

# Los Alamos Science

LOS ALAMOS NATIONAL LABORATORY





In contrast to the postwar era in which the United States (blue) and Russia (yellow) were the two dominant powers, the rapid growth in technological, economic, and perhaps military power of Japan (green), China (red), Western Europe (brown), and other regions is making those nations into world powers as well. A conference sponsored by the Laboratory on “The Future of Nuclear Weapons—The Next Three Decades” explored this theme as well as the impact on nuclear weapons policy of public opinion (top), economic trends (upper left), military needs (left and bottom), and science and technology (right). The last theme is represented by a seismic recording of an actual underground nuclear test, a technology of key importance to verification. (Cover art by Gloria Sharp.)

Los Alamos is known worldwide as the birthplace of the atomic bomb. For the last forty-six years the Laboratory has remained the leader in development of nuclear weapon technology—leadership meant to guarantee a world safe from global conflict. The paradoxical role of nuclear weapons (peacekeeping through the threat of mutual assured destruction) is hard for any one to fathom without developing a simplistically polarized viewpoint. As the world grows more complex it appears to many that world stability must come to rest on other limits.

What will be the future of nuclear weapons? Will the public continue to support their role as a peacekeeping force? Are there any immediate alternatives? If not, can the Laboratory maintain its preeminence alongside growing perceptions that nuclear weapons may become irrelevant or too difficult to maintain?

When Sig Hecker became Director of Los Alamos in 1986, he faced the challenge of guiding the Laboratory through an evolving political climate. To understand that climate and to forge an appropriate and necessary role for the Laboratory, Sig created the Center for National Security Studies. The Center is a mini think tank that will help to shape technological decisions through careful consideration of changing political realities. One of the early projects of the Center was sponsorship of an unprecedented conference whose title, “The Future of Nuclear Weapons—The Next Three Decades,” states the major concern of this institution. In the article “Debating the Future,” members of the Center report on the conference with a spirit of objectivity reflecting the seriousness of the issues. They do not attempt to predict the future. Rather they set before us the many ambiguities, diverse opinions, and conflicting changes that make decision-making difficult. In response to the conference report, Sig Hecker

offers his view of the role of the Laboratory—a view that will undoubtedly evolve along with the rapid changes we must all somehow adapt to. Sig emphasizes the need to maintain nuclear competence and explains in simple terms what such competence entails. We cannot take for granted the delicate fabric of working scientists and stored experience that this Laboratory represents. It has undoubtedly been a mainstay of our sense of security, and the continued health and vitality of its programs are crucial to the future of our nation.

Solving urgent national problems is the living heritage of those who work at the cutting edge of nuclear weapons technology. Among those problems is a particularly difficult one: How do we redesign nuclear weapons with the necessary confidence in performance in a time of reduced, restructured, or prohibited nuclear testing? We hope such questions will stimulate our readers to rethink the complex issues and choices presently before us.

One of the major changes occurring right now is a decreased reliance on nuclear weapons as tactical alternatives and a greater reliance on conventional weapons. The Laboratory has been involved in conventional weapons for many years, but that role is now increasing. In this issue we report on one of the areas in which the Laboratory is making a significant contribution—the area of conventional tank warfare. It is well known that the Soviet Union relies heavily on the strength of its armored forces and invests heavily in modernizing those forces at regular intervals. In contrast, the United States lags behind in deploying the technology developed at research laboratories such as Los Alamos. Don Sandstrom, the inventor of a new type of ceramic armor, reports here on the major advances in the development of materials for armored vehicles and for the projectiles that penetrate armor. In “Armor/Anti-Armor—

Materials by Design,” Don explains the technology, computer simulations, and diagnostic techniques used to develop the new materials. In a follow-up article Phyllis Marten and Richard Mah describe a unique collaboration between industry and the Laboratory that will facilitate the movement of those technological advances from the laboratory bench into the field. This effort is just one among a number of programs in conventional and non-nuclear weapons development in which the finely tuned expertise developed in the nuclear weapons program is being used to great advantage.

