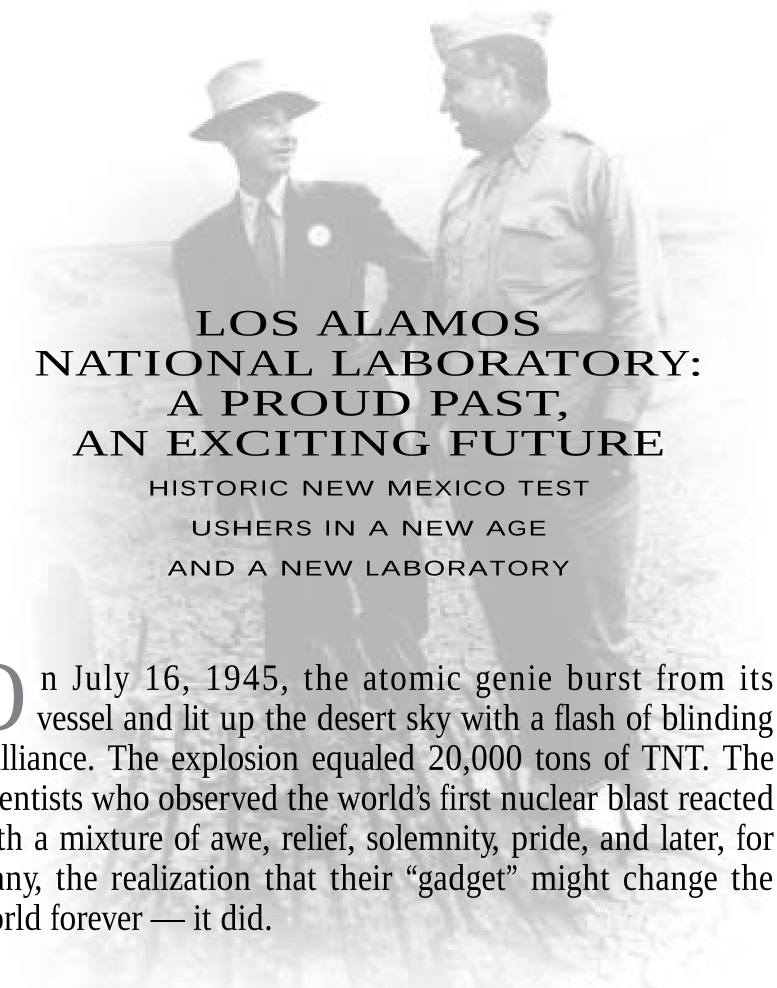
LOS ALAMOS NATIONAL LABORATORY · WHERE SCIENCE MAKES A DIFFERENCE

DATELINE LOS ALAMOS



LOS ALAMOS NATIONAL LABORATORY: A PROUD PAST, AN EXCITING FUTURE

HISTORIC NEW MEXICO TEST USHERS IN A NEW AGE AND A NEW LABORATORY

On July 16, 1945, the atomic genie burst from its vessel and lit up the desert sky with a flash of blinding brilliance. The explosion equaled 20,000 tons of TNT. The scientists who observed the world's first nuclear blast reacted with a mixture of awe, relief, solemnity, pride, and later, for many, the realization that their "gadget" might change the world forever — it did.

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This July marks the 50th anniversary of the Trinity test near Alamogordo, N.M. No one knows for sure why J. Robert Oppenheimer, the first director of Los Alamos, chose the name "Trinity" for the test, which successfully capped two years, three months, and 16 days of scientific research and preparation. But the name signifies the dawn of the atomic age and the first of many scientific achievements for what ultimately became known as Los Alamos National Laboratory.

This issue of *Dateline: Los Alamos* departs from the publication's traditional content to look back at that time in our nation's history when imminent danger threatened the United States and the world. This issue is a tribute to the men and women who worked on Project Y — the Laboratory's wartime code name — and to those who followed and added their contributions during the next 50 years.

What began as a crash effort to develop the world's first nuclear weapon to end World War II grew into a world-class laboratory whose great science, flexibility, and resilience continue to respond effectively to needs brought about by changing national requirements.

DATELINE LOS ALAMOS

A MONTHLY PUBLICATION OF THE PUBLIC AFFAIRS OFFICE OF LOS ALAMOS NATIONAL LABORATORY

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In the years following Trinity, Los Alamos contributed mightily to defense research and ultimately helped bring about the end of the Cold War. The Atomic Energy Commission, established by an act of Congress in 1946, succeeded the Manhattan Engineer District of the U.S. Army Corps of Engineers, which managed the wartime efforts at Los Alamos and elsewhere to produce an atomic bomb. The AEC was charged by President Harry S. Truman to control the development and production of nuclear weapons and to direct research and development of peaceful uses of nuclear energy.

In 1974, Congress disbanded the AEC and transferred its functions to two new agencies, the Energy Research and Development Administration and the Nuclear Regulatory Commission. 1n 1977, President Jimmy Carter established the U.S. Department of Energy to provide the framework for a comprehensive, balanced national energy policy. Los Alamos, which is funded by the DOE, has been operated by the University of California since its inception.

Although nuclear weapons research and development always remained its central mission, Los Alamos' program portfolio changed frequently during its first 50 years, often in response to unpredictable external events. The promise of civilian nuclear power and fusion ushered in a civilian program component in the late 1940s and early 1950s. Sputnik in 1957 opened up an intense interest in space and nuclear propulsion. The 1973 oil embargo launched a substantial diversification to energy programs to the point where by 1980 the Laboratory's funding was approximately half defense and half energy.

Defense buildup under President Ronald Reagan re-established priorities so that by 1987 the Laboratory was almost 80 percent defense-oriented. The collapse of the Soviet Union and the rise of international economic competition resulted in a swing toward a greater civilian portfolio in the early 1990s.

One of the most profound external changes was the court decision at Oak Ridge, Tenn., in the mid-1980s that brought independent environmental oversight inside the previously sheltered DOE complex. Less than 10 years later the budget for environmental restoration and waste management at Los Alamos climbed from a few million dollars to $240 million — exceeding the budget for nuclear weapons research, development, and testing for the first time.

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Today, scientists from Los Alamos and the former Soviet Union work together on peaceful pursuits that will benefit both countries and promote global stability. Ironically, the half-century-long arms race between the United States and the former Soviet Union secured the world for 50 years against another global conflict. Without the Cold War, the danger of weapons of mass destruction proliferating in unstable and unfriendly countries is very real but much harder to identify. As one scientist remarked, “The bear is out of the woods, but the jungle is full of snakes.” The Laboratory’s mission has changed accordingly to meet the challenges presented by a new and uncertain world.

Los Alamos is poised to play a leadership role in its core mission of reducing the global nuclear danger. This mission includes stewardship of the existing nuclear weapons stockpile, managing nuclear materials, stemming the proliferation of weapons of mass destruction, and cleaning up the legacy of 50 years of nuclear weapons production. In addition to its core mission, Los Alamos conducts research in nonnuclear defense programs and a broad array of nondefense programs, including research in energy, biomedical science, computational science, environmental science, and materials science. Technologies developed at Los Alamos frequently spin off into the private sector.

Two U.S. presidents have visited Los Alamos. In 1962, John F. Kennedy told Laboratory employees, “There is no group of people in this country whose record over the last 20 years has been more pre-eminent in the service of their country than all of you here in this small community in New Mexico.”

Two decades later, Bill Clinton visited Los Alamos and reaffirmed the Laboratory’s contribution to national defense. “From the Berlin crisis of 1948 to the Berlin celebration in 1989, when the Wall came down, the work of this laboratory helped to ensure America’s might, America’s security, and in the end a total triumph for democracy and freedom and free-market economics.”

Great science has been the hallmark of Los Alamos since its inception and this *Dateline* issue highlights many of the Laboratory’s historic achievements. Los Alamos’ strength in basic research and ability to solve complex problems of national importance has served the nation well for more than 50 years, from the countdown to Trinity to the Laboratory’s new compelling central mission of reducing the global nuclear danger.

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COUNTDOWN TO TRINITY

WORLD'S FIRST ATOMIC BLAST CULMINATES MONTHS OF INTENSE SCIENTIFIC RESEARCH AND DESIGN

For most observers of the world's first atomic explosion, the immediate reaction was elation, then relief. "When the bomb first went off I had the same feelings that anyone else would have who had worked for months to prepare this test, a feeling of exhilaration that the thing had actually worked," said Kenneth Bainbridge, an experimental physicist from Harvard University who was the director of the Trinity test on July 16, 1945. "This was followed by another quick reaction — a sort of feeling of relief that I would not have to go to the bomb and find out why the thing didn't work," Bainbridge added.

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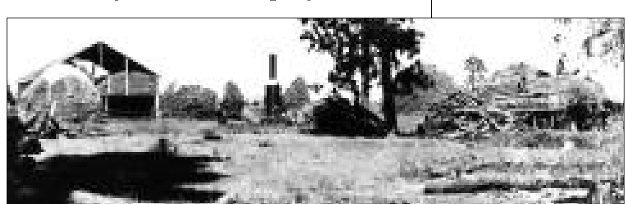

THE SEARCH FOR A SITE Gen. Leslie Groves, who headed the nationwide Manhattan Engineer District, wanted isolation, and that's what he got. The site chosen for the new laboratory was situated on an isolated mesa populated by only a few homesteaders and the inhabitants of the Los Alamos Ranch School for Boys. From the top: the boys' ranch school buildings clustered around Ashley Pond; Groves; the road leading to Los Alamos; a ranching homestead on the Pajarito Plateau photographed before the founding of the boys' school.

The Trinity test in the desert of south central New Mexico culminated a period of intense scientific research and design that had begun 27 months earlier on a remote mesa 200 miles north of the test site. By any measure, the project was enormously successful. Even today, 50 years later, politicians and policy-makers often employ the term "Manhattan Project" as a favorable description of a proposed scientific crash program.

The Manhattan Project was launched at a time when the geopolitical realities of World War II intersected the scientific realities of nuclear physics. Developing a new weapon based on the energy of the atom was not only believed to be possible, it was thought to be advisable: Germany and Japan were advancing militarily; much of the early work on uranium fission had been conducted by German researchers; and U.S. leaders feared that Germany could develop an atomic weapon first.

Nuclear fission was discovered in Germany in 1938. Four years later, the summer after the United States entered the war, University of California physicist J. Robert Oppenheimer organized a conference at which leading theorists concluded that a fission bomb was feasible and developed the theoretical basis for the design of such a weapon.

By that time, a number of research programs were under way across the United States to explore various scientific and engineering problems of nuclear energy. Collecting and comparing technical data and information was difficult because the research sites were scattered and security restrictions hampered long-distance communication.

John Manley, a physicist from the University of Chicago who was assisting Oppenheimer, traveled around the country to different project sites to acquire information. "It didn't take very long to realize that you just couldn't run a railroad in this fashion," Manley said, recalling how the need for a single research facility became apparent.

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In the fall of 1942, the decision was made to build a new laboratory to centralize the research and design programs, and Gen. Leslie Groves, who had been named to head the weapons project a few months earlier, selected Oppenheimer as the director. The search for a site began immediately.

Groves wanted the new laboratory to be located in a remote area that was sparsely populated and at least 200 miles from a coastline or international boundary for safety from attack. The site should have room for explosives testing, good enough weather for construction to proceed year-round, and enough housing to accommodate the first group of scientists.

Maj. John Dudley of the Manhattan District staff scouted the Southwest for a site, eventually recommending Jemez Springs, N.M. That site, however, was rejected by Oppenheimer. Groves asked him if he had a better idea, and Oppenheimer suggested Los Alamos, the site of a boys' school that he had visited while staying at his family's summer home in northern New Mexico.

The site, a high mesa slashed by deep canyons on the eastern slopes of the Jemez Mountains, met the criteria for the new laboratory. It was remote and sparsely populated, security could be established and maintained relatively easily, housing existed at the school, and there was lots of room for testing.

Dudley, who earlier visited and rejected Los Alamos as a possible site, escorted Groves, Oppenheimer, and Edwin McMillan of the University of California Radiation Laboratory to the site on Nov. 16, 1942. When the group arrived, Groves took one look, "and said, in effect, 'This is the place,' " McMillan recalled.

SCHOOL DAYS Ashley Pond and Edward Fuller opened the Los Alamos Ranch School for Boys in 1918. Their names are still prominent in daily life in Los Alamos: a small body of water in downtown Los Alamos is called Ashley Pond (or should it be Ashley Pond Pond?), and Fuller Lodge, one of the original ranch school log buildings, serves as a gathering place for many of the town's social events. From the top: students gather for lunch on the porch of Fuller Lodge; a corner of the dining hall in the lodge; ranch school graduation ceremonies; students in front of the "Big House," where the boys slept year-round in unheated porches; students play hockey on Ashley Pond. (The Big House is no longer standing: It was torn down after being declared a fire hazard.)

