Celebrating 60 Years

Inspiration from Our Past

The Laboratory Today

Building the Future

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Los Alamos
NATIONAL LABORATORY
Ideas That Change the World

This volume of *Los Alamos Science* commemorates six decades of service to the nation by the Los Alamos National Laboratory staff and by the University of California.

Over the years, the freedom to explore new ideas has been protected by the traditions and prestige of the University of California and has made Los Alamos one of the great scientific organizations in the world. The connection between Los Alamos and the University began in 1942 with the Berkeley summer study on the building of the atomic bomb. Soon thereafter, in February 1943, the University and the government signed an agreement "for certain investigations to be directed by Dr. J. R. Oppenheimer." Since then, the University's connection to Los Alamos has been uninterrupted. In 1946, when the Laboratory's future was in question, Director Norris Bradbury represented Los Alamos as an institution with a "very definite academic tradition in spite of the fact that we are only about three years old. The entire staff of the Laboratory has been drawn almost without exception from the staffs of academic institutions and from their graduate students."

The intellectual leadership and diversity of the staff, constantly renewed through collaborations with the international community, have ensured the unmatched strength of the nation's nuclear deterrent and have produced new ideas and technologies, many of which are applicable to issues of national security. Because the interior workings of a nuclear bomb involve temperatures and pressures that could never be reached in the laboratory, theoretical physics, mathematics, and new diagnostic techniques played an essential role in filling that gap at the founding of the Laboratory. Those capabilities continue to be central today, as we work to maintain the nuclear deterrent in the absence of nuclear testing. Because Oppenheimer, himself a theoretical physicist and a master at managing creative people, believed that openness among all levels of the scientific staff was essential to achieving the goal, the staff were quick to learn, adapt, and respond as new facts presented themselves. That heritage serves us well right now, as we adapt to evolving issues of national security. Given our shared experience on uniquely difficult problems, we strongly believe that a continuing relationship between the University and the Laboratory is in the best interest of the nation.

In the last six months, many of us have participated in the anniversary activities inspired by the theme "Ideas That Change the World." Publication of this special volume is a fitting close to those activities. *Los Alamos Science* typically presents the excellence of our science to the international scientific community, but this volume was produced with a different purpose in mind. The idea was to create a forward-looking portrait of the Laboratory, from which we could learn more about ourselves and about the tough problems we face in stewardship, threat reduction, and national security in the broadest sense. The volume begins by taking us back to the Laboratory's first decade through Harris Mayer's personal reflection "People of the Hill," and then it turns the spotlight on our present and future national security missions. It gives presence to both older and younger staff, voice to fears and hopes, and welcome to the enthusiasm, dedication, and can-do spirit that continue to motivate this institution.

In my vision of our Laboratory, all members of the staff learn about the technical issues we face and become actively engaged in their solution. The articles in the section on nuclear stewardship are a step in that direction. Both management and research staff share their varying views on the scientific challenges of certifying the safety and reliability of the nuclear weapons stockpile without the benefit of nuclear testing. In "How Archival Test Data Contribute to Certification," two of our most experienced scientists, in collaboration with a young designer, give us a palpable description of the workings of a nuclear bomb and the complex physics experiments that were performed during more than a thousand nuclear tests to record and analyze the time history of events. After 60 years, that legacy of research is still the bedrock of knowledge for the present certification of the stockpile and a training ground for new staff. That intellectual legacy derives from the excellence of our staff and attests to our University of California heritage. At the same

time, the staff work on new theory, computational techniques, and experimental measurements and from them construct high-fidelity computer simulations of weapons performance. Those simulations, we hope, will fill the gap left by the moratorium on testing. I am encouraged by advancements in the key diagnostic of quantitative radiography, including the new technique of proton radiography. That diagnostic should help us image the early stages of weapon assembly and resolve important uncertainties ("The Development of Flash Radiography"). Another significant development is a new, efficient computational model for simulating the detonation of high explosives ("High-Explosives Performance"). That model is adding certainty into the simulations of the initial stages of weapon performance.

The tragic day of September 11, 2001, was a devastating realization of some of our worst forebodings. After the collapse of the Soviet Union, the Laboratory had begun to focus on the prospect that nuclear weapons or materials could find their way into the hands of dangerous proliferants or terrorists. The second major mission of the Laboratory became to prevent, deter, detect, respond to, and reverse the threat of weapons of mass destruction, proliferation, and terrorism. Some of our most innovative scientists and engineers, working in multidisciplinary teams, are applying their talents and best ideas to these highly complex problems. In our work on biothreat reduction, for example, spinoffs from the Laboratory's work on the Human Genome Project helped us penetrate the secrets of the bioweapons programs in the former Soviet Union and in Iraq ("Reducing the Biological Threat"). Our long history of using satellites to verify nuclear nonproliferation treaties has prepared us to develop the types of remote sensing we need today ("Eyes in Space"). We are now working with universities, research laboratories, the very best high-technology companies, and scientists worldwide to prevent the illegal migration of nuclear materials and technologies. Most of all, because our work is increasing the safety and security of freedom-seeking people everywhere, the men and women of this Laboratory are proud of their role in the post-9/11 world.

In "Six Decades of Reducing Threats and Allaying Fears," Terry Hawkins gathers in a few short pages the story of Los Alamos from the dark days of World War II to our present contribution to the war on terror. Should you ever doubt the role of the Laboratory in maintaining freedom and democracy around the world, let that article remind you of how the silent presence of our strategic and tactical nuclear weapons and the visible power of our surveillance have brought caution and sanity when there might have been none.

Our Laboratory's "self-portrait" closes with the section "Strategic Investments," that is, research in fundamental science and in technologies that can provide the intellectual foundations of our mission and help sustain the health and well-being of life on our planet. We are preparing for the national security issues of the future by investing broadly in advancing the frontiers of science and in nurturing the talented scientists whose ideas will change the world.

In the years ahead, the world is likely to become more complicated, and the challenges to national security, more diverse. To perform its missions effectively, the Laboratory is renewing itself inside and out. We are creating business and process systems that mirror and support our excellence in science. We are developing the leadership qualities to meet the growing demands of our complex society. We are planning every leg of this journey with purpose and deliberation. As the new director, I am bullish about the future before us. We will continue to be the best because of our creativity, diversity, and unswerving dedication. ■

G. Peter Nanos, Laboratory Director

Los Alamos Science

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Developing Strategies and Tools for Protecting Our Nation and the World

BUILDING THE FUTURE

Strategic Investments