Since the topic of this issue is national security, we should point out that the concept of national security encompasses more than just weapons but rather the health of the nation. As such the Laboratory sees its role as being much broader than weapons development and includes in that role the application of science and technology to many national problems and challenges. In that vein, Laboratory scientists are tackling such topics as high-temperature superconductivity, supercomputing, the human genome, and even the AIDS epidemic, the topic of our next issue. ■



**Los Alamos Science Staff**

*Editor*

Necia Grant Cooper

*Managing Editor*

Roger Eckhardt

*Editorial Consultant*

Nancy Shera

*Art Director*

Gloria Sharp

*Design, Illustration, and Production*

Gloria Sharp

Katherine Norskog

*Photography*

John Flower

*Circulation*

Dixie McDonald

**Other Contributors**

IS-9 Photography Group  
Tech Reps Inc.  
Smith and Associates, Inc.

*Printing*

Guadalupe D. Archuleta

*Address Mail to*

Los Alamos Science  
Mail Stop M708

Los Alamos National Laboratory  
Los Alamos, New Mexico 87545

Los Alamos Science is published by Los Alamos National Laboratory, an Equal Opportunity Employer operated by the University of California for the United States Department of Energy under contract W-7405 - ENG-36.

THE FUTURE OF NUCLEAR WEAPONS—THE NEXT THREE DECADES

**An Introduction**

*by Paul C. White* . . . . . 4

In today's complex and changing strategic environment, a new Center at Los Alamos will help focus the long-term direction of technical programs through objective studies of national security issues.

The Center for National Security Studies

**Debating the Future**

*by Patrick J. Garrity and Robert F. Pendley* . . . . . 10

Political, technological, and military trends will influence the future of nuclear weapons over the next three decades. A recent conference chaired by Brent Scowcroft, John Foster, and Joseph Nye explored a continued but changing role for nuclear weapons as the world's balance of power comes to rest on not two dominant nations but on many.

**The Laboratory View**

*with Sig Hecker, Director of Los Alamos National Laboratory* . . . . . 28

Nuclear weapons cannot be designed from first principles alone. Even if the nuclear stockpile were substantially reduced, the maintenance of a credible deterrent would require a significant research and development effort, including the continuation of nuclear testing and increased initiatives in non-nuclear and conventional weapons.

CURRENT RESEARCH ON CONVENTIONAL WEAPONS

**Armor/Anti-Armor—Materials by Design**

*by Donald J. Sandstrom* . . . . . 36

Materials-by-design is the key phrase to describe the development and dynamic testing of new materials for the armor and the bullets of conventional warfare.