On Nov. 25, the acquisition was approved by the War Department, and

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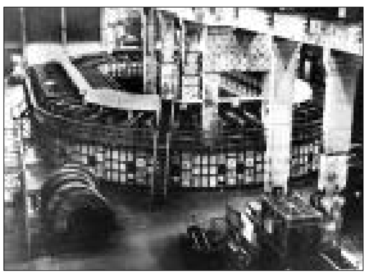
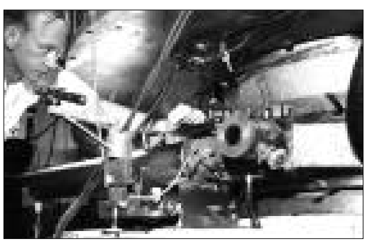


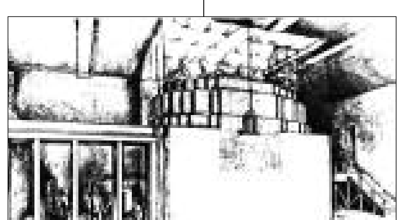


on Dec. 7, exactly one year after the Japanese attack on Pearl Harbor, the school received notification from Secretary of War Henry Stimson that the site was needed for military purposes.

Groves convinced the University of California to operate the site under a contract with the government, an association that continues today, while Oppenheimer and Manley began an intensive effort to recruit a staff. They looked for top-notch scientists and engineers who would agree to live in relatively primitive conditions in a remote location under absolute secrecy for an unspecified length of time while working on a difficult project with an uncertain chance of success.

Despite those obstacles, they succeeded spectacularly. The staff at Los Alamos, plus its advisers, comprised some of the nation's best scientific talent. In addition to Oppenheimer and McMillan, Emilio Segrè, Hans Bethe, Enrico Fermi, Edward Teller, I.I. Rabi, Luis Alvarez, Victor Wiesskopf, Richard Feynman, Robert Bacher, John Von Neumann, Robert Wilson, George Kistiakowsky, Seth Neddermeyer, and dozens of other talented researchers participated in the Los Alamos Project. Another two dozen scientists from Great Britain joined the project in the spring of 1943.

The theoretical basis for nuclear weapons was reasonably well understood when the Laboratory was founded, but most details were unknown and the engineering problems had to be tackled. A nuclear bomb should detonate when all its components are completely assembled; obviously, this must occur only at the target. The Los Alamos staff had to figure out how to make fis-



A NATIONAL EFFORT The crash wartime program to build an atomic bomb involved sites across the country. From the top: one of eight plutonium-producing reactors at Hanford Works in Richland, Wash.; the Y-12 Plant in Oak Ridge, Tenn., where enriched uranium was produced; a section of the electromagnetic process equipment at Y-12; a cyclotron loaned by Harvard University; Enrico Fermi (front row, left) and his associates at the University of Chicago, where the first sustained nuclear chain reaction was achieved in December 1942 in a squash court underneath the university's football stadium (Harold Agnew, who became Los Alamos' third director, is in the second row at left, behind Fermi); an artist's conception of Fermi's historic experiment at Stagg Field. Fermi photo courtesy of Argonne National Laboratory

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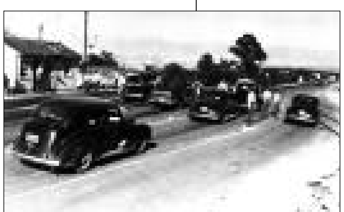
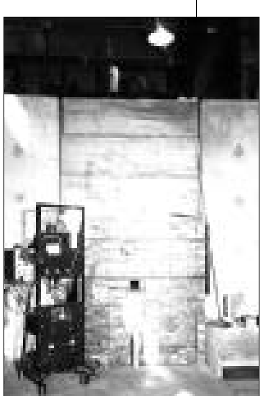
sionable material, either uranium-235 or plutonium-239, release its energy efficiently and at the right time, and how to do it in a bomb casing that was small enough to be carried on an airplane.

On the arrival of the first group of scientists, Robert Serber, an assistant to Oppenheimer, prepared a series of lectures about the state of nuclear physics at the time.



"The immediate experimental program is largely concerned with measuring the neutron properties of various material and with the ordnance problem," said Serber, whose lectures became known in the physics community as "The Los Alamos Primer."

Research projects under way in early 1943 included measurements of the neutron flux and energy range during fission, the time between fission and neutron emission, and the probability that a certain reaction would occur in a given target area; development of new techniques to



conduct the measurements; radiochemical studies of neutron sources needed to initiate a chain reaction; studies of the chemistry and metallurgy of plutonium and uranium; studies of high explosives to trigger the fission process; and experiments for the development of a fusion, or thermonuclear, bomb.

Two bomb designs were eventually employed. One, called the "gun-type" method, involved the "firing" of a mass of fissionable

THE PROJECT
From the top and left to right: Life as you knew it ended at the Los Alamos Project Main Gate, where your identity was exchanged for a number and your address became "Box 1663, Santa Fe, New Mexico" (even the birth certificates of babies born during the Project listed their place of birth as Box 1663); guards stationed at the entrance to the community checked cars and their occupants for official passes; tech area personnel went through another set of gates to the Laboratory; two views of the technical area, the lower photo shows buildings clustered around Ashley Pond; pulling radioactive equipment from a storage building; the world's first enriched uranium reactor, the "water boiler," under construction; the stone building used by the boys' ranch school to store ice was used by Project Y staff to store the nuclear components of the first atomic bomb.

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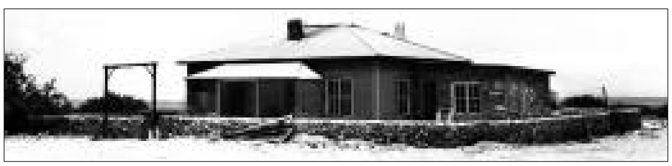
material at another mass of the material so that when the two came together, they formed a critical mass. The other design was the "implosion" type, in which a slightly subcritical mass was surrounded by explosives; when the explosives detonated, the shock compressed the fissionable material, increasing its density and causing it to go critical.

Experiments showed that the gun-type design would not work with plutonium, so work proceeded on that assembly method using uranium-235 as the fissionable material. Questions continued concerning the implosion design using plutonium, and in the spring of



1944, the decision was made that a test firing would have to be conducted, launching another site search.

The test site would have to be flat, have generally good weather, be largely uninhabited, and be relatively near Los Alamos. Sites were considered in California, New Mexico, Texas, and Colorado before the decision was made in September 1944 to select what was then part of the Alamogordo Bombing Range in south central New Mexico.

The test became a top priority project in March 1945 and Bainbridge, a group leader in the Explosives Division, was selected as the test director. One of his first jobs was to prepare for a trial run in which 100 tons of conventional explosives would be detonated in a dress rehearsal that would provide information about taking measurements.

The trial test on May 7 was extremely successful and provided the impetus for the real thing in July.

TRINITY SITE
From the top and left to right: Trinity Base Camp was built by the Army in the winter of 1944 and occupied by a detachment of military police — by the summer of 1945, it was home to more than 200 scientists, technicians and soldiers; a trip to the Base Camp mess hall, where antelope steak made a frequent appearance on the menu; the McDonald ranch house was used for the final assembly of the atomic device; crates of high explosives are stacked on a 20-foot high wooden tower for the trial run, May 7, 1945; fission products from Hanford are prepared for insertion in the high explosive to simulate, at a low level, the radioactive products dispersed from the nuclear explosion; the 100 tons of TNT are stacked and ready for the test. Carpenters, returning to the site after the test, were appalled to find the structure completely obliterated.

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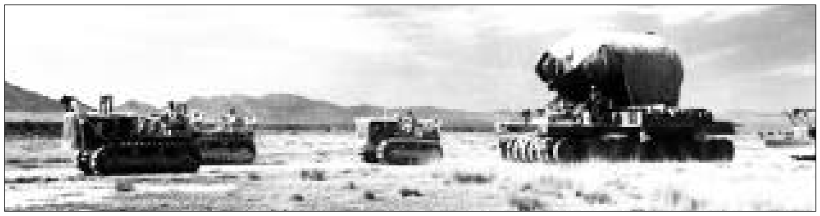
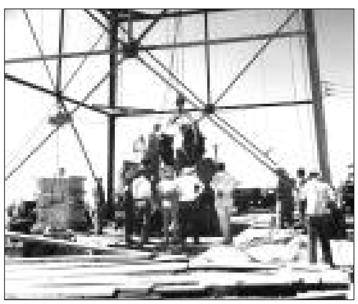
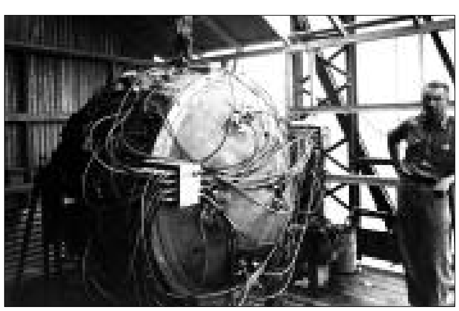
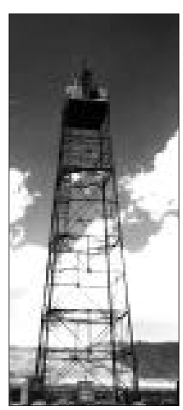
A THING CALLED JUMBO
Plutonium was in short supply in 1944, so scientists designed a 214-ton steel vessel, nicknamed "Jumbo," to contain the blast and allow them to recover the active material if the test were unsuccessful. Jumbo was never used; By the time the Trinity test took place, plutonium production was up and scientists had more faith in the success of the implosion device. There also were concerns that the containment vessel would affect test measurements. Jumbo, erected on a tower 800 feet from Ground Zero, survived the blast unscathed, but the tower was demolished.









The objectives of the test were to characterize the nature of the implosion, measure the release of nuclear energy, and assess the damage. The scientists reviewed all they knew about the bomb shortly before the test and came away dismayed. "It seemed as though we didn't know anything," recalled physicist Frederick Reines.

Shortly before dawn on July 16, they learned that they knew more than they thought. The light that illuminated the countryside "with (an) intensity many times that of the midday sun" was followed by a blast of air pressure and a sustained, loud roar, recalled one observer, Brig. Gen. Thomas Farrell. The success of the test was immediately apparent, so

FINAL PREPARATIONS
From the top and left to right: Jumbo is hoisted onto its tower; a special 64-wheel trailer carries Jumbo across the desert to Trinity Site; active material for the Trinity device is removed from the car that brought it to the ranch; initiators for the device are brought into the McDonald ranch house in a shock-proof case; on July 14, the device, complete except for its detonators, was raised to the top of the 100-foot tower; Oppenheimer, in his familiar pork-pie hat, oversees final preparations; Norris Bradbury, who would become the Lab's second director, with the "gadget"; the device sits in a steel shelter at the top of the tower, waiting for the countdown to begin.

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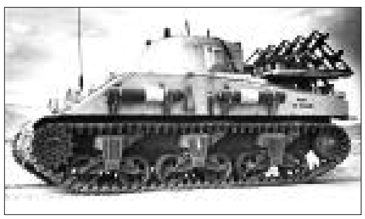

AFTER THE BLAST
From the top: The blast left a huge scar in the desert at Ground Zero; "Fermi's tank" — this special lead-lined tank was used to obtain soil samples from the crater shortly after the test; J. Robert Oppenheimer and Gen. Leslie Groves at Ground Zero about two months after the test; after the war Los Alamos received the Army-Navy Award of Excellence — Groves presented the award to Oppenheimer in a special ceremony at Fuller Lodge.

apparent that Groves had a coded message relayed to War Secretary Stimson at the Potsdam Conference the same day reporting that the "results seem satisfactory and already exceeding expectations."

The initial feelings of relief and elation were quickly superseded by a sense of awe and, for some observers, second thoughts and misgivings. None of them could fail to recognize that they had changed the world.

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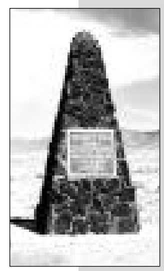
Epilogue: Shortly after the Trinity test, the nuclear components for two bombs were transported to Tinian Island in the Pacific for combat operations. On the morning of Aug. 6, the gun gadget, known as Little Boy, exploded 1,750 feet over Hiroshima. Three days later, on Aug. 9, the implosion gadget, known as Fat Man, exploded over Nagasaki. The Japanese began negotiating for a cessation of hostilities on Aug. 10, and Emperor Hirohito ordered his government to officially accept the Allied terms of surrender on Aug. 14. Formal surrender ceremonies took place on the Battleship Missouri in Tokyo Harbor on Sept. 2.

