Commemorating Controversy: Place-making at the Birthplace of the Bomb

Ellen D. McGehee

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Approved by the Dissertation Committee:

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Samuel Truett
COMMEMORATING CONTROVERSY:
PLACE-MAKING AT THE BIRTHPLACE OF THE BOMB

by

ELLEN D. MCGEHEE

Bachelor of Arts, Anthropology, University of Arizona, 1984
Master of Arts, History, University of New Mexico, 2004

DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
History

The University of New Mexico
Albuquerque, New Mexico

December, 2015
DEDICATION

Great teachers impart more than knowledge, they model behaviors that motivate and encourage their students. When I think about my favorite teachers, three important human qualities immediately come to mind: *patience, compassion,* and *enthusiasm.* I would like to dedicate this dissertation to two true enthusiasts of atomic history who were kind-hearted and patient mentors, and who are sorely missed.

To the memory of Professors Timothy D. Moy and Ferenc M. Szasz,

University of New Mexico, History Department Faculty
ACKNOWLEDGMENTS

Many people have been instrumental to the success of this dissertation, which would have certainly lost its way without their help. The origin of this project extends back to the 1980s, with my first job as an archaeologist at Los Alamos researching the history and material culture of the Homestead era on the Pajarito Plateau, and I am indebted to countless co-workers who have encouraged my professional interests since then. In general, I would like to recognize the support of Los Alamos National Laboratory (LANL) and the Department of Energy (DOE) for allowing me to accomplish my personal goal of higher education while pursuing my professional career in cultural resources management and historic preservation.

Although I have been fortunate to be able to work in LANL’s remarkable history archives, I did rely on individuals from other archives and institutions to host my research trips and to help me with photographs and archival materials. I would like to acknowledge the kind assistance provided to me by the staff of the University of New Mexico (UNM)’s Zimmerman Library (government document collection), Center for Southwest Research, and Physics Department; by the staff of the Washington Navy Yard and Naval History departments, including Lisa Crunk, Julie Darsie, and William Manley; and by Navy staff at Dahlgren and Indian Head, including Mary Geil and Thomas Wright. I was hosted on my trip to Mare Island by Barbara Davis and Joyce Giles of the Mare Island Museum; Navy staff helped facilitate my visit to the former Port Chicago, including Melissa Montag and Pamela Ramirez (MOTCO area) and Patricia Mcfadden and Glen Nelson (inland Concord area). I would also like to acknowledge the kind help I received from Taigh Ramey during my visit to Stockton Field’s Vintage Aircraft. Closer
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The Los Alamos Historical Society has graciously given me permission to use photographs, oral histories, and other archival materials from their collections, and I am beholden to the ever-patient Rebecca Collinsworth, Los Alamos Historical Society archivist. Los Alamos Historical Society board members, some no longer with us, have also provided me with endless encouragement, for which I am grateful.

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Historians have to rely on other historians for intellectual feedback (they are often the only ones who understand why your historical discoveries matter or who even care). In this vein, I would like to formally thank Terrence “Terry” Fehner, DOE Chief Historian, and F. G. “Skip” Gosling, former DOE Chief Historian, for their wise counsel, and acknowledge a debt of gratitude to former LANL historian Roger Meade and to Oak Ridge historians D. Ray Smith and the late William “Bill” Wilcox for readily sharing their vast historical knowledge. LANL historian Alan Carr has especially provided intellectual sustenance during the dissertation process, helping me negotiate the LANL archives and providing a friendly forum for all things Manhattan Project at our Friday morning history chats. His feedback, enthusiasm, and assistance are gratefully acknowledged.

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COMMEMORATING CONTROVERSY:
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by

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Ph.D., History, University of New Mexico, 2015

ABSTRACT

In early 1943, the U.S. government’s Manhattan Project built a secret laboratory at Los Alamos, New Mexico, for a single military purpose—to develop the world’s first atomic weapons. Today, the remaining places and spaces of the bomb at Los Alamos are being preserved for future generations through their inclusion in the Manhattan Project National Historical Park, a unique partnership between the Department of Energy, which will continue to own and manage its wartime properties located “behind the fence,” and the Department of Interior’s National Park Service, which will take the lead on interpreting the complex history and continuing legacy of nuclear weapons. This study, a blend of social, architectural, and scientific history, examines the historical contexts of the remaining World War II buildings and structures at Los Alamos National Laboratory that are listed in the park legislation. Arguing that the decision to use atomic weapons against the people of Japan is the polarizing master narrative of the Manhattan Project, this dissertation focuses instead on the narratives of people, places, and institutions that have been overshadowed by controversy.

Using primary, secondary, and oral history sources, along with historical photographs and architectural drawings, this research project explores the Manhattan Project through the lens of place. This study examines the voices of women and the
military, documents lost technologies and places, and discovers connections between
Los Alamos and other institutions that supported the development and deployment of the
first atomic bombs, including the underappreciated contributions of the U.S. Navy and
the University of New Mexico, which have been obscured by past government secrecy
practices.

