LOS ALAMOS NATIONAL LABORATORY ◇ SUMMER 2023

NATIONAL ★ SECURITY SCIENCE

THE OPPENHEIMER ISSUE

The man under the porkpie hat: Meet J. Robert Oppenheimer, father of the atomic bomb and the first director of Los Alamos National Laboratory.

A history fit for Hollywood: Laboratory employees played crucial roles in bringing the movie *Oppenheimer* to life.

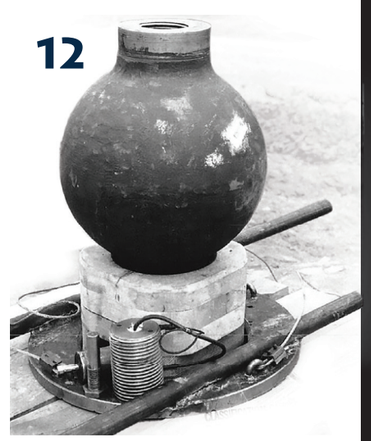
+ PLUS:

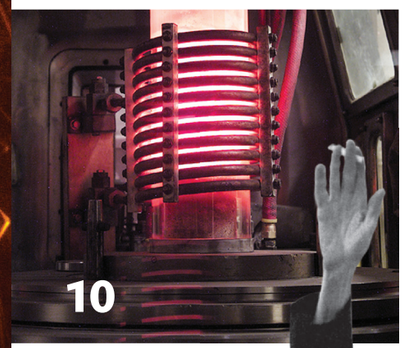
PHOTOBOMB

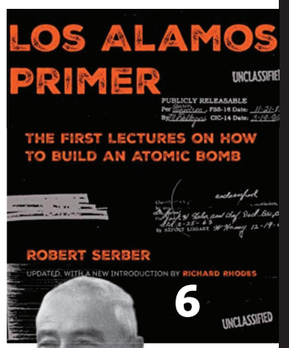
Since the Manhattan Project, Los Alamos National Laboratory has developed explosives for national security applications. Today, Los Alamos scientists regularly create new types of explosives, often with the goal of making them safer, that is, less likely to inadvertently detonate.

Here, an explosive burns during a drop-weight impact test, which helps scientists and engineers study the explosive's sensitivity—the degree to which the explosive can be ignited by impact, heat, or friction. The test, in concert with other tests, enables explosives experts to make important decisions related to handling explosives. ★

Photo: Los Alamos National Laboratory/Daniel Preston







IN THIS ISSUE

FEATURES

About the cover: *National Security Science* art director Brenda Fleming created this issue's cover art using digital oil paints and watercolor brushes. "I've seen hundreds of black and white photos of Oppenheimer," she says. "I hoped a color portrait would not only capture Oppie's piercing blue eyes but also convey how alive his legacy is today." ★

THE OPPENHEIMER ISSUE

The undisputed genius, charismatic leader, and fallen hero was also the first director of what is today Los Alamos National Laboratory.

BY BRYE STEEVES
DIRECTOR, NATIONAL SECURITY RESEARCH CENTER

This issue of *National Security Science* magazine explores the dynamic legacy of physicist J. Robert Oppenheimer, who came to Los Alamos, New Mexico, in 1943 to direct the top-secret weapons laboratory of the Manhattan Project. In just 27 months, as the world would later learn, he led the effort to create the atomic bomb, helping to end World War II.

These scientific achievements brought the secret lab into the public eye and the world into the Atomic Age, with Oppenheimer as the face of both.

In many ways, his legacy is our legacy. True to its beginnings, Los Alamos has remained a locus of collaborative innovation and held its position at the forefront of national security research, development, and stewardship throughout its 80-year history.

Laboratory contributions to nuclear science, including many by Oppenheimer himself, have been preserved through the decades and are archived in the Lab's National Security Research Center (NSRC). The NSRC began as Oppenheimer's wartime technical library and today serves as a leading research institution, curating millions of classified holdings that are accessed daily by researchers in support of our national security.

The NSRC also curates unclassified collections of historical value. These photos, films, documents, and other media include details about Oppenheimer that may otherwise have been lost to time. Thanks to Christopher Nolan's *Oppenheimer* film being released this summer, many stories about the Lab's founding director are being shared with renewed interest.

The NSRC, too, is creating an Oppenheimer film. The documentary is based on the historical information in NSRC collections as well as interviews with Laboratory staff, current Lab Director Thom Mason, and Oppenheimer biographers Kai Bird and Jim Kunetka, authors of *American Prometheus* and *The General and the Genius*, respectively.

Over the years, the NSRC has written extensively about Oppenheimer. He appears in presentations and has been the subject of podcasts. Oppenheimer was a complex, complicated man, but he can certainly be better understood through these stories.

I particularly like the anecdote of him as a 12-year-old boy presenting his research paper to the New York Mineralogical Club and subsequently being made an honorary member. Or, the story of Oppenheimer as a young academic learning Dutch in six weeks to deliver a technical lecture in the Netherlands. (It was there he was first dubbed "Oppie," or "Opje" in Dutch.)

As a professor at the California Institute of Technology and the University of California, Berkeley, Oppenheimer seemed to both inspire and influence his students, earning a loyal following—quite literally, as many joined him in Los Alamos. "Like most of his students, I would more or less follow him to the ends of the earth," recalled Manhattan Project scientist Robert Christy in a 1983 interview.

By the time he was the director at Los Alamos, stories portray Oppenheimer as charming and charismatic, holding court at parties while sipping his signature martini and chain-smoking cigarettes.

Recollections from his directorship also point to Oppenheimer's incredible drive and ambition. Perhaps this is what Manhattan Project leader General Leslie Groves saw in Oppenheimer beyond his lack of managerial experience and questionable past associations. According to the transcript of the call Groves made to Oppenheimer after the release of the Little Boy bomb, Groves said, "I think one of the wisest things I ever did was when I selected the director of Los Alamos."

Personally, though, the story I like best is much lesser known and comes from Dimas Chavez, whose oral history interview is a part of the NSRC's collections. Chavez was a young boy who didn't speak English when he moved to Los Alamos in 1943 for his father's new job. In the evenings, Chavez sold newspapers in front of the Lab. One of his customers had "piercing blue eyes," a "peculiar-looking hat," and would "always come over to me, and he'd give me a nickel or a dime as a tip—he always did."

In town one afternoon with his father, Chavez saw Oppenheimer, who greeted the boy by name. "My dad about fainted," Chavez recalled with a laugh. "I walked on a cloud on the way home."

Oppenheimer's story is varied and told by many, and it continues to evolve as new anecdotes, like Chavez's and others you'll read in this magazine, are shared. I hope you enjoy this timely issue of *NSS*. ★

MASTHEAD
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NSS STAFF SPOTLIGHT

What better way to channel J. Robert Oppenheimer than by reading Manhattan Project–era poetry in Oppenheimer's living room? That's what *National Security Science* editor Whitney Spivey, art director Brenda Fleming, and writers Jill Gibson and Ian Laird did in preparation for making this magazine and an accompanying podcast. Many thanks to the Los Alamos Historical Society for opening the Oppenheimer house to the magazine team. To listen to the podcast, scan the QR code. ★

ADDRESS REPLY TO
CHIEF OF ENGINEERS, U. S. ARMY
WASHINGTON, D. C.

REFER TO FILE NO. _____

~~SECRET~~ AUG 3 1943

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON

~~CLASSIFICATION CANCELLED PER DOC REVIEW JAN. 1973~~

July 29, 1943.

Dr. J. R. Oppenheimer
P. O. Box 1663
Santa Fe, New Mexico.

■ As part of his role as scientific director of Project Y, physicist J. Robert Oppenheimer was subject to stringent security measures. In this letter, dated July 29, 1943, Manhattan Project Director General Leslie Groves outlines several precautions he felt were necessary for Oppenheimer's personal safety. ★

Dear Dr. Oppenheimer:

In view of the nature of the work on which you are engaged, the knowledge of it which is possessed by you and the dependence which rests upon you for its successful accomplishment, it seems necessary to ask you to take certain special precautions with respect to your personal safety.

It is requested that:

(a) You refrain from flying in airplanes of any description; the time saved is not worth the risk. (If emergency demands their use my prior consent should be requested.)

(b) You refrain from driving an automobile for any appreciable distance (above a few miles) and from being without suitable protection on any lonely road, such as the road from Los Alamos to Santa Fe. On such trips you should be accompanied by a competent, able bodied, armed guard. There is no objection to the guard serving as chauffeur.

(c) Your cars be driven with due regard to safety and that in driving about town a guard of some kind should be used, particularly during hours of darkness. The cost of such guard is a proper charge against the United States.

I realize that these precautions may be personally burdensome and that they may appear to you to be unduly restrictive but I am asking you to bear with them until our work is successfully completed.

Sincerely,

L. R. GROVES,
Brigadier General, C. E.

SPECIAL RE-REVIEW
FINAL DETERMINATION
UNCLASSIFIED, DATE:

VERIFIED UNCLASSIFIED
PUBLICLY RELEASABLE
LANL Classification Group
Daniel Grant 10/14/04

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UNCLASSIFIED

Classification changed to ~~SECRET~~ UNCLASSIFIED
by authority of the U. S. Atomic Energy Commission,
Per L. M. REDMAN APR 10 1969
(Date)
BY APR 10 1969

INFOGRAPHIC

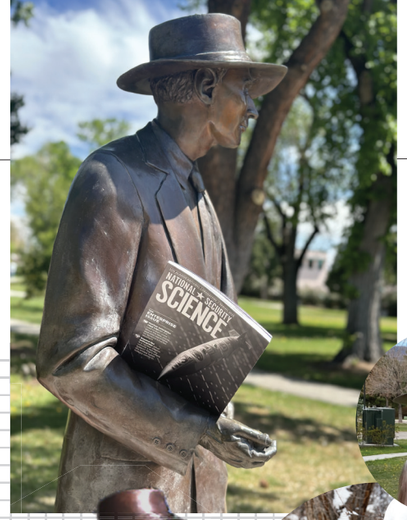
THE INTERSECTION

Science and culture converge in northern New Mexico—and beyond.

“Now I am become Dog, the destroyer of furniture,” is the motto of Oppenheimer, a 2-year-old border collie mix. He belongs to Jamie Farrow, a production controls specialist in the Lab’s Weapons Production associate directorate.

“At Play in the Atomic Age” is on display at the National Museum of Nuclear Science and History in Albuquerque through December 31, 2023. The exhibit features toys, games, music, and books that reflect the promise of atomic technology and the threat of nuclear war. Photo: National Museum of Nuclear Science and History

SCIENCE



Los Alamos residents take care to make sure this life-size statue of Oppenheimer participates in city events and celebrations. Oppie is often seen wearing festive hats and outfits. Sometimes he even enjoys reading material, such as *National Security Science* magazine.

CULTURE

Oppenheimer’s silhouette is painted in the Los Alamos Community Art Tunnel. Part of the Canyon Rim Trail, the tunnel is a space for individuals of all talents to create art that will be on display for a year.

Years ago, before being transported from Los Alamos to Albuquerque, a model of the Fat Man bomb went through a car wash. A photo circulated online with the caption, “No one likes a dirty bomb.”

Parts of the *Oppenheimer* movie were filmed in Oppenheimer’s actual house, which was outfitted with historically accurate furniture. Universal Studios has since donated the furniture to the Los Alamos Historical Society, which owns the house. The house will be open to the public after undergoing some preservation work.

Bathtub Row Brewing Co-op is located across the street from the Oppenheimer house in Los Alamos. “The Tub,” as it’s known to locals, brews a Hoppenheimer IPA and sells T-shirts that refer to Los Alamos as “a drinking town with a science problem.” In June, the co-op commissioned a colorful Oppenheimer mural. Photo: Bathtub Row Brewing Co-op

THEN & NOW

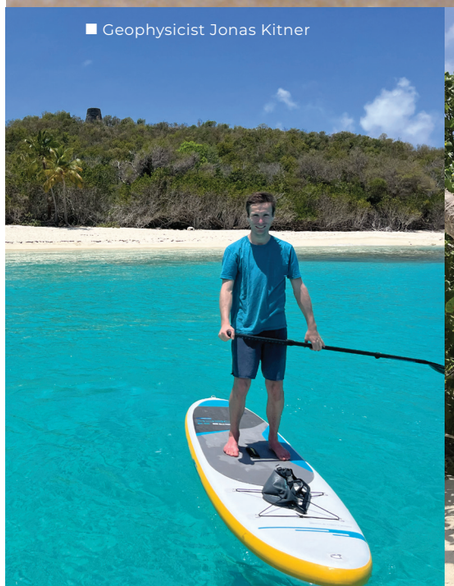
OPPENHEIMER BEACH

A little slice of paradise on St. John was a refuge for the famous physicist.

In 1957, Robert and Kitty Oppenheimer purchased property on the north shore of St. John in the U.S. Virgin Islands. There, they built a cottage and enjoyed time with their children, Peter and Toni. The tropical isle provided a much-needed respite in the years after Robert’s security clearance was revoked. Upon her death in 1977, Toni left the property to “the people of St. John.” The Oppenheimer house has since been destroyed by a hurricane, but the secluded beach remains a hallowed destination for tourists—including these Laboratory employees. ★

■ Oppenheimer and his family comb their beachfront property on Hawksnest Bay. Photos courtesy of Kitty Oppenheimer and the J. Robert Oppenheimer Memorial Committee

■ Editor Whitney Spivey



■ Geophysicist Jonas Kitner

■ Geophysicist Mike Begnaud

■ Geophysicist Mike Cleveland

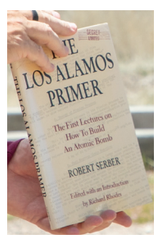
SCAN QR CODE WITH A SMARTPHONE CAMERA
Read LA-1, the first Los Alamos technical report.

LITERATURE

THE LOS ALAMOS PRIMER

The Laboratory's first official technical report captures what was known about atomic weaponry in 1943.

BY WHITNEY SPIVEY



"Are we saying there's a chance that when we push that button, we destroy the world?"

In the movie *Oppenheimer*, that's the question General Leslie Groves (played by Matt Damon) asks physicist J. Robert Oppenheimer (played by Cillian Murphy) in reference to the imminent test of the Gadget—the world's first atomic device—in July 1945.

When Oppenheimer responds that "chances are near zero," Groves snidely replies, "Zero would be nice."

Moviegoers might be interested to know that a version of this conversation did, in fact, happen in real life. "Physicist Edward Teller said the atmosphere might catch on fire," paraphrases John Lestone, a scientist at Los Alamos National Laboratory. "And physicist Hans Bethe went away and came back an hour later and said 'rubbish.' He knew there was no way the atmosphere would catch on fire."

This anecdote and many others are captured in the *The Los Alamos Primer: The First Lectures on How to Build an Atomic Bomb.*

The book documents a lecture series given by physicist Robert Serber in April 1943 to his fellow Manhattan Project scientists at the secret wartime laboratory in Los Alamos, New Mexico. Physicist Edward Condon transcribed the lectures and compiled the notes into the first official Los Alamos technical report, or LA-1, which was then distributed to incoming scientists. LA-1 was declassified in 1965. In 1992, the report was published as a book in which Serber (then 83 years old) annotated his lecture notes.

The purpose of Serber's lecture series was to outline the goal of the project and the current understanding of nuclear physics. Serber didn't waste any time getting to the point. Right off the bat, he told his audience of approximately 50 people that "the object of the project is to produce a practical military weapon in the form of a bomb in which the energy is released by a fast neutron chain reaction in one or more of the materials known to show nuclear fission."

■ Robert Serber and J. Robert Oppenheimer
Photo: Niels Bohr Library & Archives

"Oppenheimer's whole thing was free exchange of information," explains Lestone, referencing the Laboratory's first director who authorized the lecture series. "People are more inspired when they know what they're working on."

The Primer goes on to discuss fission, fast neutron chain reactions, neutron capture, and more than a dozen other topics.

"When *The Primer* was published, I just began digging into it," recalls Cameron Reed, author of *A Physicist's Guide to the Los Alamos Primer*. "What struck me was the breadth of issues in its 24 pages—Serber touches on everything."

Lestone agrees. "What did they miss? What's the chapter they should have added? I can't think of one. They knew it all in 1943."

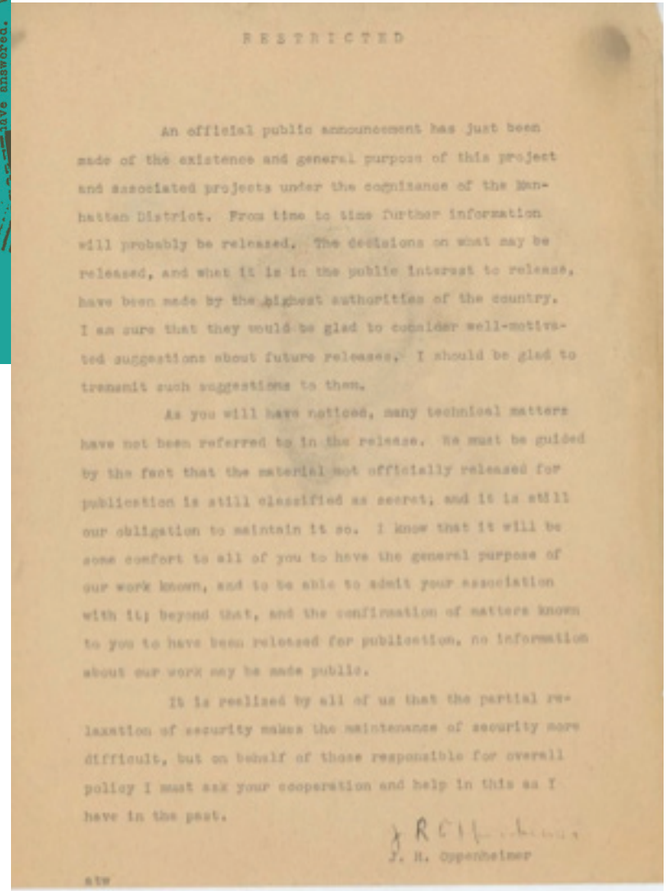
And not only did they know it all, but they were highly confident in their ability to turn theory into reality—to successfully build an atomic weapon despite being relatively unfamiliar with plutonium, which had been discovered only three years earlier.

"At this point in 1943, they were talking about plutonium with certainty," Lestone says. "But at the time of these lectures, there was maybe a microgram of plutonium in existence. But they knew that we were going to have gobs of it—that other people would bring them the plutonium, and their job was to do all the stuff in the book."

Today, 'all the stuff in the book' is common knowledge—"mathematics and physics that are largely at an undergraduate level," Reed explains. "It's not as exotic in some ways as one might think."

However, Reed, Lestone, and many of their contemporaries still find value in *The Primer*. "Read it word for word; it has so many gems in it," Lestone says. "It's cool to go back and look at it and remember what they were working out in 1943 and put that into context." (Lestone drew on that context while working as an extra in the *Oppenheimer* film in 2022.)

"It's a stunning document in the breadth of what it covers, the issues they anticipated, and the things they were getting right," Reed concludes. "It's a founding document of the nuclear age." ★



RESTRICTED

An official public announcement has just been made of the existence and general purpose of this project and associated projects under the cognizance of the Manhattan District. From time to time further information will probably be released. The decisions on what may be released, and what it is in the public interest to release, have been made by the highest authorities of the country. I am sure that they would be glad to consider well-motivated suggestions about future releases. I should be glad to transmit such suggestions to them.

As you will have noticed, many technical matters have not been referred to in the release. We must be guided by the fact that the material not officially released for publication is still classified as secret, and it is still our obligation to maintain it so. I know that it will be some comfort to all of you to have the general purpose of our work known, and to be able to admit your association with it; beyond that, and the confirmation of matters known to you to have been released for publication, no information about our work may be made public.

It is realized by all of us that the partial relaxation of security makes the maintenance of security more difficult, but on behalf of those responsible for overall policy I must ask your cooperation and help in this as I have in the past.

J. R. Oppenheimer

arw

FROM THE ARCHIVES

80 YEARS OF NUCLEAR SECRETS

Classification of information has been essential since the Manhattan Project.

During the Manhattan Project, J. Robert Oppenheimer wrote and distributed a memo (pictured) that stressed the importance of guarding classified information. "The success of the Manhattan Project is owed to the fact that there was a true classification culture," explains Diana Hollis, head of the Classification Office at Los Alamos National Laboratory. "People were aware of their roles in protecting government secrets; it was in their DNA."

Today, expert classification analysts, whose cumulative technical expertise can address the full spectrum of classification matters across the Lab's broad mission space, and a large contingent of derivative classifiers embedded across the Laboratory, all work together to protect government secrets in service of national security.

Hollis explains that this work is more important than ever. "If it was true back then when the threat to national security was defined and singular and there was some friction in accessing information, it is even more true today when threats to national security are evolving and multidomain, and information is available at the touch of a keyboard." ★

QUOTED

"Your passion can mean many things: higher education, construction, craft-related work, or another occupation. Whatever you choose, be the very best at it. It requires raw grit, persistence, drive, and a relentless focus on the endgame."

—Associate Laboratory Director for Weapons Engineering James Owen in a speech to the 2023 Peñasco High School graduates. Owen began working at Los Alamos National Laboratory when he himself was a sophomore at Peñasco High School, which is about 50 miles northeast of Los Alamos, New Mexico. ★

TRINITY TRIUMPHS

10 scientific advancements born from the Manhattan Project.

On July 16, 1945, at 5:29 a.m., a blinding flash came from the desert in southern New Mexico. A young Army sergeant would later call the explosion "brighter than 20 suns."

This was the Trinity test: the world's first detonation of a nuclear device.

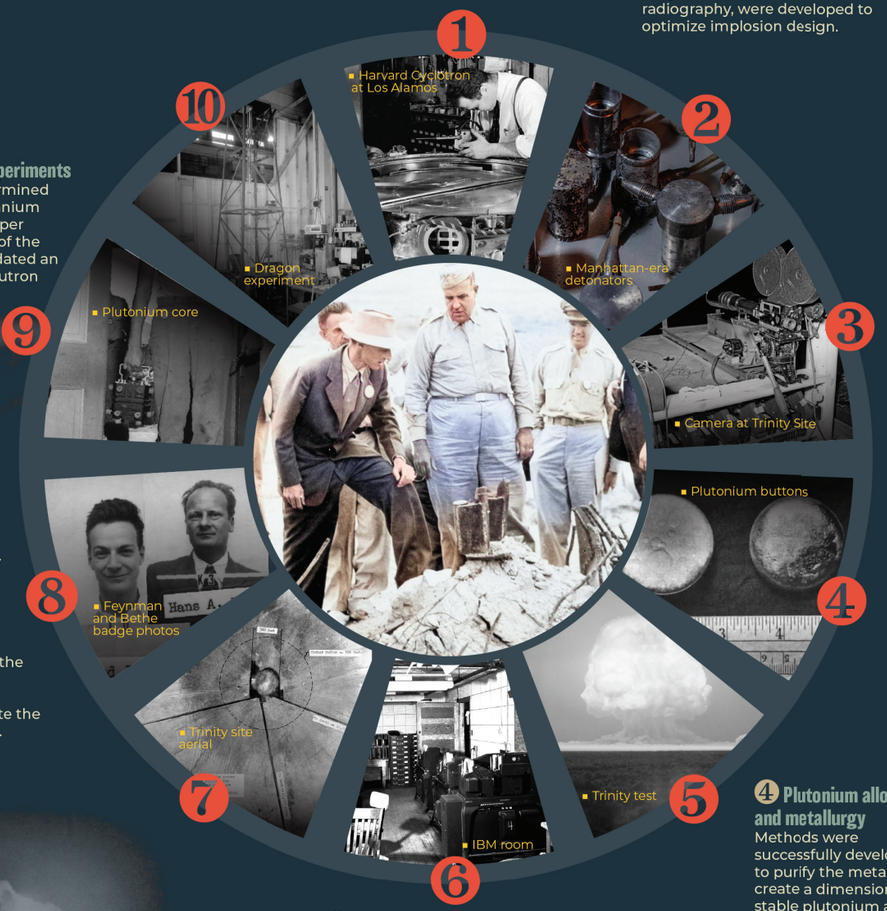
Nearly three years earlier, some of the world's best physicists, engineers, and mathematicians convened in Los Alamos, New Mexico, to work on Project Y, which was part of the Manhattan Project—the secret effort to develop an atomic bomb to help end World War II.

In creating the world's first atomic device, the men and women of Project Y developed many techniques and technologies that are foundational to weapons science and to the national security work currently underway, 80 years later, at Los Alamos National Laboratory. Here are 10 of the many scientific breakthroughs born from the Manhattan Project. ★

1 Plutonium
Scientists confirmed a newly discovered isotope of plutonium, plutonium-239, had attractive nuclear fission properties for an implosion-type atomic weapon.

2 Precision implosion
Project Y scientists developed exploding bridgewire detonators (see p. 9) with a pioneering high-explosive lens system. When positioned on high explosives surrounding a plutonium pit (nuclear weapon core) and set off simultaneously, the detonators created a convergent detonation wave that would symmetrically compress a plutonium pit—the key to obtaining a nuclear reaction.

3 Advanced imaging techniques
Diagnostics, such as flash radiography, were developed to optimize implosion design.



10 Critical assembly experiments
These experiments determined the critical masses of uranium and plutonium with tamper materials for the design of the atomic weapon and validated an understanding of the neutron chain reaction.

9 The origins of stockpile safety
Project Y scientists designed relatively simple safety features—such as fuzing plugs and insertable cores—to ensure a nuclear weapon would not unintentionally detonate. These innovations inspired later complex and more effective weapons safety technology.

8 The Bethe-Feynman formula
Nobel laureates Hans Bethe and Richard Feynman developed the physics equation used to estimate the yield of a fission weapon.