Sources for this article include "Los Alamos 1943-1945: The Beginning of an Era," a brochure published by Los Alamos National Laboratory; a series of articles in the Los Alamos Newsbulletin in 1992 and 1993 by science historian Robert Seidel; "Project Y: The Los Alamos Story" by David Hawkins; and "The Making of the Atomic Bomb" by Richard Rhodes.

HOW TO VISIT TRINITY SITE



Trinity Site, where the world's first atomic bomb was exploded in 1945, is traditionally open to the public the first Saturday in April and the first Saturday in October. This year, the site also will be open on July 16, the 50th anniversary of the Trinity test. The Trinity Site is between the New Mexico towns of Carrizozo and Socorro, on the northern end of the 3,200-square-mile White Sands Missile Range.

A small monument now marks the site where the atomic bomb was placed on a 100-foot steel tower and exploded. Visitors also can see the McDonald ranch house where scientists assembled the plutonium core.

For more information, call the White Sands Missile Range Public Affairs Office at (505) 678-1134.

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PHOTOGRAPHER 'SPELLBOUND' BY TRINITY BLAST

MOTION-PICTURE PHOTOGRAPHER OF RECORD IS DETERMINED TO CATCH THE EVENT ON FILM

In the predawn hours of July 16, 1945, Berlyn Brixner positioned himself in a concrete bunker just 6 miles from Ground Zero, site of the world's first nuclear explosion.

The 34-year-old journeyman photographer had spent months preparing for this moment, never quite knowing what to expect. Some said the force of the blast might destroy Earth, but others thought that "the gadget" — an implosion device designed to exploit the power of atomic fission — could prove to be a dud. Whatever the outcome, Brixner was determined to catch the event on film. Earlier that year, he had been selected to be the motion-picture photographer of record for the so-called Trinity test.

Brixner, a Laboratory retiree, said his selection as official photographer had more to do with luck than experience. "I was in the right place at the right time with enough experience to run 37 motion-picture cameras." The facts would indicate more than luck was involved. During his 35-year tenure at the Laboratory, Brixner spe-

Berlyn Brixner (with drill) installed the framework to hold a machine gun turret that was used as a camera mount during filming of the Trinity test.

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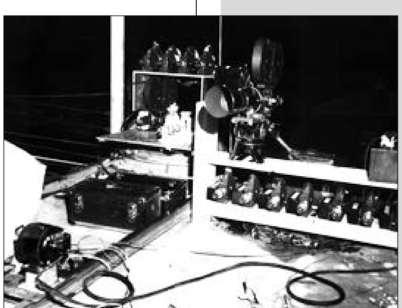
cialized in the design and operation of motion-picture and high-speed cameras used in explosive phenomena research. Some of his cameras were the fastest in the world at the time they were built.

His first camera designs, after World War II, were chronograph cameras for precise measurement of times in explosions. In 1952, he designed a high-speed frame camera that recorded at the rate of 3.5 million images per second and was more than three times faster than similar cameras in existence at the time. It was used to document the Mike Shot, which demonstrated that a large thermonuclear explosion was possible.

Berlyn Brixner sat in an observation bunker behind the 35mm Mitchell camera and four 16mm Kodak Cine E cameras mounted on the pivotal turret shown in the top photo; the lower photo shows 13 of the 37 motion-picture cameras used to film the test.



Brixner, a self-taught engineer who excelled in his chosen line of work, says his job with the Laboratory gave him opportunities he simply wouldn't have had anywhere else. It all began when a boyhood friend recommended him for a technical photographer's position at the Laboratory in 1943. His photographic experience before the war included three years as an apprentice and eight years as a regional photographer for the Soil Conservation Service in Albuquerque.

Unlike others involved in the Trinity test, Brixner was given special permission to look directly at the initial blast through a welding glass filter. Others had been instructed to wait a few seconds and then peer through similar material. Brixner was initially blinded, but a few seconds after detonation, he looked at the nearby Oscura Mountains that were lighted as if by the noonday sun.

"I was spellbound and immediately realized that the bomb had worked beyond expectations," Brixner said. He suddenly had to re-orient himself to the task at hand — recording the behavior of the awesome fireball created by the explosion. Recovering from his momentary distraction, he quickly jerked the camera to follow the rising ball of fire — an awkward transition that remains part of the historic record today. Luckily, he said, all the cameras were automatically set to begin filming just before the explosion.

The first still images of the event, made by automated Fastax cameras positioned just 800 yards away from Ground Zero, show the now-familiar rapidly expanding ball of fire as it reaches the ground about 0.0006 of a second after detonation.

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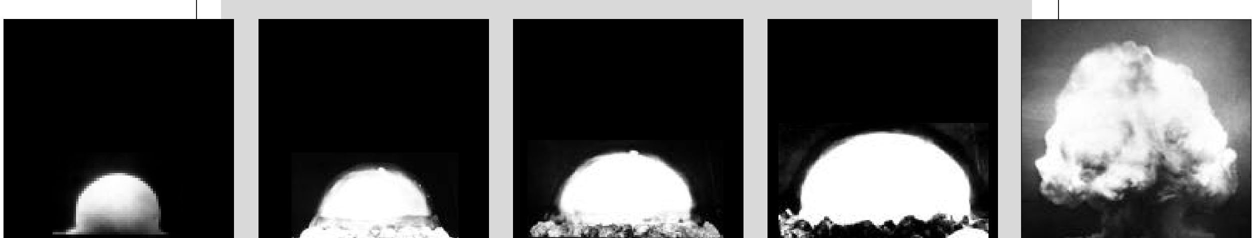
Brixner said original plans for the closest bunkers were abandoned after new studies indicated that the large amount of radiation produced by the explosion would penetrate them and completely blacken the film. As a result, he designed two new bunkers of steel and lead, with very thick lead glass windows. The cameras were mounted on a sled and aimed upward, through the windows, toward a corresponding number of 45-degree adjustable mirrors aimed at the 100-foot tower built to support the explosive device.

"The new bunkers worked well enough so that the films were not damaged beyond use, although they did get considerable fog from the radiation produced," he explained. Brixner's series of 21 slides detailed the development of the fireball and its effect on the atmosphere and surrounding terrain. The brilliance of the explosion caused image reversal due to the overexposure in early frames of a camera with a large aperture lens.

Months of frantic work ended almost literally in a flash. Within about a minute, the fireball evolved into a huge column of smoke, crowned by an expanding dome, and rose to a height estimated at 30,000 feet. The smoke hung stationary for a moment before the wind began to disperse it. Inside the bunkers, everyone started talking at once. Brixner said he shared in the enormous sense of pride and accomplishment felt at that moment. Now, years later, he describes his involvement in an animated yet matter-of-fact way: "The war was on and we had a job to do. We did it. A month later, the war ended."

In the days immediately following the test, Brixner delivered his film to a military base in Wendover, Utah, to be developed. Before the bomb was dropped on Hiroshima, he was personally dispatched to Washington, D.C., to deliver his 35mm motion-picture negative films to Gen. Leslie Groves, director of the Manhattan District, expressly for use in newsreels. It wasn't long before the American public saw firsthand the successful outcome of the Trinity test.

The formation of the fireball.



Dateline: Los Alamos

LIVING AT LOS ALAMOS

THE MUD, THE MESA, THE MEMORIES

The absence of grass and the absence of strangers were what physicist Edward Teller said he recalled most about living at Los Alamos. In the early years of the Laboratory, Los Alamos appeared to newcomers as half Army post, half mining camp. It was actually a tight-knit community of scientists, spouses, children, and military personnel, nearly all of whom were transplants from somewhere else. Throughout the spring and summer of 1943, hundreds of bewildered families converged on New Mexico to begin an unforgettable adventure. Recruiting wasn't easy for the managers of Project Y, the Laboratory's wartime code name. Scientific personnel were told about the nature of the work that awaited them but they were instructed to tell their families nothing. Most administrative and technical personnel knew only that they were moving to an unknown place for an unknown purpose for an unknown length of time.

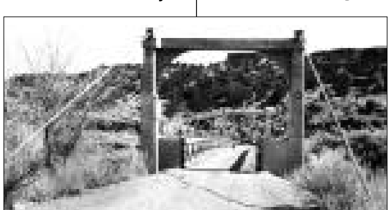
DATELINE: LOS ALAMOS

GETTING THERE WASN'T HALF THE FUN

From the top: The entrance to 109 East Palace Ave. as it appeared after the war; Santa Fe in summer and winter; a driver inspects passes before passengers board the bus that ran between Los Alamos and Santa Fe (early resident Jane Wilson thought the bus drivers must have been selected for their social skills. "As the bus plowed down the hairpin turns of our mesa into the New Mexico desert, I found it disconcerting to have the driver swivel around for a little chat with a passenger."); the old bridge at Otowi crossing over the Rio Grande; horseback riders on the tortuous, winding dirt road that led to the secret community.

The first stop for new arrivals — civilian and military alike — was a Santa Fe office at 109 East Palace Ave. During the first months of migration to Los Alamos, office manager Dorothy McKibbin each day dispatched 65 people, two vans of furniture, and one truck of freight to "the Hill." For security reasons no one associated with Project Y referred to Los Alamos by its name. In addition, McKibbin handled daily more than 100 telephone calls and issued dozens of passes. Despite the volume of activity and the stresses placed on her, McKibbin's hospitality and graciousness endeared her to new residents.

For some recruits, just finding the East Palace Ave. office was a leveling experience. Nick Metropolis, a young physicist from Chicago, recalled being handed a packet containing instructions on how to get to Santa Fe and then to a small unmarked office in the Bishop Building. For security reasons, the Palace Ave. office was not noted in his instructions. To his dismay, Metropolis found that the train did not stop in Santa Fe, but rather at Lamy, a small village 15 miles from Santa Fe. After catching a bus into Santa Fe, he searched for the Bishop address given him.



When he reached that address, a voice from behind the door told him to go to 109 East Palace Ave. While searching for the Palace Ave. office, he noticed a man who seemed to be following him but whenever he turned to see who it was, the man disappeared. Later, Metropolis learned that his mysterious shadow was Berkeley chemist Rene Prestwood, who had simply been trying to avoid Metropolis while searching for the same office.

THE FRONT DOOR TO LOS ALAMOS

Newcomers to the Project were instructed to report to 109 East Palace Ave., where they were issued temporary passes and given directions on how to get to the Hill, 45 miles away. When Dorothy McKibbin, who ran the office for 20 years, was hired, she asked what her duties would be. She was told never to ask questions and never ask for a name to be repeated, and that was that. You could never say the word "physicist" in the office, and the words "Los Alamos" were completely forbidden. Thirteen wartime weddings were celebrated in McKibbin's house, and secrecy prevailed at those, too, as she recalled: "I couldn't tell the judge or minister the full names of the couples, although these were entered on the certificates. The officiating person would just say, 'Do you, Priscilla, take Robert ...'

Dateline: Los Alamos

THE BUILDINGS "LOOKED LIKE HELL"
New arrivals to the Project were impressed by the ugliness of the housing. The buildings were often constructed of green lumber, and residents lived in fear of being turned into kindling by the overlarge, overheated furnaces, which gave off so much heat they cast an eerie glow in the winter night. Apartments were supplied with modern electric refrigerators, but had antiquated stoves, nicknamed "Black Beauties." Cooking on one of these huge wood- and coal-burning ranges was an acquired skill. Many residents gave up trying to learn how to handle the infamous beauties and did their cooking on hot plates. "This was difficult but not impossible," remembered Jane Wilson, "except when the power was shut off. There were periods when this happened frequently, sometimes for hours at a time."

Unlike Metropolis, former resident Bernice Brode and her two boys found their way to 109 East Palace Ave. without difficulty and what she saw there amused her: "A big soldier was good-naturedly loading his bus with awkward household purchases such as brooms, mops, mirrors, potted plants, and kiddie cars. He was taking orders from pert little housewives with toddlers in tow. ... This was the daily bus, going to Los Alamos."

After processing at the Santa Fe office, new residents boarded the bus or drove themselves up the tortuous, winding dirt road to Los Alamos. Another early resident, Eleanor Jette, who drove her family to the site, described the nerve-wracking trip in which she narrowly avoided sliding into the Rio Grande at Otowi crossing. Her first impression, once she was admitted through the Los Alamos main gate, was soot covering new-fallen snow. Jette thought the apartment buildings "looked like hell" and as soon as she parked her car, it sank hub-deep into the mud.