As national sites of memory—Pierre Nora’s _lieux de mémoire_—the meaning of
these atomic places and landscapes will change through time, ever responding to the
dynamics of collective memory and experience. The goal of this study is to look beyond
the controversy of atomic weapons to reveal hidden narratives and historical associations
that will provide the intellectual stage for continued public dialogue about the memory
and meaning of the development and use of nuclear weapons.
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<td>49</td>
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<td>627A</td>
<td>Code name for Mare Island Navy Yard, also known as “The Yard,” supported repackaging of items for tropical shipment; Building 627-A was an annex to Building 627 at Mare Island</td>
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<td>AEC</td>
<td>Atomic Energy Commission</td>
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<tr>
<td>Batch</td>
<td>Equipment and supplies sent to Tinian Island in support of Project Alberta</td>
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<tr>
<td>Bowery</td>
<td>Standard shipments to Tinian of replaceable items</td>
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<tr>
<td>Bradbury</td>
<td>Bradbury Science Museum</td>
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<td>Bronx</td>
<td>High-priority item shipments to Tinian</td>
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<tr>
<td>Buggies</td>
<td>Code name for B-29 aircraft</td>
</tr>
<tr>
<td>BuOrd</td>
<td>Navy Bureau of Ordnance</td>
</tr>
<tr>
<td>Centerline</td>
<td>Center Line, Michigan, location of a naval ordnance plant that supported the construction of weapon parts</td>
</tr>
<tr>
<td>CIT</td>
<td>California Institute of Technology, Caltech</td>
</tr>
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<td>Creutz Test</td>
<td>Almost exact copy of the Trinity test, without a fissile core; the test was conducted at Pajarito Site on July 14, 1945</td>
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<td>Destination</td>
<td>Code name for Tinian Island</td>
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<td>Detroit Office</td>
<td>Code name for office run by George Chadwick that coordinated weapon design and fabrication under contract with the University of Michigan</td>
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<td>DOE</td>
<td>Department of Energy</td>
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<tr>
<td>D&amp;RG</td>
<td>Denver and Rio Grande</td>
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<tr>
<td>EP</td>
<td>Explosion-Proof</td>
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<tr>
<td>ERL</td>
<td>Explosives Research Laboratory, see Project Q</td>
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<tr>
<td>Gadget</td>
<td>Code name for Trinity test device; also used to describe Fat Man and Little Boy prototype weapons generally</td>
</tr>
<tr>
<td>Gun Site</td>
<td>Development and testing area for Little Boy, known originally as Anchor Ranch Proving Ground, Anchor Ranch West, or Anchor (G.S.) Site; also known today as TA-8</td>
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<tr>
<td>Fat Man</td>
<td>Atomic bomb that used high explosives to generate an inward explosion or “implosion” to compress a subcritical mass of plutonium in order to achieve a supercritical chain reaction and nuclear explosion; dropped on Nagasaki, Japan, on August 9, 1945</td>
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<td>HE</td>
<td>High Explosives</td>
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<td>Jumbino</td>
<td>Scale-models of the Jumbo vessel; originally built as spherical test units and later built in more cylindrical test shapes, more closely resembling the final Jumbo design</td>
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<td>Term</td>
<td>Description</td>
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<td>Jumbo</td>
<td>A large steel containment vessel manufactured by Babcock and Wilcox; designed to contain the Trinity device’s plutonium in the event of an atomic “fizzle”</td>
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<td>Kingman</td>
<td>Code name for Wendover Air Field, Utah (see also W-47)</td>
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<td>Kit</td>
<td>A single shipping manifest of items, from buildings to special tools, put together to support a specific task at Tinian</td>
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<td>K-Site</td>
<td>Wartime firing site/implosion testing area, also “K” Site; known today as TA-11</td>
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<tr>
<td>LANL</td>
<td>Los Alamos National Laboratory</td>
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<tr>
<td>Little Boy</td>
<td>Atomic bomb that achieved a supercritical chain reaction and nuclear explosion through gun-assembly (shooting a subcritical mass of uranium at another subcritical mass); dropped on Hiroshima, Japan, on August 6, 1945</td>
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<td>LOPO</td>
<td>First Water Boiler reactor built at Los Alamos’s Omega Site; LOPO stands for Low Power</td>
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<td>L-Site</td>
<td>Wartime firing site/implosion testing area, also “L” Site; known today as the former TA-12</td>
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<td>Main Tech Area</td>
<td>Main Technical Area; the primary laboratory area located in the Los Alamos townsite, comprised of administrative buildings and scientific laboratories; known after the war as TA-1</td>
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<td>MED</td>
<td>Manhattan Engineer District</td>
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<tr>
<td>MeV</td>
<td>One million electron volts</td>
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<td>NDRC</td>
<td>National Defense Research Committee</td>
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<td>NOTS</td>
<td>Naval Ordnance Test Station, see Site I</td>
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<td>Omega Site</td>
<td>Located in Los Alamos Canyon and also known as TA-2 after the war; Los Alamos Canyon is sometimes known as Omega Canyon because of its association with Omega Site</td>
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<td>OSRD</td>
<td>Office of Scientific Research and Development</td>
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<td>Pajarito Site</td>
<td>Also Pajarito Laboratory Site; known after the war as TA-18</td>
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<td>Project A</td>
<td>Secret project to assemble and deliver material, personnel, and bombs to Tinian (Project Alberta)</td>
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<td>Project Camel</td>
<td>Secret project at Inyokern, California, involving both Caltech and the Navy; supported implosion weapon prototype tests, including production of components as well as inert pumpkin bombs</td>
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<tr>
<td>Project Q</td>
<td>Code name for the Explosives Research Laboratory (ERL), located in Bruceton, Pennsylvania</td>
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<tr>
<td>Project Trinity</td>
<td>Secret project to test the first non-weaponized implosion device at southern New Mexico base of operations, known as Trinity Site</td>
</tr>
<tr>
<td>Project Y</td>
<td>Code name for secret laboratory located at Los Alamos, New Mexico; also known as Site Y</td>
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Pumpkins  Fat Man-type casings filled with inert materials or live explosives; orange-colored and used for drop tests and practice bombing runs; distinct from Fat Man prototype units used to test actual weapon components

PX  Post Exchange

Q-Site  Wartime firing site/implosion testing area, also “Q” Site; known today as TA-14

RaLa  Radiolanthanum

Redball  High-priority shipping speed; usually by air

rep  Roentgen equivalent physical

rem  Roentgen equivalent man

Sandy Beach  Code name for Salton Sea

SED  Special Engineer Detachment

Silverplate  Code name for high-priority status.

Site I  Inyokern, California (also Site “Eye”); Naval Ordnance Test Station (NOTS)

Site M  Muroc Army Air Base (now Edwards Air Force Base)

Site W  Hanford, Washington; code name for the Hanford Engineer Works (HEW); primary site for the production of the plutonium used in Fat Man

Site X  Oak Ridge, Tennessee; code name for the Clinton Engineer Works (CEW); primary site for the production of fissile uranium used in Little Boy

Site Y  See Project Y; code name for Los Alamos laboratory

S-Site  Also Site S or “S” Site; the “S” stands for sawmill (site of wartime high-explosives research and development; today’s TA-16)

TA  Technical Area (a postwar term for a discrete geographical area within the larger Los Alamos laboratory boundary)

TD  Trap Door

Thin Man  A failed gun-assembled weapon design unsuitable for use with plutonium; its technology was similar to what was eventually used in the Little Boy weapon

TIJ  Code name for Port Chicago, California (TIJ stands for Three Igloo Job); sometimes known as Kinne’s Place for Base Commander Kinney

TNT  Trinitrotoluene

TR  Code name for Trinity

Tuballoy  Code name for natural uranium

Two Mile Mesa Site  Also 2 Mile Mesa Site (upper); location of Jumbino and Concrete Bowl tests; known today as TA-6

UNM  University of New Mexico

V-J Day  Victory in Japan day, August 15, 1945 (although September 2, 1945, is the official date of the formal signing of surrender)
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<td>V-Site</td>
<td>Also &quot;V&quot; Site or the &quot;Mock-up Site,&quot; used for the assembly of implosion devices, including the Trinity Gadget</td>
</tr>
<tr>
<td>W-47</td>
<td>Wendover Air Field, Utah, also known by its code name &quot;Kingman&quot;</td>
</tr>
<tr>
<td>WAC</td>
<td>Women’s Army Corps</td>
</tr>
<tr>
<td>Wig-Wag</td>
<td>An arm-bar gate restricting access to firing site locations, usually counterbalanced to stay in an upright position when not in use</td>
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The purpose of this study is to identify overshadowed and hidden narratives and themes, and incorporate them as appropriate into the historical contexts of the Manhattan Project properties included in the Manhattan Project National Historical Park legislation. The object is to understand better the current and future meanings of these soon-to-be public sites of memory.¹ The genesis of this interpretive work, however, extends back to the late 1990s, with the first Los Alamos National Laboratory (LANL) efforts to identify and save the last remaining Manhattan Project buildings and structures from certain destruction. Spearheaded by John Isaacson, former LANL archaeologist and environmental manager, and assisted by Kari Garcia, another long-time member of the national laboratory’s cultural resources team, the preservation of these nationally significant properties, along with their historical contexts and themes, was the main objective; that some of these same properties will be part of the new park is a happy coincidence.

This dissertation draws on archival materials from historical society, university, and state archives in New Mexico, and from documents in the closed government archives at LANL. Other sources include historical photographs, period maps, original building drawings, archived oral histories, previously published memoirs and histories,

¹ The Manhattan Project National Historical Park was authorized as part of the FY 2015 National Defense Authorization Act, signed into law on December 19, 2014. The concept of “sites of memory” (les lieux de mémoire) comes from an article by Pierre Nora about place, meaning, and memory. Pierre Nora, "Between Memory and History: Les Lieux de Mémoire," Representations, no. 26, Special Issue: Memory and Counter-Memory (Spring 1989).
and the author’s own experience documenting and restoring Manhattan Project properties at Los Alamos.