7 Foundational radiochemical yield analysis
Wartime radiochemistry techniques developed and used at Trinity provided the foundation for subsequent analyses of nuclear detonations, both foreign and domestic.

6 New frontiers in computing
Human computers and IBM punched-card machines together calculated the hydrodynamics, instabilities, and neutronics algorithms necessary for understanding complex physics interactions, such as those found in a nuclear detonation. Thus began the modern era of multi-physics simulations.

5 The dawn of the atomic age
Trinity validated fission could be harnessed in the form of a revolutionary weapon that helped bring World War II to an abrupt end. Today, this technology underlies the current U.S. nuclear stockpile and also provides the basis for clean nuclear energy.

4 Plutonium alloying and metallurgy
Methods were successfully developed to purify the metal and create a dimensionally stable plutonium alloy that enabled the machining of the Gadget's core.


■ A technician reviews detonator cables that will go into stockpiled weapons.


■ This 1940s–era exploding bridgewire detonator is part of the collections at the Laboratory's Bradbury Science Museum.


■ A modern exploding bridgewire detonator is much smaller than those manufactured during the Manhattan Project.

WEAPONS PRODUCTION

DECADES OF DETONATORS

Los Alamos has designed and produced this essential weapons component since the 1940s.

BY JILL GIBSON

For fourscore years—or eighty, as we'd say today—Los Alamos National Laboratory has designed and produced the detonators for nuclear weapons.

"Los Alamos has been making detonators since the Manhattan Project," says Daniel Mendoza, the Detonator Production division leader. "Detonators are extremely important. Without them working very precisely and reliably, you do not have a functioning nuclear weapon."

In an implosion-method nuclear weapon, the core (or pit) that contains nuclear material is surrounded by high explosives. Detonators set off the high explosives, causing the weapon core to compress and generate a nuclear reaction. To ensure this implosion happens evenly, the detonators around the core must go off at exactly the same time.

During the Manhattan Project, scientists designed detonators that used an electrical charge from a capacitor to heat and explode a hair-thin wire inside the detonator, setting off a small amount of explosive inside the device. These detonators, called exploding bridgewire detonators, were used in the Gadget (detonated at the Trinity site) as well as in the Fat Man and Little Boy devices used to bring about the end of World War II. Although exploding bridgewire detonators are still made and used for some purposes, the Lab has developed new detonator designs over the years.

One new detonator is called a chip slapper. Chip slappers work similarly to exploding bridgewire detonators, but they allow for increased separation of the electrical components from the explosive, thus improving safety. Chip slappers have replaced exploding bridgewire detonators in some modern nuclear weapons.

The Lab is also building detonators that use optical energy instead of electricity to set off the explosion. "Rather than having an electrical pathway to detonation, an optical detonator relies on a small, robust laser, removing all electrical means of detonation," says Mike Bowden, leader of the Lab's Optical Initiation Technology Readiness team. "The greatest challenge in developing optical detonators is delivering the energy from the laser to the detonator. We use optical fibers for this. The result is the safest and most reliable detonators ever made."

Following World War II, detonators continued to be designed by scientists at Los Alamos, but production moved to Mound Laboratories in Ohio. In 1989, production capability returned to Los Alamos and has been a key part of the Lab's mission ever since.

Bowden says he often reflects on the fact that he is following in the footsteps of the designers who created detonators during the Manhattan Project. "When I think about the historical significance and scientific importance of these tiny devices, I feel honored to be part of Los Alamos' 80-year commitment to national security." ★

WEAPONS PRODUCTION

PLUTONIUM INFRASTRUCTURE AT LOS ALAMOS

Many facilities have supported plutonium pit production since the Manhattan Project.

BY ALEXA HENRY

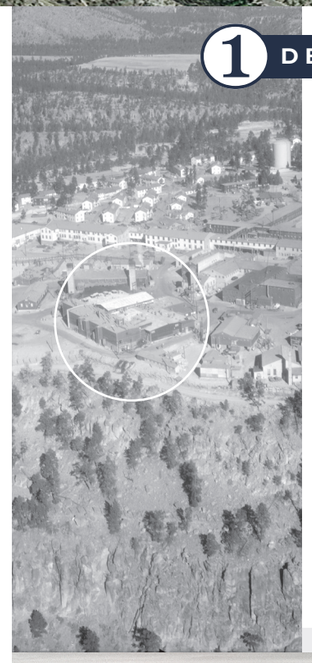
Since the Manhattan Project, Los Alamos National Laboratory has been involved in the manufacture of plutonium pits. These pits form the cores of nuclear weapons; a compressed pit generates a nuclear explosion. Los Alamos produced the first plutonium pits in 1945 and has conducted limited pit production over the years. At the direction of the National Nuclear Security Administration (NNSA), the Laboratory is currently ramping up its pit production capability to be able to manufacture at least 30 pits per year by 2030.

Pit manufacturing at Los Alamos has primarily taken place in three buildings since the 1940s: D Building, DP West, and the Plutonium Facility (PF-4). Each was designed and constructed to meet the production requirements of the time. PF-4, which is still in use today, is being updated to execute the current pit production requirements.

Here is a brief overview of each facility, as well as two others that support pit manufacturing and plutonium research and development. ★

Jeremy Brunette, Drew Kornreich, John Moore, and Steve Schreiber contributed to this article.

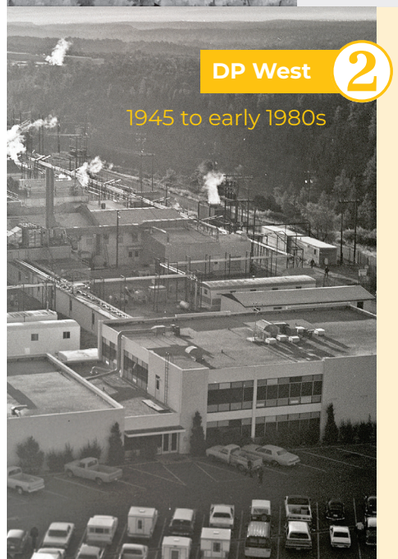
SCAN QR CODE WITH A SMARTPHONE CAMERA
Read more about pit production at Los Alamos.



1 D Building

February 1944 to August 1945

Perched on the northern rim of Los Alamos Canyon near modern-day downtown Los Alamos, D Building was part of Technical Area 1, a collection of buildings that formed the core of Project Y—the code name for the Los Alamos branch of the Manhattan Project. Some of the world's first plutonium was processed at D Building, a structure made mostly of wood with a sheet metal roof. The plutonium metal came from Hanford Engineering Works (now the Hanford Site) in Washington state. Processing involved purification, shaping, machining, and assembly into pits for use in implosion weapons, which were detonated at the Trinity site in southern New Mexico and above Nagasaki, Japan.

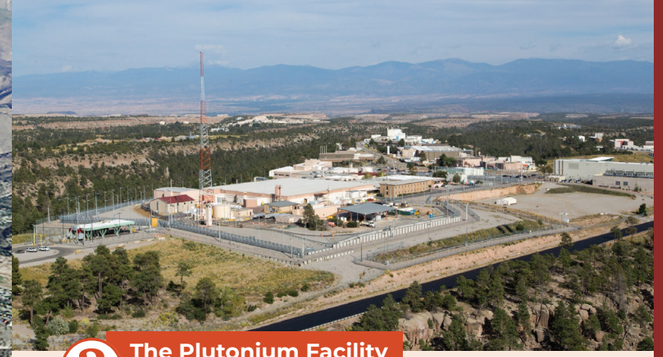


2 DP West

1945 to early 1980s

After World War II, the U.S. nuclear stockpile increased in size and weapon diversity as the Cold War intensified. D Building was not large or safe enough to meet pit production demands, so in 1945, Technical Area 21 was constructed in just five months on a mesa southeast of downtown Los Alamos. The western area of the site was dubbed Delta Prime (DP) West and was dedicated to plutonium operations and plutonium storage. (At one point, a rumor circulated that "DP" stood for "displaced persons," perhaps due to the site's isolation from the main Laboratory.)

In the early 1950s, the Rocky Flats Plant near Denver, Colorado, began producing most plutonium pits for U.S. nuclear weapons. DP West pivoted from pit manufacturing to uranium and plutonium research and development. In addition to studying plutonium for weapons-related purposes, scientists at DP West determined that plutonium could be used to power everything from human heart pacemakers to spacecraft.



3 The Plutonium Facility Building 4

1978 to present

In the early 1970s, the Laboratory, in conjunction with Fluor Engineers and Constructors of Los Angeles, began construction on a new facility in Technical Area 55, south of downtown Los Alamos. Completed and operational in 1978, the Plutonium Facility, or PF-4, was the first Department of Energy facility designed to withstand potential disasters such as tornadoes, wildfires, and earthquakes. The more than 236,000 square-foot facility, which includes a basement, has thick exterior walls, a sturdy roof, and a floor all made of heavily reinforced concrete.

PF-4 is the only plutonium facility in the nation currently capable of producing plutonium pits. Although the facility was initially established for plutonium research and development purposes, in 2003, PF-4 produced the nation's first war reserve (stockpile quality) plutonium pit since the closure of the Rocky Flats plant in 1992. From 2007 to 2011, 31 pits for W88 warheads were manufactured at PF-4. In 2018, NNSA tasked Los Alamos with producing at least 30 pits per year by 2030. PF-4 is being renovated to handle this increase in production work.

In addition to the facility's significant role in sustaining America's nuclear weapons, PF-4 also supports other NNSA defense programs as well as NASA deep space missions. For example, plutonium heat sources manufactured at Los Alamos currently power the Mars Curiosity and Perseverance rovers.

QUOTED

"The incredible, confounding complexity of plutonium–something well recognized today–was completely unknown to the pioneers of the Manhattan Project. This complexity manifested itself in conflicting data from measurements on the first tiny bits of metallic plutonium and later proved a vexing challenge to be overcome by intuition, rigorous experimentation, and as these pioneers themselves claimed, good old-fashioned luck."

—Los Alamos scientists Joseph Martz, Franz Freibert, and David Clark in their paper "The Taming of Plutonium: Pu Metallurgy and the Manhattan Project," published by the American Nuclear Society in 2021.

5 The Chemistry and Metallurgy Research building

1952 to present

The Chemistry and Metallurgy (CMR) facility was built to house research and experimental activities for analytical chemistry and plutonium and uranium metallurgy. Analyses and research performed at CMR support national security and space exploration programs, including pit production at PF-4. In 1962, President John F. Kennedy visited the facility to check on the progress of Project Rover, a program to develop nuclear rocket engines for space travel.

4 The Plutonium Facility Building 400

2011 to present

Named the Radiological Laboratory Utility Office Building (RLUOB) when it opened in Technical Area 55 in 2011, the Plutonium Facility Building 400, or PF-400, took on analytical chemistry and materials characterization capabilities from the aging CMR building starting in 2014. A state-of-the-art actinide lab, PF-400 provides 19,000 square feet of laboratory space for chemical and materials analysis. In February 2023, the building was designated a hazard category 3 nuclear facility, allowing it to handle larger quantities of plutonium. Pit manufacturing does not occur in PF-400, but the work happening there directly supports the Laboratory's pit production mission.

At the Trinity site near Alamogordo, New Mexico, visitors can see the remains of Jumbo.

CONTAINING SOLUTIONS

Jumbo, Dumbo, and the Jumbinos informed the design of modern confinement vessels.

BY JILL GIBSON

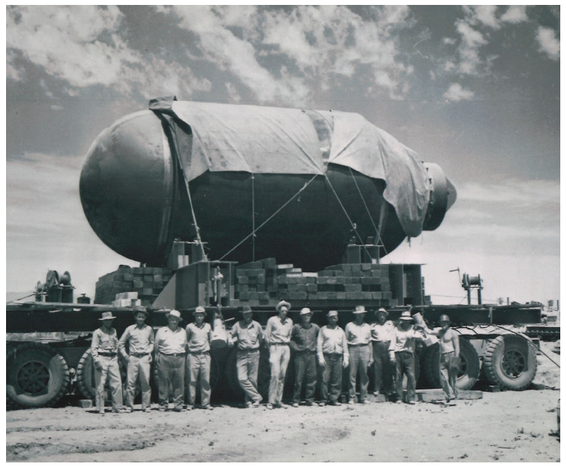
During the Manhattan Project, scientists developing the first atomic devices came up with the idea to conduct nuclear and nonnuclear explosives tests inside steel containers. Today, this same approach is used for subcritical and hydrodynamic experiments that help maintain the United States' nuclear stockpile.

The use of containers during the 1940s came from concerns about squandering weapons-grade plutonium, which was man-made and available in limited quantities. Scientists wanted to be able to recover the plutonium and reuse it if their experiments failed.

However, "no data existed on the subject, and the team faced numerous challenges," writes Los Alamos National Laboratory engineer Jonathan Morgan in a paper titled "The Origins of Blast Loaded Vessels."

The team constructed an assortment of small cast-steel spherical vessels, nicknamed Jumbinos. Explosives were detonated inside the vessels, many of which failed to contain the blasts. But even the failed tests had value; scientists used these to calculate how far fragments of a vessel might travel during a nuclear detonation.

The team also explored larger spherical containers, calling their first concept Jumbo #1. They also experimented with cylindrical



Jumbo traveled from Ohio to New Mexico by train. For the final leg of the journey, three tractors pulled a specially built trailer to the Trinity site.

containers, first testing explosions in barrel-shaped Jumbinos, then building Dumbo: a 6-foot-long cylinder that weighed 10 tons.

The next vessel, Jumbo #2 (and later simply Jumbo), was created to hold the Gadget, the first atomic device, which would be detonated at the Trinity site in southern New Mexico. Jumbo was a steel cylinder 10 feet in diameter and 25 feet long. With walls that were 14 inches thick, the entire device weighed 200 tons. In constructing this 12-million-dollar vessel, manufacturers "adopted cautious welding techniques that produced 100 percent flawless welds" that

A Jumbino

did not fail or crack, according to Morgan.

However, by the time Jumbo arrived at the Trinity site, scientists had decided not to use it. There were concerns that the thick vessel would prevent them from taking high-speed motion pictures and making other critical data measurements. So, instead of containing the Gadget, Jumbo helped scientists learn how a nuclear blast impacts an object. Morgan writes that Jumbo "was ready to take a beating unlike anything the world had ever seen."

When the Gadget was detonated on July 16, 1945, "the heavy-duty tower holding the vessel was blown down, and yet Jumbo emerged unscathed—a testament to the strength and durability of the vessel," Morgan writes.

A few months later, U.S. Army personnel used Jumbo to contain several simultaneous nonnuclear detonations. However, according to Morgan, Jumbo was not sealed correctly and was damaged. The vessel, now missing its ends, remains at the Trinity site today.

Two years later in 1947, scientists at Los Alamos Scientific Laboratory (formerly Project Y of the Manhattan Project and later Los Alamos National Laboratory) once again found themselves in need of a vessel to contain explosives experiments. So, a third Jumbo vessel was built. For nearly two decades, scientists used Jumbo #3 to carry out high-explosives experiments.

Scientists considered using Jumbo #3 to house cameras on the PHERMEX (Pulsed High Energy Radiographic Machine Emitting X-Rays) project at the Lab. After building a road and transporting the cumbersome Jumbo #3 up the mesa to site, the project was discontinued, and the vessel remains there today.

As researchers continued to conduct numerous open-air explosives tests at Los Alamos, they kept searching for a way to protect experiments from inclement weather and shield the surrounding forest from flying fragments and fire. In the mid-2000s, they turned to the idea of building smaller high-strength steel confinement vessels that could withstand a great deal of stress and absorb a significant amount of energy. Such vessels have been used since 2007 at the Lab's Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility, where two linear-induction accelerators produce high-powered x-ray images of materials that implode at more than 2.5 miles per second. Because the experiments conducted at DARHT do not contain special nuclear material (highly enriched uranium or weapons-grade plutonium), the vessels (which are 6 feet in diameter) are cleaned and reused.

Steel confinement vessels are also used for subcritical nuclear tests (tests that use small amounts of special nuclear material but do not create a self-sustaining nuclear reaction). These tests are designed by Los Alamos or Lawrence Livermore national laboratories and take place underground at the Nevada National Security Site (NNSS). After each test, the used vessels (which are 3 feet in diameter) are permanently sealed off, or entombed, in underground chambers. Data from these experiments is an essential part of stockpile stewardship, allowing for the maintenance of the nuclear weapons stockpile without full-scale nuclear testing.

Using confinement vessels also allows scientists to carry out safer and faster experiments, explains Joshem Gibson, a vessel engineer at the Lab. Now, the goal is to extend the life of existing multiuse vessels and produce new ones to meet increased testing needs. "With nearly 80 years of confinement vessel history, present day vessel engineers have a solid foundation to stand on as we continue to refine confinement vessel designs and add to the knowledge base," Gibson says.

"It was a surprise for me to learn that confinement vessel design and use dated back to the Manhattan project," says Ty Brooks, lead engineer for vessel procurement at Los Alamos. He adds that he has been inspired by the history and challenges of designing, creating, testing, and transporting the Jumbos.

The Lab's last major procurement of vessels for both DARHT and NNSS was in 2004. Scientists are now working with production companies to fabricate new vessels and vessel components. Each vessel will cost approximately $2 million. As scientists move forward with these plans, they are also working with the U.S. Navy to explore improved materials and manufacturing processes. Brooks and Gibson say the goal is to develop higher-strength steel alloys that will allow for lighter, thinner, stronger vessels.

"The design and material of our current vessel is decades old," Brooks says. "Although the design is great and has functioned well, we are always striving for improvements." ★

Crews transport a vessel at DARHT.

GLOBAL SECURITY

CHALLENGES CREATE INNOVATION

A counterterrorism test series paves the way for experimental breakthroughs.

BY JILL GIBSON

Los Alamos National Laboratory wrapped up a groundbreaking series of experiments to determine how to safely detonate and disable terrorist weapons. Scientists say the test series, which concluded May 24, 2023, represents several significant technological advances.

"These tests were unlike any we have ever conducted at DARHT before," says Jacob Mendez, who leads the Experiments and Diagnostics group at the Laboratory's Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility. "This series forced us out of our comfort zone, creating challenges that led to innovation in several areas."

The Tier Threat Modeling Archive-Validation (TTMA-V) series began in 2013 in response to a presidential national security directive. It consisted of 2 campaigns and 10 experiments. Each experiment considered different terrorism approaches and different types of threat devices. The findings will be used to train Nuclear Emergency Support Team responders. "Terrorists don't give us examples of their devices so we can practice with them," Mendez says. "These tests give us information to be prepared."

Scientists carried out the experiments at DARHT, which uses two linear accelerators to create high-powered x-ray pulses that image the detonation of mock weapons inside a steel containment vessel. The x-ray images, or radiographs, allow scientists to "see" materials inside the vessel that are moving at more than 2.5 miles per second.

Among the numerous innovations prompted by TTMA-V was the installation of a rail system that allowed scientists to adjust the position of DARHT's x-ray sources. This new capability enabled a variable and expanded field of view, which greatly enhanced data quantity and reduced uncertainty when recording images.

Mendez says the TTMA-V test series also pushed his team to develop new diagnostics, shielding methods, and dimensions for the vessels containing the experiments. In one case, scientists increased a vessel's volume by installing a 2.5-foot-tall "top hat" extension in what was dubbed the "mad hatter" test.

Test results were also analyzed using a groundbreaking method. Scientists in the Laboratory's Theoretical division devised a new modeling technique that can reconstruct highly accurate 3D models of detonations. This will provide previously unavailable data that can be applied in multiple ways. "We have been developing this technique for several years," says scientist Marc Klasky. "Using machine learning natural language processing architectures similar to those found in Chat GPT, we can create accurate models of dynamic events and increase our ability to apply our data."

The TTMA-V series was a collaborative effort between Los Alamos and Lawrence Livermore national laboratories, the National Nuclear Security Administration, and the Defense Threat Reduction Agency. Mendez says all parties benefited from such a unique experimental series. "We've learned a lot that we otherwise wouldn't have learned," he says, "and we've shown DARHT is the place to do this kind of work." ★

■ The volume of this six-foot-tall vessel was increased by installing a "top hat." For more on confinement vessels, see p. 12.

■ From left: Thuy-Ai (Bi) Nguyen, Alex Mueller, Bryce Tappan, Von Whitley, Andrew Schmalzer, and Cameron Brown are among the researchers who developed switchable explosives.

WEAPONS ENGINEERING

THE HOLY GRAIL OF HIGH EXPLOSIVES

Los Alamos–developed "switchable" explosives mitigate the risk of an unintended detonation.

BY BRIAN KEENAN

In August 2020, an accidental detonation of stored ammonium nitrate in Beirut, Lebanon, killed more than 200 people. The explosion leveled the port district and was felt across the country and beyond. Although unusually large, the explosion was not unprecedented: approximately 500 unplanned explosions occurred at munitions plants from 1979 to 2013, according to a study by the Small Arms Survey.

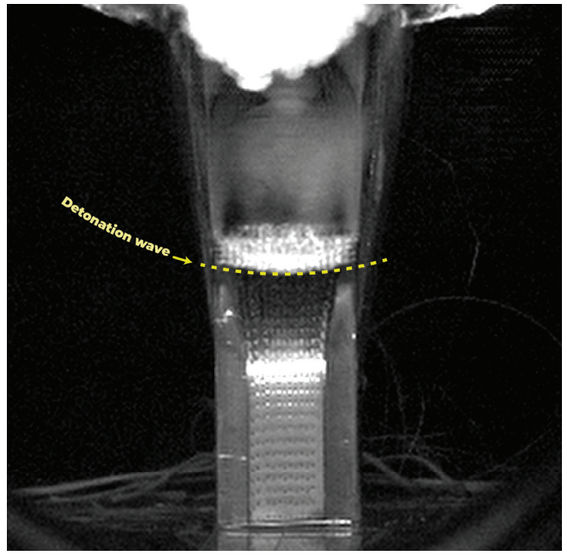
For people who work with explosives or live near areas where explosives are used (such as a mine or munitions plant), the volatility of certain explosives presents a potential hazard. Impact, heat, and friction are all sensitivities that can produce an unplanned explosion.

In an effort to mitigate accidental detonations of stored explosives, a multidisciplinary team of Los Alamos National Laboratory scientists developed "switchable" explosives that won't detonate unless they are filled with a fluid, such as water.

"A system that is completely insensitive to unplanned stimuli but switches to high performance during use is the holy grail of high explosives," said Los Alamos scientist Alexander Mueller, principal investigator for the project. "We've designed a high explosive system that won't work when it's not supposed to, like during transport and storage, but can quickly be made ready when required."

The Los Alamos team used additive manufacturing to fabricate 3D lattice-shaped high-explosive charges. Researchers found that the charges would not detonate unless filled with a fluid. They also discovered that altering the fill fluid changed the power and speed of the detonation.

Scientist Cameron Brown, the lead author on a recent paper in *Physical Review Letters*, explains that additional experiments using different lattice structures and fill fluids are necessary to fine-tune switchable explosives for specific purposes. "We now have a path forward," he says, "for quantifying the detonative performance of switchable explosives with different structural parameters and optimizing them for mining, oil and gas exploration, blasting or military applications." ★



■ A detonation wave propagates through a liquid-filled, 3D-printed, high-explosive lattice. The lattice was "switched on" when it was filled with water.

■ As part of the Lab's Knowledge Management Program, videographer Andrew Windham records scientists at the Nevada National Security Site sharing what they learned from historical testing.

YOU CAN'T DOWNLOAD A BRAIN

New initiatives capture knowledge that might otherwise be lost.

BY JILL GIBSON

During the Manhattan Project, J. Robert Oppenheimer established a technical library that contained technical reports, notebooks, memos, letters, photographs, x-rays, documents from other sites, and more.

Today, Oppenheimer's original library is part of the National Security Research Center (NSRC) at Los Alamos National Laboratory. "Our history underlies every aspect of our work and culture," says Brye Steeves, NSRC director. "This information tells the story of the science that changed the world 80 years ago and the evolution of that innovation since then."

Today, the NSRC contains millions of historical materials that serve scientists, researchers, and engineers. Steeves notes that the Lab has new initiatives underway to build on that legacy of preserving information and transferring knowledge between Los Alamos employees. Several of the NSRC's recent projects focus on a concept called "knowledge management," which involves identifying, capturing, evaluating, retrieving, and sharing an organization's information assets.

"Knowledge management is relatively new as a discipline," explains technical project manager Andie Turner. She says that recent initiatives have gained importance as the Lab is undergoing a period of increased hiring.

"With all of the work that's coming into the Lab now, we are running fast into the future," Turner says. Over the course of 2021 and 2022, 646 Lab employees retired and 3,353 new employees came on board, according to Jacklyn Herrera in Human Resources. Nearly 30 percent of Lab employees are younger than 35 years old. Turner notes that "We have a lot of early career people coming in. We are looking at what we can do to create tools to support mentorship of multiple people in a short amount of time."

One of those tools involves making informational videos. The Knowledge Management team is recording videos for new hires of Lab employees explaining the intricacies of their work.

"Our people are our processes," Trinity Overmyer, the NSRC's Knowledge Management team leader and researcher, says. "Before human beings could write, we transferred our knowledge through myths and stories. You can't download a brain." That's why Overmyer spends her days recording employees from all levels of the weapons program. Her goal is to capture people discussing the "art and craft" of their work.

"Imagine what someone knows after working 40 years as a machinist at the Laboratory," Overmyer says. "That sort of muscle memory, how a part smells when it's right, how the sparks look, that is not something that can just be trained into you. You don't get a degree in that and just walk in and be able

■ Trinity Overmyer, Knowledge Management researcher and team leader, prepares for a technical knowledge capture video interview in the studio.

to do that. It takes hands-on work and collaboration. We want to make that evolving information accessible to people."

Turner says she feels an urgency about her work because of the number of retirees and the influx of new employees. "A lot of this information resides only in the heads of people. The window is closing on the people who have these memories."