Before 1942, Los Alamos existed primarily as the site of an exclusive boys school and a few homesteads. The Ranch School property included 27 houses, dormitories and other living quarters, and 27 miscellaneous buildings all sitting atop the Pajarito Plateau — a high desert mesa cut by deep canyons into long finger-like extensions. After the U.S. Army acquired the Ranch School property and about 54,000 surrounding acres

From the top: Housing ranged from eight-plexes to Quonset™ huts to expandable trailers; the interior of a Sundt apartment shows how the owner's belongings could bring a little charm to the apartment; the military personnel fared much worse, however, as this barracks photo shows.

DATELINE: LOS ALAMOS

owned primarily by the Forest Service, Los Alamos went up like a boomtown.

The school's handsome stone and log buildings, which served as Project Y headquarters and general meeting areas, were quickly obscured by mushrooming construction. Hurriedly built green Laboratory buildings, rows of barracks, apartments, Quonset™ huts, government trailers, and prefabricated units created an unsightly assortment of accommodations that lined row upon row of nameless, unpaved streets. New Mexico soft coal fueled the town's furnaces and soot and dust from the streets fell in endless layers on every surface. Winter snows and summer rains left streets and yards mired in mud.

From the top: One of the coveted Bathtub Row houses that were parceled out to high-ranking Project personnel; a victory garden in front of the original boys' ranch buildings, Fuller Lodge is at the left, the Big House is on the right, and the Bathtub Row houses are in between; the main room at Fuller Lodge served as a dining room for Project Y families, just as it had for the boys at the ranch school.

As a community in the early 1940s, Los Alamos was atypical. The population was homogenous; most people were in their 20s or 30s, healthy and middle-class. Unemployment did not exist. Despite the informality of the place, it was not, as former resident Ruth Marshak remembered, a casteless society. Employees' ranking in the Laboratory dictated their social standing as well as the quality of their assigned housing. This fact came as a surprise to at least one Navy captain who saw one of his senior officers slighted in housing by a junior officer with the proper scientific credentials named Norris Bradbury. Senior Laboratory officials occupied "Bathtub Row" homes previously used by schoolmasters and the only domiciles in Los Alamos with bathtubs. The name has stuck to this day.

Water, or the lack of it, was a constant problem. Soldiers hand-delivered to Los Alamos residents bulletins with precise instructions on water use: "Leaking faucets should be reported immediately. Watering of lawns and gardens is forbidden. Toilet bowls should not be flushed in play. And

BATHTUB ROW

Early resident Ruth Marshak recalled that even though houses on Bathtub Row were rat-ridden and in many particulars less convenient than the government-built housing, there was social prestige in living there. "More than one acrimonious battle was fought to determine who might move to the Row." Another resident, Jean Bacher, remembered that living on the Row had another perk: "Baby sitters were eternally scarce and on Sundays were almost nonexistent, unless one lived on Bathtub Row and could offer a tub as bait." The restaurant at Fuller Lodge was inconsistent at best, according to Marshak. "(It) would serve splendid food for a few months and then slump back to its usual standard of mediocre cooking."

Dateline: Los Alamos

DAILY LIFE
Jane Wilson remembered the hardships of living at Los Alamos: "Our electric power was uncertain. Our water supply ran out. Crisis succeeded crisis. Everything went wrong. We had few of the conveniences which most of us had taken for granted in the past. No mailman, no milkman, no laundryman, no paper boy knocked at our doors." But in spite of the hardships and isolation endured by Los Alamos residents, Ruth Marshak noted, "there was some compensation in the fact that to many scientists, Los Alamos stood for the same sort of thing that Hollywood represents to an aspiring starlet. Most of the great men of physics and chemistry were there at one time or another."

bodies should be soaped before entering the shower," a ceremony, resident Jane Wilson noted, "which could be disastrous if the water didn't come on."

For ordinary civilians, military security took some getting used to. Laboratory members were not allowed personal contact with relatives or permitted to travel more than 100 miles from Los Alamos. A chance encounter with a friend outside the Project

had to be reported in detail to the security force. Security personnel censored outgoing mail and monitored long-distance calls. Incoming mail was addressed simply to "P.O. Box 1663, Santa Fe, New Mexico." Birth certificates of infants born at Los Alamos during the war even listed P.O. Box 1663 as their place of birth. A high barbed wire fence surrounded the community and mounted guards patrolled the rugged outer boundaries

of the site until Los Alamos became an open city in 1957.

Recalled one early resident, "I couldn't go to Santa Fe without being aware of hidden eyes upon me, watching, waiting to pounce on that inevitable misstep. It wasn't a pleasant feeling."

The homogeneity of the community led to some interesting problems. Because so many scientists brought spouses and young children to the site, the need for a school ranked in importance with the need for a

From the top and left to right: shopping at the commissary — groceries could be bought at cost plus 10 per cent; a commissary checkout line; the community laundry was a busy place — washers were 30 cents an hour, mangles (irons) 40 cents; the precious water pipeline, which was the cause of major headaches; checking a resident's pass; the mud was a problem for military personnel as well as civilians.

Dateline: Los Alamos

new physics laboratory. The relative youth of the inhabitants also led to a baby boom. In the first year of the project, 80 babies were born; by 1945 Los Alamos had more than 330 infants. The housing demand quickly exceeded the housing supply, and by mid-1944 the Governing Board of the Laboratory gave serious thought to limiting future hiring to singles.

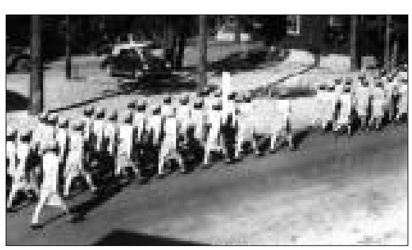
Los Alamos also was atypical in that it was the only army post in the United States that housed civilians on a permanent basis. And unlike any other Army base, this one was predominantly civilian.

To partially overcome some of the tensions between the Army and the civilians, residents created a Town Council. Early council member Alice Kimball Smith recalled: "According to its bylaws, the Town Council had magnificent powers embodied in a kind of general welfare clause for the mesa, but its efforts were always circumscribed by the hard fact that we lived on an Army post."

Smith remembers that the council handled an assortment of topics, including snapping dogs, inadequate restaurant facilities, requests for a shoe-repair service on the Hill, changes in movie schedules, and overcrowding in public laundries.

Los Alamos had two movie theaters. One showed movies every night; the other showed movies three nights a week. The latter doubled as a chapel on Sunday mornings and members of the congregation found themselves sweeping up popcorn and other litter before the services began.

Enrico Fermi's wife, Laura, reminisced that "we had no telephones and we ran around a lot. We gave large parties, cooking on rudimentary appliances. We rushed to



From the top: military inspection; choosing a Christmas tree; the soda fountain at the PX; mounted guards patrolled the perimeter of Los Alamos until 1957, when Los Alamos became an open city; WACs on parade.

LIFE ON AN ARMY POST

According to Bernice Brode, the civilian population found living in an Army post unique and "I'm sure the Army regarded us ... as equally strange." At Los Alamos things did not work (the Army's) way at all, she remembered. Gen. Leslie Groves, who did not live at Los Alamos and represented a sort of absentee landlord to the civilian residents, got blamed for everything that went wrong. There were, however, many small benefits, courtesy of the Army. Soldiers cut and stacked wood, collected garbage and trash, and fixed plumbing or anything else. At Christmas they cut trees of every size for the residents to choose from. "We became accustomed to administrators and doctors in uniform; WACs selling sodas and checking groceries, selling postage stamps and cashing checks; and military police with guns ..."

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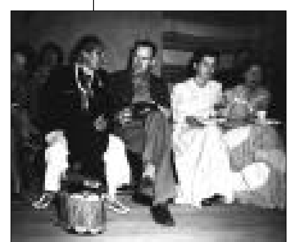
PUEBLO PARTY
San Ildefonso Pueblo invited the Los Alamos square dancers for an evening of fun. The square dancers took cookies, soft drinks, and sandwiches with them. San Ildefonsians supplied coffee, tamales, and luscious little dried fruit pies. Eleanor Jette wrote: "During the first part of the program our group did exhibition square dances. Afterward, people from the pueblo took the floor. They danced 'fun dances' very different from the ritualized religious dances we saw when we visited the pueblo on its feast day." Bernice Brode wrote: "Our Indian friends were a little hurt because our feet gave out. They always danced until sunrise. We went home about three o'clock."

Santa Fe for anything that was not food or the little else that the Army could sell." One telephone line installed by the Forest Service served the community until 1943; only three lines existed until 1945.

"Whenever things went wrong, and that was often," another resident said, "we always had our mountains — the Jemez on one side, the Sangre de Cristos on the other." A lot of residents kept horses and rode the rugged countryside.



One resident recalled that "the Hill dwellers were amateur everything: hikers, riders, photographers, ethnographers, mineralogists, musicians, and artists-craftsmen in all assorted fields. Saturday nights they partied and square danced. Sundays they fished or exploited their hobbies."

The parties were frequent and well attended. Resident Jean Bacher recalled that "Saturday nights, the mesa rocked ... fenced in as we were, our social life was a pipeline through which we let off steam."

In the memories of many early residents, two parties stand out from all the rest. On a cold December night in 1945, the San Ildefonso Pueblo, a tribe of Native Americans living next to Los Alamos, invited a group of Los Alamos square dancers to their pueblo for an evening of fun and entertainment. The two communities had seen a lot of each other during the war as men and women from the pueblo commuted daily to work at Los Alamos. The association produced a cross fertilization of cultures.

This page: the San Ildefonso Pueblo party, December 1945.

Bernice Brode wrote: "Some of us had more Indian crafts in our Army apartments than the Indians had in their homes, (and) modern American conveniences such as refrigerators and linoleum began cropping up in the pueblo." At the dance, the Indians performed for the square dancers and the square dancers performed for the Indians. After the demonstrations, members from the two groups began dancing with each other. Charlie Masters, a teacher at the Los Alamos school, wrote:

Dateline: Los Alamos

This page: scenes from the British Mission party. "Our social life reached some sort of peak when it was officially recognized by the British government," remembered Jean Bacher. "And there on that singular mesa in New Mexico, we raised our glasses of burgundy to toast the King."

"This fiesta-hoedown I like to remember as the climax of our relations with the natives."

A lot of foreigners lived on the mesa, including Poles, Canadians, Germans, Swiss, and Austrians. The British Mission, a group of top-flight British scientists sent by Prime Minister Winston Churchill to aid American scientists, arrived in the summer of 1944. Members of the British Mission hosted a huge bash to celebrate the success of the Trinity test. Jean Bacher recalled that the British government had given them $500 with which to celebrate. They did all of the work themselves in order to stretch the money over a giant guest list. The evening's entertainment included a well-received pantomime of living in Los Alamos as it had seemed to foreign eyes.

In spite of the military rule, the isolation, and the mud, most early residents have fond memories of Los Alamos. Kathleen Mark wrote: "When one considers that we lived ... closely packed together — aware of every detail of our neighbors' lives — even what they were having for dinner every night — one can't help but marvel that we enjoyed each other so much."

J. Robert Oppenheimer, the Laboratory's first director, summed up what most residents felt when he reported, "Almost everyone knew that this job, if it were achieved, would be part of history. This sense of excitement, of devotion, and of patriotism in the end prevailed."

Sources for this article include "Standing by and Making Do: Women of Wartime Los Alamos," a book edited by Jane S. Wilson and Charlotte Serber; "Inside Box 1663," a book by Eleanor Jette; "Reminiscences of Los Alamos, 1943-1945," a book edited by Lawrence Badash, Joseph O. Hirschfelder, and Herbert P. Broida; "Los Alamos 1943-1945: The Beginning of an Era," a brochure published by Los Alamos National Laboratory; and "The Atom" May/June 1980, a magazine published by Los Alamos National Laboratory.

THE BRITISH MISSION

"We frequently sipped mulled wine while (physicist) Otto Frisch recited limericks learned from years of riding the London Tubes or sketched our pictures in caricature," Eleanor Jette wrote of the British Mission parties. "When Frisch finished his caricature of you, you wanted to cut off your head." Frisch was even more popular for his piano playing, Jette recalled. He could coax "heavenly melodies from the most ill-tuned instrument." Jean Bacher remembered one of the Englishmen who "arrived in this country with only one pair of shoes and some bedroom slippers (and) felt he could not risk the shoes so he would turn up in his lusty red carpet slippers and last the evening comfortably."