Beyond simply adding to the historical narrative of Los Alamos’s role during World War II, the ultimate goal of this research project is to provide a greater understanding of the complexity of the Manhattan Project. The decision to use atomic weapons on the people of Japan during the waning months of the war is the polarizing master narrative of Manhattan Project history. This dissertation demonstrates that an examination of wartime places and landscapes reveals cultural and scientific narratives, themes, and meanings long eclipsed by the dropping of the bomb. Furthermore, the very physical experience of visiting the new park properties promises to create individual memories that, in turn, will influence the current and future collective meaning of the development and use of the world’s first atomic weapons.

Historical contexts and themes associated with the park properties located at LANL are presented in seven core chapters (4 – 10) laid out in roughly chronological fashion. Each focuses on scientific and social histories that have been ignored or lost, but that will likely be reinterpreted as part of the formal, site-specific, place-making process related to the establishment of the new national park. Photographs of place, including newly discovered historical images from the LANL Archives, supplement each chapter’s narrative and provide a window to the past.

The dissertation is divided into five parts. Part I, “Introduction and Background,” includes chapter 1, “Introduction: Public Memory and Place-Making,” which provides background information regarding the Manhattan Project National Historical Park legislation and explores concepts of commemoration, memory, meaning, and place-
making that underpin the study. As part of this introductory section, chapter 2, “Manhattan Project Commemoration and Controversy,” presents several national and local responses to museum and other public projects involving the interpretation and commemoration of the Manhattan Project’s history and legacy. These case studies demonstrate that the controversy over the decision to use nuclear weapons to end World War II is the overarching and ultimately polarizing metanarrative that will inform much of the new park’s interpretation efforts.

Part I also contains chapter 3, which provides background for the core research chapters of this study. “Project Y: Origins and Scientific History” describes the early days of Los Alamos’s Project Y, including a synopsis of the neglected story of the Hispanic and Anglo homesteaders and ranch owners whose lands were appropriated by the government. The inclusion of the largely undocumented story of Hispanic homesteading on the Pajarito Plateau speaks to the importance of local land-use traditions that were disrupted by the arrival of the Manhattan Project. The main focus of chapter 3, however, is a chronological overview of the key events of Project Y from 1942 through 1946 to help the reader better understand the scientific history of the wartime development of atomic weapons. This chapter also places the specific LANL properties listed in the park legislation within the Manhattan Project timeline.

Part II, “Initial Designs (1943–1944),” focuses on the initial wartime research at Los Alamos and presents the historical contexts of the “Pond Cabin” (chapter 4) and “Gun Site” (chapter 5), two of the properties included in the Manhattan Project National Historical Park legislation. Chapter 4, “The Pond Cabin: Western Places in the History of the Nation,” is an examination of the history of the Pond Cabin and its location in the
Pajarito Plateau’s remote Pajarito Canyon. The chapter’s narrative sidesteps the technical history of Emilio Segrè’s plutonium chemistry work, which has supplanted the story of the Pond Cabin, and focuses instead on a history of the cabin as a symbol of the history of the West in the twentieth century, one that touches lightly on the historiographical scholarship of western history. The focus of this chapter is less on the cabin’s role during the Manhattan Project and more on its significance and its meaning as a site of public memory to the broader history of the twentieth-century West, from its association with the ranching era of the early 1900s through its continued role during the Cold War.

Chapter 5, “Gun Site and the Role of the Navy in the Development of Little Boy,” looks at the birthplace of the Little Boy bomb, a group of buildings known today as Gun Site. Associated first and foremost with the use of Little Boy in August of 1945 against Hiroshima, Japan, this place of contested memory holds additional meanings that have been eclipsed by controversy. The chapter examines how the development of the Little Boy gun-assembled weapon was really the result of a close relationship with the U.S. Navy, its gun designers, gun production facilities, proving grounds, and personnel, some of whom, such as Captain William “Deak” Parsons, worked at Los Alamos and played major roles in the development and eventual deployment of the Manhattan Project’s atomic weapons. Chapter 5 also introduces the concept that government practices of secrecy have effectively obscured not only the story of the Navy’s involvement, but the stories of other organizations whose contributions have been, up until now, effectively hidden in closed government archives.

Part III, “The Implosion Problem (1944),” describes the efforts associated with the development of a second Los Alamos weapon during the war and includes several
chapters that highlight additional park-eligible properties: S-Site’s “High Explosives Magazine” (chapter 6), as well as Pajarito Site’s “Battleship Building,” L-Site’s “Firing Pit,” K-Site’s “Betatron and Cloud Chamber Facility,” and Q-Site’s “Darkroom and Shop Building” (chapter 7). Continuing the chronological narrative of the places and spaces of the bomb, chapter 6, “High Explosives and the Special Landscapes of Project Y,” focuses on the special landscape of high-explosives research and development that grew up at S-Site in Los Alamos in response to Emilio Segrè’s findings that plutonium would not work in the gun-assembled weapon being designed at Gun Site. Using the lone high-explosives magazine that remains as example of an underappreciated place of meaning, the chapter documents S-Site’s wartime high-explosives area and, using landscape and architectural details, reveals risks inherent in Manhattan Project weapons work. Chapter 6 also refers to the future research potential of untapped and overshadowed memoirs and oral histories related to the personal experiences of the youthful members of the Special Engineer Detachment (SED), who were unique Army recruits brought to Los Alamos just for the development of the Fat Man implosion weapon.

Taking on a concept first presented by Lillian Hoddeson in *Critical Assembly*, a technical account of the work conducted by the Los Alamos laboratory during the war, chapter 7, “Engineering the Bomb: Implosion Testing, A Workforce Shortage, and the Women of Project Y,” focuses on the themes of problem solving and ingenuity that will be part of the public meaning and memory associated with implosion testing. This chapter describes several relatively unknown buildings and experimental structures, included in the park legislation, that speak directly to the scientific and engineering challenges faced by the Project Y workforce during the development of the Fat Man
implosion weapon. The important and often-neglected contributions of nonscientists are also highlighted in this chapter, including the underrepresented stories of female technicians, so often overlooked in favor of accounts about famous scientists and by the controversy over the development and use of atomic weapons.

Part IV, “Final Testing, Delivery, and Legacy (1945–1946),” introduces key Los Alamos assembly buildings and associated properties: “V-Site and the Concrete Bowl” (chapter 8) and the “Quonset Hut” (chapter 9). Part IV also completes the documentation of the proposed places of the new national park with an exploration of the site of a well-known postwar radiation accident: the “Slotin Building” (chapter 10). In chapter 8, “V-Site and the Trek to Trinity: Reclaimed, Neglected, Forgotten, and Contested Spaces of the Bomb,” the story line continues with an examination of additional Los Alamos properties that supported the full-scale test at Trinity Site in southern New Mexico prior to Fat Man’s wartime use. In this chapter, past practices of selective preservation and commemoration are revealed by using examples of reclaimed, neglected, forgotten, and contested places, including the little-known Creutz test and the site of the Trinity test itself.