The videos that the Knowledge Management team captures are stored online where they can be used by multiple people for training. Turner says that she hopes these recordings will prevent crucial knowledge from being lost. But, she adds that the term 'knowledge management' is somewhat of a misnomer. "You can't manage knowledge," Turner says. "It's impossible to manage what people have in their heads." Instead, she describes what her team does as managing the flow of knowledge from one person and one organization to the next. "I don't think anybody wants to leave the Lab and have their expertise go nowhere. Your knowledge is your legacy, and we want to help you push your legacy into the future," she says.

Other knowledge management initiatives include a classified video series for employees called "Unlocking the Vault." This series of in-person presentations takes archival videos and explains their modern relevance. Recent topics have included the 1999 Wen Ho Lee espionage investigation and the closing of the Rocky Flats Plant, which manufactured plutonium pits from 1952 to 1989. "A lot of employees at the Lab were not here when certain events took place, but they need to understand how those events have influenced the work we do today," says Veronica Rodriguez, another member of the Knowledge Management team.

A comprehensive virtual training program for new and early career employees called "Nuclear Fundamentals Orientation" has also been launched. So far, about 2,000 employees from all areas of the Lab have participated in this training. "People have to understand the context of the work in order to contribute to the mission," Rodriguez says.

Steeves agrees, noting that knowledge management is an essential part of the NSRC. "Information is our duty. Be it curating 15 million-plus materials in our collections, making information available to researchers through online repositories, or growing the information through new knowledge capture initiatives, the NSRC's resources are vital to today's mission work."

Preserving history and making it available paves the way for the future, according to Steeves. "Ensuring that scientific evidence is not lost—and is discoverable—means the Lab's researchers have access to diverse thought, proof of successful and failed experimentation, and the opportunity for their own fortuitous discoveries today." ★

■ Park ambassador and Laboratory archaeologist Jeremy Brunette discusses Pond Cabin with a tour group.

LEGACY

MANHATTAN PROJECT NATIONAL HISTORICAL PARK

Access is hard to come by at the Los Alamos branch of the park, which commemorates the top-secret effort to build the world's first atomic bombs.

BY IAN LAIRD

Manhattan Project National Historical Park isn't your average national park.

Most national parks are established by the Department of the Interior, keeper of the National Park Service. This one was established by the Department of the Interior *and* the Department of Energy.

Most national parks are located in one area. This one has locations in three states: Los Alamos, New Mexico; Oak Ridge, Tennessee; and Hanford, Washington.

Most national parks are easy to visit. This one requires special access because many of its features are located in secure areas that aren't open to the public. Nowhere is this more true than at the Los Alamos branch of the park, most of which is located "behind the fence," as locals say, in protected areas of Los Alamos National Laboratory.

"Understandably the public continues to clamor for more access," says Carrie Gregory, a historic facilities specialist at the Laboratory. The Lab is doing its best to accommodate these requests, offering carefully orchestrated tours in the fall and spring. Each tour can accommodate up to 25 U.S. citizens 18 and older, and Gregory says that all spots are booked almost immediately after they become available online through the Laboratory's Bradbury Science Museum. Approximately 250 people tour Laboratory sites annually.

Although the park has existed since 2015, it wasn't until the fall of 2022—during a break from tours because of the coronavirus pandemic—that park interpreters updated informative scripts for tour stops, including Pond Cabin (home to Emilio Segrè's plutonium research group), the Slotin Building (the site of a criticality accident in May 1946), and Battleship Bunker (which supported diagnostic experiments on implosion weapons).

Along with discussing the role of these facilities during the Manhattan Project, park interpreters describe the layers of history at each site. Many people—including the Ancestral Puebloans and homesteaders—occupied the Los Alamos area before the Manhattan Project took it over in 1942. "The biggest thing we push on these tours is that history is a continuum," Gregory says. "The context is changing. As we move away from points in time, the historic context broadens, and more historical perspectives emerge."

Fourteen other facilities on Laboratory property are part of the park but aren't part of the tour—yet. Access to these sites depends mostly on Laboratory leaders, who must consider how touring might affect that Lab's national security work, and the Department of Energy, which is responsible for facility upkeep on Lab property.

The National Park Service handles public-facing information. "The National Park Service is the primary interpreter," Gregory explains. "They're the ones that develop the interpretive plan and tell us what the interpretation should focus on. Then the Lab [which falls under the Department of Energy] does the maintenance, the operations, the historic preservation, and the interpretive activities."

Most of the park's facilities were built in 1943 or 1944 during the Manhattan Project, and their upkeep is challenging. "Two key words to remember when looking at these sites are temporary and expedient," explains science historian Elliot Schultz. "The goal was to build the atomic bombs as fast as they could, and that is reflected in some of these buildings."

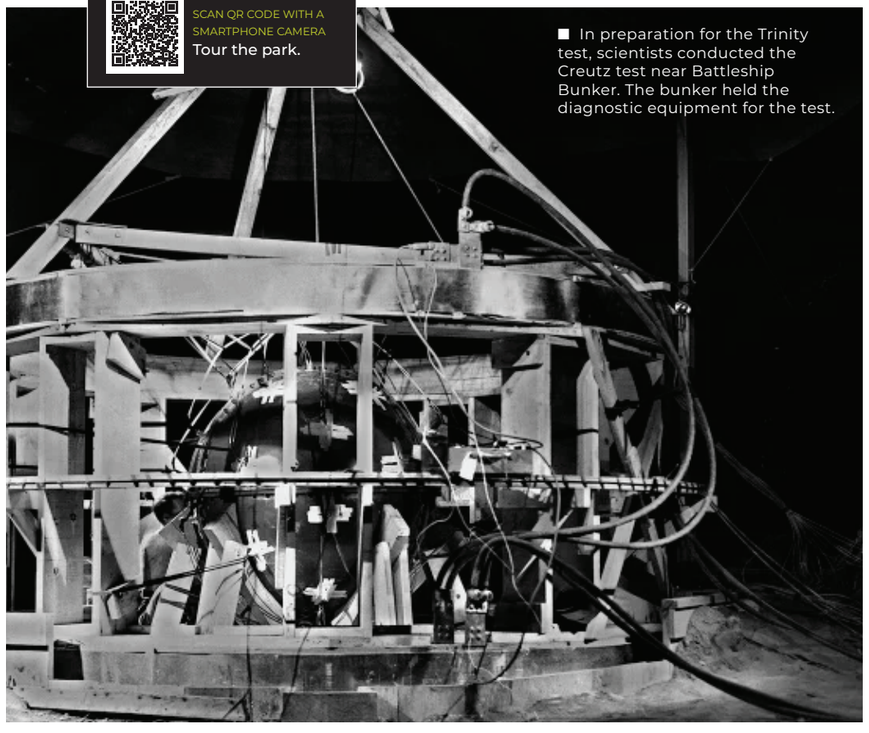
Restoring the buildings is a collaborative effort. "We have worked really closely with our craft staff [employees who handle maintenance, construction, and utility work] at the Lab to try to get these sites ready in a short amount of time," says program manager Cheryl Abeyta. As buildings are preserved, the goal is to maintain their historical integrity. Pond Cabin, for example, dates back to 1914, and is the oldest structure in the park. During its recent restoration, the original logs were preserved and new mortar was applied between them. Additionally, structural improvements repaired one side of the cabin that was sinking.

For the Slotin Building, refurbishment is more challenging because the building was used for Laboratory work as recently as 2015. During its many decades as a machining shop, partitions and equipment were installed. Today, yellow tape marks items that will be removed from the building. "The goal is to have it look almost exactly as it did in 1946, with replicas of the items from that time," says park ambassador David Miko.

Gregory is optimistic about future preservation efforts in the park. "We're getting funding, and we've got a strong strategic plan for preservation treatments on the buildings," she says. "I'm excited about the park, and I think it's got a bright future. ★

■ The Slotin Building as it appears today.

SCAN QR CODE WITH A SMARTPHONE CAMERA
Tour the park.



■ In preparation for the Trinity test, scientists conducted the Creutz test near Battleship Bunker. The bunker held the diagnostic equipment for the test.

■ The Battleship Bunker as it appears today.

Mark and Tim Byers

LEGACY

ALL IN THE FAMILY

A job offer back in the 1940s led to decades of employment for four generations.

BY JILL GIBSON

"Once upon a time when I was working on the Manhattan Project…"

It's not the typical bedtime story a young boy hears from his grandfather. Growing up, now-retired Los Alamos National Laboratory research technologist Mark Byers enjoyed hearing his grandfather, Ellis Byers, reminisce about the 1940s in Los Alamos. Ellis was a machinist, building parts for the first atomic bombs. He worked for the Laboratory until his retirement in 1965, establishing a family tradition that continues to this day.

It all began when Ellis, who was too old to enlist when World War II began, wanted to do his part for his country. So, he started a job working in weapons manufacturing at the Rock Island Arsenal in Illinois.

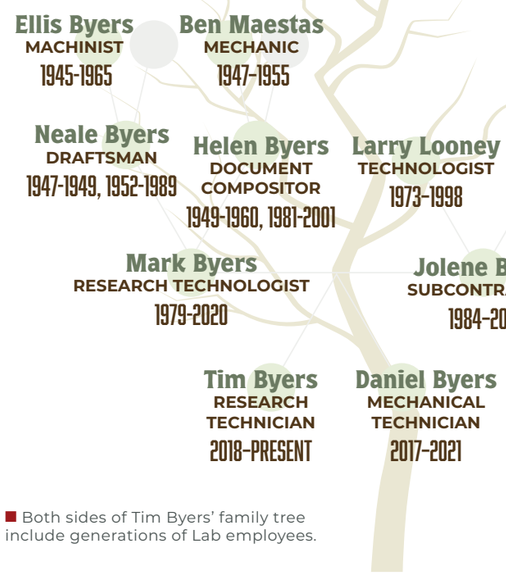
"What grandpa told me is that one day Army personnel showed up at the Arsenal looking for machinists," Mark explains. "They told him they needed machinists for a project that they said would end the war."

So, in 1945, Ellis packed up his family and moved to Los Alamos, where, as a machinist, he began manufacturing parts. "Grandpa used to tell me that somebody would bring him a blueprint to make a part, but he didn't know exactly what he was working on," Mark says. "He knew it was important, and it was some type of weapon, but he didn't know it was part of a bomb."

Both Mark and his son, Tim, a research technician in the Lab's Integrated Weapons Experiments group, point out that things at the Laboratory have changed since the '40s. "Back then, there was lots of secrecy because of the war, but the scientists at the Lab today explain things more than they did then," Mark says. "They go out of their way to make sure everyone on the team understands what they are working on. You ask a question, and they are more than willing to share information."

Tim nods in agreement. "It's a great work environment," he adds.

Tim remembers attending a Lab family day event when he was only eight years old. Now, he works at one of the same research locations he visited then. "Unlike people who start working here without understanding what the Lab does, I got to see what it was like as a kid," Tim says. "I'll probably end up retiring from Los Alamos."



Both sides of Tim Byers' family tree include generations of Lab employees.

Mark says that everyone in the family is proud of their contributions. "I think it's unique that we were all able to work at the same place, and so many of us were working here at the same time."

Right after the war, Mark says his grandfather left the Lab briefly. He told Mark he was shaken by the bombings in Japan and needed some time to consider whether he wanted to continue with that line of work. "Then he started thinking about how many relatives his family had lost in the war and how many might have died if the atomic bomb had not ended the fighting. That's when he decided to return to the Lab."

Mark glances at Tim. "Yeah, I'm proud of our family's work here," he says. "Plus, being able to see Tim get excited about his work is pretty nice." ★

Glow-in-the-dark Oppenheimer bust

INNOVATION

OPPENHEIMER IN 3D

Additive manufacturing technology brings Lab history to life.

BY JAKE BARTMAN

Like many modern technologies, 3D printing began as science fiction. In his 1945 short story *Things Pass By*, writer Murray Leinster described a process in which a robotic arm placed one layer of molten plastic on top of another to produce an object—a process that has since come to be known as additive manufacturing, or 3D printing. Although the concept didn't become feasible until the 1970s, in recent years 3D printing has been used to fabricate automobile parts, construction materials, and even human organs, with new applications ever on the horizon.

At Los Alamos National Laboratory, 3D printing is used to create components for experiments related to everything from space exploration to stockpile stewardship, which ensures the reliability of the nation's nuclear deterrent without resorting to nuclear testing. And it is also being used to make history tangible in a way that even Christopher Nolan's *Oppenheimer* film cannot.

Los Alamos' Visible team produces 3D simulations, videos, and other media that help elucidate aspects of the Laboratory's mission and history. In 2016, the team released an app, "The Secret City: Project Y," which allows users to explore 3D renderings of historic Manhattan Project sites. The app includes the Trinity site, where the world's first atomic detonation took place, and the Gun Site, where Little Boy—the bomb detonated above Hiroshima in August of 1945—was developed.

"The goal is to make history come alive a little bit and educate people about things in a fun way," says Jake Green, a 3D animator and game designer. "The idea is that if people see these sites in the app, not only does it educate them on the history of our country and the Laboratory, but it helps them realize there are so many historic things still around to explore."

On a whim, Green decided to try feeding graphics from the app into the Visible team's two 3D printers. The experiment resulted in scale plastic models of wartime Los Alamos, along with miniature busts of J. Robert Oppenheimer, the Manhattan Project's scientific director.

Prints such as these might make for exhibits at the Laboratory's Bradbury Science Museum or elsewhere. Recent updates to "The Secret City" app have improved the quality of its graphics, which means that Green can now print Oppenheimer busts that are almost life-size. His latest Oppie even glows in the dark. ★

"The Secret City: Project Y," and its companion app "Project Y Computing," are available for free and to the public on Apple's App Store and on Google Play.

THE MAN UNDER THE

PORKPIE HAT

Meet J. Robert Oppenheimer, father of the atomic bomb and the first director of Los Alamos National Laboratory.

BY EMILY SEYL

IN 1943, AT 38 YEARS OLD AND WITH NO PREVIOUS administrative experience, physicist J. Robert Oppenheimer accepted responsibility for a national security mission of unprecedented scale.

His charge, handed down by Manhattan Project director General Leslie Groves, was to lead a team of the world's foremost scientific minds in developing the first nuclear weapon. Under Oppenheimer's leadership, more than 6,000 scientists, engineers, and other personnel lived and worked at a top-secret lab in Los Alamos, New Mexico, and completed their task in only 27 months. Weeks later, they delivered the world's first two nuclear bombs to the U.S. military. World War II ended shortly thereafter.

Long before joining the Manhattan Project, Oppenheimer had a personal connection to northern New Mexico. Prone to illness in his youth, an 18-year-old Oppenheimer spent a restorative and formative summer at Los Piños ranch near Santa Fe. He returned often to the area in adulthood, even as a busy academic teaching physics at the University of California, Berkeley and California Institute of Technology.

The fall of 1942 found Oppenheimer back in New Mexico touring a potential site—Jemez Springs—for Project Y, the wartime codename for what would eventually become Los Alamos National Laboratory. Both Oppenheimer and Groves found Jemez Springs unsuitable, and Oppenheimer proposed a nearby alternative: Los Alamos, which he had once visited during a horse-packing trip. There, a few homesteads and a boys' boarding school sat on an isolated, nearly inaccessible plateau—the perfect location for a secret lab.

Within a few months, the federal government had acquired 50,000 acres of land, including the boy's school, which rushed to graduate its oldest students by January 1943. That spring, crews broke ground on the additional buildings necessary for a full-scale nuclear research laboratory.

Even before the construction dust settled, in March 1943, Oppenheimer and Groves began assembling a team of the world's brightest scientific minds. Oppenheimer, of course, was brilliant himself. An accomplished theoretical physicist, intellectual jack-of-all-trades, and a deep thinker well-read in Eastern philosophy, Oppenheimer was a guiding force in asking and answering the research questions that led to groundbreaking innovations at the Lab.

Though he had no shortage of expert advisors and team leaders, including more than a dozen current or future Nobel laureates, Oppenheimer bore the responsibility of making critical scientific and personnel decisions to keep the Lab on track and on schedule. Many who worked with Oppenheimer said that there was no other man for the job. His profound understanding of both nuclear physics and human nature made Oppenheimer a natural leader of his technical staff and an able keeper of the specialized research underway across the Lab's four divisions.

Oppenheimer's counsel continued to pave the way as Los Alamos reached a crossroads in mid-1944. Atomic

▲ J. Robert Oppenheimer

▲ Nestled high on the Pajarito Plateau, Project Y brought together Oppenheimer's two great loves: "physics and New Mexico." Here, Oppenheimer is pictured at his property near Pecos, New Mexico.
Photo: Niels Bohr Library & Archives.

"MY TWO GREATEST LOVES ARE PHYSICS AND NEW MEXICO."
—J. ROBERT OPPENHEIMER

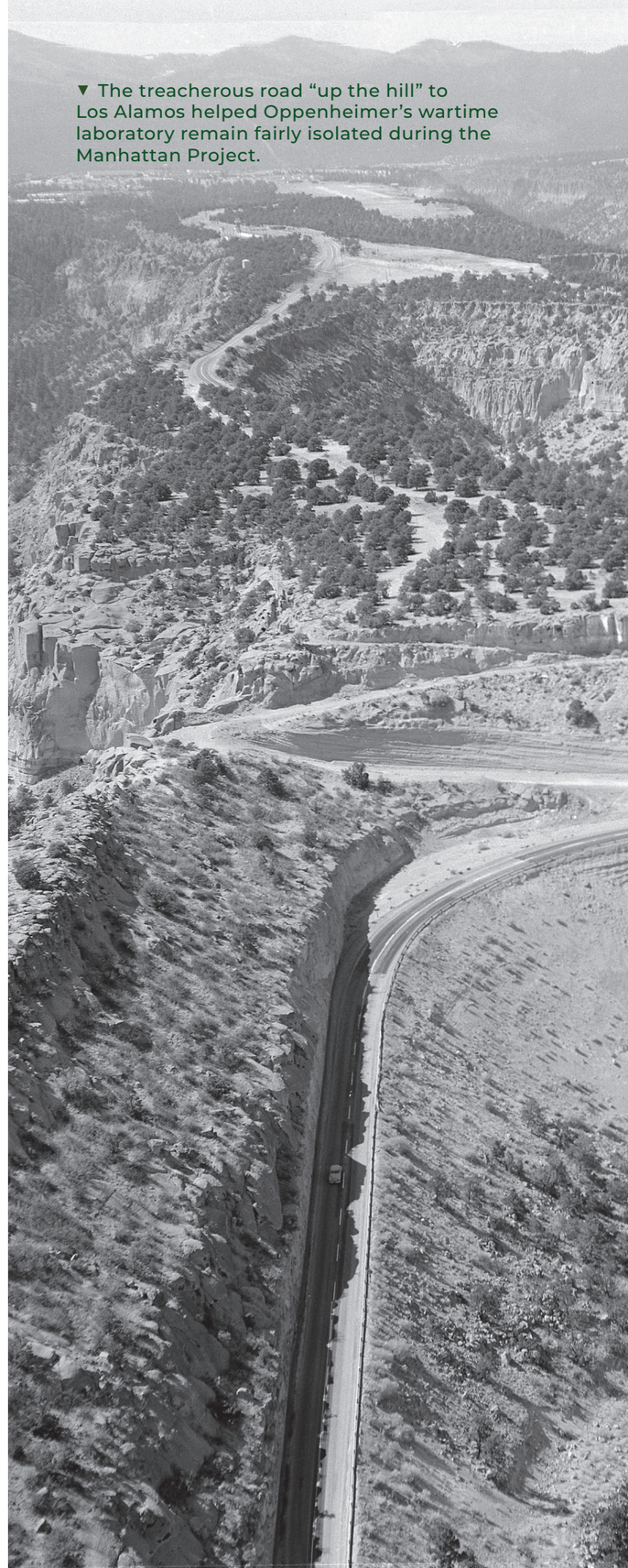
bomb design had been progressing along two lines: a gun-type uranium device called Little Boy and a gun-type plutonium device called Thin Man. After a series of failed experiments that were attributed to an incompatibility between the gun type mechanism and plutonium fuel, Oppenheimer gave the order to abandon the Thin Man design. He then raised two new divisions—Explosives and Weapons Physics—to design and build a complex and unproven imploding weapon. On July 20, 1944, he declared at an administrative board meeting that "all possible priority should be given to the implosion program."

The decision paid off. The Gadget—an implosion device with a plutonium core—was detonated on July 16, 1945, at the Trinity site in southern New Mexico. The successful design—patented by Oppenheimer—was replicated as Fat Man, one of two atomic bombs supplied to the U.S. military in August 1945.

The Little Boy and Fat Man atomic bombs were released above Japan on August 6 and 9, respectively. Japan surrendered shortly thereafter, and World War II officially ended on September 2, 1945.

The Manhattan Project was complete. On October 16, 1945, the Army-Navy E Award for excellence in war production was bestowed upon Oppenheimer and the scientists, engineers, military personnel, and others at the Lab whose patriotism "helped our country along the road to victory." On the day of this capstone event, Oppenheimer announced his resignation.

He would go on to serve in important advisory roles as the United States debated the future of nuclear research and the wartime lab at Los Alamos. ★



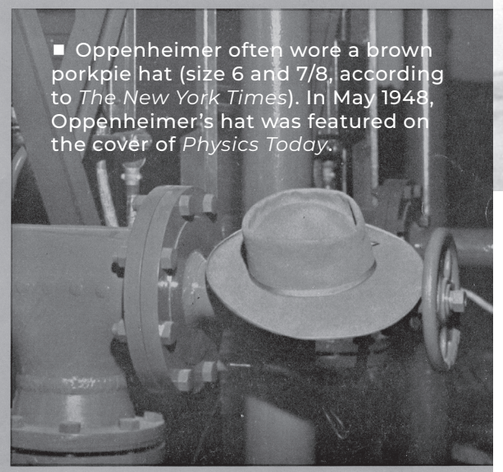
▼ The treacherous road "up the hill" to Los Alamos helped Oppenheimer's wartime laboratory remain fairly isolated during the Manhattan Project.

OPPENHEIMER AND

LEADERSHIP

“…LIKE MOST OF HIS STUDENTS, I WOULD MORE OR LESS FOLLOW HIM TO THE ENDS OF THE EARTH.”

—ROBERT CHRISTY

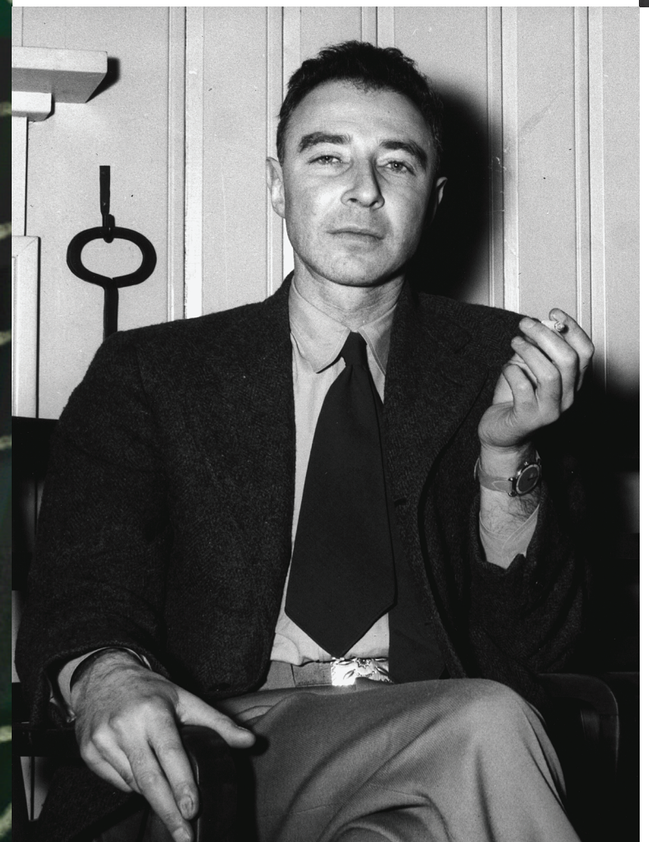


PHYSICS *today*

■ Oppenheimer often wore a brown porkpie hat (size 6 and 7/8, according to *The New York Times*). In May 1948, Oppenheimer’s hat was featured on the cover of *Physics Today*.

▲ Shortly after the end of World War II, General Groves called Oppenheimer a genius. “Why, Oppenheimer knows about everything,” he said. “He can talk to you about anything you bring up. Well, not exactly. I guess there are a few things he doesn’t know about. He doesn’t know about sports.”

► Oppenheimer’s charm is widely noted. Scientist Robert Christy remembered when Oppenheimer asked Christy to join him at the secret Los Alamos Lab. “I said I would be delighted because like most of his students, I would more or less follow him to the ends of the earth.”



“HIS MIND WAS SO QUICK AND HIS SPEECH SO FLUENT THAT HE DOMINATED NEARLY EVERY GATHERING.”

—ROBERT SERBER

◄ Oppenheimer smoked for most of his life and died in 1967 from throat cancer at the age of 62. One of Oppenheimer’s physics students at the University of California, Berkeley recalled that “the most distinctive feature of his lectures [was] his chain smoking. He spoke quite rapidly, and puffed equally rapidly. When one cigarette burned down to a fragment he no longer could hold, he extinguished it and lit another almost in a single motion.”