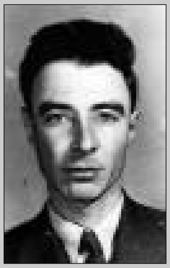
DATELINE: LOS ALAMOS

LOS ALAMOS TIMELINE

SIGNIFICANT EVENTS AND 50 YEARS OF RESEARCH HIGHLIGHTS

Los Alamos National Laboratory is a scientific research institution. While its primary mission has been the design and development of nuclear weapons, Los Alamos scientists and engineers also have conducted basic and applied research in many fields. During the Laboratory's first half century, its researchers achieved numerous technical and scientific breakthroughs. From the development of the first atomic weapons to the creation of space power sources to the testing of the first modern supercomputers to the establishment of a national AIDS databank, the Laboratory has been at the forefront of scientific achievement. The following timeline highlights scientific accomplishments across a broad spectrum of scientific disciplines as well as significant events in the Laboratory's history.

Dateline: Los Alamos



J. Robert Oppenheimer 1943 to 1945

Oppenheimer was a theoretical physicist at the University of California at Berkeley, when he was selected to head Project Y, part of the secret nationwide research and development program known as the Manhattan Engineer District of the War Department. He was instrumental in selecting Los Alamos as the site for its mission to research, develop, and produce a nuclear weapon. He earned a doctorate in physics from the Georg-August-Universität in Göttingen, Germany. After the war, Oppenheimer became a key adviser to the government on U.S. atomic policy. In 1954 Oppenheimer was the subject of a security hearing and was stripped of his security clearance by the Atomic Energy Commission. He was director of the Institute for Advanced Study at Princeton, N.J., a research facility for postdoctoral fellows, until his retirement in 1966. In 1963 President Lyndon Johnson presented Oppenheimer with the Atomic Energy Commission's $50,000 Enrico Fermi Award, the highest honor the AEC could bestow. He died in 1967.

1943 — Los Alamos laboratory was created by the Manhattan Engineer District under the direction of J. Robert Oppenheimer and known by its wartime code name: Project Y.

1943 — The Bethe-Feynman formula, a simple method for calculating the yield of a fission bomb, was derived.

1944 — The world's first nuclear reactor using enriched uranium — known as the "water boiler" to Lab employees — achieved criticality. A plutonium-fuel equivalent called "Clementine" achieved criticality in 1946. Neither one of these historic reactors are operational today.

1945 — Final measurements obtained of the critical mass of uranium and plutonium. These measurements were vital to the design of the first fission weapons.

1945 — Development of the high-explosive lens system. Los Alamos scientists developed the high-explosive lens system for producing a spherical symmetric means of detonating the main explosive charge. An explosive lens is not an optical lens, although it functions similarly: the explosive lens bends the explosion wave going through the explosive. This achievement was a key milestone in the development sequence of the implosion concept to atomic weapons during the Manhattan Project. In addition, exploding bridge wire technology was concurrently developed to detonate the lens system. These pioneering works also were the basis for subsequent improvements in implosion systems that were central to the performance, safety, and reliability of the early stockpile.

The plutonium-fueled reactor Clementine got her name because, like the song of the same name, she was in a canyon.

DATELINE: LOS ALAMOS

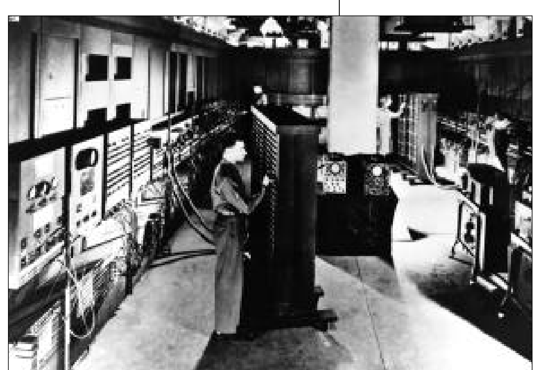
1945 — Successful test of the first atomic weapons. On July 16, 1945, the Trinity test in southern New Mexico demonstrated that the Laboratory had succeeded in its wartime mission to investigate the possibility of building and using nuclear weapons in World War II. The type of bomb tested in the New Mexico desert ("Fatman") and another type of nuclear weapon ("Little Boy") were dropped on Japan within a month of the Trinity test; Japan surrendered five days later.

The Trinity test, July 16, 1945.

"Fatman" in the Pacific.

1945 — First integrated hydrodynamics and neutronic calculation. This integration, known as the Serber-Wilson model, estimated the performance and yield of both the implosion and gun-assembled "gadgets." It provided the genesis for the subsequent application of integrated physics models and computational tools to the design and development process of complex engineering systems. Models for the transport of neutral and charged particles were recognized as a key ingredient to be developed for future understanding and improvements.

1945 — ENIAC computer solves weapons design problems. ENIAC (electronic numerical integrator and calculator), the world's first large-scale electronic computer, was built at the University of Pennsylvania to solve ballistics problems for the Army Air Corps. As its construction neared completion, researchers proposed that it also be used in the "Los Alamos problem," a calculation needed for the design of thermonuclear weapons. The results demonstrated the ability of electronic computers to solve weapons design problems, and high-speed computing and weapons design have been linked ever since.

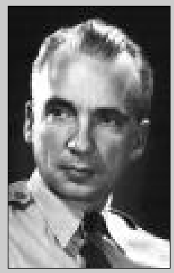


ENIAC, the first large-scale electronic computer, provided a calculation needed for the "Los Alamos problem."

1945 — Norris Bradbury became the second director of the Laboratory.

Dateline: Los Alamos

1947 — Monte Carlo computational techniques developed. Computational techniques known as Monte Carlo methods, which use random processes to discover precise details, were initially developed to simulate the paths of neutral particles in a weapon or a reactor. Monte Carlo techniques, a name suggesting an association with games of chance, have been widely used for studies in such areas as radiation safety, nuclear safeguards programs, reactor design, fusion engineering, medical radiation therapy, and diagnostics. They are also used to study basic physical processes, biological systems, and quantum mechanics.



Norris E. Bradbury
1945 to 1970

Bradbury came to Los Alamos in 1944 as an officer in the U.S. Naval Reserve, where he was put in charge of the implosion field-test program and later headed the assembly of all non-nuclear components of the implosion device. After the war, he was asked by J. Robert Oppenheimer to take on the directorship of the Laboratory. Bradbury said he'd do it for "a short period." That short period lasted 25 years. He holds a doctorate in physics and math from the University of California at Berkeley. Bradbury is a recipient of the 1968 Atomic Energy Commission Citation — the highest award given by the AEC to individuals who have made especially meritorious contributions to the nuclear energy program. Other honors Bradbury has received include the Navy's Legion of Merit, the Department of Defense Distinguished Public Service Medal, and the New Mexico Academy of Science Achievement Award. Bradbury is retired and lives in Los Alamos.

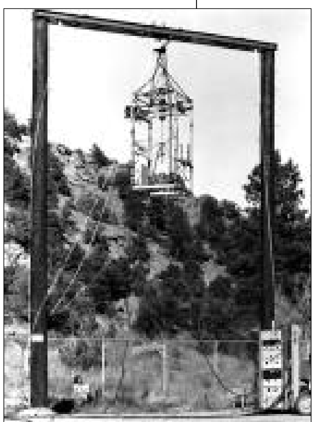
1947 — First U.S. critical assembly facility becomes operational. Experiments with critical assemblies, the minimum mass of fissile material of a given shape and isotopic composition that is needed to sustain a chain reaction, are vital for nuclear weapons design and valuable in such areas as nuclear reactor safety. The nation's first critical assembly facility went into operation at the Laboratory's Pajarito Site (TA-18) in April 1947. Critical assemblies were placed in concrete and steel kivas and operated remotely from a control room. Thousands of criticality experiments have been conducted safely at the site since it became operational.

The critical assembly Flattop was named after the Dick Tracy cartoon character because it sat on a flat-topped table.

1948 — First liquefaction of helium-3. Helium-3 is a rare isotope whose ability to be liquefied was part of a controversy among theoretical physicists about its properties. Los Alamos researchers first liquefied it,

Dateline: Los Alamos

then conducted measurements of its physical and thermal properties. The effort made the Laboratory prominent in the emerging field of low-temperature physics, an area of importance for the nuclear weapons program.



Lady Godiva — so named because her uranium core was unclad, as was the woman in the legend.

1951 — Lady Godiva nuclear reactor is put in operation. A replica of the portable device that first brought the fast-neutron fission chain and all of its varied behavior into the Laboratory is now on display at the National Atomic Museum in Albuquerque. The Godiva is recognized as a nuclear historic landmark by the American Nuclear Society.

1951 — Successful demonstration of "boosting." Boosting is the enhancement of fission weapon performance by exploiting neutrons released in thermonuclear reactions produced within the core. The successful demonstration of boosting established the feasibility of the design path for the successive development of smaller nuclear designs and is the genesis of all primary designs in the stockpile today. The design, development, and engineering of high-pressure storage and transfer systems marked key milestones in the weaponization of boosted primary designs for the stockpile.

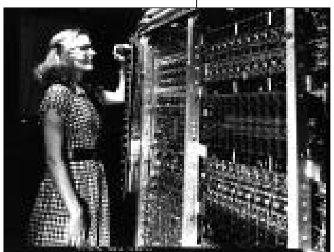
1951 — First thermonuclear reactions produced: the George shot. The George nuclear test proved the feasibility of radiation implosion of a secondary stage and demonstrated the successful ignition of thermonuclear fuel. This test provided the physics basis for the design principles of subsequent thermonuclear weapons.

1952 — First thermonuclear test: the Mike shot. The first thermonuclear explosion occurred in the Mike shot of the Ivy test series in the Pacific; it produced a yield of 10 megatons (equivalent to 20 billion pounds of TNT). The elements plutonium-244, plutonium-246, americium-246, einsteinium-253, and fermium-256 were discovered in the debris of the Mike shot, and the extensive cryogenic equipment needed to liquefy the deuterium fuel gave rise to the modern cryogenics industry.

The Mike shot was the world's first thermonuclear explosion.

1952 — MANIAC became operational. The MANIAC (mathematical analyzer, numerical integrator, and computer) was built at Los Alamos to solve large-scale hydrodynamic problems. It has also been used for problems related to nonlinear phenomena, particle physics, DNA

DATELINE: LOS ALAMOS



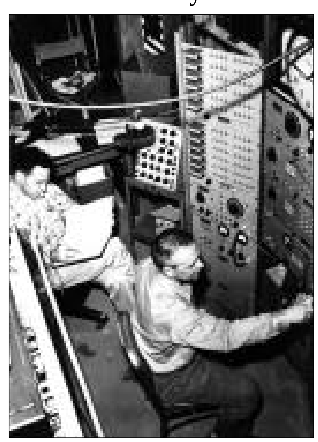
Top: She's a MANIAC — the computer that is. MANIAC was built to solve large-scale hydrodynamic problems. Above: The name MANIAC was coined by Nick Metropolis (right) who played chess with Paul Stein and the computer.

sequencing, and chess. The name was coined by Nick Metropolis, who said at the time he hoped to halt the rash of such acronyms to name machines. It appears, instead, that he may have only stimulated their continued use.

1953 — Los Alamos moved from its original site around Ashley Pond to its present site on the other side of Los Alamos Canyon.

1954 — Successful demonstration of the feasibility of dry, solid thermonuclear fuel for thermonuclear weapons. This development greatly simplified the weaponization and engineering of all subsequent generations of thermonuclear weapons. The first thermonuclear bomb containing solid fusion fuel was demonstrated in the Castle-Bravo shot.

1955 — Rover rocket program launched. Project Rover, a collaboration between the Laboratory and NASA, was initiated to launch large payloads into deep space. The basic technology involved passing hydrogen through a very high temperature nuclear reactor, where it expanded and blasted out of the reactor at high velocity. Project Rover was active for 17 years and at its peak was the Laboratory's second largest program. It was phased out in 1972 after concerns were raised about the cost of the nation's space program.



Frederick Reines (left) and Clyde Cowan discovered the existence of the free neutrino. They are pictured here monitoring recording equipment at Hanford in an early experiment that gave hints of successful detection.
Photo courtesy of Hanford Works

1956 — First definitive detection of the neutrino. Los Alamos researchers using super-sensitive detectors discovered the existence of the free neutrino, a subatomic particle that has no charge and little or no mass. The existence of the elusive particle had been postulated by Wolfgang Pauli in 1930. A year later Enrico Fermi provided the theoretical basis for the neutrino's existence. The Los Alamos detectors were set up underground near a production reactor at the Savannah River plant in South Carolina. An earlier detector located near the Hanford reactor in the state of Washington had given the scientists hints of successful detection. The neutrino detectors later evolved into the whole-body radiation counters pioneered at Los Alamos. Whole-body counters provided much of the

Above: The Phoebus IA reactor at the Nevada Test Site was used in Project Rover.

Dateline: Los Alamos

The security gates came down in February 1957, opening Los Alamos to the world.

fundamental data for diagnosis with radioactive tracers and for the development of radiation protection standards.