Moving forward in time to the final design, assembly, and deployment of the Little Boy and Fat Man bombs at war’s end, chapter 9, “The Fat Man Quonset Hut and Overshadowed Narratives of Final Design, Assembly, and Delivery,” examines the untold story of Los Alamos’s role in weaponizing the final combat units and delivering them to the Pacific, and also documents the little-known history of the Quonset Hut, where key components of the Nagasaki bomb were assembled. Additional hidden stories emerge in this chapter, including the role of support institutions, such as U.S.
universities with secret Manhattan Project contracts. Many details of this narrative have been overlooked due to the selectiveness of commemoration and the underappreciated yet vital role of military logistics.

In the final section of Part IV, chapter 10, “Critical Assembly and the Slotin Parable,” explores existing public meanings and memories associated with the Louis Slotin criticality accident and documents previously unknown wartime radiation accidents. Slotin’s fatal accident at Pajarito Site in 1946 and Harry Daghlian’s earlier fatal accident at Omega Site in 1945 have captured the public’s attention and have become the substance of twentieth-century myth and legend. The main purpose of this chapter is to reveal accurate but previously hidden and obscured details of the Slotin accident, which took place on May 21, 1946, using period documents from closed government archives. The Slotin Building’s story is presented as one of the greatest interpretive challenges facing the National Park Service as it begins developing the place of the accident as a public site of memory.

Part V, “Conclusion,” completes the dissertation with an epilogue summarizing the study’s key findings.
PART I.
INTRODUCTION AND BACKGROUND
CHAPTER 1

INTRODUCTION:
PUBLIC MEMORY AND PLACE-MAKING

Once a tightly guarded secret, the story of the atomic bomb’s creation needs to be shared with this and future generations. There is no better place to tell a story than where it happened, and that’s what national parks do. The National Park Service will be proud to interpret these Manhattan Project sites and unlock their stories in the years ahead.

Jonathan B. Jarvis, National Park Service Director

If the preservation movement is to be successful . . . it must attempt to give a sense of orientation to our society, using structures, and objects of the past to establish values of time and place.

United States Conference of Mayors, With Heritage So Rich

The Manhattan Project National Historical Park

In 2004, the U.S. Congress directed the National Park Service to study the feasibility of establishing a Manhattan Project National Historical Park that would contain the most significant Manhattan Project properties at Dayton, Ohio; Oak Ridge, Tennessee; Hanford, Washington; and Los Alamos, New Mexico. The historical importance of the Manhattan Project has long been acknowledged, but the 2004 proposal to preserve the remaining buildings and structures associated with the creation and use of the world’s first atomic weapons was denounced by many as an affront to the memories of Hiroshima and Nagasaki. While the creation of the world’s first atomic weapons has worldwide significance, the interpretation of the history of the Manhattan Project is mired in controversy.

The National Park Service study and the Manhattan Project National Historical Park legislation that arose from it serve as the framework for this dissertation. Key to the present project is the observation that the use of atomic weapons to end the war has overpowered all other wartime narratives with the raw emotions that the story and images of the Japanese bombings still evoke. Through an examination of some of the remaining places and landscapes included in the park legislation, the chapters that follow seek to bring to light Manhattan Project histories that have been obscured by the shadow of the bomb.

**The National Park Service Study**

Foretelling the emotional response to the commemoration of Manhattan Project history that continues today, the 2004 park proposal was characterized by its detractors as an unseemly celebration of a tragic historical event that continues to haunt the world with its geopolitical legacy of nuclear warfare.\(^3\) Strong reactions to the initial park study—both positive and negative—were common, even with the passage of close to sixty years since the end of World War II. Public education, historic preservation, and place-making, which were the intent of the study, had come face to face with the controversy surrounding the birth of the A-bomb, the divisive master narrative that has kept the exploration of the history of the Manhattan Project in an intellectual stranglehold.

In spite of the divisive nature of the park study, many supporters believed that the preservation of the few remaining Manhattan Project properties was a national

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imperative. Without the physical places and spaces of the bomb to experience as a way to understand the significance of this world-changing event, the opportunity for future dialogues about the meaning and memory of the development of atomic weapons during World War II would be lost forever. After conducting site visits and holding public hearings, the National Park Service issued its draft study in November 2009, in which several non-park alternatives were identified along with one that named Los Alamos as the only potential park unit.4 However, public outcry from the Manhattan Project communities located in Washington state and Tennessee compelled the National Park Service to issue a final study document in September 2010 containing a revised alternative that listed Los Alamos, Hanford, and Oak Ridge as potential park units. The study acknowledged that properties at the three sites represented the most important events of the Manhattan Project.5

Looking beyond the controversy and siding with historic-preservation advocates, the National Park Service proposed a new unit that would be one for the twenty-first century. Unlike traditional parks, such as Yellowstone or Yosemite, whose lands are owned by the National Park Service, the Manhattan Project National Historical Park would be similar to newer parks and monuments where park areas are managed through formal agreements with non-park service property owners. Acknowledging the unique nature of a park that would be located at active Department of Energy (DOE) installations, the final study document, in an attempt to reassure both federal agencies


involved, noted the importance of the continued DOE ownership and management of its historic properties.

The Department of Interior had initially been reluctant to take responsibility for potentially contaminated industrial properties located within high-security areas. Similarly, the DOE had been reluctant to participate in a park experiment that might jeopardize control of its own property and restrict any aspect of future mission-critical work. In addition to the park study’s acknowledgment of joint-agency responsibilities and the need for continued DOE ownership of its properties “behind the fence,” the study clarified that the National Park Service’s role in a new Manhattan Project park would be to provide interpretation, education, and technical preservation assistance for properties owned and managed by the DOE.

**Park Legislation**

After the DOE’s concurrence with the study’s findings, bipartisan congressional members drafted the initial Manhattan Project National Historical Park legislation, and it was introduced to Congress in June 2012.\(^6\) Specific park properties at Oak Ridge, Hanford, and Los Alamos were identified in the legislation, including properties in downtown Los Alamos associated with the Manhattan Project but built earlier as part of the Los Alamos Ranch School (circa 1921-1942) (fig. 1.1). These included the “Bathtub Row” houses built for the school’s instructors and for other school functions, the Ranch School’s former powerhouse, and Fuller Lodge, now the town’s most important community space. A former dormitory building and a former cafeteria built by the U.S. Army during the Manhattan Project and located in the downtown area were also included.

\(^6\) U.S. Congress, Senate Bill S. 3300 (2012).
Seventeen Los Alamos National Laboratory (LANL) properties representing key events in the timeline of the Manhattan Project’s scientific and engineering history were included in the initial legislation (fig. 1.2). LANL’s potential park properties directly supported the design, assembly, testing, and much-debated use of the world’s first atomic weapons, including the “Little Boy” weapon detonated over Hiroshima and the “Fat Man” weapon exploded over Nagasaki.

Reintroduced unsuccessfully in 2013, the park legislation was eventually signed into law on December 19, 2014, as part of a public lands package included in the National Defense Authorization Act for Fiscal Year 2015. The Manhattan Project National Historical Park Act stipulated that a year’s grace period would be in effect before the park’s formal establishment. This period would allow for an agreement to be developed between the Secretary of the Interior and the Secretary of Energy, which would identify the initial DOE properties included in the park and establish key roles and responsibilities regarding enhanced public access, management, interpretation, and historic preservation.7

Similar to the initial reactions to the 2004 park-study proposal, responses to the new Manhattan Project National Historical Park were mixed. Some felt that a new park commemorating the history of the Manhattan Project would inappropriately celebrate the controversial creation and deployment of the world’s first atomic bombs; others expressed concerns that adding any new parks at all would stress the already underfunded National Park Service. Still others saw the new Manhattan Project park and its three-state

location in Tennessee, Washington State, and New Mexico as a boon to heritage tourism and an opportunity for local and regional economic growth.  