THE WHITE HOUSE
WASHINGTON

June 29, 1943

Secret

My dear Dr. Oppenheimer:

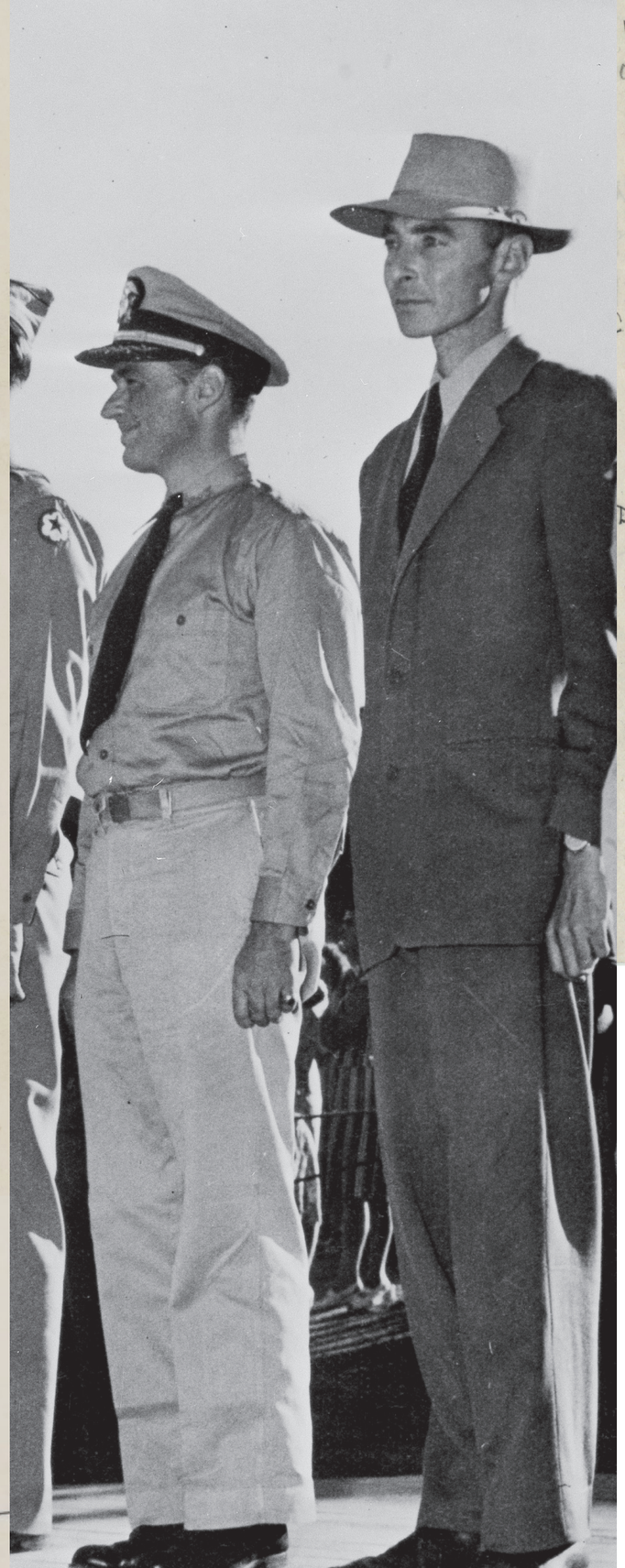
I have recently reviewed with Dr. Bush the highly important and secret program of research, development and manufacture with which you are familiar. I was very glad to hear of the excellent work which is being done in a number of places in this country under the immediate supervision of General L. R. Groves and the general direction of the Committee of which Dr. Bush is Chairman. The successful solution of the problem is of the utmost importance to the national safety, and I am confident that the work will be completed in as short a time as possible as the result of the wholehearted cooperation of all concerned.

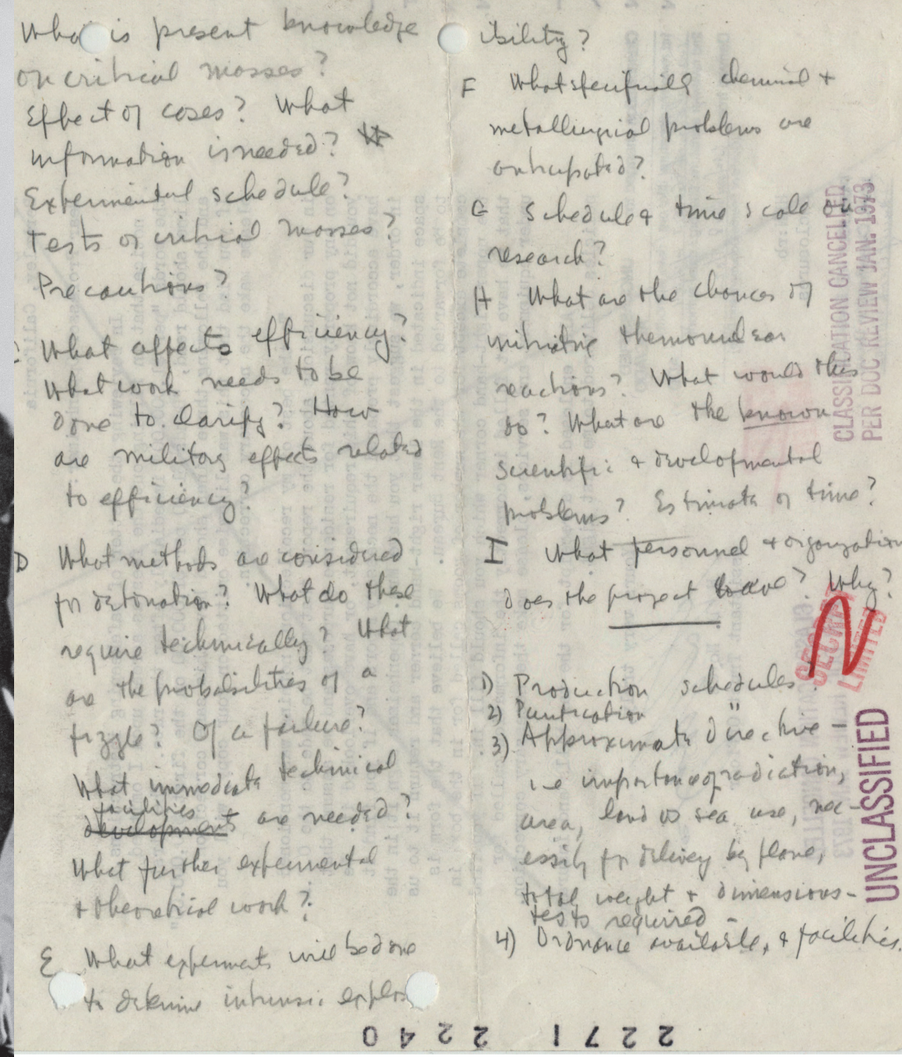
I am writing to you as the leader of one group which is to play a vital role in the months ahead. I know that you and your colleagues are working on a hazardous matter under unusual circumstances. The fact that the outcome of your labors is of such great significance to the nation requires that this program be even more drastically guarded than other highly secret war developments. I have therefore given directions that every precaution be taken to insure the security of your project and feel sure that those in charge will see that these orders are carried out. You are fully aware of the reasons why your own endeavors and those of your associates must be circumscribed by very special restrictions. Nevertheless, I wish you would express to the scientists assembled with you my deep appreciation of their willingness to undertake the tasks which lie before them in spite of the dangers and the personal sacrifices. I am sure we can rely on their continued wholehearted and unselfish labors. Whatever the enemy may be planning, American science will be equal to the challenge. With this thought in mind, I send this note of confidence and appreciation.

Though there are other important groups at work, I am writing only to you as the leader of the one which is operating under very special conditions, and to General Groves. While this letter is secret, the contents of it may be disclosed to your associates under a pledge of secrecy.

Very sincerely yours,

Franklin D. Roosevelt





▲ Before his arrival at Los Alamos, Oppenheimer recorded some thoughts about the challenges of Project Y on the back of a letter from his bank.

"I AM WRITING TO YOU AS THE LEADER OF ONE GROUP WHICH IS TO PLAY A VITAL ROLE IN THE MONTHS AHEAD."

—PRESIDENT FRANKLIN ROOSEVELT

◆ In a 1967 interview, Oppenheimer recalled meeting General Leslie Groves for the first time: "The first meeting with Groves was at the house of the president of the University for California. ... I said, 'This thing will never get on the rails unless there is a place where people can talk to each other and work together on the problems of the bomb. And this could be at Oak Ridge [Tennessee], it could be some California desert, but someplace, there has got to be a place where people are free to discuss what they know and what they do not know and to find out what they can.' And that made an impression on him."

OPPENHEIMER AND CREATING A TEAM AT

LOS ALAMOS

"THIS THING WILL NEVER GET ON THE RAILS UNLESS THERE IS A PLACE WHERE PEOPLE CAN TALK TO EACH OTHER."

—J. ROBERT OPPENHEIMER

▼ A portion of a letter from Oppenheimer regarding conditions of operations at Los Alamos.

You will note that these arrangements differ in some respects from those which I outlined in our discussions. I hope that you will not feel that the changes are such as to lead you, or those responsible to you, to reconsider your commitment to the project. You will also note from the enclosure that there are certain phases of the initial organization which have been determined for us. The essential reason for this is that our project is a part of a much larger one that involves a major national commitment. It is my hope that such restrictions as are imposed on us by this will in fact be a help to us rather than a hindrance.

In any event, we must get on with our work. I should like to hear from you at my Berkeley address promptly. I plan to move to the site in the near future and hope to see you there before long.

Very sincerely,

Robert Oppenheimer

◆ Oppenheimer's badge photo was taken in 1943 as he began his directorship at the top-secret lab in northern New Mexico.

FINAL DETERMINATION

NATIONAL ★ SECURITY SCIENCE

▲ Oppenheimer's McKibbin card (as Laboratory personnel cards were called in reference to their issuer, Dorothy McKibbin) notes his date of final departure from Los Alamos. The cards were employment verification and were issued to every Lab employee during the Manhattan Project era.

▼ In 1929, a log and stone cottage was built at 1967 Peach Street in Los Alamos. Part of the Los Alamos Ranch School, the house was called Master's Cottage #2. During the Manhattan Project, the Oppenheimers occupied the house from April 1943 to October 1945. In 2020, the house became part of the Los Alamos Historical Society, which is working to restore the structure and open it to the public.

▲ Dorothy McKibbin, Oppenheimer, and Victor Weisskopf enjoy a party at the Oppenheimer house.

OPPENHEIMER AND THE REALIZATION OF THEORY

◆ The only known imagery of Oppenheimer's wartime office at Los Alamos is part of the collections of the Laboratory's National Security

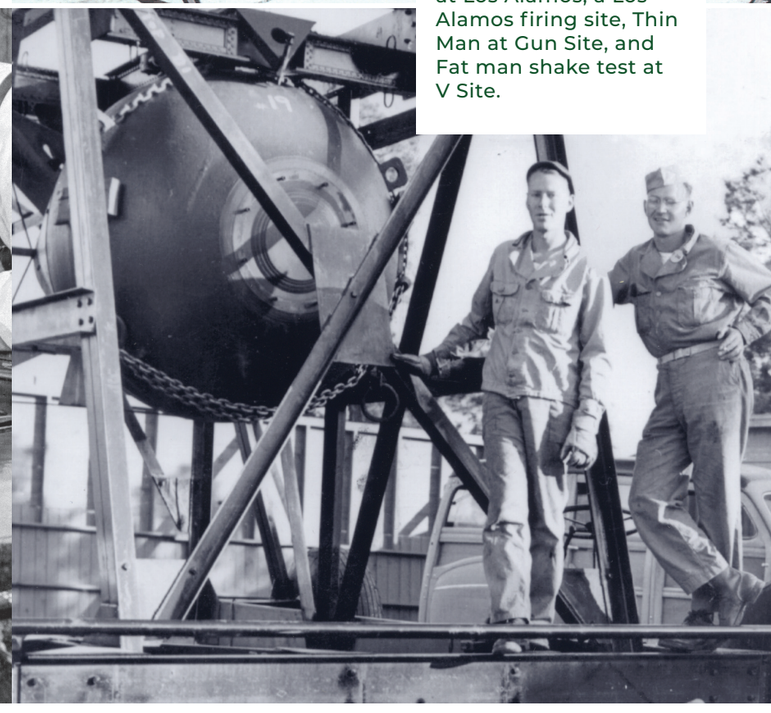
◂ Oppenheimer's military issued chair was made by the B.L. Marble Company and is currently on display in the National Security Research Center. The chair, available in catalogs from 1930 to 1943, was typically offered in a stained birch color. Oppenheimer's chair, however, is green, which means the color was likely customized.

"I KNEW ANYTHING HE WAS CONNECTED WITH WOULD BE ALIVE."

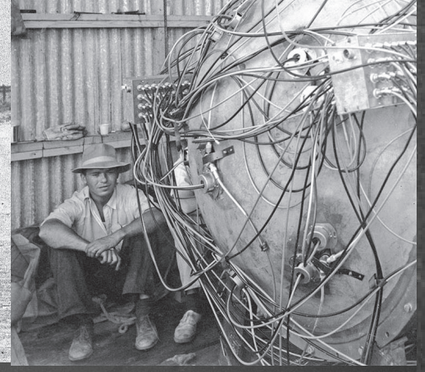
—DOROTHY McKIBBIN

◆ These Manhattan Era photos are from various scientific sites at Los Alamos. Clockwise from upper left: Harvard Cyclotron at Los Alamos, a Los Alamos firing site, Thin Man at Gun Site, and Fat man shake test at V Site.

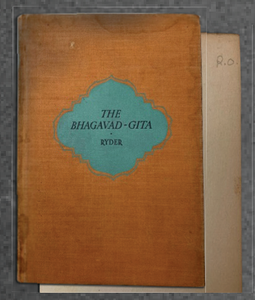
◆ Dorothy McKibbin, J. Robert Oppenheimer, and Victor Weisskopf enjoy a party at the Oppenheimer house. During the Manhattan Project, Oppenheimer often hosted parties and informal gatherings at his Los Alamos home. One guest, Pat Sherr, remembered, "He served the most delicious and coldest martinis." Oppenheimer's martini recipe was four ounces of gin and a dash of vermouth; the rim of the chilled glass was dipped in honey and lime juice. Oppenheimer is pictured here in 1946 at a party at his Los Alamos home (he had moved out of it by then).



OPPENHEIMER, FROM THEORY TO TESTING

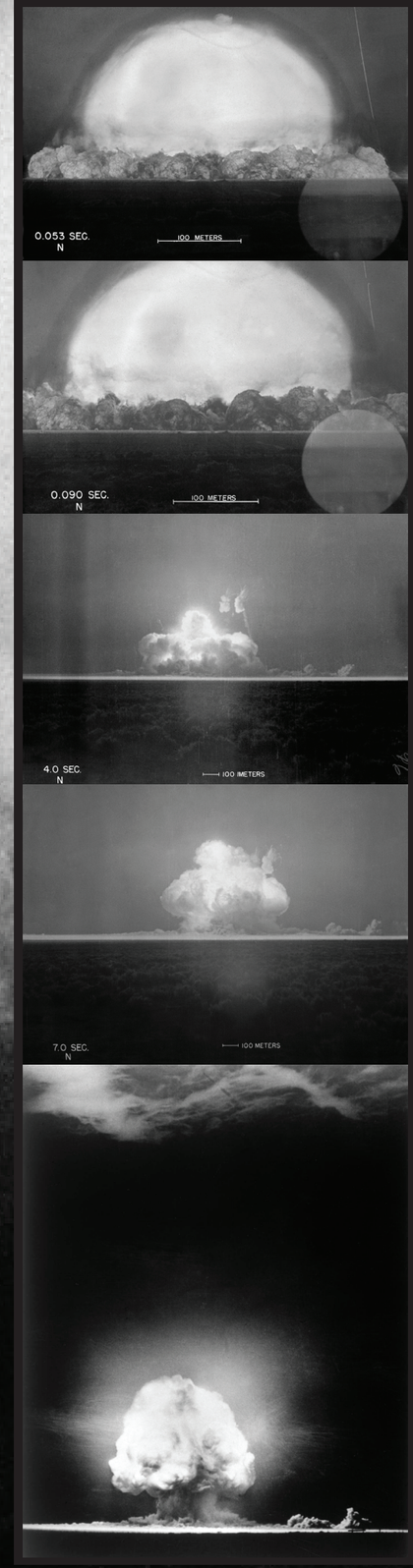


◆ Oppenheimer oversees the final assembly of the Gadget.



▲ Oppenheimer's copy of *Bhagavad Gita*, translated from Hindu to English by Arthur Ryder, is part of the collections at the Lab's Bradbury Science Museum. Oppenheimer's handwritten initials appear in the upper right corner of the front endpapers. After the successful Trinity test, Oppenheimer was said to have recalled the line: "Now I am become death, destroyer of worlds."

► In 1962, Manhattan Project leader General Leslie Groves wrote to Oppenheimer to ask about the origins of the name Trinity. According to a copy of the letter that is a part of the collections of the Lab's National Security Research Center, Oppenheimer said, "Why I chose the name is not clear, but I know what thoughts were in my mind. There is a poem of John Donne, written just before his death, which I know and love." Oppenheimer then quoted the sonnet "Hymn to God, My God, in My Sickness" about a man unafraid to die because he believed in resurrection. Oppenheimer continued, "That still does not make a Trinity, but in another, better known devotional poem Donne opens, 'Batter my heart, three person'd God.' Beyond this, I have no clues whatever." Here, Oppenheimer and Groves are pictured at the Trinity site in September 1945.



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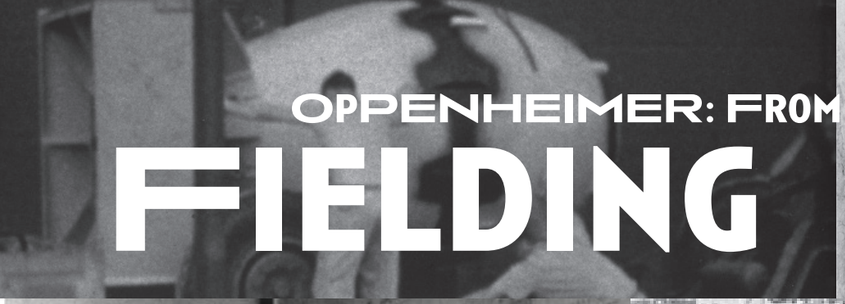
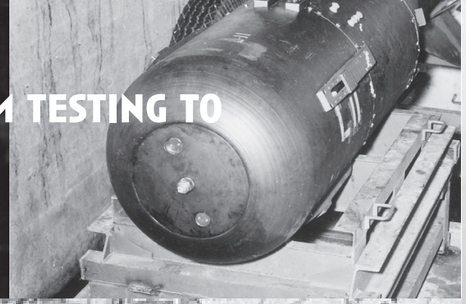
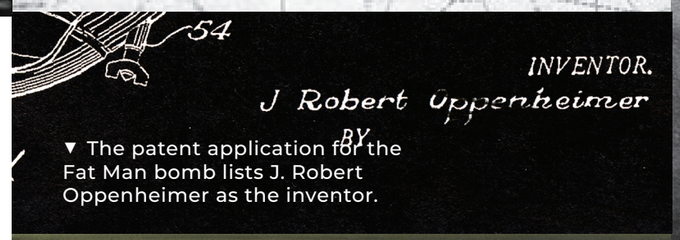
OPPENHEIMER: FROM TESTING TO

FIELDING







54

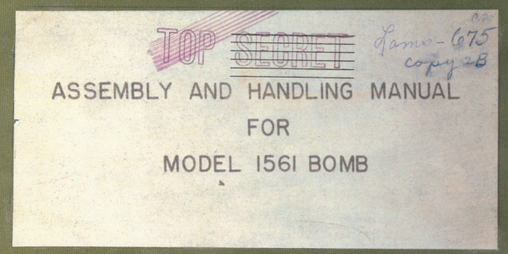
INVENTOR.

J Robert Oppenheimer

BY

▼ The patent application for the Fat Man bomb lists J. Robert Oppenheimer as the inventor.

▼ A recently rediscovered 149-page manual includes detailed drawings that show how to assemble the Fat Man bomb. The manual is the only known copy of the 25 originals that still exists.



TOP SECRET

Lamx-675
copy 2B

ASSEMBLY AND HANDLING MANUAL

FOR

MODEL 1561 BOMB

"I KNEW SUCCESS WAS POSSIBLE. I LEARNED THIS AS I WORKED WITH THE PEOPLE AT THE MANHATTAN DISTRICT, PARTICULARLY DR. OPPENHEIMER AND THE PEOPLE AT LOS ALAMOS."

—COLONEL PAUL TIBBETS, PILOT OF THE ENOLA GAY

THIS IS A WARNING TO THE JAPANESE PEOPLE!
LEAVE THIS CITY IMMEDIATELY!

The contents of this flyer are very important. The Japanese people are facing a very significant change. Your Military rulers were presented the opportunity to stop this pointless war in the Thirteen Articles of the Joint Resolution. Your Military Rulers refused. For this reason the Soviet Union has declared war on Japan. Further, the United States has invented and tested a most formidable weapon, the atomic bomb, even though it was thought impossible. This atomic bomb, alone, is as destructive as the usual bomb load of two-thousand B-29's. (end of first page)

You will know this is true when you have seen the devestation caused by only one atomic bomb dropped on Hiroshima. The Japanese military is causing this pointless war to continue, so we are going to destroy them with this fearsome weapon. Before the United States uses many of these atomic bombs on Japan we wish the Japanese people would petition the Emporer to stop this war.

The President of the United States has announced the Thirteen Articles of the Joint Declaration and hopes the Japanese people will accept these Articles very soon, become a peace loving people and build a new Japan. The Japanese people must stop their military resistance now. If you do not stop this war the United States will be forced to use the atomic bomb and other superior military weapons.

LEAVE THIS CITY IMMEDIATELY!

WORLD WAR II ENDS WITH JAPAN'S

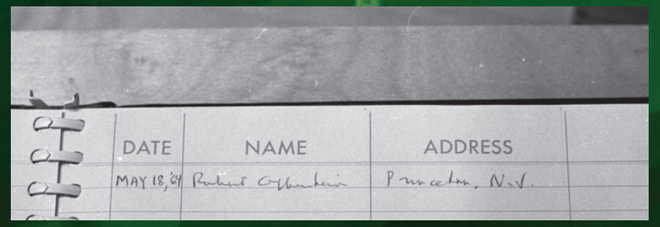
SURRENDER

OPPENHEIMER'S RETURN TO

LOS ALAMOS

◄ On May 18, 1964, Oppenheimer returned to Los Alamos for the first time since 1945. In addition to visiting the Laboratory, he gave an evening lecture at the Civic Auditorium in Los Alamos High School. According to the June 1964 issue of *The Atom* magazine, "Oppenheimer received a standing ovation as he approached the lectern and again when he finished his speech." He spoke about Danish physicist Niels Bohr, winner of the 1922 Nobel Prize in Physics.

▲ Norris Bradbury (left) and J. Robert Oppenheimer both served as directors for what is now known as Los Alamos National Laboratory. They are pictured here in 1964.

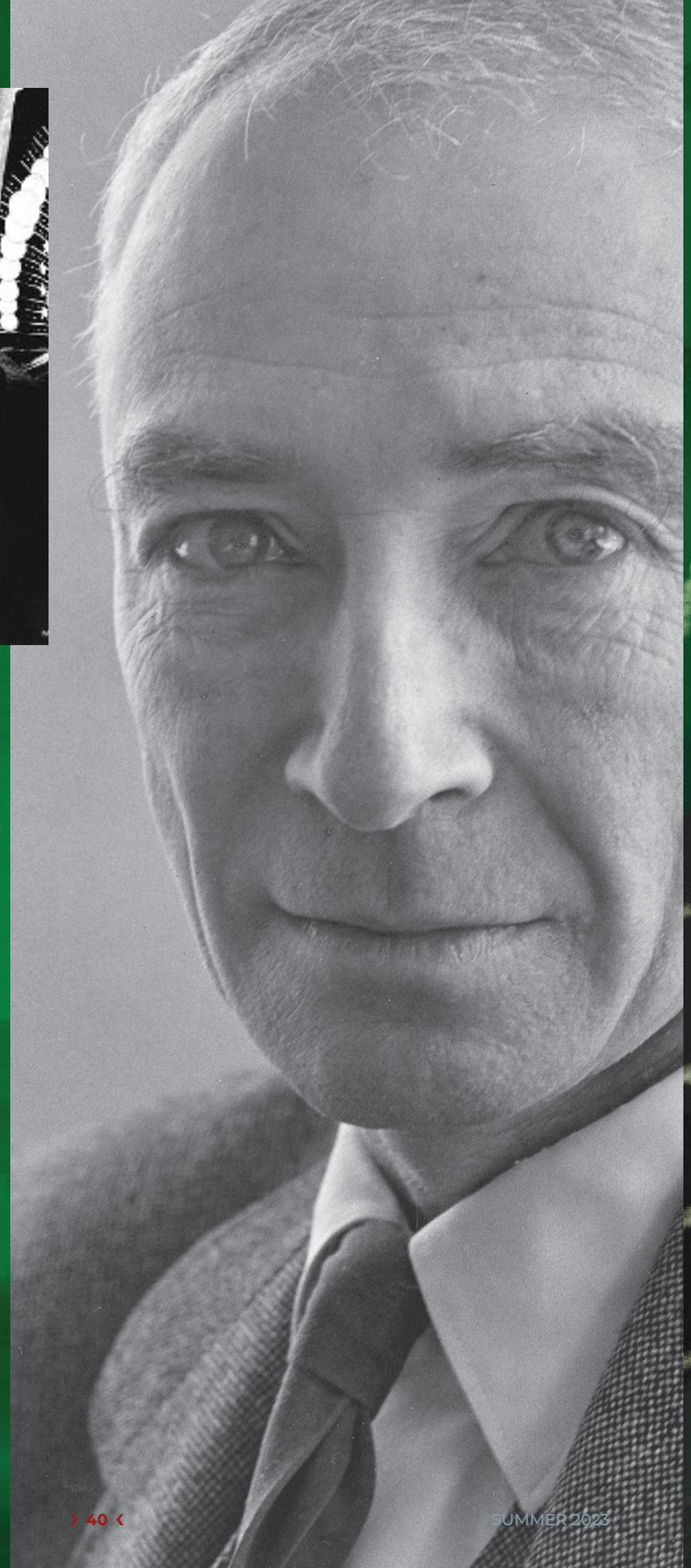


SCAN QR CODE WITH A SMARTPHONE CAMERA
Listen to audio of Oppenheimer's speech.