1956 — Improvements to the primary stage of a nuclear weapon began. A remarkable set of improvements occurred from 1952 to 1956 in the physics, design, and engineering of the primary stage of a nuclear weapon. The diameter of the primary stage decreased by more than a factor of three and weight decreased by more than a factor of 30. Collectively, these improvements allowed the nation to rapidly expand the flexibility and utility of its nuclear stockpile. The improved stockpile made possible multiple delivery platforms, including ballistic missiles and tactical applications, and facilitated the shift of national policy from massive retaliation and targeting of cities and populous areas to a flexible response strategy designed to deter and counter Soviet war-fighting capabilities.

1956 — The first use of plastic-bonded explosives in a nuclear explosion. This development allowed the shift from precision machined cast explosives to formulations containing high concentrations of high-energy density compounds with reduced sensitivity, more uniformity, and better mechanical characteristics. Pressed, plastic-bonded explosives are the key energetic materials in today's enduring stockpile.

1957 — The security gates come down, opening Los Alamos to the world.

1957 — Los Alamos achieves first controlled thermonuclear plasma. The Scylla theta pinch device used a rapidly rising axial magnetic field to heat plasma through a combination of shock and compression heating. Los Alamos contributed to the development of controlled thermonuclear research by taking part in Project Sherwood, a national program to achieve magnetic fusion energy involving several laboratories.

Local legend says the Perhapsatron got its name because "perhaps it would work and perhaps it wouldn't."

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Work at Los Alamos began in 1952 involving a toroidal Z-pinch called the Perhapsatron in which an induced toroidal current in the plasma produced a self-magnetic field that pinched the plasma column.

1959 — Nonproliferation technology started at Los Alamos. Technology to halt the spread of nuclear weapons began this year following recommendations to use satellites to monitor compliance with the nonproliferation treaty.

1961 — The Stretch computer is developed in collaboration with IBM. The ideas incorporated in this early supercomputer heavily influenced IBM operating systems for the next 20 years.

A dynamic test at the PHERMEX facility of a weapon design using conventional explosives but mockup fissile material. Another PHERMEX test is pictured on Page 24.

1962 — PHERMEX facility completed. The world's highest intensity X-ray facility, known as PHERMEX (pulsed high-energy radiographic machine emitting X-rays), was built as a diagnostic tool to study the process of implosion. PHERMEX sends X-rays through an imploding mockup of a weapons assembly and provides researchers with detailed snapshots of the locations and configurations of implosion systems. This technology resulted in more efficient use of subsequent nuclear tests. The PHERMEX facility has also been used to study fluid dynamics and the behavior of matter under extreme conditions. The proposed DARHT (dual-axis radiographic hydrodynamic test) facility is intended to replace PHERMEX when it is completed.

A researcher demonstrates the flexibility of a bendable heat pipe.

1963 — Invention of the heat pipe. A heat pipe is a passive heat transfer device that rechannels waste heat back into the production cycle of a system. It consists of a tube containing a fluid that circulates between heated and cooled areas. The fluid is vaporized as it absorbs heat and flows to the cooler area, where it condenses back into liquid. Heat pipes were invented at Los Alamos for use in space power systems, but they have found applications in other areas ranging from permafrost control on the Alaska pipeline to heat-transfer devices in solar collection systems.

Vela satellite sensors were developed to monitor compliance with the nonproliferation treaty.

1963 — Vela satellite sensors developed to detect nuclear explosions. The Limited Test Ban Treaty was signed by the nuclear powers in 1963, and two months later a pair of satellites with sensors designed in part at Los Alamos were fired into orbit to monitor compliance with the treaty. The satellites, named Vela,

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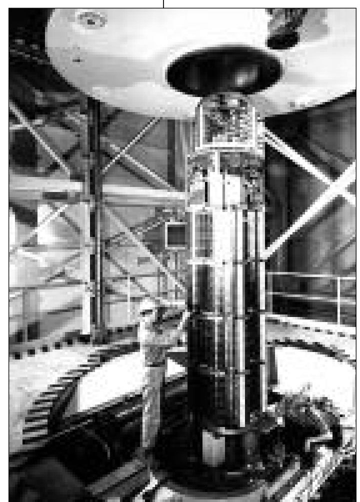
and four additional pairs of similar satellites acted as international "eyes in the sky" to detect nuclear explosions in the atmosphere and in space.

1964 — The world's highest-voltage Van de Graaff accelerator is completed. This was a key experimental facility in the measurement of neutron and charged particle cross sections for the weapons and nuclear energy program at Los Alamos.



A vertical Van de Graaff accelerator.

1966 — Nuclear safeguards program begins. The nation's first research and development program in nuclear safeguards began at Los Alamos. Its purpose was to develop nondestructive techniques and instruments to investigate and evaluate nuclear facilities to ensure their compliance with increasingly stringent international requirements. By the end of the 1970s, instruments and techniques developed at the Laboratory were being used around the world. In addition, hundreds of people, including all International Atomic Energy Agency inspectors, have received their initial training at Los Alamos.

1966 — Los Alamos Scientific Laboratory is designated a Registered National Historic Landmark.

1967 — The side-coupled cavity is developed for the future Los Alamos Meson Physics Facility (LAMPF) linear accelerator. Every radiology machine in the United States today uses this design for the production of X-rays, benefitting thousands of patients each year.

1969 — RTG research and development began. RTGs, or radioisotope thermoelectric generators, are plutonium-powered devices that provide electrical energy to NASA spacecraft. The Laboratory-developed units contain plutonium to provide a continuous supply of thermal energy and a thermoelectric converter to convert the thermal energy into electrical power. The plutonium cores also supply heat to keep a satellite's instruments functioning in deep space. They have been used successfully for numerous space missions, including the Voyager, Galileo, and Ulysses spacecraft.

Dwarfed by a penny, this plutonium-oxide pellet was developed as a heat source to provide a controlled temperature for delicate instruments aboard the Galileo space probe.

Dateline: Los Alamos

1970 — Harold M. Agnew became third director of the Laboratory.

1971 — Underground test containment program began. The Containment Program at Los Alamos was founded in 1971. During the next 20 years, more than 150 underground nuclear tests were conducted by Los Alamos without a single instance of an unplanned radioactive release. These tests, conducted at the Nevada Test Site, spanned a wide range of explosive yields, from near zero to near the threshold value of 150 kilotons of TNT. The tests were conducted in a variety of geologic settings that ranged from porous, dry alluvium to highly fractured, welded rocks. In the 1980s, Los Alamos also tested concepts relevant to nuclear driven X-ray lasers at the Nevada Test Site. The results obtained made significant contributions to the understanding of the physics and performance of such laser schemes.

Harold M. Agnew 1970 to 1979

Agnew was a member of the small working group headed by Enrico Fermi that achieved the first fission chain reaction at the University of Chicago in December 1942. He came to the Laboratory as a staff member in 1943. Agnew flew with the 509th bombardment group as a scientific member in its nuclear weapon strike against Hiroshima in August 1945. Before becoming Laboratory director, he served as a scientific adviser to NATO in the 1960s, headed Los Alamos' Weapons Division, and was a member of the General Advisory Committee to the Arms Control and Disarmament Agency. He holds a doctorate in physics from the University of Chicago and is a recipient of the Enrico Fermi Award, the highest scientific award of the Department of Energy. He was also the first state senator for Los Alamos County and served two terms. Agnew left Los Alamos to become president of GA Technologies Inc. in San Diego. He has since retired.

At right above: The surface of the Nevada Test Site resembles a moonscape. At right: an underground tunnel at the NTS that leads to a test area at the tunnel's terminus. The tube serves as a conduit for high-energy photons and particles sent to data-collection areas. Below: The birth of a crater.

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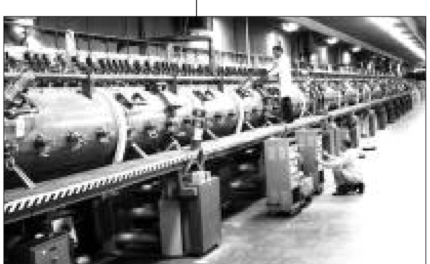
1972 — Clinton P. Anderson Meson Physics Facility completed. Four years after its groundbreaking, construction of the world's most powerful medium-energy research accelerator was completed. Known colloquially as LAMPF (Los Alamos Meson Physics Facility), the half-mile-long linear accelerator achieved its design goal of 800 million electron-volts the same year. The accelerator fires protons at nearly the speed of light into targets to produce subatomic particles called pi mesons that are used to study the structure of atomic nuclei and nuclear interactions. LAMPF has been used by researchers from around the world. The facility was renamed for U.S. Sen. Clinton P. Anderson because of the late New Mexico senator's long-time support of the Laboratory.



At left and from the top: An aerial view of LAMPF, the half-mile-long linear accelerator; a Cockcroft-Walton generator, where protons in the primary beam start their flight; the drift-tube section of LAMPF, where particles are accelerated to millions of electron volts.

1973 — Discovery of cosmic gamma-ray bursts. Laboratory-designed sensors carried aboard Vela satellites to monitor international compliance with provisions of the Limited Test Ban Treaty first detected the mysterious natural phenomena called cosmic gamma-ray bursts. These blasts of extremely high energy, which seem to originate from all parts of the universe, are still poorly understood, but their discovery showed astrophysicists that the cosmos is more chaotic and transient than they had previously believed.

1974 — First radioisotope produced at LAMPF for medical research shipped. A small bottle of strontium-82 for medical research was shipped from Los Alamos to the Veterans Administration Hospital in Denver. It was the first shipment as part of a program to produce radioactive isotopes for medical facilities throughout the world to use for diagnostic and therapeutic purposes. It was produced by irradiating a molybdenum target at the Los Alamos Meson Physics Facility.

1974 — National Stable Isotope Resource established. This national resource advanced biomedical applications of the stable isotopes carbon-13, nitrogen-15, oxygen-18, and selenium-77 by developing new efficient routes for synthesizing isotopically labeled compounds and distributing to accredited researchers labeled compounds that are not readily available from commercial sources. The ready availability of stable isotopes and stable isotopically labeled compounds has led to significant advances in

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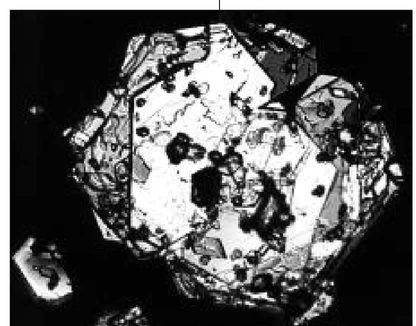
structural molecular biology, particularly using nuclear magnetic resonance and vibrational spectroscopies, as well as neutron scattering.

1974 — Insensitive high explosives for use in nuclear weapons are developed. The first nuclear test using an insensitive high explosive as the main explosive charge was successful. This test demonstrated the feasibility of using shock-resistant explosive compounds in nuclear weapons. Insensitive high explosives were subsequently incorporated into new and existing weapons systems.



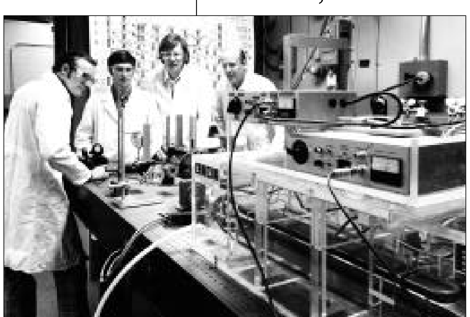
In 1974, Lab researchers reported a breakthrough in identifying explosive materials that are effective, but safe to handle and transport. This picture was taken through a microscope and shows a tiny slice from an insensitive high-explosive crystal. The crystal itself is smaller than a grain of sugar.

1974 — Weapon performance milestone achieved. In a nuclear test, a yield-per-weapon-weight milestone that physicists had long aspired to was achieved. This achievement provided options for reducing the size and weight of the warhead for strategic delivery systems while maintaining militarily significant yields.

1974 — Los Alamos acquired the first vector supercomputer from Cray Research Corp. Los Alamos worked with Cray Research in developing operating systems and compilers for this early innovative supercomputer.

1975 — First separation of isotopes by a laser. Specific forms, or isotopes, of an element are valuable in many areas — tracers, medical research, nuclear reactor fuel, and so on — but isolating them from other isotopes is difficult. The first laser separation by Los Alamos researchers was of sulfur isotopes. A similar demonstration by Russian researchers was also published in 1975. Within the year, Los Alamos scientists reported separation of isotopes of boron, carbon, silicon, and molybdenum. The technique relied on the variation of molecular vibrational frequencies according to isotopic mass. Researchers irradiated a molecular sample with a laser tuned to a specific vibrational frequency. This induced the molecules containing the selected isotope to absorb many infrared photons and to dissociate. This phenomenon of infrared multiple-photon absorption was a revolutionary discovery in molecular physics.