In spite of the successful passage of the park legislation and local support at each of the park’s three sites, the controversy surrounding the interpretation of the culminating events of World War II is not expected to diminish as the new Manhattan Project park enters its formative years. The interpretation of this contested history will be one of the greatest challenges facing the National Park Service as it begins the planning phase. At Los Alamos, initial research will focus on the historical contexts of the potential park properties to understand how local narratives fit into the broader context of a national Manhattan Project story that will be interpreted at each of the three park sites located across the country. As part of formal park-making efforts, the wartime landscapes of Los Alamos will be preserved, and locally significant social and scientific histories will be unearthed during the place-making process.

**Commemoration and Public Memory**

The passage of the Manhattan Project National Historical Park legislation brings with it a new mandate for enhanced public access to previously inaccessible Manhattan Project areas located at LANL. The seventeen potential park properties that tell the scientific and technical story of wartime Los Alamos have never been interpreted for the public, and their various landscapes and building areas are certainly not “park ready.” A

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key element of the new park will be the commemoration of the scientific events of the Manhattan Project embodied today in the remaining buildings and structures located “behind the fence” at the national laboratory.

Seen by some as a form of celebration, commemoration is more the process of deliberately elevating and interpreting the significance of a historical event, person, or place. Commemorative ceremonies usually involve not just memory but remembering, and memorialization is a related concept that alludes to the deliberate preservation of memories. Key to commemoration is the concept of hegemony, for whoever controls the narrative determines how something or someone is memorialized. Typically, public memories are crafted by historians, historic-preservation institutions, stakeholder groups, museums, the media, or governments. Today, however, collective memory can also be appropriated by the strong pull of social media. At the new Manhattan Project park, the National Park Service, “the nation’s storyteller,” has already been given the task to create official memories of Los Alamos, Hanford, and Oak Ridge for future park visitors—many of whom will have no lived memory of World War II or of the bomb’s legacy of Cold War tension and conflict.

While codified and formalized collective memories are what make up our national history, memories themselves are inherently personal and are experienced and held by the individual. Even national events of the largest scale are remembered by a collection of diverse individuals, and the personal nature of memory making often results in a diversity

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of associated meanings. French historian Pierre Nora has written considerably about collective memory and its association with special sites or places of memory that have enhanced public meaning. For Nora, his *lieux de mémoire* must hold enough significance and importance both in the past and in the present to ensure continued social relevance for future generations:

For if we accept that the most fundamental purpose of the *lieu de mémoire* is to stop time, to block the work of forgetting . . . it is also clear that *lieux de mémoire* only exist because of their capacity for metamorphosis, an endless recycling of their meaning and an unpredictable proliferation of their ramifications.10

The National Park Service has determined through its initial park study that the story of the creation of the world’s first atomic weapons has national importance. Arguably one of the most significant events of the twentieth century, the use of nuclear weapons against Japan to end World War II remains a controversial narrative, and the August 6 bombing of Hiroshima, like December 7 and September 11, is a day of historical remembrance. However, with the volume of information already written about the history of World War II and the development of nuclear weapons, why should we preserve the actual places, spaces, and landscapes of the bomb?

10 Nora, "Between Memory and History," 19.
Park-making and Place-making

Historian Richard Rhodes, in a speech given after the passage of the park legislation, argues that the places of the bomb should be preserved because we will lose important physical connections to the past if they disappear. Rhodes notes that “we preserve what we value of the physical past because it specifically embodies our social past. However weightless and invisible social reality might be.” He goes on to acknowledge the world-changing importance of the Manhattan Project, adding that “the places and structures that the Manhattan Project Historical Park will preserve embody the social reality of that millennial transformation.”

Place-making itself is a long-standing cultural practice. Noted anthropologist Keith Basso has studied the cultural meanings that can be gleaned from the formal ethnographic study of place and, specifically, the importance of place-making and place-naming in Apache culture. Basso’s four essays in his book *Wisdom Sits in Places* focus on the people and cultural practices of the village of Cibecue located on the Fort Apache Indian Reservation, Arizona. For Basso, cultural notions of space and place are rooted in local individuals and local knowledge, and often reflect the thoughts and values of a community. Basso explores several themes that could easily be modified to the general study of place, not just Apache places. He notes that places become important in people’s lives once they become objects of awareness. He also sees that the landscape of the past

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12 Ibid., 3.
13 Ibid., 10.
is intertwined with the landscape of the present and acknowledges that awareness of place and history is experienced first and foremost on an individual level; for it is people, not communities or cultural groups, who sense the importance of place. Basso observes that the things that individuals bring—their ideas, experiences, knowledge, and feelings—are what give life and meaning to a place.\textsuperscript{14}

As part of historic preservation, place-making is a deliberate action, a way of constructing historical significance and appropriating physical landscapes for others to experience. Place-making is more than just saving historic landscapes and buildings; it is the act of creating a relationship between the physical location of an event and the historical context of that event. With place-making, however, comes the responsibility of preserving not just a physical locale, but its historical sense of place, including its setting, feeling, architecture, and artifacts. Place-making, like commemoration, is usually reserved for individuals or institutions in positions of power—those who control the spaces or who are entrusted to tell the dominant historical narrative.

At Los Alamos, place-making by the National Park Service will be an integral part of the founding of the new Manhattan Project park. The raw places and spaces of the bomb at the national laboratory will be preserved, interpreted, restored, and reconstructed.\textsuperscript{15} This dissertation’s focus on the historical contexts of the specific


buildings and landscapes identified in the park legislation will reveal lost, hidden, and neglected narratives that will inform future park visitors about the importance of the multilayered history of the Manhattan Project.

Ironically, preservation can also bring about loss. For example, developing new park sites as part of park-making will likely result in a loss of original historical integrity through the National Park Service’s packaged and uniform visitor experience. The formal marking of the earth and the drawing of maps and boundary lines—the very creation of landmarks—will also introduce a sense of artificiality not present during Manhattan Project times. The landscapes of the remaining wartime areas will be cleaned up, made safe, and populated with walkways and outdoor interpretive signage. Further, as part of the park-making process, the histories and meanings of the remaining places of the bomb will be formalized within introductory videos, visitor center displays, and pamphlets.

Still, interpreting these atomic places will create historical associations and meanings that are not currently evident in the undeveloped landscapes of the bomb. With park-making and place-making, the remaining Manhattan Project buildings and experimental areas will become national sites of memory, and the National Park Service will interpret their meanings using historical themes understood to be relevant for today’s public.


Nora, "Between Memory and History." See Nora’s discussion on page 12 of his article about the loss that comes with preserving sites of memory.
The decision to use atomic weapons is the polarizing master narrative of Manhattan Project history. Los Alamos’s remaining wartime buildings and structures are contested places that will forever be associated with the development and use of the world’s first atomic weapons—places that will always be haunted by the atomic devastation of Hiroshima and Nagasaki. This controversial history has overshadowed local histories in the past and could derail much of the new park’s future interpretive efforts. However, there are hidden Manhattan Project histories that, when examined through the lens of place and landscape, will allow greater public engagement with the meaning and memory of the bomb. The varnish of historical meaning is applied anew by each successive generation, and, without exception, the places and spaces of the Manhattan Project presented in the following chapters will be interpreted in the years to come in ever-changing ways in response to a future world’s sensibilities, values, and experiences.
Fig. 1.1. Location map showing Manhattan Project National Historical Park sites.