▲ Nearly a decade after his security clearance was revoked, Oppenheimer received the Enrico Fermi Award from the Atomic Energy Commission on December 2, 1963. The award recognized Oppenheimer's "unique role in the development of physics in the United States, as a teacher, as an originator of several fundamental concepts and as the administrator under whose leadership the atomic bomb was successfully developed at Los Alamos Scientific Laboratory during World War II" and came with $50,000.

"One of President Kennedy's most important acts was to sign the Enrico Fermi Award for Dr. Oppenheimer for his contributions to theoretical physics and the advancement of science in the United States of America," explained President Lyndon Johnson, who presented the award to Oppenheimer in the wake of Kennedy's death just 10 days prior.

Upon receipt of the award, Oppenheimer said: "I think it just possible, Mr. President, that it has taken some charity and some courage for you to make this award today. That would seem to be a good augury for all our futures."



OPPENHEIMER, THE

LEGACY

► Oppenheimer's obituary, which was published in *The New York Times*, explains that "J. (for nothing) Robert Oppenheimer lived the remainder of his life [after the 1945 Trinity test] in the blinding light and the crepusculine [sic] shadow of the world's first manmade atomic explosion, an event for which he was largely responsible."

► The letter J in Oppenheimer's first name is still a mystery. Most sources—including Oppenheimer's own birth certificate and a 1944 letter from the War Department granting Oppenheimer his security clearance—state that Oppenheimer's first name was Julius. Numerous other people, though—including Oppenheimer himself— insisted the J didn't stand for anything at all. In a 1946 letter to the U.S. Patent Office, Oppenheimer wrote: "This is to certify that I have no first name other than the letter J, and that my full and correct name is J Robert Oppenheimer."

50c beyond 50-mile zone from New York on Long Island, higher in air

J. Robert Oppenheimer, Atom Bomb Pioneer, Dies

Physicist Cancer Victim —Censured and Later Honored by the A.E.C.

Special to The New York Times

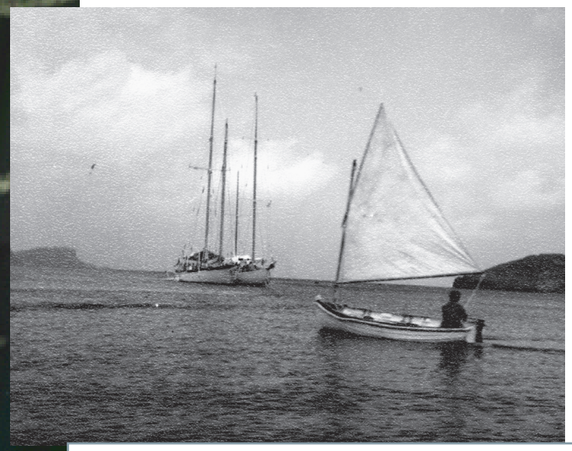
PRINCETON, N. J., Feb. 18 —Dr. J. Robert Oppenheimer, the nuclear physicist, died here tonight at the age of 62.

A spokesman for the family said Dr. Oppenheimer died at 8 o'clock in his home on the grounds of the Institute for Advanced Study. He had been ailing since early last year with cancer of the throat.

The physicist took part in the development of the first atomic bomb.

In 1954 he was stripped of security clearance by the Atomic Energy Commission because of alleged association with Communists.

The same agency nine years later awarded Dr. Oppenheimer



◄ Oppenheimer died at his New Jersey home February 18, 1967, after unsuccessful treatments for throat cancer. He was 62, survived by his wife, Kitty, and their two children. Kitty spread his ashes near their simple beach home in the U.S. Virgin Islands (pictured), following a memorial service at Princeton University.
Photo: Kitty Oppenheimer and J. Robert Oppenheimer Memorial Committee

Interested in learning more about the Lab's first director and its wartime history? A documentary on J. Robert Oppenheimer, created by the Lab's National Security Research Center and based on its collections from the Manhattan Project era as well as interviews with today's Lab staff and Oppenheimer experts, will be released in July 2023. ★

SCAN QR CODE WITH A SMARTPHONE CAMERA
Watch trailer.

OPPENHEIMER'S

FAREWELL

TO LOS ALAMOS

Oppenheimer's speech to the Association of Los Alamos Scientists on November 2, 1945, was delivered shortly after Oppenheimer resigned as Los Alamos director.

I am grateful to the executive committee for this chance to talk to you. I should like to talk tonight—if some of you have long memories perhaps you will regard it as justified—as a fellow scientist, and at least, as a fellow worrier about the fix we are in.

I do not have anything very radical to say, or anything that will strike most of you with a great flash of enlightenment. I don't have anything to say that will be of an immense encouragement. In some ways, I would have liked to talk to you at an earlier date, but I couldn't talk to you as a director. I could not talk, and will not tonight talk, too much about the practical political problems which are involved. There is one good reason for that: I don't know very much about practical politics.

And there is another reason, which has to some extent restrained me in the past. As you know, some of us have been asked to be technical advisors to the secretary of war, and through him to the president. In the course of this, we have naturally discussed things that were on our minds and have been made, often very willingly, the recipient of confidences. It is not possible to speak in detail about what Mr. A thinks and Mr. B doesn't think, or what is going to happen next week, without violating these confidences. I don't think that's important.

I think there are issues which are quite simple and quite deep, and which involve us as a group of scientists—involve us more, perhaps than any other group in the world. I think that it can only help to look a little at what our situation is—at what has happened to us—and that this must give us some honesty, some insight, which will be a source of strength in what may be the not-too-easy days ahead. I would like to take it as deep and serious as I know how, and then perhaps come to more immediate questions in the course of the discussion later. I want anyone who feels like it to ask me a question, and if I can't answer it, as will often be the case, I will just have to say so.

What has happened to us, it is really rather major. It is so major that I think in some ways one returns to the greatest developments of the 20th century, to the discovery of relativity, and to the whole development of atomic theory and its interpretation in terms of complementarity, for analogy.

These things, as you know, forced us to reconsider the relations between science and common sense. They forced on us the recognition that the fact that we were in the habit of talking a certain language and using certain concepts did not necessarily imply that there was anything in the real world to correspond to these. They forced us to be prepared for the inadequacy of the ways in which human beings attempted to deal with reality, for that reality. In some ways I think these virtues, which scientists quite reluctantly were forced to learn by the nature of the world they were studying, may be useful even today in preparing us for somewhat more radical views of what the issues are than would be natural or easy for people who had not been through this experience.

But the real impact of the creation of the atomic bomb and atomic weapons—to understand that one has to look further back, look, I think, to the times when physical science was growing in the days of the renaissance, and when the threat that science offered was felt so deeply throughout the Christian world.

The analogy is, of course, not perfect. You may even wish to think of the days in the last century when the theories of evolution seemed a threat to the values by which men lived. The analogy is not perfect because there is nothing in atomic weapons—there is certainly nothing that we have done here or in the physics or chemistry that immediately preceded our work here—in which any revolutionary ideas were involved. I don't think that the conceptions of nuclear fission have strained any man's attempts to understand them, and I don't feel that any of us have really learned, in a deep sense, very much from following this up.

It is in a quite different way. It is not an idea, it is a development and a reality, but it has in common with the early days of physical science the fact that the very existence of science is threatened, and its value is threatened. This is the point that I would like to speak a little about.

I think that it hardly needs to be said why the impact is so strong. There are three reasons:

One is the extraordinary speed with which things which were right on the frontier of science were translated into terms where they affected many living people, and potentially all people.

Another is the fact, quite accidental in many ways, and connected with the speed, that scientists themselves played such a large part, not merely in providing the foundation for atomic weapons, but in actually making them. In this we are certainly closer to it than any other group.

The third is that the thing we made—partly because of the technical nature of the problem, partly because we worked hard, partly because we had good breaks—really arrived in the world with such a shattering reality and suddenness that there was no opportunity for the edges to be worn off.

In considering what the situation of science is, it may be helpful to think a little of what people said and felt of their motives in coming into this job. One always has to worry that what people say of their motives is not adequate. Many people said different things, and most of them, I think, had some validity.

There was, in the first place, the great concern that our enemy might develop these weapons before we did, and the feeling, at least, in the early days, the very strong feeling, that without atomic weapons it might be very difficult, it might be an impossible, it might be an incredibly long thing, to win the war. These things wore off a little as it became clear that the war would be won in any case.

Some people, I think, were motivated by curiosity, and rightly so; and some by a sense of adventure, and rightly so. Others had more political arguments and said, "Well, we know that atomic weapons are in principle possible, and it is not right that the threat of their unrealized possibility should hang over the world. It is right that the world should know what can be done in their field and deal with it." And the people added to that, that it was a time when, all over the world, men would be particularly ripe and open for dealing with this problem, because of the immediacy of the evils of war, because of the universal cry from everyone that one could not go through this thing again, even a war without atomic bombs.

And there was finally, and I think rightly, the feeling that there was probably no place in the world where the development of atomic weapons would have a better chance of leading to a reasonable solution, and a smaller chance of leading to disaster, than within the United States. I believe all these things that people said are true, and I think I said them all myself at one time or another.

But when you come right down to it, the reason that we did this job is because it was an organic necessity. If you are a scientist, you cannot stop such a thing. If you are a scientist, you believe that it is good to find out how the world works; that it is good to find out what the realities are; that it is good to turn over to mankind at large the greatest possible power to control the world, and to deal with it according to its lights and its values.

There has been a lot of talk about the evil of secrecy, of concealment, of control, of security. Some of that talk has been on a rather low plane, limited really to saying that it is difficult or inconvenient to work in a world where you are not free to do what you want. I think that the talk has been justified, and that the almost unanimous resistance of scientists to the imposition of control and secrecy is a justified position, but I think that the reason for it may lie a little deeper. I think that it comes from the fact that secrecy strikes at the very root of what science is, and what it is for.

It is not possible to be a scientist unless you believe that it is good to learn. It is not good to be a scientist, and it is not possible, unless you think that it is of the highest value to share your knowledge, to share it with anyone who is interested. It is not possible to be a scientist unless you believe that the knowledge of the world, and the power which this gives, is a thing which is of intrinsic value to humanity, and that you are using it to help in the spread of knowledge, and are willing to take the consequences.

> "THERE EXISTS A POSSIBILITY OF REALIZING, OF BEGINNING TO REALIZE, THOSE CHANGES WHICH ARE NEEDED IF THERE IS TO BE ANY PEACE."
>
> —J. ROBERT OPPENHEIMER

And, therefore, I think that this resistance, which we feel and see all around us, to anything which is an attempt to treat science of the future as though it were rather a dangerous thing, a thing that must be watched and managed, is resisted not because of its inconvenience—I think we are in a position where we must be willing to take any inconvenience—but resisted because it is based on a philosophy incompatible with that by which we live, and have learned to live in the past.

There are many people who try to wiggle out of this. They say the real importance of atomic energy does not lie in the weapons that have been made; the real importance lies in all the great benefits which atomic energy, which the various radiations, will bring to mankind. There may be some truth in this. I am sure that there is truth in it, because there has never in the past been a new field opened up where the real fruits of it have not been invisible at the beginning. I have a very high confidence that the fruits—the so-called peacetime applications—of atomic energy will have in them all that we think, and more.

There are others who try to escape the immediacy of this situation by saying that, after all, war has always been very terrible; after all, weapons have always gotten worse and worse; that this is just another weapon and it doesn't create a great change; that they are not so bad; bombings have been bad in this war and this is not a change in that—it just adds a little to the effectiveness of bombing; that some sort of protection will be found.

I think that these efforts to diffuse and weaken the nature of the crisis make it only more dangerous. I think it is for us to accept it as a very grave crisis, to realize that these atomic weapons which we have started to make are very terrible, that they involve a change, that they are not just a slight modification: to accept this, and to accept with it the necessity for those transformations in the world which will make it possible to integrate these developments into human life. As scientists, I think we have perhaps a little greater ability to accept change, and accept radical change, because of our experiences in the pursuit of science. And that may help us—that, and the fact that we have lived with it—to be of some use in understanding these problems.

It is clear to me that wars have changed. It is clear to me that if these first bombs—the bomb that was dropped on Nagasaki—that if these can destroy ten square miles, then that is really quite something. It is clear to me that they are going to be very cheap if anyone wants to make them; it is clear to me that this is a situation where a quantitative change, and a change in which the advantage of aggression compared to defense—of attack compared to defense—is shifted, where this quantitative change has all the character of a change in quality, of a change in the nature of the world. I know that whereas wars have become intolerable, and the question would have been raised and would have been pursued after this war, more ardently than after the last, of whether there was not some method by which they could be averted.

◆ On October 16, 1945, in a ceremony at Fuller Lodge in Los Alamos, the Army and Navy presented the E Flag Production Award to the team of scientists, engineers, military personnel, academics, and others who worked at the secret Project Y site in northern New Mexico, helping end World War II.

The flag dates to the early 20th century, when it was a Navy award. During World War II, the award was combined with awards presented by the Army and the Army-Navy Munitions Board. The E Flag recognized exceptional performance in the production of war equipment, and the combined award was given only between 1942 and 1945.

Pictured here are J. Robert Oppenheimer, Army General Leslie Groves, University of California President Robert Sproul, and Navy Commodore William "Deak" Parsons.

But I think the advent of the atomic bomb, and the facts which will get around that they are not too hard to make—that they will be universal if people wish to make them universal, that they will not constitute a real drain on the economy of any strong nation, and that their power of destruction will grow, and is already incomparably greater than that of any other weapon—I think these things create a new situation, so new that there is some danger, even some danger in believing, that what we have is a new argument for arrangements, for hopes, that existed before this development took place.

By that, I mean that much as I like to hear advocates of a world federation, or advocates of a United Nations organization, who have been talking of these things for years—much as I like to hear them say that here is a new argument, I think that they are in part missing the point, because the point is not that atomic weapons constitute a new argument. There have always been good arguments. The point is that atomic weapons constitute also a field, a new field, and a new opportunity for realizing preconditions.

I think when people talk of the fact that this is not only a great peril, but a great hope, this is what they should mean. I do not think they should mean the unknown, though sure, value of industrial and scientific virtues of atomic energy, but rather the simple fact that in this field, because it is a threat, because it is a peril, and because it has certain special characteristics, to which I will return, there exists a possibility of realizing, of beginning to realize, those changes which are needed if there is to be any peace.

> "IT IS NOT POSSIBLE TO BE A SCIENTIST UNLESS YOU BELIEVE IT IS GOOD TO LEARN."
> —J. ROBERT OPPENHEIMER

Those are very far-reaching changes. They are changes in the relations between nations, not only in spirit, not only in law, but also in conception and feeling. I don't know which of these is prior; they must all work together, and only the gradual interaction of one on the other can make a reality. I don't agree with those who say the first step is to have a structure of international law. I don't agree with those who say the only thing is to have friendly feelings. All of these things will be involved.

I think it is true to say that atomic weapons are a peril which affect everyone in the world, and in that sense a completely common problem, as common a problem as it was for the Allies to defeat the Nazis. I think that in order to handle this common problem there must be a complete sense of community responsibility. I do not think that one may expect that people will contribute to the solution of the problem until they are aware of their ability to take part in the solution.

I think that it is a field in which the implementation of such a common responsibility has certain decisive advantages. It is a new field, in which the position of vested interests in various parts of the world is very much less serious than in others. It is serious in this country, and that is one of our problems. It is a new field, in which the role of science has been so great that it is, to my mind, hardly thinkable that the international traditions of science, and the fraternity of scientists, should not play a constructive part. It is a new field, in which just the novelty and the special characteristics of the technical operations should enable one to establish a community of interest, which might almost be regarded as a pilot plant, for a new type of international collaboration.

I speak of it as a pilot plant because it is quite clear that the control of atomic weapons cannot be, in itself, the unique end of such operation. The only unique end can be a world that is united, and a world in which war will not occur. But those things don't happen overnight, and in this field it would seem that one could get started, and get started without meeting those insuperable obstacles which history has so often placed in the way of any effort of cooperation.

Now, this is not an easy thing, and the point I want to make, the one point I want to hammer home, is what an enormous change in spirit is involved. There are things which we hold very dear, and I think rightly hold very dear; I would say that the word 'democracy' perhaps stood for some of them, as well as any other word. There are many parts of the world in which there is no democracy.

There are other things which we hold dear, and which we rightly should. And when I speak of a new spirit in international affairs, I mean that even to these deepest of things which we cherish, and for which Americans have been willing to die—and certainly most of us would be willing to die—even in these deepest things, we realize that there is something more profound than that; namely, the common bond with other men everywhere.

It is only if you do that, that this makes sense; because if you approach the problem and say, "We know what is right and we would like to use the atomic bomb to persuade you to agree with us," then you are in a very weak position, and you will not succeed, because under those conditions you will not succeed in delegating responsibility for the survival of men. It is a purely unilateral statement; you will find yourselves attempting by force of arms to prevent a disaster.

I want to express the utmost sympathy with the people who have to grapple with this problem, and, in the strongest terms, to urge you not to underestimate its difficulty. I can think of an analogy, and I hope it is not a completely good analogy: in the days in the first half of the 19th century, there were many people, mostly in the North, but some in the South, who thought that there was no evil on earth more degrading than human slavery, and nothing that they would more willingly devote their lives to than its eradication.

Always when I was young, I wondered why it was that when Lincoln was president he did not declare that the war against the South, when it broke out, was a war that slavery should be abolished, that this was the central point, the rallying point, of that war. Lincoln was severely criticized by many of the abolitionists, as you know, by many then called radicals, because he seemed to be waging a war which did not hit the thing that was most important.

But Lincoln realized, and I have only in the last months come to appreciate the depth and wisdom of it, that beyond the issue of slavery was the issue of the community of the people of the country, and the issue of the Union. I hope that today this will not be an issue calling for war; but I wanted to remind you that in order to preserve the Union, Lincoln had to subordinate the immediate problem of the eradication of slavery, and trust—and I think if he had had his way it would have gone so—to the conflict of these ideas in a united people to eradicate it.

These are somewhat general remarks, and it may be appropriate to say one or two things that are a little more programmatic, that are not quite so hard to get one's hands on. That is, what sort of agreement between nations would be a reasonable start. I don't know the answer to this, and I am very sure that no a priori answer should be given, that it is something that is going to take constant working out. But I think it is a thing where it will not hurt to have some reasonably concrete proposal.

And I would go a step further and say of even such questions as the great question of secrecy—which perplexes scientists and other people—that even this was not a suitable subject for unilateral action. If atomic energy is to be treated as an international problem, as I think it must be, if it is to be treated on the basis of an international responsibility and an international common concern, the problems of secrecy are also international problems. I don't mean by that that our present classifications and our present, in many cases inevitably ridiculous, procedures should be maintained. I mean that the fundamental problem of how to treat this peril ought not to be treated unilaterally by the United States, or by the United States in conjunction with Great Britain.

The first thing I would say about any proposals is that they ought to be regarded as interim proposals, and that whenever they are made, it be understood and agreed that within a year, or two years—whatever seems a reasonable time—they will be reconsidered, and the problems which have arisen, and the new developments which have occurred, will cause a rewriting. I think the only point is that there should be a few things in these proposals which will work in the right direction, and that the things should be accepted without forcing all of the changes, which we know must ultimately occur, upon people who will not be ready for them.

This is anyone's guess, but it would seem to me that if you took these four points, it might work:

First, that we are dealing with an interim solution, so recognized.

Second, that the nations participating in the arrangement would have a joint atomic energy commission, operating under the most broad directives from the different states, but with a power which only they had, and which was not subject to review by the heads of State, to go ahead with those constructive applications of atomic energy which we would all like to see developed—energy sources, and the innumerable research tools which are immediate possibilities.

Third, that there would be not merely the possibility of exchange of scientists and students; that very, very concrete machinery more or less forcing such exchange should be established, so that we would be quite sure that the fraternity of scientists would be strengthened, and that the bonds on which so much of the future depends would have some reinforcement and some scope.

And fourth, I would say that no bombs be made.

I don't know whether these proposals are good ones, and I think that anyone in this group would have his own proposals. But I mention them as very simple things, which I don't believe solve the problem, and which I want to make clear are not the ultimate, or even a touch of the ultimate, but which I think ought to be started right away; which I believe—though I know very little of this—may very well be acceptable to any of the nations that wish to become partners with us in this great undertaking.

One of the questions which you will want to hear more about, and which I can only partly hope to succeed in answering, is to what extent such views—essentially the view that the life of science is threatened, the life of the world is threatened, and that only [by] a profound revision of what it is that constitutes a thing worth

fighting for, and a thing worth living for, can this crisis be met—to what extent these views are held by other men. They are certainly not held universally by scientists; but I think they are in agreement with all of the expressed opinions of this group, and I know that many of my friends here see pretty much eye to eye. I would speak especially of Bohr, who was here so much during the difficult days, who had many discussions with us, and who helped us reach the conclusion that [it was] not only a desirable solution, but that it was the unique solution, that there were no other alternatives.

I would say that among scientists there are certain centrifugal tendencies which seem to me a little dangerous, but not very. One of them is the attempt to try, in this imperiled world, in which the very function of science is threatened, to make convenient arrangements for the continuance of science, and to pay very little attention to the preconditions which give sense to it. Another is the tendency to say we must have a free science and a strong science, because this will make us a strong nation and enable us to fight better wars. It seems to me that this is a profound mistake, and I don't like to hear it. The third is even odder, and it is to say, "Oh give the bombs to the United Nations for police purposes, and let us get back to physics and chemistry." I think none of these are really held very widely, but they show that there are people who are desperately trying to avoid what, I think, is the most difficult problem. One must expect these false solutions, and over-easy solutions, and these are three which pop up from time to time.

As far as I can tell, in the world outside, there are many people just as quick to see the gravity of the situation, and to understand it in terms not so different from those I have tried to outline. It is not only among scientists that there are wise people and foolish people. I have had occasion in the last few months to meet people who had to do with the government—the legislative branches, the administrative branches, and even the judicial branches, and I have found many in whom an understanding of what this problem is, and of the general lines along which it can be solved, is very clear. I would especially mention the former secretary of war, Mr. Stimson, who, perhaps as much as any man, seemed to appreciate how hopeless and how impractical it was to attack this problem on a superficial level, and whose devotion to the development of atomic weapons was, in large measure, governed by his understanding of the hope that lay in it: that there would be a new world. I know this is a surprise, because most people think that the War Department has as its unique function the making of war. The secretary of war has other functions.

I think this is another question of importance: that is, what views will be held on these matters in other countries. I think it is important to realize that even those who are well informed in this country have been slow to understand, slow to believe that the bombs would work, and then slow to understand that their working would present such profound problems. We have certain interests in playing up the bomb, not only we here locally, but all over the country, because we made them, and our pride is involved. I think that in other lands it may be even more difficult for an appreciation of the magnitude of the thing to take hold. For this reason, I'm not sure that the greatest opportunities for progress do not lie somewhat further in the future than I had for a long time thought.

"I THINK WE HAVE NO HOPE AT ALL IF WE YIELD IN OUR BELIEF IN THE VALUE OF SCIENCE."
—J. ROBERT OPPENHEIMER

There have been two or three official statements by the president which defined, as nearly as their, in some measure, inevitable contradictions made possible, the official policy of the government. And I think that one must not be entirely discouraged by the fact that there are contradictions, because the contradictions show that the problem is being understood as a difficult one, is temporarily being regarded as an insoluble one.

Certainly you will notice, especially in the message to Congress, many indications of a sympathy with, and an understanding of, the views which this group holds, and which I have discussed briefly tonight. I think all of us were encouraged at the phrase "too revolutionary to consider in the framework of old ideas." That's about what we all think. I think all of us were encouraged by the sense of urgency that was frequently and emphatically stressed. I think all of us must be encouraged by the recognition, the official recognition by the government of the importance—of the overriding importance—of the free exchange of scientific ideas and scientific information between all countries of the world. It would certainly be ridiculous to regard this as a final end, but I think that it would also be a very dangerous thing not to realize that it as a precondition.

I am myself somewhat discouraged by the limitation of the objective to the elimination of atomic weapons, and I have seen many articles—probably you have, too—in which this is interpreted as follows: "Let us get international agreement to outlaw atomic weapons and then let us go back to having a good, clean war." This is certainly not a very good way of looking at it. I think, to say it again, that if one solves the problems presented by the atomic bomb, one will have made a pilot plant for solution of the problem of ending war.

But what is surely the thing which must have troubled you, and which troubled me, in the official statements was the insistent note of unilateral responsibility for the handling of atomic weapons. However good the motives of this country are—I am not going to argue with the president's description of what the motives and the aims are—we are 140 million people, and there are two billion people living on earth. We must understand that whatever our commitments to our own views and ideas, and however confident we are that in the course of time they will tend to prevail, our absolute—our completely absolute—commitment to them, in denial of the views and ideas of other people, cannot be the basis of any kind of agreement.

As I have said, I had for a long time the feeling of the most extreme urgency, and I think maybe there was something right about that. There was a period immediately after the first use of the bomb when it seemed most natural that a clear statement of policy, and the initial steps of implementing it, should have been made; and it would be wrong for me not to admit that something may have been lost, and that there may be tragedy in that loss.

But, I think the plain fact is that in the actual world, and with the actual people in it, it has taken time, and it may take longer, to understand what this is all about. And I am not sure, as I have said before, that in other lands it won't take longer than it does in this country. As it is now, our only course is to see what we can do to bring about an understanding on a level deep enough to make a solution practicable, and to do that without undue delay.

One may think that the views suggested in the President's Navy Day speech are not entirely encouraging, that many men who are more versed than we in the practical art of statesmanship have seen more hope in a radical view, which may at first sight seem visionary, than in an approach on a more conventional level.

