsh, and R. A. Bartsch, "Bifunctional Anion-Exchange Resins for Improved Separations of Nuclear Materials," LA-UR-96-3835; and D. K. Veirs, J. M. Berg, and C. A. Smith, "New Spectroscopic Studies of Plutonium (IV) Nitrate Complex Formation in Solution and on Ion Exchange Resins."

The following papers were presented at the 21st Actinide Separations Conference, Charleston, SC, June 23–26, 1997: J. A. McNeese, W. J. Griego, and E. Garcia, "Pyrochemical Oxidation of Residue Salts"; E. Garcia, J. A. McNeese, W. J. Griego, and V. R. Dole, "Demonstration of the Salt Distillation Process"; V. R. Dole and E. Garcia, "Aqueous Dissolution of Oxidized Calcium Chloride DOR Residues"; A. J. Vargas, G. D. Bird, and E. Garcia, "In-Situ Chlorination of Plutonium Metal"; and S. B. Schreiber and S. L. Yarbro, "Impacts of the Waste Isolation Pilot Plant Waste Acceptance Criteria on Transuranic Waste Handling."

The following papers were presented at the JOWOG 22 Meeting, Aldermaston Weapons Establishment, United Kingdom, June 11–13, 1997: S. D. Owens, G. Bird, and A. Vargas, "Americium Extraction by In-Situ Chlorination" and S. D. Owens and T. E. Ricketts, "Plutonium Metal Oxidation."

The following papers were presented at the American Chemical Society National Meeting Nuclear Chemistry and Technology Division, Las Vegas, NV, September 7-11, 1997: D. K. Veirs, G. M. Rosenblatt, C. R. Heiple, and J. P. Baiardo, "The Use of Acoustic Resonance Spectroscopy to Detect Changes within Storage Containers" and E. Garcia, J. A. McNeese, W. J. Griego, and V. R. Dole, "Demonstration of the Salt Distillation Process for Rocky Flats Salt Residues."

P. L. Wallace, "Crystal Chemistry Principles Applied to the X-ray Diffraction Identification of Metallurgical Phases," 1997 Denver X-ray Conference, Steamboat Springs, Colorado, August 5, 1997.

D. G. Kolman, D. K. Ford, T. O. Nelson, and D. P. Butt, "General and Localized Corrosion Behavior of 304 Stainless Steel Exposed to Room and High Temperature Nitric Acid/ Halide Solutions," NACE 97 (National Association of Corrosion Engineers), Symposium on Corrosion Issues in Liquid Radioactive Waste Storage, New Orleans, LA, March 9–14, 1997.

J. R. Hurd, G. W. Veazey, T. H. Prettyman, G. A. Sheppard, T. E. Ricketts, and R. K. Nakaoka, "Performance of NDA Techniques on a Vitrified Waste Form," 38th Annual Meeting of the Institute of Nuclear Materials Management, Phoenix, Arizona, July 20–24, 1997.

R. C. Hagan, J. Gladson, and T. Wickland (Nuclear Technology Technology, Inc.), "Containers for Short-Term Storage of Nuclear Materials at the Los Alamos Plutonium Facility," American Nuclear Society 1997 Annual Meeting, Orlando, Florida, June 1–5, 1997.

W. J. Turner, R. Brown, and G. D. Rael, "Instrumentation System to Implement Leak Test Program," 1997 IEEE Instrumentation & Measurement Technology Conference, Ottawa, Canada, May 19–21, 1997.

N. G. Pope and J. C. Higgins (Brookhaven National Lab), "Human Factors Aspects of the Major Upgrade to the Control Systems at the LANL Plutonium Facility," Global Perspective of Human Factors in Power Generation, The Power Engineering Society of IEEE, 1997 IEEE 6th Conference on Objectives, Orlando, FL, June 8–12, 1997.

N. G. Pope and T. Donovan, "Lessons Learned from the TA-55 Operation Center Upgrade Project," Conduct of Operations Training, Nevada Test Site, April 2, 1997.

J. M. Macdonald, "Implementation of an Intranet for Industrial Control," Industrial Society of America (ISA), Anaheim, CA, October 1997.

J. T. McFarlan, "Modifications to Vacuum Atmospheres MO-40-2 Dri-Train to Prevent Pressure Changes in Plutonium Processing," American Glovebox Society Conference, Denver, CO, July 21–24, 1997.

R. L. Long (NMSU) and S. L. Yarbro, "Applications of a New Interfacial Area Transport Equation," Mixing XV Conference, Williamsburg, VA, June 23–27, 1997.

P. C. Stark, B. F. Smith, T. W. Robison, G. D. Jarvinen, M. R. Lin, J. E. Anderson, "Solid-State Europium Luminescence for the Investigation of Metal-Binding to Water-Soluble Chelating Polymers," MARK IV Conference, April 6–11, 1997, Honolulu, HI.

Editorial
Personas Elementum

From a human viewpoint, elements are not born equal. Some elements enjoy affectionate attention throughout human history, some are cast as villains with bad reputations, and a majority of the others are destined to live forever in the blue-color working class of the elemental hierarchy. Take the example of copper. The advancement of the early tool-making human society was much aided by copper so that this particular epoch was called the "Bronze Age" after copper combined with its minor partner, tin. Gold, among several celebrated aristocratic elements, has been used for adornment as a precious and decorative element, and it appears that gold will not lose its luster for the foreseeable future. Then there is the element lead, which followed the rise and fall of the Roman Empire. This element even stirred up the modern day public's anti-element sentiment as in "no-lead" gasoline. Silicon is, of course, a modern-day "hero" element. In its embodiment in the form of microchips, it already controls our daily lives in every imaginable way. The anecdotal stories go on and on. It would take many book volumes to tell a significant part of every elemental story.