Fig. 1.2. LANL properties listed in the new park legislation.
CHAPTER 2

MANHATTAN PROJECT
COMMENORATION AND CONTROVERSY

The peoples of this world must unite, or they will perish. This war, that has ravaged so much of the earth, has written these words. The atomic bomb has spelled them out for all men to understand.

J. Robert Oppenheimer, October 16, 1945, Robert Oppenheimer: Letters and Recollections

The interpretation of the Manhattan Project and its role in the birth of atomic weapons has been a contested topic for decades, with debates intensifying in the mid-1990s in response to the fifty-year anniversary of the end of World War II. Central to the ongoing debate is the decision to drop atomic bombs on the people of Hiroshima and Nagasaki. The actual use of the weapons, more so than their development, is the main polarizing issue, a national master narrative of controversy that has eclipsed local historical contexts at Oak Ridge, Hanford, and Los Alamos, the three DOE installations listed in the Manhattan Project park legislation. The contested metanarrative of the first atomic bombs still fuels public debate today, some seventy years later, because of the continuing environmental and geopolitical legacies of nuclear weapons. The following case studies, beginning with the national story of the Smithsonian Institution’s Enola Gay exhibit, demonstrate the intensity and longevity of this controversy and serve as a reminder of the interpretive challenges faced at the three park communities.

17 Sections of this chapter were previously published in a Journal of the West article by the author, with intellectual contributions by John Isaacson, Los Alamos National Laboratory. See Ellen McGehee and John Isaacson, "Interpreting the Bomb: Contested History and the Proposed Manhattan Project National Historical Park at Los Alamos," Journal of the West 50, no. 3 (Summer 2011).
Past interpretive and commemorative projects involving Manhattan Project artifacts, memorial objects, statues, museum displays, and monuments have received a flood of public response, both positive and negative. As a result, project organizers have had to alter, delay, or even abandon their original plans. Mirroring the national-level controversy surrounding the Enola Gay exhibit, municipal governments and museum organizations at nuclear history sites have also had to engage in conversations with local community members about the appropriateness of World War II exhibits and peace monuments. Common themes in past national and local debates over the public interpretation of the history of the Manhattan Project include the role of veterans’ groups and others who were alive during World War II, and the specific meaning of symbols, objects, and places. Questions have focused on whether commemoration is synonymous with celebration; disputes have arisen over who will have ultimate control over the content of interpretive displays and narrative texts.

Past National and Local Debates

Enola Gay—Washington, D.C.

If past experience is any indication of the controversy yet to come, then the 1995 Enola Gay exhibit at the Smithsonian Institution is a cautionary tale of competing interpretations about the Manhattan Project and the legacy of nuclear weapons. As planned, the exhibit was to include a display about the Enola Gay, the B-29 airplane used to drop the Little Boy bomb on Hiroshima, along with accompanying text to provide historical context about the use of atomic weapons at the end of the war (fig. 2.1). Edward Linenthal and co-author Tom Engelhardt, in their book History Wars, describe how the exhibit’s narrative included highly emotional and unresolved issues that
eventually overpowered museum administrators, especially the text dealing with the
debate over whether the bombs should have been used. The book’s account of the role
that military veterans played in the exhibit’s ultimate failure highlights the influence of
living participants and the power of perspective and memory.

The Air Force Association, one of the players in the Enola Gay controversy, also
chronicled the exhibit’s history. According to the Air Force Association, the Air and
Space Museum began planning to interpret the Enola Gay in 1993, intending to open the
exhibition in 1995, the fiftieth anniversary of the end of World War II. Almost
immediately, various groups expressed concerns about the text of the exhibit. Some saw
the Enola Gay exhibit as revisionist history, especially the portrayal of the United States
as the aggressor in its relationship with Japan. Others saw the influence of special-interest
groups, such as veterans’ organizations and government officials, as proof that
government censorship was part of the exhibit’s development process. Some of the most
contentious battles were over whether the Japanese should be portrayed as victims or
aggressors. Joseph Masco, writing in his book Nuclear Borderlands, notes that the
Enola Gay controversy, which led to the cancellation of the original exhibit and the
resignation of the director of the National Air and Space Museum, effectively “alerted

18 Edward Linenthal and Tom Engelhardt, History Wars: The Enola Gay and Other Battles for

19 "The Air Force Association, "The Enola Gay and the Smithsonian Chronology of the
communities throughout the United States that the fiftieth anniversary of the bombing of Hiroshima and Nagasaki was a particularly politicized event."20

**International Friendship Bell–Oak Ridge**

Far away from Washington, D.C., another battle over meaning and memory was brewing in Oak Ridge, Tennessee. Known as the Clinton Engineer Works during World War II, the facilities located near the town of Oak Ridge were responsible for producing the uranium used in the Little Boy weapon dropped on Hiroshima, Japan, on August 6, 1945.

In the late 1980s, Oak Ridge community members started what would become a more than ten-year-long controversy over the proposed creation of a Japanese friendship bell for the community. Local Oak Ridge researcher Edward Lollis has documented the various public clashes over the creation, placement, and use of the International Friendship Bell in what he has dubbed the “bell wars.”21 The first bell war occurred in October 1991, in response to the announcement of an upcoming Friendship Bell Festival. The proposed bell project received a mixed public reaction. Negative comments included concerns about using taxpayer funds for the project and statements that the project was pro-Japanese, religious in nature, and an insult to the Oak Ridge workers who supported the war effort. In 1993, a public controversy surfaced over the bell’s design. Some community members took issue over the placement of names and dates of key events from World War II on the bell. They interpreted the listing of both Japanese and U.S. war


actions as giving a *de facto* moral equivalency to the events that included the bombing of Pearl Harbor, the bombings of Hiroshima and Nagasaki, and V-J Day. This second public debate about the bell saw the entry of a non-local veterans’ group—the Pearl Harbor Survivors Association—into the community’s dialogue.\(^\text{22}\)

The third bell war erupted in the Oak Ridge press in 1995, the anniversary year that seemed to rekindle the nation’s feelings, both pro and con, about the end of the war. Anti-bell factions expressed fears that the bell would become a gathering place for activists. In response to the last bell war and in order for the city to agree to the acceptance and public placement of the bell, the Oak Ridge City Council created the Bell Policy Committee, which developed a statement of purpose and a plaque to clarify the meaning of the bell. The city council also created formal restrictions on the ringing of the bell, decreeing that the bell’s striker could only be unlocked by special permission.\(^\text{23}\)

The friendship bell was still not without controversy even after its official dedication. In April 1996, a suit filed against the City of Oak Ridge claimed that the bell was a Buddhist religious symbol and that placing it on public land was a violation of the U.S. Constitution. The U.S. Court of Appeals eventually ruled in favor of the town of Oak Ridge in 2000.\(^\text{24}\) Later, in 1997, a group of visiting Japanese women rang the bell “far in excess of the legal limits,” and community members demanded unsuccessfully that the police prosecute the offenders. According to Lollis, the final chapter of the story

\(^{22}\) Ibid.

\(^{23}\) Ibid.