I don't have very much more to say. There are a few things which scientists perhaps should remember, that I don't think I need to remind us of; but I will, anyway. One is that they are very often called upon to give technical information in one way or another, and I think one cannot be too careful to be honest. And it is very difficult, not because one tells lies, but because so often questions are put in a form which makes it very hard to give an answer which is not misleading. I think we will be in a very weak position unless we maintain. at its highest. the scrupulousness which is traditional for us in sticking to the truth, and in distinguishing between what we know to be true from what we hope may be true.

The second thing I think it right to speak of is this: it is everywhere felt that the fraternity between us and scientists in other countries may be one of the most helpful things for the future; yet it is apparent that even in this country, not all of us who are scientists are in agreement. There is no harm in that; such disagreement is healthy. But we must not lose the sense of fraternity because of it; we must not lose our fundamental confidence in our fellow scientists.

I think that we have no hope at all if we yield in our belief in the value of science, in the good that it can be to the world to know about reality, about nature, to attain a gradually greater and greater control of nature, to learn, to teach, to understand. I think that if we lose our faith in this we stop being scientists, we sell out our heritage, we lose what we have most of value for this time of crisis.

But there is another thing: we are not only scientists; we are men, too. We cannot forget our dependence on our fellow men. I mean not only our material dependence, without which no science would be possible, and without which we could not work; I mean also our deep moral dependence, in that the value of science must lie in the world of men, that all our roots lie there. These are the strongest bonds in the world, stronger than those even that bind us to one another, these are the deepest bonds—that bind us to our fellow men. ★

September 17, 1945

To: All Laboratory Personnel

From: J. R. Oppenheimer

Subject: Army-Navy Production Award

I have received the following letters from Robert P. Patterson, Under Secretary of War, and Lt. Colonel Robert B. Clark, Jr., of the Army Board for Production Awards. The formal Production Award will be made at Los Alamos on October 16, 1945:

WAR DEPARTMENT
Office of the Under Secretary
Washington, D. C.

15 September 1945

To the Men and Women
of the University of California Los Alamos Scientific Laboratory
Santa Fe, New Mexico

This is to inform you that the Army and Navy are conferring upon you the Army-Navy Production Award for high achievement in the production of war equipment.

Your patriotism, as shown by your remarkable production record, has helped our country along the road to victory. May I extend to you men and women of the Los Alamos Scientific Laboratory my congratulations on your great accomplishments.

In conferring this Award, the Army and Navy will give you a flag to fly above your plant and will present to every individual within it a lapel pin symbolic of leadership on the production front.

Sincerely yours,

/s/ Robert P. Patterson
Under Secretary of War

WAR DEPARTMENT
Office of the Under Secretary
Washington, D. C.

15 September 1945

Dr. J. R. Oppenheimer, Director
University of California Los Alamos Scientific Laboratory
Santa Fe, New Mexico

Dear Dr. Oppenheimer:

In order that the inclosed letter may reach the men and women of your laboratory, the Under Secretary of War has directed me to suggest that you reproduce and post it on the bulletin boards throughout your laboratory as soon as possible.

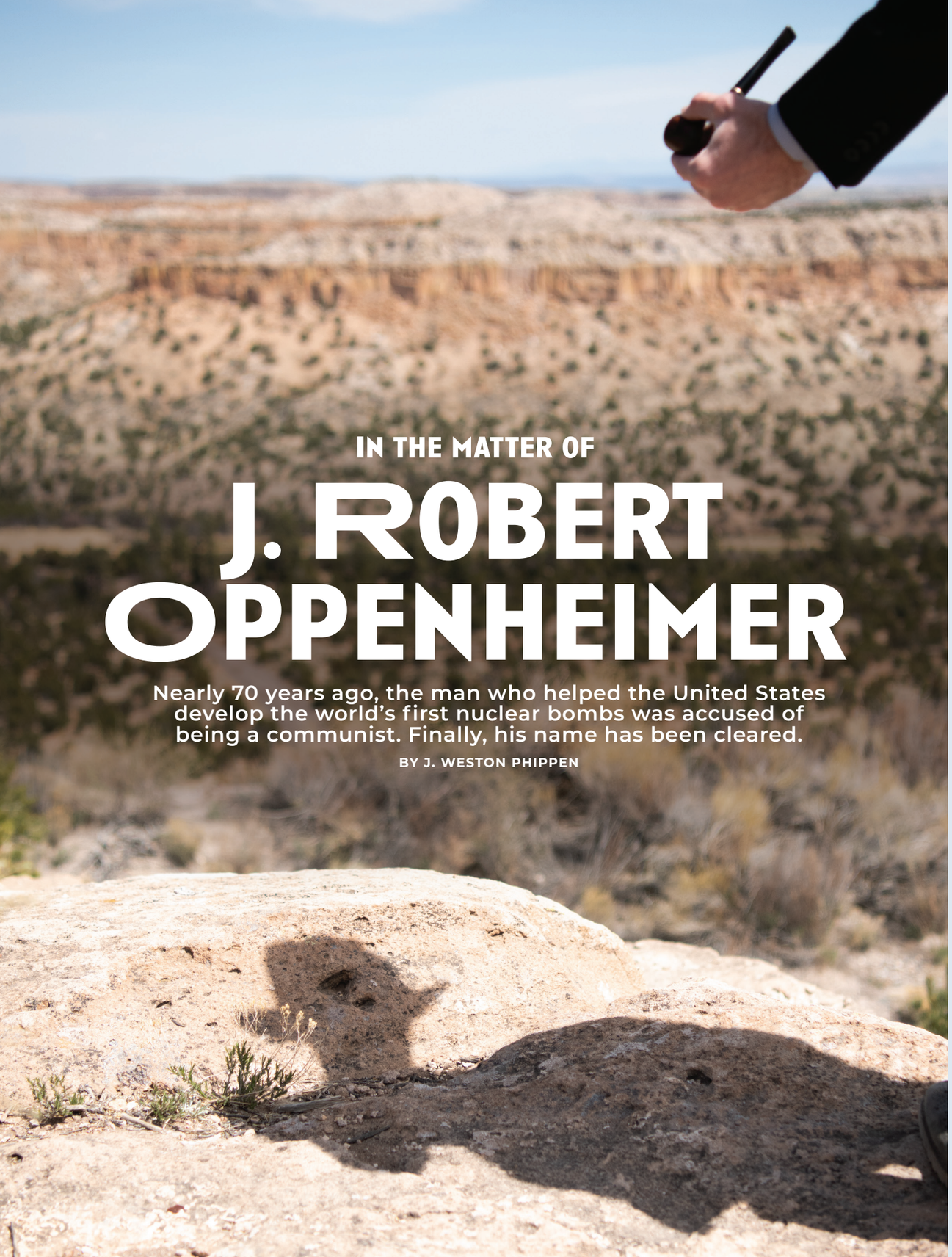
I have also been directed to call your attention to the inclosed material containing information pertinent to the Army-Navy Production Award.

Sincerely yours,

/s/ Robert B. Clark, Jr.
Lt. Colonel, O. D.
Recorder
Army Board for Production Awards

▲ A September 17, 1945, memo from Oppenheimer to all Project Y staff shares news from the under secretary of war that the Lab would receive the Army-Navy E Award for excellence in war production in recognition of the successful development of the atomic bomb.

SCAN QR CODE WITH A SMARTPHONE CAMERA
Listen to Oppenheimer deliver this speech.



IN THE MATTER OF

J. ROBERT OPPENHEIMER

Nearly 70 years ago, the man who helped the United States develop the world's first nuclear bombs was accused of being a communist. Finally, his name has been cleared.

BY J. WESTON PHIPPEN

In the late spring of 1954, the Atomic Energy Commission (AEC) held a closed-door hearing to decide the fate of J. Robert Oppenheimer's security clearance. Oppenheimer, a physicist, had led the scientific effort to build the world's first nuclear weapons that helped end World War II, and now, nine years later, his loyalty to the country was being questioned.

The four-week hearing became a national spectacle. Politicians, high-ranking military officials, and some of the world's most renowned physicists testified both for and against the revocation of Oppenheimer's security clearance.

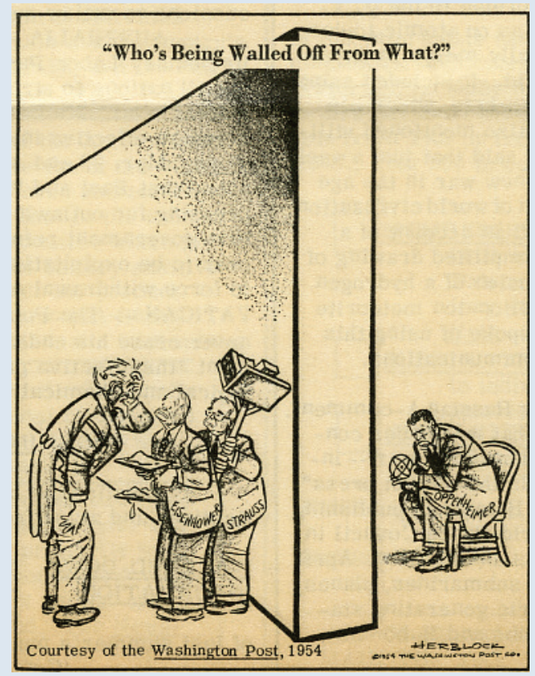
"We have an A-bomb" because of Oppenheimer's work, physicist Isidor Rabi told commissioners as he vouched for his friend and colleague. "What more do you want, mermaids?"

In the end, the AEC ruled to revoke Oppenheimer's clearance, which denied him all access to the nation's atomic secrets—science that he played a major part in developing.

"My train wreck," is how Oppenheimer later referred to the hearing, and his close friends say he was never the same.

However, in December 2022, the Department of Energy (DOE, the successor to the AEC) nullified the AEC's earlier ruling, calling the entire hearing flawed. "As time has passed, more evidence has come to light of the bias and unfairness of the process that Dr. Oppenheimer was subjected to," Energy Secretary Jennifer M. Granholm said in a statement, "while the evidence of his loyalty and love of country have only been further affirmed."

Provided the context now available, it is widely believed that the hearings against Oppenheimer arose from personal grievances and insider politics. Clearing his name, however, was a much more public struggle, one that generations of Los Alamos National Laboratory scientists, and even directors, took on.



▲ The AEC decision to revoke Oppenheimer's security clearance was meant to "wall off" Oppenheimer from classified information. But, as this cartoon depicts, some members of the public wondered if the government was hurting itself by ending its relationship with the brilliant scientist.

A Soviet spy?

After World War II, Oppenheimer became chairman of the AEC's General Advisory Committee, a post that solidified him as America's leading mind on atomic weapons. At the time Oppenheimer led the committee, one major priority was how the nation should proceed after, in 1949, the Soviet Union successfully detonated its own atomic bomb.

Almost immediately, the AEC called for a series of planning sessions. During these sessions, Oppenheimer sometimes displayed little patience toward people who spoke on topics they didn't comprehend, and at one AEC session before Congress, Oppenheimer clashed with fellow AEC commissioner Lewis Strauss, a former naval officer. Strauss thought the United States should *not* export radioactive isotopes to foreign countries because the isotopes held special military value.

Radioactive isotopes are indeed necessary for nuclear weapons, but they also have myriad peaceful uses, which is why Oppenheimer believed that the United States *should* share this technology with other countries. During the session, Oppenheimer offered a condescending remark to Strauss' recommendation: "My own rating of the importance of isotopes," Oppenheimer said, "is that they are far less important than electronic devices, but far more important than, let us say, vitamins."

Strauss was humiliated, publicly. It was the start of a rivalry that would end in Oppenheimer losing his security clearance.

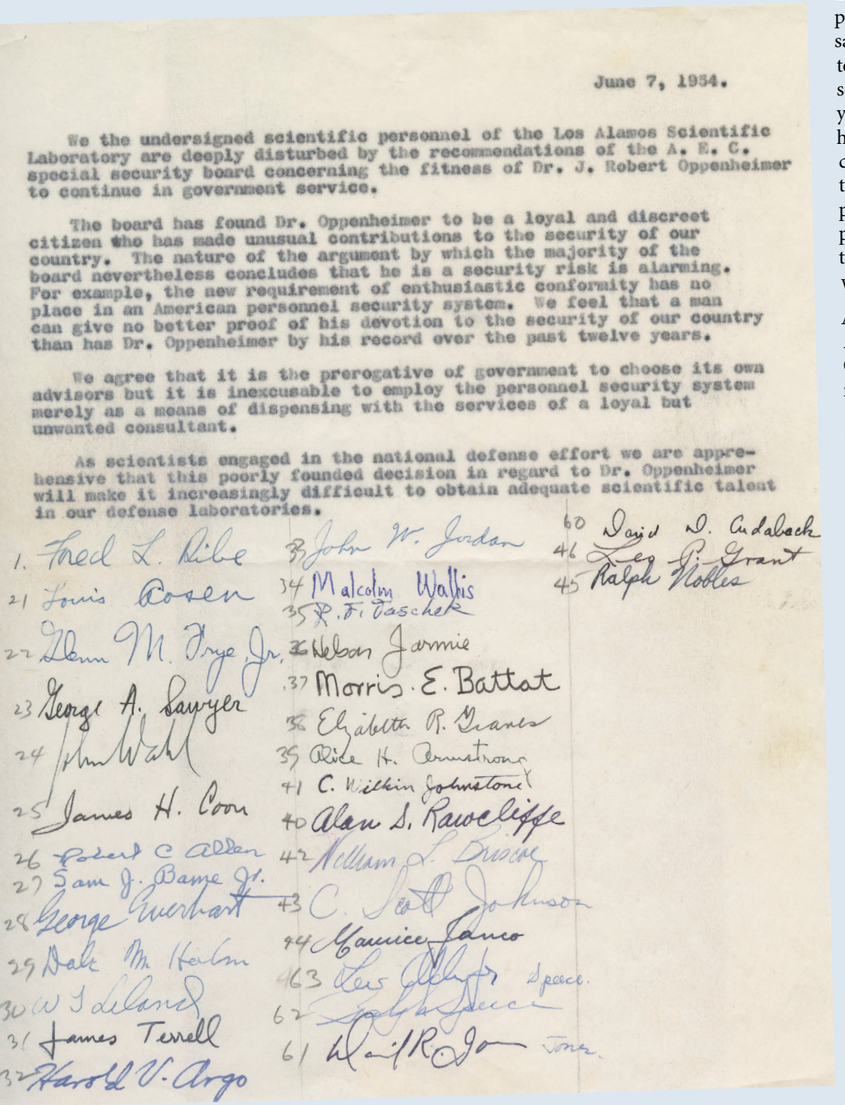
The greatest contention between Oppenheimer and Strauss was whether to build a hydrogen bomb, a potentially smaller but more powerful weapon than the first-generation atomic bombs developed during the Manhattan Project. Strauss, alongside physicists Edward Teller and Stanislaw Ulam, both of whom Oppenheimer had worked with at Los Alamos, believed the United States needed the hydrogen bomb to gain technological advantage over the Soviet Union. Oppenheimer was against such a device, which many assumed to mean he was anti-American.

A hydrogen bomb would require large quantities of the rare hydrogen isotope tritium. This element is made by irradiating lithium in nuclear reactors that, in 1949, would have otherwise been devoted to breeding plutonium for atomic bombs. Oppenheimer felt the nation faced a binary choice: build more of something the country knew it was capable of building, his atomic bomb, or risk precious space in nuclear reactors to breed tritium for a still-theoretical hydrogen bomb.

By 1953, in the middle of the McCarthy "Red Scare" era, Strauss was appointed chairman of the AEC. Strauss seemed to have never let go of Oppenheimer's comments, or his stance against the hydrogen bomb. As AEC chairman, Strauss called for an investigation into Oppenheimer, claiming there was evidence the physicist was a Soviet spy.

In previous decades, especially during his time at the University of California, Berkeley, Oppenheimer had associated with many communist sympathizers—his brother, a former fiancée, and close friends, to name a few. On a Manhattan Project security questionnaire, Oppenheimer had once joked that while he'd never been a communist, he'd "probably belonged to every communist-front organization on the West Coast."

▼ Los Alamos physicist Fred Ribe collected nearly 500 signatures from Lab staff in 1954, shortly after Oppenheimer's security clearance was revoked following accusations of his loyalty, among other issues.



June 7, 1954.

We the undersigned scientific personnel of the Los Alamos Scientific Laboratory are deeply disturbed by the recommendations of the A. E. C. special security board concerning the fitness of Dr. J. Robert Oppenheimer to continue in government service.

The board has found Dr. Oppenheimer to be a loyal and discreet citizen who has made unusual contributions to the security of our country. The nature of the argument by which the majority of the board nevertheless concludes that he is a security risk is alarming. For example, the new requirement of enthusiastic conformity has no place in an American personnel security system. We feel that a man can give no better proof of his devotion to the security of our country than has Dr. Oppenheimer by his record over the past twelve years.

We agree that it is the prerogative of government to choose its own advisors but it is inexcusable to employ the personnel security system merely as a means of dispensing with the services of a loyal but unwanted consultant.

As scientists engaged in the national defense effort we are apprehensive that this poorly founded decision in regard to Dr. Oppenheimer will make it increasingly difficult to obtain adequate scientific talent in our defense laboratories.

1. Fred L. Ribe
21 Louis Rosen
22 Glenn M. Frye Jr.
23 George A. Sawyer
24 John Wahl
25 James H. Coon
26 Robert C Allen
27 Sam J. Barne Jr.
28 George Everhart
29 Dale M. Helm
30 W S Leland
31 James Terrell
32 Harold V. Argo
33 John W. Jordan
34 Malcolm Wallis
35 R. F. Taschek
36 Nelson Jarmie
37 Morris E. Battat
38 Elizabeth R. Graves
39 Rose H. Armstrong
41 C. Wilkin Johnstone
40 Alan S. Rawcliffe
42 William L. Russell
43 C. Scott Johnson
44 Maurice Langa
63 Lew Allen Space
62 [illegible]
61 Neil R. Jones
60 David D. Calabach
46 Leo P. Grant
45 Ralph Nobles

In December 1953, Strauss sent a letter to Oppenheimer saying his security clearance was suspended pending an investigation into his loyalty to the nation. Give up his clearance and resign from the AEC, the letter demanded, or appear before an investigatory board. Oppenheimer chose the latter.

The hearing took place in Washington, D.C., near the White House. Oppenheimer's defense lawyer was never granted the clearance to review classified documents, however, so the team was cut off from much of the prosecution's evidence. Strauss acted as chief appellate judge. Secretly, Strauss had also contacted the FBI, which illegally wiretapped Oppenheimer's phone communications with his attorney.

At the hearing, which began on April 12, 1954, two of the most damning testimonies came from long-time colleagues. One was General Leslie Groves, who'd handpicked Oppenheimer to lead the Manhattan Project. Groves defended the physicist at the hearing, but the general also said that he would probably not be allowed to clear Oppenheimer using the updated security clearance regulations introduced that year. Teller, who would go on to develop the hydrogen bomb, questioned Oppenheimer's character, his methods, and his hesitancy to develop a hydrogen bomb. "I would feel personally more secure," Teller testified, "if public matters would rest in other hands." For this, the Los Alamos scientific community would later shun Teller.

At the end of the four-week hearing, the AEC board voted two-to-one to revoke Oppenheimer's clearance. The board found no evidence to support Strauss's claim that Oppenheimer was a spy, but noted that he had many past ties to communists, as Oppenheimer had already revealed. In its decision, the board also emphasized Oppenheimer's resistance to the hydrogen bomb, writing that his position "had an adverse effect on recruitment of scientists and the progress of the scientific effort."

Later that year, the AEC published a redacted transcript of the hearing, called *In the Matter of J. Robert Oppenheimer*, which revealed to the public the blatant unfairness of the hearing. (In 2014, the U.S. government released previously classified information on the hearing, and many of the details upheld Oppenheimer's loyalty to the nation.)

Correcting a historical wrong

Meanwhile, back in Los Alamos, Oppenheimer's colleagues at the Lab fought to restore their former director's good name. Led by physicist Fred Ribe, 494 scientists risked their own careers when they signed a petition and sent it to President Dwight Eisenhower and the AEC in 1954.

"The nature of the argument by which the majority of the board nevertheless concludes that he is a security risk is alarming," Ribe wrote. "…we are apprehensive that this poorly founded decision … will make it increasingly difficult to obtain adequate scientific talent in our defense laboratories."

The petition never delivered the desired effect.

In the years after his security clearance was revoked, Oppenheimer retired from public service, though he still contributed heavily to the scientific community. He helped found the World Academy of Arts and Sciences in 1960, and he continued to lecture and write about physics. Oppenheimer, a constant smoker, eventually died of throat cancer in 1967.

Over the decades, the scientific community at the Lab tried repeatedly to correct the historical mistake that left a black mark on Oppenheimer's name. There were small moments of victory, like in 2004 when the U.S. Senate—on the 100th anniversary of Oppenheimer's birth—passed a resolution to recognize "the loyal service to America of Dr. J. Robert Oppenheimer," but the smirch upon his security clearance remained.

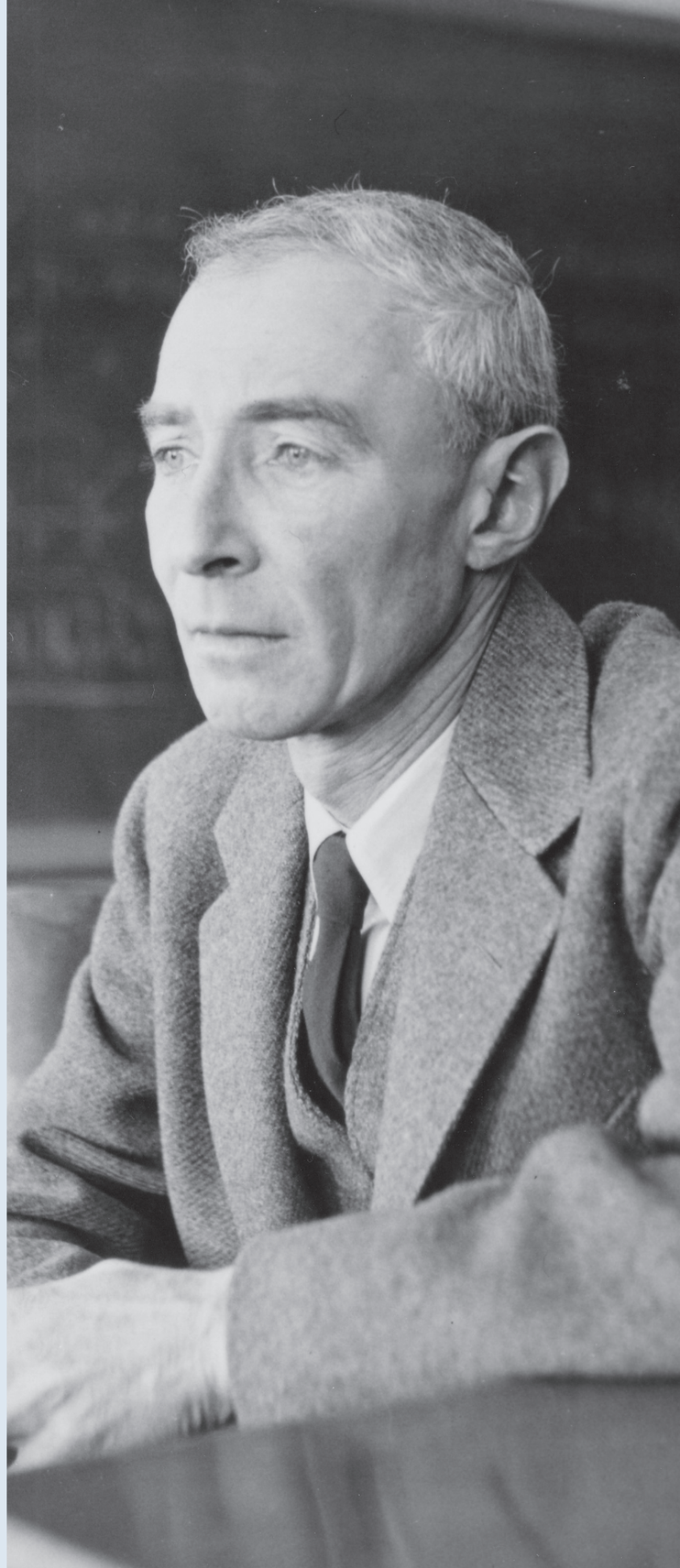
Then in April 2022, members of the Lab tried once more to nullify the AEC's decision.

Laboratory Director Thom Mason and eight former Los Alamos directors signed a letter and delivered the note to Secretary of Energy Granholm, urging DOE to nullify the AEC's decision as a "historically appropriate remedy" to what they saw as an egregious mistake. In December 2022, Granholm made the DOE's decision known.

"As a successor agency to the Atomic Energy Commission, the Department of Energy has been entrusted with the responsibility to correct the historical record and honor Dr. Oppenheimer's profound contributions to our national defense and the scientific enterprise at large," Granholm said in a statement. "Today, I am pleased to announce the Department of Energy has vacated the Atomic Energy Commission's 1954 decision *In the Matter of J. Robert Oppenheimer*."

The decision was roundly hailed—by scientists, historians, and the media—as an appropriate gesture to clear the name of a man who dedicated his career to the nation's security.

"Although this brings no peace to Dr. Oppenheimer, who died long ago, it brings needed perspective to the real truth of his legacy, integrity, and moral courage," Mason said of the decision. "It also sends a message that while the U.S. government takes security seriously and expects truthfulness, it must reciprocate with a fair analysis and principled decisions." ★



► Those who knew Oppenheimer said he was never the same following the hearing. In time, he retreated from public life.
Photo: Emilio Segrè Archives

▲ Kitty and Robert Oppenheimer meet Kiyokata and Tsuya Kusaka in Osaka, Japan. The Kusakas were the parents of Shuichi Kusaka, a physicist who had worked with Oppenheimer. Photo courtesy of Kitty Oppenheimer and the J. Robert Oppenheimer Memorial Committee

OPPENHEIMER'S VISIT TO JAPAN

Fifteen years after the bombings of Hiroshima and Nagasaki, the father of the atomic bomb visited Japan to speak about science and policy.