With this simple off-the-shelf carbon dioxide laser, scientists were able to separate, for the first time, valuable isotopes of three elements in experiments that were part of a laser isotope separation program called JUMPer.



1975 — Technology transfer office established at Los Alamos. Los Alamos has aggressively sought out industrial partnerships that improve the scientific and technical capabilities required to fulfill its mission of

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supporting national security. The Industrial Partnership Office at Los Alamos currently oversees partnerships with more than 200 companies. The partnerships have a total value of approximately $400 million. Although not an official Laboratory program until 1975, informal interactions with industry had gone on long before the technology transfer office was formed.

1976 — Los Alamos is designated as a National Environmental Research Park by the U.S. government.

1977 — Weapons Neutron Research Facility produced first neutrons. The Weapons Neutron Research Facility uses neutrons produced at the Los Alamos Meson Physics Facility for research in high-energy density physics, the study of the behavior of matter under extreme temperatures and densities. Researchers use the facility for experiments in radiation effects, obtaining nuclear data for weapons design, improved radiochemical diagnostics, and basic nuclear physics.

A worker handles special nuclear materials in a glove box at the Laboratory's plutonium processing facility.

1977 — Fusion neutrons are detected in a plasma confined by radiation from a carbon-dioxide laser.

1978 — Plutonium processing facility became operational. The facility was built to conduct chemical and metallurgical research on plutonium and other special nuclear materials. It remains the most capable of the nation's plutonium-handling facilities.

1978 — First class of International Atomic Energy Agency Inspectors trained at Los Alamos.

1979 — Donald M. Kerr became the fourth director of the Laboratory.

1980 — IGPP branch established at LANL. The University

Donald M. Kerr
1979 to 1985

Kerr joined the Laboratory in 1966 as a staff member in the High-Altitude Phenomenology Group. He conducted and led research in high-altitude weapons effects, nuclear test detection, weapons diagnostics, ionospheric physics, and alternative energy programs. Before becoming director, he was acting assistant secretary for energy technology at the Department of Energy in Washington, D.C. He holds a doctorate in plasma physics and microwave electronics from Cornell University. He has earned several awards including the National Merit Scholarship, the Ford Foundation Fellowship, and the Department of Energy's Outstanding Service Award. Kerr is now corporate executive vice president and a director of Science Applications International Corp. in San Diego.

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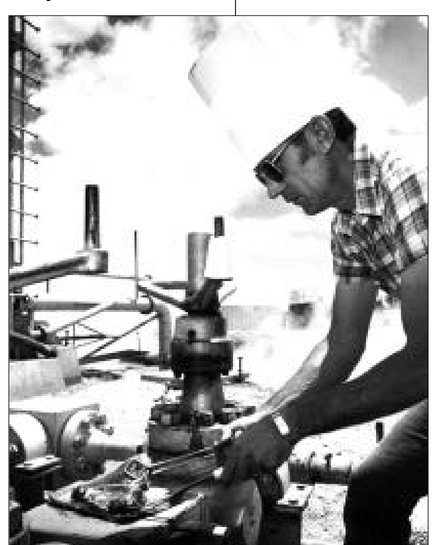
of California established a branch of its Institute of Geophysics and Planetary Physics (IGPP) at Los Alamos. The IGPP was created by UC in 1946 to be a center for research into various Earth and space sciences. The Los Alamos branch is aimed at developing closer research ties between the Laboratory and the UC campuses. It supports broadly based research in geology, geochemistry, geophysics, space science, atmospheric sciences, and astrophysics.

Scientist Ed Knapp with a cutaway model of the Radio Frequency Quadrupole.

1980 — Radio Frequency Quadrupole first successfully tested. The RFQ is a small linear accelerator that uses electric fields to focus as well as accelerate a beam of atomic ions. It is a compact and efficient means of starting the beam on its way and is now used in the front end of most ion beam particle accelerators.

1980 — CNLS established. The Center for Nonlinear Studies conducts research into the growing field of nonlinear problems, including chaos theory. Many of the Laboratory's energy and defense programs have involved complex nonlinear phenomena, making the development of analytical methods in this area important in several lines of research. The center also promotes interdisciplinary research and collaborations with researchers at other institutions.

1980 — Hot Dry Rock Project produces electricity. The Hot Dry Rock program started in the early 1970s when Laboratory researchers decided to investigate the applicability of techniques developed during a rock-melting earth penetrator program (Subterrene) to drilling in geothermal fields. A patent was granted and drilling began at the Fenton Hill site (located in the Jemez Mountains a few miles west of Los Alamos) in 1974, and electricity was generated during experiments in 1980. The project, conducted in conjunction with agencies of the governments of West Germany and Japan, has demonstrated the feasibility of producing electricity by fracturing and flooding naturally heated rock. Commercial viability is evidenced by the growing number of companies proposing to invest in a cost-shared prototype generating plant.



A researcher fries a T-bone steak with the heat produced at the Fenton Hill site of the Hot Dry Rock Project.

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1981 — CMS established. The Center for Materials Science was established to focus materials research activities and foster interactions with the national materials science community. The center supports workshops and collaborations to promote a better understanding of the behavior and suitability of various materials.

1981 — Los Alamos Scientific Laboratory gets a name change; it's now Los Alamos National Laboratory.

1982 — GenBank established. GenBank, an electronic database that serves as a national repository for genetic sequence information, was established at Los Alamos because of the Laboratory's expertise in genetics and computer science. It houses data about the sequence of the four organic molecules that combine to form human DNA, and it is used routinely by 50,000 researchers around the world. In 1993, the name was changed to the Genome Sequence Data Base, while the name "GenBank" reverted to an agency of the National Institutes of Health.

Developed at Los Alamos more than two decades ago, flow cytometers permit high-speed analysis, sorting, counting, and measuring of single cells, chromosomes, and molecules.

1982 — National Flow Cytometry Resource established at LANL. The first flow cytometers, which can analyze and sort individual cells and chromosomes at a rate of thousands per second, were built at Los Alamos in the 1960s. They were developed because biologists needed to analyze and sort cells and chromosomes rapidly and accurately according to specific characteristics. Cells are stained to identify a specific property, such as the amount of DNA, put into suspension in a conducting medium that is forced through a chamber, and illuminated by laser light of a particular frequency. Flow cytometry is valuable for basic research, as well as tumor cell identification, disease diagnosis, and studies of the effects of drugs and radiation therapy on cells.

1982 — Yucca Mountain selected. The Nuclear Waste Policy Act was passed and studies of Yucca Mountain, a candidate site for a geologic repository for high-level nuclear waste, gained momentum. Los Alamos was assigned responsibility for assessing subsurface processes expected to affect radionuclide transport. Los Alamos also was responsible for on-site coordination and

The proposed Yucca Mountain underground storage site for high-level nuclear waste is located In southwest Nevada, about 100 miles from Las Vegas.

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volcanology studies on the efficacy of the Yucca Mountain subsurface as a natural barrier to the migration of radioactive waste over the next 10,000 years.

1983 — Antares laser fusion facility achieved goal. The Antares laser fusion facility was designed and built between 1975 and 1983. The purpose was to investigate whether a carbon dioxide laser with a wavelength of 10.6 micrometers could be used to initiate inertially confined fusion. Antares, the most powerful carbon dioxide fusion laser in the world, succeeded in delivering an energy of 37 kiloJoules in one nanosecond on a fusion target. This was a major achievement in laser optics technology. Never before had so much laser energy been focused on such a tiny spot at a distance of 200 feet. The experimental work was terminated in 1984 when it became clear that fusion "breakeven" — a term used when the power produced is equal to the power consumed — could not be easily achieved with a carbon-dioxide laser. Even though the experiment was terminated, the technology developed was spun off into several industrial and institutional uses, such as the high-precision diamond turning technology used in the machining of high-precision parts.

This 10-foot-diameter optical spool expanded and relayed beams from Antares, a carbon-dioxide laser system built to investigate whether such a system could initiate inertially confined fusion.

1984 — National Laboratory Gene Library Project initiated. The National Laboratory Gene Library Project produces and distributes selections of DNA fragments to geneticists and other scientists around the world. The fragments come from of one of 24 "libraries" that each contain DNA specific to one of the 24 types of human chromosomes. The project was established at Los Alamos and Lawrence Livermore national laboratories and is funded by the Department of Energy as a contribution to biomedical research.

1984 — Solid storage system of boost gas successfully demonstrated. Solid storage systems allow more predictable weapon performance over a long lifetime. Longer periods between the exchange of limited-life components enhance a weapon's military robustness and readiness.

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1986 — Siegfried S. Hecker became the fifth director of the Laboratory.

Siegfried S. Hecker
1986 to Present

Hecker joined the Laboratory as a staff member in the Physical Metallurgy Group in 1973 and served as chairman of the Center for Materials Science and leader of the Materials Science and Technology Division. Before becoming a staff member, Hecker served two years as a postdoctoral appointee at Los Alamos and then began his career as a senior research metallurgist with the General Motors Research Laboratories. He holds a doctorate in metallurgy from Case Western Reserve University. Hecker is a recipient of several distinguished awards including the Department of Energy's E.O. Lawrence Award for Materials Science, the 1990 AIME James O. Douglas Gold Medal Award, and the Wesley P. Sykes Outstanding Metallurgist Award from the Case Institute of Technology.

1986 — AIDS database established. The AIDS database was created at the Laboratory and funded by the National Institute of Allergy and Infectious Diseases to compile nucleotide sequence data from researchers around the world and help them keep up with developments. A quarterly publication containing information about the database, known formally as the HIV (human immunodeficiency virus) Sequence Database and Analysis Project, is distributed to investigators free of charge. The staff not only compiles and publishes sequence data, it analyzes sequences and includes its results in the database.

1987 — HIPPI developed. HIPPI (high-performance parallel interface) is a high-speed channel that allows supercomputers to talk to each other at a rate as fast as 800 million bits of data per second. It was developed by a team of researchers to handle the vast amount of data needed for full-motion imaging, or "movies," of complex problems, such as the flow of a fluid into another medium. Its other applications became apparent in a short time, and it was adopted by the American National Standards Institute in 1991.

1988 — Center for Human Genome Studies established. The presence at Los Alamos of GenBank, the National Laboratory Gene Library Project, and related individual research projects all contributed to its selection as a center for human genome research when the first such centers were designated by the DOE in 1988. The goal of the CHGS is to help locate and understand the chemical structure of parts of the human genetic sequence, or genome, and develop ways to apply such knowledge in the study of medicine and treatment of disease.

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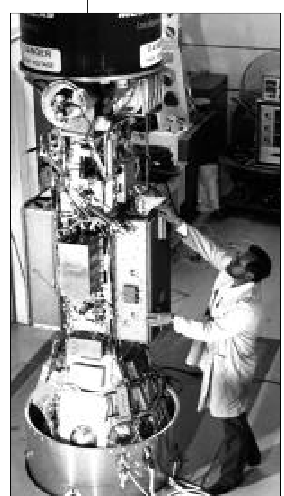
1988 — Advanced Computing Laboratory established. The Advanced Computing Laboratory was established to promote research into new computer techniques, technologies, and applications, and to serve as a gateway for interactions with industry, academia, and government. It is designed to team computer scientists and mathematicians with physicists, chemists, biologists, and other researchers. The facility is the interface for the Laboratory's designation as a National Science Foundation Center for Research into Parallel Computation.

1988 — U.S. and Soviet joint verification experiment. CORRTEX, a technology developed at Los Alamos for measuring the yields of underground nuclear explosions, was adopted as the system the United States proposed to use for verification of the Threshold Test Ban Treaty. To address concerns raised during the negotiations of the TTBT, a U.S.-Soviet Joint Verification Experiment was agreed to and planned by the negotiators in Geneva. These plans called for a team, led by Los Alamos scientists, to use CORRTEX to measure the yield of the SHAGAN explosion at the Semipalatinsk Test Site in the U.S.S.R. A team of Soviet scientists came to the Nevada Test Site and used a similar technology to measure the yield of the KEARSARGE explosion. Following the successful conclusion of the JVE, the TTBT negotiations were completed and the treaty was ratified.

1988 — Discovery of the human telomere. The human telomere is the DNA sequence that defines the end of each chromosome. This sequence of DNA base pairs is one of the most fundamental landmarks in our genetic material since it tells the molecular replication machinery of the cells where to stop and start.



A researcher checks the radio-frequency power amplifiers of the Beam Experiment Aboard a Rocket, or BEAR, which was the first U.S. test of a neutral particle beam in space.