\(^{24}\) Ibid; Robert Brooks v. City of Oak Ridge, (U.S. Court of Appeals, Sixth Circuit, July 21, 2000).
concluded in 2001 when a local teenager spearheaded the repeal of the policy restricting
the ringing of the bell.²⁵

Oak Ridge historian D. Ray Smith summarized some of the history of the
friendship bell in his OakRidger newspaper column.²⁶ Smith attributes much of the
conflict to the debate over the meaning of the bell. According to Smith, the bell was
meant to be a symbol of peace and friendship, while also serving as a reminder of the
significant events of World War II. Contrary to the beliefs of some local veterans and
former Oak Ridge workers, Smith insists that the bell was not meant to be an apology by
Oak Ridge for making the uranium that was used in the Little Boy bomb.²⁷

Children’s Peace Statue–Los Alamos
A past debate over the placement of the Children’s Peace Statue in downtown
Los Alamos may predict future responses to proposed commemorative projects
associated with the new national historical park, especially those focusing on the more
controversial aspects of the Manhattan Project, such as Japanese deaths from radiation
exposure. The idea for the Children’s Peace Statue project, unlike that of the Oak Ridge
International Friendship Bell, came from outside the Los Alamos community, and the
controversy over the statue centered on its meaning as a permanent object of public
memory.

²⁵ Lollis, "The International Friendship Bell, Oak Ridge, Tennessee".
²⁶ D. Ray Smith, "Historically Speaking: Forging Lasting Friendships, a Lasting Monument,"
OakRidger (July 14, 2008). http://www.oakridger.com/x1768846290/Forging-lastling-friendships-
a-lasting-monument (accessed November 13, 2011).
²⁷ Ibid.
Researchers and peace groups have written about the genesis and goals of the Children’s Peace Statue project and have documented some of the key events. In 1989, a group of schoolchildren at Arroyo del Oso, a school located in Albuquerque, New Mexico, was inspired to create the statue after reading the book, Sadako and the Thousand Paper Cranes, about a survivor of the bombing of Hiroshima who later developed leukemia and died. The peace statue, which grew beyond its Albuquerque roots to become a national initiative, was funded by a five-year campaign that solicited one dollar from each child supporting the project. The completed statue, a globe showing the earth’s continents, included small cast figures of plants and animals made by children from all over the world (fig. 2.2). As originally envisioned, the statue was to be commemorated annually on the anniversary of the bombing of Hiroshima with the hanging of strings of paper cranes on its metal framework.

Statue-project organizers approached the Los Alamos County Council for permission to locate the sculpture on county land. In November 1994, the council rescinded its earlier support for the project, and, soon after, local residents petitioned the county council to re-evaluate its decision. The residents submitting the petition felt that opposition to the project was dividing the community and that it stemmed from a misguided fear that the statue would be used as a focal point for protesters. They cited the 


30 Cranes for Peace, "Ninth Annual Peace Day Santa Fe".
use of Ashley Pond, a local park, as the established gathering place for peace activists.\textsuperscript{31}

In a split vote, the county council denied the request in February of 1995. After its temporary installation at the Albuquerque Museum, the statue was moved to downtown Santa Fe.

Kathleene Parker, writing for \textit{The New Mexican} in 1995, notes that the council rejected the proposal out of fear that the statue would focus criticism against Los Alamos, the self-ascribed birthplace of the bomb.\textsuperscript{32} Parker’s article also mentions the vehement opposition to the statue by members of the community. In \textit{Nuclear Borderlands}, Joseph Masco argues that Los Alamos’s complex identity as a symbol for peace formed the fundamental core of the peace-statue conflict. The city is viewed by some as playing a major role in ending World War II, saving lives, and preventing future world wars. Others see the city in a more critical light as the birthplace of the bombs dropped on Japan and as a peace symbol only in the sense that one must never forget the human costs of using nuclear weapons.

\textbf{Bradbury Science Museum Public Forum Wall–Los Alamos}

In the early 1990s, another long-running controversy broke out in Los Alamos over the content of the “Alternative Perspectives Public Forum Wall” located at LANL’s Bradbury Science Museum (Bradbury), one that could foreshadow future interpretive battles at Los Alamos and other park sites between antinuclear and veteran or promilitary groups.\textsuperscript{33} Part educational institution and part national laboratory public relations arm,

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one of the museum’s most important functions is to allow the general public access to
information about the national laboratory, which, for the most part, is located away from
the center of town in secured areas (fig. 2.3).

Before 1993, the Bradbury began to work with members of the Los Alamos Study
Group, a Santa Fe-based, self-avowed antinuclear group. Believing that its views were
not adequately captured in the Bradbury’s permanent exhibits, the study group asked for
and was granted a space in the museum to present its ideas about the bomb and the legacy
of nuclear weapons. The national laboratory honored this request, in part due to a similar
request and lawsuit made by California activists at the visitor center of one of
Los Alamos’s sister laboratories.34

The Los Alamos Study Group’s original exhibit included several panels focusing
on the modern-day political and environmental consequences of nuclear weapons. During
the summers of 1993 and 1994, however, the study group modified its exhibit to include
images related to the wartime deployment of atomic weapons, including historical
photographs of the destruction of Hiroshima and the bomb’s effects on its residents.35 In
1995, in response to the text and graphic photographs in the study group exhibit, a group
of national laboratory retirees and veterans’ organizations from Los Alamos and
elsewhere formed the Los Alamos Educator’s Group. Its members included Navajo
Code-Talkers, the Bataan Death March Organization, Veterans of Foreign Wars, the
American Legion, and the Laboratory Retiree Group. This new rival group requested
equal access to the public forum wall, labeling the study group’s display as revisionist

34 Ibid., 240-241; Bryan C. Taylor, "Revis(it)ing Nuclear History: Narrative Conflict at the
35 Taylor, "Revis(it)ing Nuclear History," 127.
history and criticizing the Bradbury’s narrative for not mentioning the reasons the bombs were dropped on Japan.36 The proposed exhibit was, in the words of Joseph Masco, “a counter-counterexhibition.”37 Masco, who included the Bradbury’s Public Forum Wall controversy in his book Nuclear Borderlands, points out the unanticipated development of “rival constituencies . . . all deriving a different meaning from the Hiroshima and Nagasaki bombings, all demanding to see their point of view in the museum space . . . a Cold War-style confrontation over control of territory, namely, wall space.”38

In the summer of 1995, the Bradbury allocated half the Los Alamos Study Group’s exhibit space to the alternative viewpoint advocated by the Los Alamos Educator’s Group.39 The Laboratory’s action was based on a legal interpretation that the use of the exhibit space was not determined by the content of the specific exhibits, i.e., either for or against nuclear weapons.40 The study group believed that the addition of the educator’s group’s exhibit, one that contained strong statements about the importance of the atom bomb in ending World War II and saving lives, did not differ from the Laboratory’s pro-nuclear messages contained in the other, permanent Bradbury exhibits. Taking action, the study group threatened to sue.41 To quell the narrative wars that had developed between the rival exhibits, the museum proposed a lottery system whereby groups could vie for the chance to display an exhibit for six months at a time. The

37 Ibid.
38 Ibid., 242-243.
39 Kathleene Parker, "Groups Battle over Nuclear Displays," The New Mexican, October 1, 1996, B-1.
40 Taylor, "Revis(it)ing Nuclear History," 132.
Los Alamos Study Group chose not to participate in the lottery and again threatened to sue. Given that the antinuclear message would be lost for half a year, the study group argued that the real purpose of the lottery was “to stifle public debate.”