BY IAN LAIRD

J. Robert Oppenheimer's only visit to Japan was for a lecture tour that began on September 5, 1960. Sponsoring the tour was the Japan Committee for Intellectual Interchange (JCII), an organization founded during the formal U.S. occupation of Japan, which lasted from 1945 to 1952. JCII's mission was to accelerate Japan's transition to democracy by introducing Western political values, economic systems, and social norms to the country.

The JCII had sponsored other high-level visits, including one by Eleanor Roosevelt in 1953, but Oppenheimer's visit presented new challenges. As the "father of the atomic bomb," Oppenheimer was inextricably linked to the bombings of Hiroshima and Nagasaki—and the death and destruction that followed.

The JCII tried to get ahead of potential issues by routing Oppenheimer through Tokyo and Osaka, avoiding Hiroshima and Nagasaki. JCII also instructed Oppenheimer to discuss recent physics and policy developments, but the bombings inevitably found their way into the conversation.

At one point following a talk in Osaka, an American who lived in Hiroshima approached Oppenheimer and handed the physicist an invitation to visit the city. The American assured Oppenheimer that he would be welcomed and forgiven by the local population. Oppenheimer politely declined, citing the JCII's recommendation, but a local newspaper reported that Oppenheimer also said, "Had it been my choice, I would have wished to have quietly visited the city."

Oppenheimer's struggle with the moral implications of developing atomic weapons was apparent throughout the JCII lectures. Oppenheimer recognized the irreversible nature of his work and warned of the responsibility that comes with each new discovery. "Indeed, even in pure science with no thoughts of weapons or immediate change in life, a great discovery is a source of terror," he said to an audience in Osaka.

He mentioned a few days later at another lecture that his friend and fellow physicist Niels Bohr once joked, "When I have a great idea, I am always close to suicide."

Oppenheimer's lectures often offered a similarly pessimistic view of the world. One was titled "The Future of Civilization in the Scientific Age," a name that he didn't seem to agree with: "The title of my lecture is 'The Future of Civilization,' this was not quite my own doing. I do not use this phrase easily, for I am one of those who share with my many colleagues at home and here in Japan profound doubts of the very existence of a future."

Oppenheimer described an exciting age of technological development laced with words of caution. "We have seen many improvements, but we have also lived through profound moral retrogression," he warned. "We must remember the two sides, science as it is for the pursuit of truth, to understand nature, to understand ourselves as a part of nature, and science as a source of technology and power to alter the world, to meet human needs, real or artificial."

In another lecture, he said: "The legend of the Tree of Knowledge, of Adam, and the legend of Prometheus—they both attest to the danger of going beyond the familiar compass of human life."

Toward the end of his trip, Oppenheimer visited with the Society of Science and Man, a group of Japanese scholars and professors. In talking to this group, Oppenheimer strayed from statements of impending doom and instead focused on how to promote collaboration among scientists and politicians. Scientists, he posited, had a duty to serve as advisers to guide politicians and ensure technology wasn't misused.

"Since the federal government, for good and bad reasons, is supporting science, they must have contact with scientists," Oppenheimer said. "In recent years [...] it has been possible to create for the president an advisory committee which does not hesitate to talk about major questions [...] it can talk to the president about what it wants." The advisory committee Oppenheimer was likely referring to was the General Advisory Committee of the Atomic Energy Commission, which he chaired from 1947 to 1952.

In a different venue, Oppenheimer commented on the human condition. "To cope with our sorrows, to limit and make noble our joys, to understand what is happening to us, to talk to one another, to relate one thing to another, to find the great themes which organize our experience and give it meaning," he said, "it is what makes us human."

Oppenheimer died less than seven years after this trip. He never did visit Hiroshima or Nagasaki. ★

■ Isao Imai, president of Japan Physical Society, wrote to Oppenheimer proposing a lecture date and location.

Physical Society of Japan
c/o DEPARTMENT OF PHYSICS, UNIVERSITY OF TOKYO
TOKYO, JAPAN

August 16, 1960

Dr. J. R. Oppenheimer
Institute for Advanced Study
Princeton, New Jersey
U. S. A.

Dear Dr. Oppenheimer:

I have been informed by Prof. T. Yamanouchi, Dean of the Faculty of Science of the University of Tokyo, that you will visit our country this September. On behalf of the members of the Physical Society of Japan, I should like to ask you to deliver a lecture for us in Tokyo. Perhaps, you have already heard of our plan from the Japan Committee for Intellectual Interchange. We are tentatively considering the following schedule:

Date? September 12, Monday, 4:00-5:00 p.m.
Place: Lecture Hall of the Faculty of Science 2,
University of Tokyo
Sponsored by the Physical Society of Japan
the Faculty of Science, University of Tokyo
and the Nishina Memorial Foundation.

We wish that your lecture will be of about 60 minutes length. If you use lantern slides for your lecture, 36mm x 24mm slides would be most convenient for us.

I should appreciate very much receiving your kind answer to our wish.

Sincerely yours,

Isao Imai

Isao Imai
President of the
Physical Society of Japan

▼ The September 22, 1960, edition of the *Asahi Evening News* covers of one of Oppenheimer's Japan lectures. Photo: Library of Congress

9/22/60

ASAHI EVENING NE

'Future of Civilization:' (1)

Oppenheimer Stresses Meaning of 'Science'

By Y. Kusanagi

Dr. J. Robert Oppenheimer, famed American nuclear physicist, lectured on the "Future of Civilization in the Scientific Age" for more than two hours last night in Tokyo's Hibiya Public Hall.

More than 600 persons attended the lecture and listened eagerly to the 56-year-old, white-haired theoretical physicist who

SUMMER 2023

OPPENHEIMER'S SCIENTIFIC CONTRIBUTIONS

Despite his brilliance, the renowned physicist was never awarded a Nobel Prize.

BY BRYE STEEVES

J. Robert Oppenheimer—the "father of the atomic bomb"—was nominated for the Nobel Prize for Physics three times: in 1946, in 1951, and in 1967. Colleagues, scholars, and surely Oppenheimer himself, pondered why he was never bestowed the honor.

"To understand this," says James Kunetka, historian and author of *The General and the Genius*, "you have to first examine the man's academic life before and after the war."

Born in 1904 into a wealthy Jewish family and raised in New York, Oppenheimer was clearly gifted. He completed the third and fourth grades in just one year and later skipped a portion of his eighth grade year. Remarkable anecdotes of brilliance illustrate his life through early adulthood. As a boy, he was interested in mineralogy and, at age 12, presented his research paper to the New York Mineralogical Club, becoming an honorary member. As a young academic, he learned Dutch in six weeks in order to successfully deliver a technical lecture on a trip to the Netherlands. It was there he was first dubbed "Oppie" ("Opje" in Dutch).

"[He was] one of the sharpest people I have ever seen or heard of, intellectually," said longtime friend Harold Cherniss in a 1979 interview. "When he became interested in anything, he very quickly picked up an enormous amount of knowledge about it."

After graduating at the top of his high school class, Oppenheimer studied science at Harvard University, where he was admitted to graduate-level physics classes during his first year. He also took courses in literature, languages, religion and philosophy, earning his degree in just three years, but with no social clubs or athletics listed under his name in the 1926 yearbook. Certainly introverted then, but also perhaps lonely, Oppenheimer once told a friend, "It's no fun to turn the pages of a book and say, 'Yes, yes, of course, I know that,'" according to an October 1949 article in *Life* magazine.

After a stint at the University of Cambridge in the United Kingdom, Oppenheimer went to the University of Göttingen in Germany, where he studied quantum physics and earned his doctorate in 1927. By 1929, he had accepted offers to teach at both the California Institute of Technology (Caltech) and the University of California, Berkeley.

Oppenheimer's early research focused on energy processes of subatomic particles, including electrons, positrons and cosmic rays, as well as neutron stars (collapsed cores of massive stars) and black holes. He was soon recognized as a leader in theoretical physics and earned the respect of scientific greats like Albert Einstein and Niels Bohr.

Some scientists, including Nobel laureate Luis Alvarez, speculated that Oppenheimer's work on black holes may have warranted the prize, had he lived long enough to see it to fruition. (Nobel prizes are not awarded posthumously.)

"However, many of his colleagues and critics point out that his production of significant papers was surprisingly thin," Kunetka says. "It was said by some that he far too often coauthored papers with his students rather than initiated them. Nobel laureate and physicist Hans Bethe noted that, while Oppenheimer and others were perhaps more brilliant, he [Bethe] was more productive."

Oppenheimer's publication record didn't seem to matter to General Leslie Groves, who was impressed by Oppenheimer's intelligence and practicality. Groves also overlooked Oppenheimer's associations with members of the Communist party and lack of large-scale managerial experience. In the fall of 1942, Groves hired Oppenheimer to lead the scientific effort to build the world's first atomic weapons at a secret laboratory in Los Alamos, New Mexico.

"He was very close to being indispensable," an unnamed Los Alamos scientist is quoted in a 1949 *Life* article. Another said, "The main decisions were made by Oppenheimer, and all proved to be correct."

Oppenheimer's directorship culminated on July 16, 1945, when the world's first atomic device, known as the Gadget, was successfully detonated in the New Mexico desert.

Weeks later, the United States military released the gun-type uranium bomb Little Boy above Japan. Groves phoned Oppenheimer after the detonation. According to a transcript of the recorded call, Groves told Oppenheimer: "I think one of the wisest things I ever did was when I selected the director of Los Alamos."

By the time Oppenheimer left Los Alamos a few weeks after the end of World War II, he was known around the world. However, even with his face on magazine covers, his celebrity did not translate into a Nobel Prize.

When Oppenheimer was first nominated in 1946 for the Nobel Prize, the Nobel committee was hesitant to award it to someone so closely tied to the atomic bombs, according to *American Prometheus*. Many scholars and scientists through the years have concurred, including Oppenheimer himself, who told *Life* magazine that creating the bombs was more inventive than scientific.

In 1947, Oppenheimer moved to Princeton, New Jersey, to lead the Institute for Advanced Study as well as serve as the chairman of the General Advisory Committee, a scientific panel that advised the newly formed Atomic Energy Commission. Much of his focus shifted from physics to policy. Oppenheimer spoke out in opposition to the development of the powerful hydrogen bomb, questioning its feasibility early on, and also deeming it an unnecessary weapon. Meanwhile, he wrote and lectured, but did not, however, resume much research.

In 1954, Oppenheimer lost his security clearance following unsubstantiated accusations against his loyalty to America. Though his supporters remained steadfast and numerous, Oppenheimer eventually retreated from his public life and work, pushing him even further from a Nobel Prize.

Oppenheimer was nominated for a Nobel Prize for a third and final time just before his death in 1967. Although he did not win, Alan Carr, senior historian at Los Alamos National Laboratory, argues that Oppenheimer's technical contributions changed the world. "Did he achieve greatness? Yes, of course," Carr says. "What Oppie led his wartime team of scientists to achieve was nothing short of remarkable. He will always have that incredible scientific

▼ In the late 1930s, Oppenheimer was a professor at the University of California, Berkeley. Here he is pictured with physicists Emilio Segrè (fourth from right) and Chien-Shiung Wu (second from right). Segrè would later join Oppenheimer in Los Alamos and was awarded the Nobel Prize in Physics in 1959. Wu would go on to become an influential experimental physicist; she was featured on a postage stamp in 2021.

✦ Oppenheimer addresses a crowd during a ceremony at Fuller Lodge on October 16, 1946. Just months earlier, the atomic weapons developed at Los Alamos helped end World War II.

A HISTORY FIT FOR

HOLLYWOOD

Los Alamos National Laboratory employees played crucial roles in bringing the movie *Oppenheimer* to life.

BY J. WESTON PHIPPEN

✦ The NSRC provided historical film of the Trinity site to the Oppenheimer movie crew.

From January to March 2022, the normally staid town of Los Alamos, New Mexico, bubbled with excitement. Residents spotted Matt Damon dining at the local Blue Window Bistro. Sightings of Cillian Murphy, Robert Downey Jr., and Emily Blunt passed between friends and colleagues on social media. The historic Fuller Lodge teemed with camera crews.

One of Hollywood's biggest directors, Christopher Nolan, had arrived in the small town atop the Pajarito Plateau, the birthplace of the atomic bomb, to shoot a biopic about one of Los Alamos' most famous residents: J. Robert Oppenheimer.

The film, titled *Oppenheimer*, was written by Nolan and is based on the Pulitzer Prize–winning book *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* by Kai Bird and Martin Sherwin. The film stars Murphy as Oppenheimer and, based on early trailers, recreates the physicist's quest to build the world's first atomic bombs at a secret laboratory in Los Alamos. Murphy's portrayal not only captures the grueling work of the time, but also the moral implications of developing such destructive weapons.

"I know of no more dramatic tale with higher stakes, more extraordinary twists and turns," Nolan said of Oppenheimer's story at CinemaCon. "J. Robert Oppenheimer is the most important person who ever lived. He made the world we live in, for better or for worse."

Los Alamos National Laboratory—as Oppenheimer's wartime laboratory is now known—played no official role in making the film, which is set to premiere July 21—five days after the 78th anniversary of the Trinity test, during which Los Alamos scientists detonated the world's first nuclear device in the New Mexico desert. But the Lab and its employees did help with the film in many ways, both behind the scenes and in front of the camera, and they left an indelible impact on the film, even if this participation is lost on many moviegoers.

"We were in the real Los Alamos," Nolan said in an interview with *Entertainment Weekly*, "and we had a lot of real scientists as extras … You've been on sets where you've got a lot of extras around and they're more or less thinking about lunch. These guys were thinking about the geopolitical implications of nuclear arms and knew a lot about it. It actually was a great reminder every day of: We have to be really on our game, we have to be faithful to the history here and really know what we're up to."

Meeting the director

Before news of the movie spread across social media and through the Los Alamos grapevine, Jonathan Creel received a call in his office.

In the winter of 2021, Creel was the Lab's public engagement specialist for the Manhattan Project National Historical Park. Creel's job was to, in conjunction with other experts from the Lab and the National Park Service, offer the most accurate possible interpretation of the Manhattan Project—right down to the shade of green paint used on buildings of the era. For a film director wanting to recreate the Manhattan Project, Creel was the perfect contact.

> "I know of no more dramatic tale with higher stakes, more extraordinary twists and turns."
> —**Christopher Nolan**

"At the time, I was helping the Los Alamos Historical Society create an interpretive plan for the Oppenheimer house here in town, so I was already in full Oppie mode," Creel says. "When the film team came to me with a bunch of questions, I said I could probably help. Next thing I know, they wanted to fly out here for a visit."

Creel helped guide the location scouts on an initial tour down Bathtub Row, the Los Alamos street so named because the houses there (including Oppenheimer's) were the only houses in town with bathtubs during the Manhattan Project. The location scouts photographed and measured historic buildings, such as a women's dormitory and Fuller Lodge, which served as a dining and meeting hall for scientists. Creel also led the location scouts around the Bradbury Science Museum, which houses about 2,000 artifacts from the Manhattan Project, including 1940s-era dosimeters used to detect radiation and a replica Fat Man bomb, the implosion-type weapon detonated above Japan.

The location scouts made tentative plans to return a few weeks later. Before they left, Creel added, "If you give us a heads up, we could probably get you all out to Technical Area 18"—part of the Laboratory where several buildings used during the Manhattan Project are not accessible to the general public, except for three scheduled tours per year.

When Creel next heard from the location scouts, they told him Nolan, the director, wanted to come out to Los Alamos. Creel was shocked. Nolan was one of his favorite directors, and he had assumed that the five-time Academy Award nominee wouldn't be interested in touring dusty, historic buildings—especially if he couldn't film in and around them (photography and videography are typically not allowed on Lab property). But several weeks later, Creel was shaking Nolan's hand in downtown Los Alamos. "Nolan pulled up with an entourage," remembers Creel, adding that

✦ *Oppenheimer* director Christopher Nolan visited Pond Cabin, which was used during the Manhattan Project by physicist Emilio Segrè.

The Army-Navy Production Award

Its History and Significance

In 1906 the Navy instituted in the Fleet an award for excellence which has been known ever since as the Navy "E." First awarded for excellence in gunnery, this was later extended to include outstanding performance in engineering and communications. An honor not easily won nor lightly bestowed, it became and has remained a matter of deep pride to the men of the Service who receive it.

When the rising tide of war in Europe placed a premium on the production of war equipment, the Navy "E" award was extended to embrace those plants and organizations which showed excellence in producing ships, weapons, and equipment for the Navy.

Then came Pearl Harbor—and with it a demand for war production such as the world has never known . . . an awareness that our fighting forces and the men and women of American industry are partners in the great struggle for human freedom . . . and on the part of all Americans a grim and enduring resolve to work and fight together until victory in that struggle was final and complete.

From that high resolve was born the Army-Navy Production Award—which stands today as our fighting forces' joint recognition of exceptional performance on the production front . . . of the determined, persevering, unbeatable American spirit which can be satisfied only by achieving today what yesterday seemed impossible.

Presentation of the

Army-Navy "E" Award

for High Achievement

to the

EMPLOYEES OF

ROBERT E. McKEE GENERAL CONTRACTOR

Los Alamos, New Mexico

October 16, 1945

4 P. M.

✦ The Army-Navy E Award program (original shown here) was among the artifacts recreated for the *Oppenheimer* film.

Nolan wore a large trench coat on that chilly winter day. "He was very nice, very fun and down to earth."

Before driving to Technical Area 18, in accordance with procedure, Creel checked everyone's identification, even Nolan's. "It was like yep, okay, you're Christopher Nolan," Creel chuckles. Creel then went through a security and safety talk, reminding people they'd need to leave their cell phones behind. Nolan's production designer grew frazzled, Creel remembers, and she furiously typed out a few last-minute emails. But Nolan, with a shrug, pulled a flip phone from his pocket and tossed it several feet away into the open car door. "He kind of just threw it four feet through the air," Creel says.

The Technical Area 18 tour included a stop at Pond Cabin, a log structure where Nobel laureate Emilio Segrè conducted plutonium research during the Manhattan Project. Along with historic buildings expert Jeremy Brunette, and park program manager Cheryl Abeyta, Creel gave Nolan the history of Battleship Bunker, where scientists performed explosive lens tests to determine if the plutonium core of the Gadget, the first test device, could be rapidly and symmetrically condensed with high explosives to start a fission chain reaction.

Creel remembers that Nolan asked a lot of great questions, and the two spoke of the pressure Oppenheimer would have been under to complete the world's first nuclear weapons. "He was curious in an informed way," Creel says of Nolan, "and very in tune with the Lab's current mission. He'd clearly done a lot of research."

Digging through history

After the tour is when the real work began. The film's production team wanted photos and measurements of as many things as possible, even seemingly trivial items.

"They bombarded us with questions," says Wendy Strohmeyer, an artifact collection specialist at the Bradbury, "and so I started to field a lot of those requests."

For instance, the film's production team wanted to recreate the E Award flag, presented to Los Alamos by the U.S. Army and Navy after the bombing of Japan. The E Award was presented during a ceremony at Fuller Lodge, and today the original flag hangs inside the Lab's National Security Sciences Building, a limited access area where photography is not allowed. But Strohmeyer was able to find photos and measurements, taken years earlier when the Lab commissioned repairs on the flag. The film's production team also wanted to recreate the E Award paper programs, so again Strohmeyer measured, photographed, and emailed copies of the Lab's two originals from October 1945.

"They could probably print a run-of-the-mill E Award program, and no one would notice," Strohmeyer says. "But as someone whose job it is to preserve history, I appreciated that accuracy was as important to them as it is to me. I also gave them some blurry photos of the ceremony, taken by a Lab employee at the time. Later on, when they were filming that scene at Fuller Lodge, I have to say, it looked pretty accurate."

Researchers from the Laboratory's classified library and archives, the National Security Research Center (NSRC), dug through troves of historic schematics, photos, and film. The researchers not only passed along hundreds of unclassified images they had at the ready, but they also combed through vault files and turned up historical videos that hadn't been viewed for decades. One special find included footage of the Trinity site bunkers where Groves and Oppenheimer witnessed the world's first nuclear blast.

Both the NSRC and the Bradbury are in the process of digitizing parts of their collections, and requests from the film crew expedited locating artifacts that hadn't been seen for decades. "In a way, this effort helped us, too," Strohmeyer says, "because that history is important for us to have available."

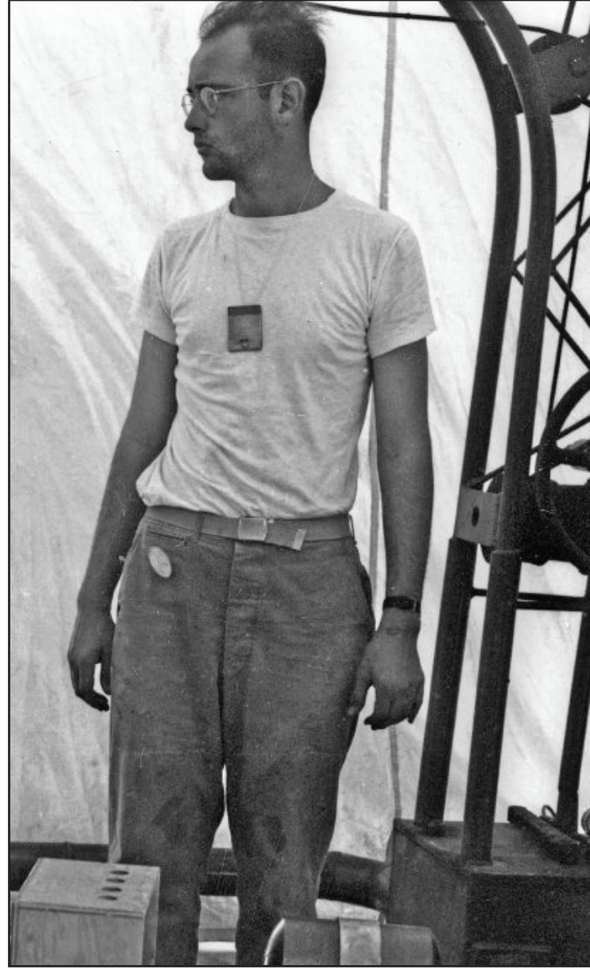
All that digging through files, however, meant the Lab's classification analysts needed to review everything to ensure it was suitable for public release. So atop their already massive daily workload, the analysts worked quickly to review these nearly 80-year-old artifacts.

Employees across these groups handled the extra work with pleasure, many of whom felt a responsibility to help Nolan accurately portray events.

"It was kind of amazing the way everyone pulled together," Creel says. "This is part of our jobs, to help people understand this moment in time. And this moment was one of the most world-changing events in human history. It's something people might know about, but that not everyone has a great understanding of—the blood, sweat, tears, and the difficulty that went into the Manhattan Project."

"It was like yep, okay, you're Christopher Nolan."

—Jonathan Creel



✦ Many Project Y scientists wore dosimeters, small devices that detect radiation. Lab historians sent pictures and measurements of these early dosimeters to the film crew.

✦ Parts of the movie were filmed at Oppenheimer's Los Alamos home, now owned by the Los Alamos Historical Society. Photo: Los Alamos County

Scientists playing scientists

In January 2022, a casting agency published a local call for extras. The agency was particularly interested in casting real-life Los Alamos scientists in the film. On a Sunday, a line of hopeful extras stretched for more than a quarter mile around Los Alamos High School. Some people waited more than two hours in 30-degree temperatures before making their way into one of the school's gymnasiums, where they submitted photos and paperwork to the casting agency.

"In the announcement, they told us to dress in whatever clothes we had that might match the time period," says Nora Jones, a technical project manager with the International Threat Reduction group. "It was quite funny to see the line of men in porkpie hats, and I remember thinking, 'How do so many people own those hats?'"

But not everyone dressed like they were from the 1940s. "I was there on a whim," says Thomas Mueller, a program manager for the Nuclear Counterterrorism and Nonproliferation group, who was later cast as a member of the military.

Joseph Smidt, part of the Laboratory's Weapons Physics associate directorate, decided to audition because "there's not many times in life when you'll have an opportunity like this. I wrote in the survey comments that I'm a scientist at the Lab. A few days later I got a call back."

The extras filmed in three primary locations around New Mexico. Some scenes were shot in the town of Los Alamos, for example, at Oppenheimer's house. But because Los Alamos has changed a bit since the 1940s, the film crew also built a 1940s version of Los Alamos near Abiquiu. The Trinity test, which occurred in what is today White Sands Missile Range, was recreated (without nuclear material) and filmed near Belen, about 30 minutes south of Albuquerque.

> "I wonder if through the entirety of the 1940s women just never slept well because of those curlers."
> —Nora Jones

Before each day of filming, male extras received haircuts and a shave—sometimes two shaves on an especially long day. On set, they were constantly reminded to pull up their pants, past their waists to just below their ribs. But the men had it easy. The women were told to sleep in hair curlers the night before filming. "They gave us a hair-setting solution, and the curls would be glued to my head for days," Jones says. "I wonder if the entirety of 1940s women just never slept well because of those curlers. It certainly gave me an appreciation for what my grandmother went through during that time."

Most extras played soldiers, military police officers, spouses, or townspeople. Smidt played a background scientist, with the first of his scenes at the faux Los Alamos in the desert of Abiquiu. A guard gate had been constructed that, he thought, looked exactly like the old black and white photos he'd seen. The main housing area also seemed straight from the '40s, although most buildings were modular and could be moved. When a scene called for fewer extras, the director sometimes ordered extras to hide themselves behind the fake buildings. Crouched together out of view, on more than one occasion Damon or Murphy would walk past the extras, flash a smile, and say hello.