Take another example, that of iron. Can you imagine a world without iron? Not only renowned for its muscular forms of every shape, this forget-me-not element will also make you feel good and energetic if you do not ignore it in your diet. On the other hand, there are many working-class elements that are doomed to remain forever in the ordinary, humdrum status like the lackluster carbon (when it's not in the form of a diamond!). All living forms, miraculous as they are, represent extraordinary arrangements of several ordinary elements such as carbon, nitrogen, oxygen, etc. Once in a while, an element rises to a meteoric status because of its role in some extraordinary discoveries. Look at the case of iridium. With their fascination for dinosaurs, Luis Alvarez and other prominent scientists found out that iridium is the "smoking gun" for all dinosaur extinction, only claiming its notoriety some 65 million years later!

Then there is the mother of all elements: hydrogen. She is most unassuming and yet perhaps the most abundant in the universe. All other elements, therefore, all things, living and dead, derived their existence from hydrogen. To this day most living things on Earth, for example, owe their existence to the sun's hydrogen energy. We should be praising hydrogen. Hydrogen's glory days may yet be coming.

The trend of elemental discovery is, of course, toward heavy elements—elements with shorter lifetimes than their lighter brethren. A relatively more recent element that is building its reputation is plutonium. Scientists claim that plutonium is man-made, elevating man's status to that of Creator. Regardless of the claim, this element from its infancy caused such havoc that on several occasions it threatened to destroy all living things on the earth thereby claiming its dominance over the entire elemental family.

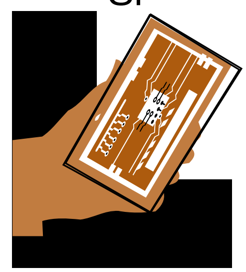
Pioneering scientists gave the name "actinide" to a family of heavy elements that includes plutonium. Almost simultaneously, human beings entered the "Nuclear Age." It is interesting to note that the first phase of the Nuclear Age began with the development of weapons using these elements just as the "Bronze Age" may have begun with weapons or hunting tools. The similarities are striking. The element plutonium was named after the farthest sun-orbiting planet Pluto by its discoverer Glenn Seaborg. Immediately after its introduction the "hyperactive" plutonium tried to assert its superiority by launching actions designed to ensure its dominance over all things, dead or alive. It declared war against all other elements.

Scientists in general like to find out the real personality of an element. For well over 50 years now, a countless number of smart people have probed plutonium to discover its inner workings as well as its relationships with its other elemental brethren. Once in a while during the course of an elemental adolescent period, we have in hand a real temper tantrum to deal with. This seems to be the case with plutonium. Presently we seem to be groping for ways of taming plutonium for peaceful elemental coexistence. No doubt, history will note how well we succeeded.

K.C. Kim

79
Au

196.9665

14
Si

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1
H

1.0079

94
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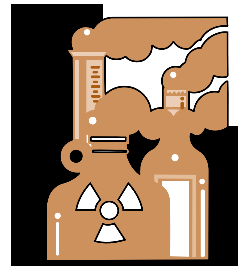
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NEWSMAKERS

■ NMT starts out fiscal year 1998 with a record amount of Laboratory-Directed Research and Development (LDRD) funds, \$2.76M. The projects are "Plutonium Aging: Investigation of Changes in Weapon Alloys as a Function of Time," Principal Investigator (PI) **Barbara Cort** (NMT-5); "Development of a System for Endoscopic Imaging and Spectroscopy of Pit Interiors," PI **Kirk Veirs** (NMT-6); "Actinide Molecular Science: f-Electronic Structure in Synthesis, Spectroscopy, and Computation," PI **Larry Avens** (NMT 6); "Hydrothermal Combustible Waste Treatment Process," PI **Laura Worl** (NMT-6); "A New Paradigm in Separations: Molecular Recognition Membranes," PI **Gordon Jarvinen** (NMT-6); and "Salt Recycle in Support of Molten Salt Oxidation of ^{238}Pu-Contaminated Combustible Waste," PI **Kevin Ramsey** (NMT-9). The third and fifth projects are in the category of competency development (CD) and are in their second and first years, respectively, of the five-year project duration.

■ Science and Technology winners for the second and final year of the Los Alamos Achievement Program are **Kevin Ramsey** (NMT-9), **Louis Schulte** (NMT-6), and **Jacob Espinoza** (NMT-9). This team was awarded in the area of program development for their work on aqueous scrap recovery of $^{238}PuO_2$. In the past two years this team has been responsible for demonstrating to our program sponsors at DOE that Los Alamos possesses the requisite expertise to bring on-line the capability for production-scale recovery of plutonium oxide for heat sources.

■ **Michael D. Diener** received his Ph.D. degree in May 1997 from Rice University. His thesis was entitled "Purification of Small Bandgap Fullerenes." **Kirk Veirs** served as Diener's mentor at Los Alamos while Diener was doing his thesis work.

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