1989 — BEAR Project successful. On July 13, 1989, an Aries rocket launched from the White Sands Missile Range in south central New Mexico carried the first, and so far only, particle beam accelerator into space. During the "Beam Experiment Aboard Rocket," the accelerator system delivered a neutral particle beam for nearly 5 minutes in a successful demonstration of the feasibility of the technology. Neutral particle beam technology, which had been studied at the Laboratory since the 1970s, envisioned the use of the beam as a counter-measure against nuclear weapons deployed in space.

1989 — LANSCE dedicated. The Los Alamos Neutron Scattering Center (LANSCE) was dedicated as the Manuel Lujan Jr. Neutron Scattering Center after the completion of a new experiment hall and support building. LANSCE is an international user facility that provides state-of-the-art resources for research into the basic structure of materials. Short bursts of

Dateline: Los Alamos

Nondestructive testing on a wide variety of products is possible at LANSCE. A researcher prepares a sample for testing.

neutrons are fired into samples being studied, and the neutrons are deflected in well-defined patterns that provide information about the structure of the material down to the atomic level. LANSCE uses the beam from the Los Alamos Meson Physics Facility's linear accelerator to produce the neutrons.

1989 — Los Alamos acquired the CM-2, a Thinking Machines Corp. massively parallel computer.

1990 — Los Alamos became a charter member of the new National High Magnetic Field Laboratory.

1990 — Concept of ATW developed. The Accelerator Transmutation of Waste concept takes advantage of Laboratory expertise in accelerator technology to deal with a persistent, difficult national problem — the disposal of radioactive waste. Laboratory researchers have proposed bombarding waste materials with neutrons from a particle accelerator and thereby transmuting the waste into different forms that are stable or more easily disposed of. In the process, the excess energy produced during the transmutation would be converted into usable electricity.

1990 — A diagnostic test for the early detection of lung cancer was developed. A quick, accurate method of detecting early lung cancer in a sample of sputum proves effective in diagnosing individuals in the earliest stages of lung cancer.

1991 — Los Alamos and Oak Ridge national laboratories were chosen as sites for the DOE's high-performance computing research centers.

LIDAR — light detection and ranging — was developed for the Gulf War. It is now used in air pollution studies.

1991 — LIDAR environmental monitoring technology used in Mexico City. A portable laser-driven detection system developed at Los Alamos makes it possible to determine the sources of air pollution in major metropolitan areas such as Mexico City. Data gathered with LIDAR helps researchers develop computer models that define the factors contributing to an air pollution problem. Ultimately, the data can result in cost-effective strategies for reducing air pollution. LIDAR was developed for Operation Desert Storm to detect biological warfare agents at great distances.

1992 — U.S. nuclear testing moratorium announced by President Bill Clinton. Maintaining a safe, secure, and reliable nuclear weapons stockpile without the benefit of underground testing is one of the biggest

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challenges facing Los Alamos today. Meeting this challenge requires that scientists use data from past nuclear tests in combination with non-nuclear testing and the aggressive application of computer and experimental models.

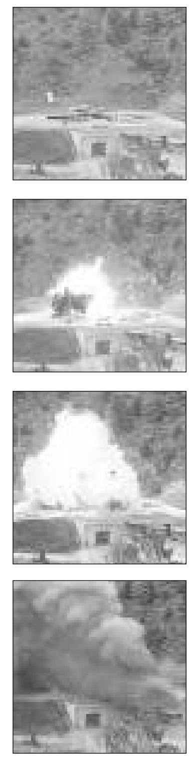
1993 — Launch of ALEXIS satellite. ALEXIS (array of low-energy X-ray imaging sensors) is a mini-satellite built at and operated from the Laboratory to track a broad range of radio frequencies and image cosmic X-rays. It was launched from an Air Force B-52 on April 25, 1993, but one of its solar panels apparently came loose during the launch, preventing contact with the satellite for several weeks. In late June contact was finally achieved, and the Laboratory team nursed it back to life while compensating for the damage. ALEXIS has been providing researchers with valuable data since that time.

1993 — A team of Los Alamos scientists visits the closed Russian city of Arzamas-16. The visit marked the beginning of a new era in Russian-U.S. relations and opened the door for scientific collaborations between the two nations.

1994 — Chromosome 16 mapped. The Center for Human Genome Studies announced the completion of an integrated, high-resolution physical map of human chromosome 16. DNA, or deoxyribonucleic acid, makes up the chromosomes that carry the genetic information found in all living organisms. A gene is a section of DNA that triggers cells to perform a variety of functions, or in some cases malfunctions. Chromosome 16 is the largest human chromosome to be mapped completely at a high level of detail and is an important milestone in the project to sequence the entire human genome.

1994 — Historic U.S.-Russian fusion experiment at Los Alamos. A collaborative experiment between scientists from Los Alamos and the All Russian Scientific Research Institute of Experimental Physics at Arzamas-16 provided American scientists with a good look at a relatively untried approach to controlled fusion energy, now known in the United States as Magnetized Target Fusion.

1994 — Isotopic signatures assist in environmental monitoring and help counter the proliferation of nuclear weapons. The isotopic signatures technique makes it possible for scientists to identify the source as well as the amount of radioactive contamination found in an environmental or biological sample. The technique, which combines the power of state-of-the-art mass spectrometry equipment with advanced chemical separation procedures, was adopted by the International Atomic

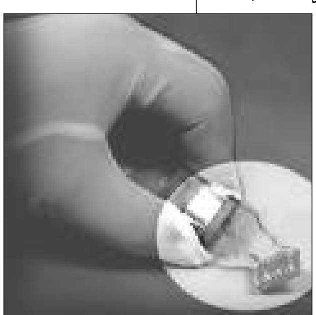


These photos of the U.S.-Russian fusion experiment show the experimental platform before, during, and after the detonation of high explosives.

Energy Agency to help inspectors verify that a country's nuclear activity is consistent with its declared activity. At home, the technique is used in environmental monitoring and was once used by litigators to establish the source of a worker's radiation exposure.

1995 — Evidence found for neutrino mass. A team of researchers from several divisions found indirect evidence that neutrinos, elusive subatomic particles that were first detected at the Laboratory (see 1956), have mass. The evidence involved the detection of a particular type of neutrino in a tank holding 180 tons of baby oil that was bombarded by protons from the Los Alamos Meson Physics Facility accelerator. If confirmed in subsequent experiments, the finding could mean that neutrinos comprise a large part of the so-called "missing mass" of the universe.

1995 — Numerical simulation of Earth's magnetic field. Los Alamos produced the first three-dimensional, time-dependent, self-consistent numerical solution of the magnetohydrodynamic equations that describe thermal convection and magnetic field generation in a rapidly rotating spherical fluid shell with a solid conducting inner core — an analogue for Earth's geodynamo. This simulation, representing roughly 40,000 years, creates a self-sustaining supercritical dynamo that has maintained a magnetic field for three magnetic diffusion times. The most exciting feature, which has never been simulated before, is a reversal of the dipolar part of the magnetic field that occurs near the end of the simulation.



A short segment of a thick-film superconducting tape flexed around a spool. The tape delivered record current levels at relatively high temperatures.

1995 — Superconductivity breakthrough achieved. Los Alamos researchers developed a thick-film superconductor that delivers world-record levels of electric current at relatively high temperatures. The achievement could potentially benefit everything from medical diagnosis to mass transportation. The flexible superconducting tape has a current density of more than 1 million amperes per square centimeter at liquid nitrogen temperatures — a current density nearly 100 times greater than other tapes in its class.

♦ ♦ ♦

The Laboratory began its second half-century facing many uncertainties. International geopolitics, budgetary constraints, and the changing nature of scientific research in the United States combined to make the future hard to predict. One thing remains certain: Los Alamos will continue to be a world-class laboratory solving complex problems of national importance where science makes a difference.

DATELINE: LOS ALAMOS

REDUCING THE GLOBAL NUCLEAR DANGER

LOS ALAMOS ACCEPTS COMPELLING NEW MISSION

BY DIRECTOR SIG HECKER

For 52 years, nuclear weapons research and development provided a compelling mission for Los Alamos. Fulfilling that mission required the Laboratory to be good in virtually all areas of science and engineering — and to be the best in some. Today, with the Cold War cycle of nuclear weapons development and deployment over, Los Alamos' new central mission reflects the global events of the past six years. Los Alamos, together with the U.S. Department of Energy, defines its new mission as helping to reduce the global nuclear danger.

Stockpile Stewardship

Reducing the nuclear danger still calls for stewardship of the existing nuclear weapons stockpile: keeping those weapons that the nation needs safe, secure, and reliable. Stewardship is more challenging in a world with no nuclear testing and one in which nuclear weapons will remain in the stockpile long beyond their originally designed lifetimes. Los Alamos is developing a science-based stockpile stewardship program, which provides the science and technology for evaluation and judgments on the efficacy of the enduring stockpile. Stockpile stewardship also requires that the nation retains the capability to respond to a variety of uncertain futures.

Stockpile Support

Reducing the nuclear danger requires stockpile support. Los Alamos must have the capability to dismantle nuclear weapons and reconstitute manufacturing in case weapons need to be replaced in the future. Stockpile support requires much more attention from the defense laboratories because the production complex is currently only partially operational and scheduled to be downsized dramatically due to budget reductions.

Nuclear Materials Management

Reducing the nuclear danger means managing the availability and disposition of plutonium, highly enriched uranium, and tritium. Scientists predict a new supply of tritium will be needed after the turn of the century. No need for new plutonium or uranium is anticipated in the near future. The nation's principal concern is one of safe disposition. Currently, many hundreds of tons of these materials exist not only in returned warheads, but also as production scrap, residues, or nuclear waste. The disposition of these weapons-grade materials in the former Soviet Union represents a significant proliferation danger.

Threat of Proliferation

Reducing the nuclear danger requires that Los Alamos help keep nuclear weapons, nuclear materials, and nuclear weapons knowledge out of the wrong hands. The proliferation threat poses the most significant risk to our national security today. Los Alamos, Lawrence Livermore, and Sandia national laboratories have the technical competencies to develop technologies for nonproliferation.

Environmental Cleanup

Reducing the nuclear danger requires Los Alamos to help clean up the legacy of 50 years of weapons production. As the global military threat recedes, it is critical to Los Alamos and other defense laboratories to turn their attention and technical talents to remediating environmental problems in the defense complexes of the United States and the former Soviet Union.

Civilian Missions

Over the past 50 years, the Laboratory has taken on a variety of national challenges outside its nuclear weapons mission. It has been able to do so because of the technical competencies and capabilities required for the nuclear programs. The end of the Cold War makes these other national challenges more important to the Laboratory. These challenges will help preserve some of the technical competencies required for the nuclear weapons program and help maintain an environment of intellectual excitement that attracts and retains the nation's best scientists and engineers.

In turn, as the nation can afford to devote its attention increasingly toward civilian and commercial problems, Los Alamos can offer its special talents to provide new solutions to vexing national or international problems.

There is no shortage of such challenging societal problems. Sustainable growth without adverse environmental impact is a significant global issue as the developing countries require vastly greater energy supplies to industrialize and improve their standard of living. The decaying national infrastructure for transportation and waste management represents a monumental problem for the United States. The explosive growth of information technologies provides grand opportunities for the nation to develop an effective national information network.

The nation also has become more sensitive to the mounting cost of health care, which represents one of the biggest impediments to increased quality of life and standard of living. The Laboratory is setting the stage for improved personalized health care with life sciences research in areas such as the Human Genome project, structural biology, and medical applications of lasers.

Los Alamos will continue to spin off into the private sector promising technologies developed in defense research. Los Alamos currently has partnerships with more than 200 companies. The partnerships have a total value of approximately $400 million.

In Conclusion ...

For more than half a century, the name "Los Alamos" has been synonymous with great science. From 1943 through the end of the Cold War, the science and technology developed at Los Alamos provided a defense umbrella for the United States and its allies. Los Alamos will continue to help keep America secure by reducing the global nuclear danger and boosting the economic competitiveness of U.S. industry. In 1993, Richard Rhodes, Pulitzer-Prize winning author of "The Making of the Atomic Bomb," told the Manhattan Project pioneers during the Laboratory's 50th anniversary reunion, "You saved civilization." For the next 50 years, we will settle for nothing less.

Dateline: Los Alamos

THE END OF AN ERA
April 13, 1993: During ceremonies observing the 50th anniversary of the Laboratory's founding, Professor Yevgenly Avrorin (right), chief scientist of the Russian nuclear weapons laboratory at Chelyabinsk 70, presented to Los Alamos Director Sig Hecker part of a thermonuclear warhead from a dismantled Soviet missile that had been aimed at the United States. The piece was inscribed, "From Russia With Love."

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