The film crews also built replicas of the early technical areas, where scientists ran experiments during the Manhattan Project. "You have these mental images of what it might have been like to participate in Trinity," Smidt says. "It was neat to be a scientist today and to put myself in the role of a scientist of the past. It took on a very personal meaning for me."

Benigno Sandoval, with the Lab's Space Instrument Realization group, played an Army soldier in one scene at the fictional Los Alamos set, then a military police officer in another scene. "A lot of times you have no context for where your scene fits into the movie because you show up and they tell you to walk here, talk with this guy in a truck, or look like you're inspecting this vehicle, and that's it," he says.

Sandoval had never played a role in a film before, and he was surprised by how many different platforms the crew used to get certain shots—sometimes the camera was attached to a cable that panned smoothly overhead, or the camera was mounted on a moving truck or even on a helicopter. Sandoval wasn't in a helicopter scene, but Smidt was, and he remembers standing in a group as Nolan directed the helicopter to fly over the fake town at a height that felt uncomfortably low.

"They had this massive, 3D Imax camera hanging from the helicopter," Smidt says. "As soon as it flew over, a wall of sand and rocks and gravel pelted us from every direction. Then they'd say, 'All right, let's shoot it again.'"

The average age of Los Alamos staff during the Manhattan Project was 25. But Peter Sandoval, a retired engineer who is also Benigno Sandoval's uncle, filled a different demographic in the movie. He was cast as a senator. "My distinguished gray hair must have caught their attention," he laughs.

✦ Fuller Lodge, now managed by Los Alamos County, is on the United States National Register of Historic Places. Many Lab extras filmed scenes here. Photo: Los Alamos County

He sat on the dais at the Santa Fe capitol building, a few chairs from Robert Downey Jr., in a recreation of the closed-door hearings that eventually stripped Oppenheimer of his security clearance.

The elder Sandoval's first scene entailed a walk down the hallway, turning left, then entering the bathroom. When they called "action," he did as told, except in his excitement he accidentally walked into the women's restroom. "I thought I was gonna get fired after my first acting role," Sandoval jokes. "Everyone gave me a hard time after that."

By far the most impressive recreation was the Trinity test, which was portrayed with a series of coordinated live explosions—nonnuclear, of course. On set, the film crew built a replica of the tower that held the device, all of it illuminated from below by lights. At night in the desert, surrounded by vintage cars and trucks and actors in period clothing, many of the extras found this set particularly powerful.

"It was a little eerie," says Creel, who beyond supplying historical information was also an extra, which required that he shave his beard for the first time in 16 years. "It was really a moment of, it was just fascinating as a historian. I have goosebumps thinking of it now."

A scene that called for a great number of extras was filmed in downtown Los Alamos, inside Fuller Lodge. Murphy, playing Oppenheimer, gave a speech after the successful bombing of Japan. As the speech ended and Murphy walked from the dais to the exit, a crowd of cheering extras slapped his shoulders in congratulations. Outside Fuller Lodge, the film crew projected apocalyptic colors through the windows to create a scene meant to reflect Oppenheimer's internal struggle with creating such a destructive weapon.

Connecting with the past

The *Oppenheimer* movie will introduce many people around the world to what's now Los Alamos National Laboratory. But how the movie will portray the Lab and its most famous resident, no one will know until the film premieres.

However the movie unfolds, being part of its creation has had a profound impact on the employees who participated. "It gave me a deeper context in terms of the history of this career field we find ourselves working in," Jones says. "We're the caretakers of all the good work started by people like Oppenheimer."

Smidt agrees. "What Oppenheimer did, and what the Manhattan Project accomplished, is one of the most influential moments in human history. That has echoed in my mind since filming. In many ways, we at the Lab need to feel that connection today more than ever, that we are part of this history and that our work now is still changing the world." ✦

FROM THE DIRECTOR'S CHAIR

Six Los Alamos leaders reflect on Oppenheimer's legacy.

BY JILL GIBSON

Including J. Robert Oppenheimer, 12 directors have sat at the helm of what is now Los Alamos National Laboratory. Each brought his own background, management style, and individual beliefs to the Lab. Despite their differences, the directors who followed Oppenheimer shared a deep respect for the Laboratory's first director. Here, six former directors reflect on the leadership legacy Oppenheimer left behind. ★

■ Oppenheimer sits in his old director's chair during a visit to Los Alamos in 1964. This photo appeared in the June 1964 issue of *The Atom* magazine with the caption: "The famed scientist...tried the old executive chair he used as Laboratory Director. Oppenheimer noted that it was 'still very hard.'"

John Browne

Lab Director: 1997–2003

I came to Los Alamos Scientific Laboratory (LASL) in 1979, and during the 24 years I worked there, I came to understand that J. Robert Oppenheimer left an important legacy on Los Alamos that can be seen in many areas. Oppie created the atmosphere and the conditions from which LASL would become a first-rate laboratory. One key aspect was Oppie's search for the best scientific minds to help accomplish Project Y, as the Los Alamos role in the Manhattan project was known. That tradition of attracting the best talent has been key to the Laboratory's success throughout its history.

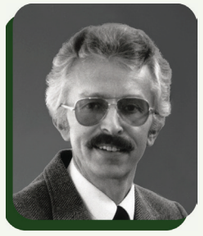
Although Oppenheimer was a theoretical physicist, he built the success of Project Y on the blending of theory with experimentation and computation. That three-legged stool still serves the Laboratory's approach to problem-solving today. Future directors built on Oppie's approach, particularly Norris Bradbury, who was faced with creating from Project Y a national laboratory, christened LASL in 1947.

■ Norris Bradbury, J. Robert Oppenheimer, John Manley, Richard Feynman, and Enrico Fermi at a 1946 colloquium.

Another aspect of Oppie's legacy that has continued to thrive at Los Alamos is the importance of allowing intellectual curiosity, which was certainly one of the reasons I joined Los Alamos. This creative "Oppie" atmosphere has been enhanced by technical colloquia open to all scientific staff, by connections to universities through students and faculty, and by collaborations with the international scientific community. There is a famous photograph from Project Y showing Oppenheimer and some scientific staff, including Enrico Fermi and Richard Feynman, at a technical colloquium. That image sums up my vision to have as much open participation as possible to solve difficult technical problems. I was not fortunate enough to meet Oppenheimer, but I did get to interact with some of his contemporaries, including Eugene Wigner, Hans Bethe, Edward Teller, and John Wheeler. Although I cannot claim that Oppenheimer affected their approaches to science, I did observe that they each supported that same atmosphere for the conduct of science.

Siegfried Hecker

Lab Director: 1986-1997



When I became the fifth director of Los Alamos National Laboratory in 1986, I was following in Oppenheimer's footsteps, but I could never step into his shoes. Throughout my career, I have carefully avoided trying to compare myself to Oppenheimer. He was a giant among giants whose legacy has influenced all things nuclear, including most of my career.

Recently I became the chair of the board of sponsors of the Bulletin of the Atomic Scientists, a group created by Albert Einstein and first led by J. Robert Oppenheimer. Over the years I have spent as a professor at Stanford University, Texas A&M University, and Middlebury College, my teaching has been founded on Oppenheimer's research, writing, and concerns for the future. I find myself often referencing him when writing and delivering talks.

As a scientist, much of my research has been on plutonium. Oppenheimer, long after his tenure at Los Alamos, once reflected that "plutonium turned out not to be a cozy metal ... It was a terrible test from beginning to end. It never stayed quiet: it gets hot, it is radioactive, you cannot touch it, you have to coat it, and the coating always peels ... It is just a terrible substance, and it is one reason why... it has never been used for peaceful atomic power because you cannot buy anyone to pay any attention to it [laugh]. And we had to do it for other reasons."

Well, I began to pay attention to plutonium as a summer graduate student at Los Alamos in June 1965. In 1983, for the 40th anniversary of the founding of the Laboratory, I co-authored an article titled, "Plutonium—A Wartime Nightmare but a Metallurgist's Dream," that enumerated the scientific and technical complexities of plutonium. The full range of plutonium's complexities continue to be under intense study at the Lab today.

Early in my directorship, the Soviet Union began to disintegrate, which led to my first of 57 trips to Russia. Academician Yuli Borisovich Khariton introduced himself with his hand extended as I stepped off the plane at the Sarov airfield on February 23, 1992. At age 88, his hand was a bit weak, but his smile was strong, and his eyes were warm as if greeting a long-lost friend. He had been the scientific director of the Russian Los Alamos since the beginning of the program in 1946. Khariton described the history of the atomic project in Russia. He addressed us in excellent English (with a decidedly British accent picked up during his graduate studies at Cambridge in 1926 to 1928).

Seven years later, I was asked to give a talk at the Khariton Scientific Conference in Sarov held to honor Khariton three years after his death. I captured Khariton's admiration of Oppenheimer in a slide comparing what they had in common as first pointed out to me by Khariton. They had the same first name because the "J" in J. Robert Oppenheimer stood for Julius, the English version of Yuli. They were born in the same year, 1904. They both studied at Cambridge in 1926, although they did not know each other. They both gained an appreciation for the arts from their mothers. They were also, of course, the first scientific directors of the first nuclear weapons institutes in each country.

In the slide, I showed portraits of Khariton and Oppenheimer. After the talk, one of their legendary nuclear designers, Academician Yuri Trutnev, congratulated me on a fine talk. He asked me to explain, however, why the chest of their Russian hero, Yuli Khariton, was bedecked with medals whereas Oppenheimer had none. I was quick on my feet with the reply, "In America, sometimes we don't treat our heroes well." I am sure that Trutnev knew of the fateful U.S. government 1954 decision not to renew Oppenheimer's security clearance. Fortunately, now some 68 years later, Department of Energy Secretary Granholm has finally vacated that decision.

■ Yuli Borisovich Khariton

■ J. Robert Oppenheimer

Robert Kuckuck

Lab Director: 2005–2006

The success of the Manhattan Project at Los Alamos was of course remarkable, and there is strong consensus that Oppenheimer's leadership was a major factor. I see that success as consisting of two major achievements: the bomb of course, and also the creation of a working model for engaging research scientists to team with the government and the military in the service of meeting national priorities. The Manhattan Project was the first effort of such magnitude in the history of the world.

With respect to the primary achievement, creating the bomb, Oppenheimer exhibited exceptional skill in attracting, motivating, organizing, and guiding a remarkably diverse collection of brilliant minds, ranging in personalities from Edward Teller to Hans Bethe. Given Oppenheimer's own complicated personality, this successful exhibition of "people skills" may have even been considered surprising to some.

The second accomplishment, teaming scientists with the military, was also no mean task. The contrast between scientists' needs for informal and open communication, collaboration, and the freedom to follow the data in real time, versus the military's hierarchical and rigid formality and the need for firm planning and secrecy, was challenging. Achieving a successful working relationship, which became fundamental to the creation of the nation's Federally Funded Research and Development Centers (of which Los Alamos National Laboratory is one), has proven to be of significant and lasting value to the nation.

Oppenheimer's project was unique. It had a single objective, and Hitler and the war provided extremely clear purpose and motivation, particularly to those displaced European scientists at Los Alamos. I believe that many of Oppenheimer's skills, particularly the "people skills" he exhibited, are relevant, in fact universal, and apply today across the many programs and projects of our national laboratories just as they did at that time to his single project on "The Hill." The broader roles and social interfaces encountered today by our national laboratories may demand an even greater weight being placed on "people skills."

■ General Leslie Groves and J. Robert Oppenheimer

With respect to Oppenheimer defending internal openness, communication, and inclusion among the scientists to insulate them from General Groves' pressures for compartmentalization and secrecy, I believe today's leaders face similar pressures from the government. The ever-increasing pressure for excessive external oversight and micromanagement is exacting serious time and resource inefficiencies upon the laboratories' research.

Today's leaders can take notice and encouragement from Oppie's success in establishing an environment conducive to scientific research and build upon that to continually optimize the national environment and opportunities for conducting science in the service of the nation.

■ Los Alamos Directors (from left) Charles McMillan, Michael Anastasio, John Browne, Bob Kuckuck, Don Kerr, and Terry Wallace gather in front of an Oppenheimer quote in 2018. The wall behind them reads: "There must be no barriers to freedom of inquiry. There is no place for dogma in science. The scientist is free, and must be free to ask any question, to doubt any assertion, to seek for any evidence, to correct any errors."

Terry Wallace, Jr.

Lab Director: 2018

It is difficult across the chasm of 80 years to understand the "social" dynamics of the success of Los Alamos and the Manhattan Project. Only two years and a few months passed between assembling the most talented scientific and engineering team in the history of the world and the successful detonation of an atomic bomb on July 16, 1945. In hindsight, there are far more reasons why it should never have succeeded: the task was enormous, and human conflict, bad decisions, accidents, or even bad luck could have delayed the weapon months or years. However, the success must be laid on the incredible leadership of Oppenheimer.

By 1940, Oppenheimer was arguably the most talented theoretical physicist in America, even if he was not the most decorated. That extraordinary competence was one of the pillars of Oppenheimer's leadership. Without respect for Oppenheimer, the collection of extraordinary scientists and engineers would have likely not focused on collective success.

The second pillar of Oppenheimer's leadership was his charisma, which was not about his ego; he was great at involving everyone. He was a polymath who could engage on topics from Indian mythology to collecting minerals (as a child Oppenheimer was a mineral collector—perhaps the only thing he and I have in common). When Oppenheimer first taught at the California Institute of Technology in the 1930s, he was a terrible teacher. He was boring and disorganized. He realized that he was ineffective, so he worked to become a great teacher. He learned to teach to the individuals in the class. It was this ability to connect to people that made him an effective and charismatic leader.

The third pillar of Oppenheimer's leadership was integrity. The Los Alamos staff trusted him.

The last pillar was sharing success. Oppenheimer never claimed credit for the success of the Los Alamos part of the Manhattan Project. He made sure that the success was recognized as a collective effort.

Brilliant, charismatic, honest and gracious, Oppenheimer left a leadership legacy for all future directors at Los Alamos.

Charles McMillan

Lab Director: 2011–2017

Among the many interesting artifacts in the Los Alamos archives is a letter to Oppenheimer from his bank, on the back of which he scribbled a set of questions that appear to have served as a project plan for the Manhattan Project. Through interactions with his graduate students, Oppenheimer seems to have honed his ability to ask questions, questions that provided critical insights into problems and served as prompts for the future.

For these reasons, it has always seemed to me that a good question is worth more than a good answer. Thus, I admire Oppie's ability to ask just the right questions—questions that might break open a topic for the people of the Lab or help to organize a difficult subject. I have attempted to follow his example throughout my career.

Thom Mason

Lab Director: 2018–present

I have often reflected on Oppenheimer's legacy. In a certain sense, Oppenheimer defined the idea of what a lab director should be. Prior to the Manhattan Project, there really wasn't a concept of national laboratories, so, as one of the first lab directors and probably the most iconic, Oppenheimer serves as a reference point and role model. He clearly worked to impart on his staff a strong sense of the national security mission, its urgency, and the need to bring the right people to bear on the problems. People felt motivated to live up to his high expectations—that was one of the reasons behind his success. I think he also saw part of his role was to serve as a buffer between the Lab and the external forces represented by senior policymakers: the military, and federal bureaucracy. He shielded the Lab from some of those factors so the staff could focus on the challenging technical issues that had to be overcome.

Oppenheimer had almost no prior management experience, so it was really a leap of faith that General Leslie Groves put him in charge. Oppenheimer was trained as a scientist, not a bureaucrat, or a manager, and this emphasis on lab directors having scientific backgrounds continues today. I think it's a strength that the Department of Energy continues to choose people with strong technical backgrounds for senior leadership roles. Even though no one can be an expert in all areas of science and engineering, a scientific background creates credibility with the staff and informs key decisions. That was important during the Manhattan Project, and it's important today.

I think at the Lab we have a desire to protect Oppenheimer's legacy. Recently, I worked closely with eight former Los Alamos directors to nullify the 1954 revocation of Oppenheimer's security clearance. We all agreed that this was something that needed to be done. In a certain sense, it's a small gesture, many decades too late, but that's not a reason not to do it. It was past time to shine a bright light on a dark spot in U.S. history.

Oppenheimer's legacy is part of what makes Los Alamos so special. The employees are so brilliant, so creative that I often find it mind-boggling to see the depth of talent here. This was also true during the Manhattan Project. That's one of the key lessons that Oppenheimer left behind for future Lab directors—success starts with an exceptional team. ★

■ Llobet visits the Oppenheimer statue in downtown Los Alamos.

GUIDING THE NEXT GENERATION

Anna Llobet honors Oppenheimer's memory through action.

BY IAN LAIRD

Anna Llobet, an experimental physicist at Los Alamos National Laboratory, is the founder of the Summer Physics Camp for Young Women—a two-week science camp that gives New Mexican and Hawaiian students a chance to explore careers in science, technology, engineering, and math. "I believe it is extremely important that we bring the love and thrill of knowledge to everyone and make it easier for marginalized or underrepresented communities to find role models," she says.

In 2023, Llobet was elected vice-chair of the J. Robert Oppenheimer Memorial Committee (JROMC), an organization dedicated to preserving the legacy of the Lab's first director and promoting the values he embodied.

The physics camp and JROMC share a common goal: to make science accessible and interesting to kids of all ages and backgrounds. Llobet believes educating students about the importance and relevance of science is essential for our society. "Science and technology have brought longevity to the human race, and hopefully science will be the basis to inform public policy when it comes to energy, conservation, defense, and exploration in the future," Llobet says. "But for that, we need a society that trusts science from an educated standpoint."

Small experiments, big effects

Born and raised in Barcelona, Spain, Llobet came to the Lab as a postdoctoral researcher in 2001. Her background is in materials science and neutron scattering, but in the past decade she has shifted to shock physics, the study of how materials respond to high pressure shock waves, such as those produced by an explosion.

As part of the Safety and Surety group in the Lab's Weapons Physics associate directorate, Llobet works at the Los Alamos Neutron Science Center (LANSCE), one of the nation's most powerful linear accelerators. Here, Llobet performs small-scale dynamic experiments with protons and materials science research with neutrons. Llobet's experimental work, combined with supercomputing simulations, helps ensure the safety and effectiveness of the nation's nuclear weapons.

After more than two decades at the Lab, Llobet feels a special connection with many of her coworkers. "Very few of us were born and raised in Los Alamos and yet, after 22 years, they are my family away from my actual family," she explains.

She also has grown to love the town of Los Alamos. "I truly believe this town and the Laboratory are amazing places where the arts, science, technology, and spirit of service and community bloom and feed into each other," she says. "As a scientist and a person, I want to be relevant to my community, society, and the world's future and that's exactly what working here offers me."

In 2022, Llobet received the Laboratory's Community Relations medal for her leadership and contributions across the region.

A lasting legacy

In 1971, a group of Oppenheimer's Los Alamos colleagues formed JROMC to honor him and his work by making science education accessible throughout northern New Mexico and by preserving documents and artifacts related to Oppenheimer.

When Llobet was nominated to be a JROMC member in 2020, she says she was unfamiliar with the committee and its goals. Most of what she knew came from the committee's annual memorial lectures. She took the time to learn more and quickly grew enamored of JROMC's history, mission, and people. "I realized their mission was broader than what I thought, and the committee was a group of amazing people," Llobet says.

One aspect of that history and mission is JROMC's fight to nullify the Atomic Energy Commission's 1954 decision to revoke Oppenheimer's security clearance (see p. 46 for more). After nearly two decades of disappointing results, the committee solicited letters of support from Los Alamos Director Thom Mason, former Lab directors, other prominent scientists, and academics. In December 2022, Energy Secretary Jennifer Granholm signed a secretarial order that vacated the 1954 decision and acknowledged the seminal role that Oppenheimer played in U.S. history.

For Llobet, the long-awaited decision was a welcome one. "I believe Oppenheimer was key in the success of the nuclear enterprise and the positioning of this country as a veil for worldwide democracy and peace," she says. "I am extremely proud of the recent decision by the DOE secretary."

Llobet says she has a great deal of admiration for the humble nature in which Oppenheimer conducted his work. "He could have sought to grow his own personal reputation after an amazing early career and yet, he felt the call to do what he could in front of the tragic progression of fascism in Europe and the war," she explains. "Oppenheimer was not only a great scientist, he was also a teacher, a patriot, a leader, and a humanist. He cared deeply about his students and met with them daily."

Through her work at the Laboratory, on JROMC, and the summer physics camp, Llobet is often reminded of Oppenheimer. "I can see his personal legacy and impact in many places in the Laboratory and our community," she says. "It is hard to wrap your head around all the fields in which one can find his fingerprints in physics." ★

■ Llobet gestures toward the Oppenheimer house, where the famed physicist lived during the Manhattan Project.

THE DISTINGUISHED ACHIEVEMENTS OF LOS ALAMOS EMPLOYEES

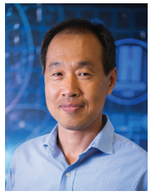
Darleane Hoffman, a nuclear chemist who spent a significant part of her career at Los Alamos National Laboratory, was honored with the Enrico Fermi Presidential Award, which is administered on behalf of the White House by the U.S. Department of Energy (DOE). Hoffman was recognized for scientific discoveries advancing the field of nuclear and radiochemistry, for distinguished service to DOE's missions in national security and nuclear waste management, and for sustained leadership in radiochemistry research and education.

Mike Furlanetto, former director of the Los Alamos Neutron Science Center, is the new senior director of the Advanced Sources and Detectors (ASD) Project, which is part of the Laboratory's Nevada Programs Office. The ASD Project, also known as Scorpius, is a cutting-edge accelerator that will be installed nearly 1,000 feet underground in the U1a test complex at Nevada National Security Site.

Associate Laboratory Director for Weapons Production **John Benner** was inducted into the 2023 Academy of Distinguished Alumni of the Department of Mechanical and Aerospace Engineering at West Virginia University.

Theoretical division leader **Marianne Francois** and **Michael Pettes**, deputy group leader at the Center for Integrated Nanotechnologies, were named fellows of the American Society of Mechanical Engineers (ASME). Francois is an expert in computational multiphase flow, heat transfer, materials processing, and associated numerical methods. Pettes was recognized for his contributions to strain and defect engineering and for his service and leadership in mechanical engineering.

The Society of Petroleum Engineers announced that Earth and Environmental Sciences division scientist **Mohamed Mehana** was awarded the Reservoir Description and Dynamics Award for the Southwestern North American Region.



Yu Seung Kim, a scientist with the Lab's Materials Synthesis and Integrated Devices group, was honored as Battelle's Inventor of the Year. The annual award is given by Battelle to recognize inventors from Battelle and the national laboratories it manages. Kim was recognized for innovative research "to design fuel cells with an ion-pair coordinated polymer membrane, which increases the temperature range a fuel cell can reliably function in and increases the power of the vehicles."

Bob Putnam was recognized by the Department of Energy with the 2023 Derivative Classifier of the Year award for his work developing guidance for the pit manufacturing mission at Los Alamos and the Savannah River Site. Putnam, who is part of the associate Laboratory directorate for Weapons Production, is known as a skillful derivative classifier (DC) with deeply embedded knowledge and a constant willingness to help others learn the ins and outs of classification. He's been a DC for 25 years.

Dusan Spernjak of the Laboratory's Mechanical and Thermal Engineering group received a certificate of recognition for outstanding service from the American Society of Mechanical Engineers (ASME). He recently served as the technical program representative for the High Pressure Technology technical committee of the ASME Pressure Vessels and Piping division.

Los Alamos, New Mexico, one of the "15 best small towns to visit in 2023," and "the best scientific small town," according to *Smithsonian Magazine*. "When director Christopher Nolan's feature film Oppenheimer premieres on July 21, New Mexico's Los Alamos will be playing a starring role," the author writes. "Tucked away at an elevation of 7,320 feet among the snowcapped peaks, canyons, and mesas of northern New Mexico, the town is home to the Los Alamos National Laboratory—a renowned scientific institution employing some of the world's top scientists and researchers, and one that also played a major part in the development of the atomic bomb." ★

> BETTER SCIENCE = BETTER SECURITY
>
> Hardworking people—the Laboratory's most important asset—enable Los Alamos to perform its national security mission.

IN MEMORIAM

Retired theoretical physicist Leon Heller passed away on April 12 at the age of 93. Heller worked for more than 55 years at Los Alamos National Laboratory and was a member of the J. Robert Oppenheimer Memorial Committee. "Leon was an incredibly well-respected scientist who had broad scientific interests and curiosity and thoroughly enjoyed being a theoretician in an experimental physics organization," says Frank Merrill, Physics division leader. "In addition to his stature as an excellent physicist, he was also an incredible colleague: smart, funny, willing to explain patiently, and interested in helping others." ★

59 YEARS AGO

On May 18, 1964, J. Robert Oppenheimer returned to Los Alamos for the first time since resigning as Laboratory director in late 1945. He visited the Los Alamos Scientific Laboratory museum, where he signed the guest register. A photograph of the Trinity test hangs in the background. ★

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THEN & NOW

From 1917 to 1943, the Los Alamos Ranch School occupied part of northern New Mexico's Pajarito Plateau. Two key features of the school were Ashley Pond and Fuller Lodge (circled). After the Ranch School was purchased by the federal government, a wartime laboratory (pictured above) sprung up around Ashley Pond. Fuller Lodge, which was a dining hall during the Ranch School days, became a popular venue for dances and other events attended by Manhattan Project scientists.

In 1953, Los Alamos Scientific Laboratory began relocating across the canyon from Ashley Pond, and Los Alamos County eventually designated the pond and surrounding green space as Ashley Pond Park. During the summer, Los Alamos residents enjoy a Friday night summer concert series at the park. Here, a crowd gathers to see Big Head Todd and the Monsters perform in May 2019. ★

Photo: Los Alamos County