**ATAC and the Armor/Anti-Armor Program**

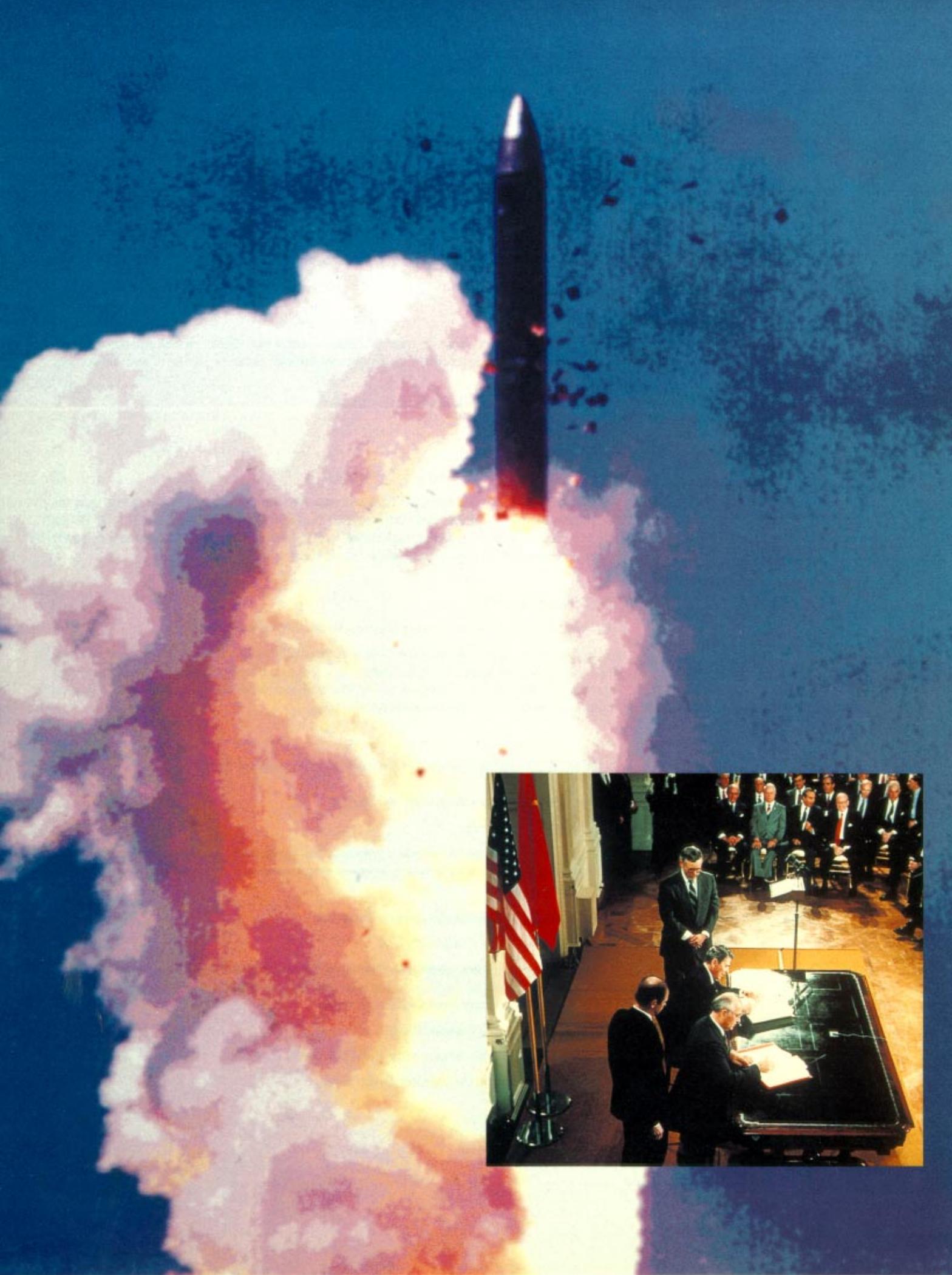
*by Richard Mah and Phyllis Martell* . . . . . 51

A unique environment, linking private contractors, the military, and the new Advanced Technology Assessment Center at Los Alamos, has been established to push developments in conventional weapons off the laboratory bench and into the field.

A Comment by General Starry.

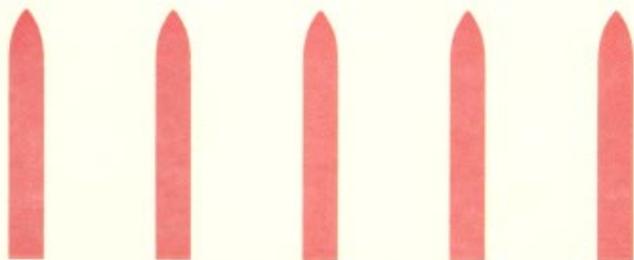
Studying Ceramic Armor with PHERMEX *by Ed Cort*

Modeling Armor Penetration *by Ed Cort*





# THE FUTURE OF NUCLEAR WEAPONS



THE NEXT THREE DECADES