Local and national media, fueled by nationwide interest in the fiftieth anniversary of the end of World War II, covered the controversy over the wall and the competing narratives that emerged. From the viewpoint of those who participated in this controversy and those who have studied it since its resolution, the tug of war over public-comment space in the Bradbury was primarily about meanings—spanning more than fifty years of U.S. and international history—related to the development, use, and ongoing political and environmental legacy of nuclear weapons and nuclear energy.

As director of the museum during this period, John Rhoades contributed some especially poignant observations about the significance of the Public Forum Wall controversy in the foreword to Nancy Bartlit’s master’s thesis, a communications analysis of visitor responses to the conflict:

Exhibits have aroused passions far beyond the imagination of their curators and developers; public controversy now takes place both inside and outside the museum walls. Whether the struggle is for ownership of the meaning of an historical event or place or over the “rightness” of an interpretation, it has divided communities, pitted boards against staffs, and generated unwelcome publicity.

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42 Parker, "Groups Battle over Nuclear Displays," B-1.
In the most in-depth analysis of this controversy to date, Bryan Taylor of the University of Colorado at Boulder conducted a communications study examining the Bradbury’s Public Forum Wall, spending time in Los Alamos as a participant-observer interviewing both museum staff and Los Alamos Study Group members. Taylor sees the series of events at the museum as an ideologically driven conflict over the dominant historical narrative. One of the key points in many Manhattan Project histories, according to Taylor, is the need to understand the historical creation of the bomb in order to understand the role of nuclear weapons today. Taylor, like Linenthal, sees science museums as epicenters in the battle over the past and present meanings of the development and use of nuclear weapons.46

In one of his most insightful moments, Taylor muses about the power of memory by asking the question, “What sort of future is likely to emerge from the form of memory that they practice?”47 This potential for cultural memory to influence the present is certainly at the heart of the contested history of the bomb, especially if one believes that institutions of power are continually refashioning cultural memory. The Bradbury battle for control of the messaging of the Manhattan Project, its meaning and memory, serves as a reminder that the decision to use the bombs against Japan may become the central and all-consuming narrative of the new national park.

46 Taylor, "Revis(it)ing Nuclear History," 120-122.
47 Ibid., 140.
Ed Grothus, the Black Hole, and the Doomsday Stones—Los Alamos

The most recent local battle over the meaning of the bomb involves the story of Ed Grothus and his attempt to place an antinuclear monument in Los Alamos. Grothus, local antiwar activist and past national laboratory employee, ran an eclectic scientific-equipment salvage business located in a former grocery store until his death in 2009. Grothus’s enterprise, named the Black Hole because “everything goes in, and nothing comes out,” became more than a surplus store, serving as a museum of sorts for the national laboratory’s Cold War castoffs (fig. 2.4).48 His ties to the community ran deep, ranging from working at LANL—a job he quit in 1969 as a protest against the Vietnam War—to running a southwestern-themed gift and jewelry shop located in the heart of the city. Ed Grothus was Los Alamos’s own homegrown peace activist, tolerated by most but also seen by some as the embodiment of the town’s conscience.

Inspired by accounts of ancient obelisks that were placed on the sides of roads and served as way markers, Grothus set about creating twin monuments weighing almost forty tons each and standing almost forty-feet high. The monuments are in three parts: the “Doomsday Stones” or “Rosetta Stones for the Nuclear Age,” which are black-granite bases engraved with antinuclear text in fifteen languages; white-granite obelisks quarried and carved in China; and black-granite spheres, which represent the high-explosives core of the implosion weapon, designed to be the capstone of each monument.49 The text on the bases includes antinuclear imagery but also highlights the complex symbol of

Los Alamos and its role in the development of nuclear energy—its potential for both good and evil:

Welcome to Los Alamos, New Mexico. . . . It was once believed that only God could destroy the world, but scientists working in Los Alamos first harnessed the power of the atom. . . . Nuclear bombs cannot be used rationally and dreams for safe and useful nuclear power may never be realized. It is only in Los Alamos that the potentials for unimaginable, fantastic good and demonstrated, horrendous evil are proximate.50

In 2007, Grothus approached Los Alamos County with the intention of giving the monuments to the county for display in a public location. The county’s Art in Public Places Board declined Grothus’s offer, citing the lack of an appropriate location and questioning the artistic merit of his proposal.51 Grothus’s plan failed because his narrative challenged the established identity of the town of Los Alamos. The Doomsday Stones proposal, if successful, would have brought Grothus’s private message of antiwar and antinuclear sentiments to a public venue—ideologies tolerated at his own surplus store but not appreciated by local institutions of power.

Continued Controversy: Responses to the Park Legislation

During the mid-1990s, with the fifty-year anniversary of key World War II events, many local and national debates arose over the interpretation of the meaning of

50 Ibid.
the Manhattan Project. Several decades later, the intensity of response to interpretive projects related to the history and use of nuclear weapons appeared to be waning. However, in July of 2011, Secretary of the Interior Ken Salazar transmitted the Manhattan Project Sites Special Resource Study to Congress with a recommendation to establish a national historical park at areas in Los Alamos, Hanford, and Oak Ridge to commemorate the Manhattan Project.52 Almost immediately, the park proposal received both local and national press coverage, with atomic-history organizations and local communities supporting the park and antinuclear groups weighing in against it. The polarizing controversy had lain dormant, but now the prospect of a new national historical park dedicated to the history of atomic weapons effectively reignited public debate.

In Los Alamos, mirroring responses at the other two park areas, the local newspaper published an article about the prospective park that highlighted anticipated community partnerships and the role of the DOE, underscoring the National Park Service’s importance as “America’s storyteller” having “overall responsibility” for interpretation at each of the proposed Manhattan Project National Historical Park units.53 The National Security Science Journal, a LANL publication, also gave brief mention of the proposed park developments, quoting statements from members of the New Mexico

congressional delegation who acknowledged the legacy of the Manhattan Project and the need to preserve history and educate the public.\(^5^4\)

Nationally, internet news sites also picked up the story, summarizing the Department of the Interior’s announcement and citing congressional support, the places involved, the DOE’s continued management of its own historic buildings, and the National Park Service’s role as chief interpreter of the new park’s narrative. Sensitive to the controversy, news sources also included negative responses from several antinuclear groups, including a statement from Greg Mello of the Los Alamos Study Group, the same Santa Fe-based group involved in the Bradbury’s Public Forum Wall dispute:

Are we really poised to make a national park out of a few shabby ruins where we built instruments of mass murder, delivered to statesmen the instruments of universal destruction and destroyed the marriage between science and human values? . . . This is a monument to the hubris of the victors, a blow to the human conscience. It is a slap at the better angels of Manhattan Project scientists, some of whom are surely turning over in their graves.\(^5^5\)

In response to this sharp reaction and others, the National Park Service issued a statement calling attention to its established role in interpreting other controversial or tragic places such as Civil War battlefields, Ford Theater, and Pearl Harbor. The National Park Service’s public response equated commemoration with education and not with patriotic celebration, noting that commemoration is interpretation “for good or bad.”\(^5^6\) In yet another article describing the response of antinuclear groups to the proposed park, The


\(^{56}\) Clausing, "Anti-Nuke Groups to Fight Manhattan Project Parks," no page number.
*New York Times* documented concerns that establishing a new park would be “celebrating the creation of a weapon of mass destruction.” The semantic battle over the meaning of the word “commemoration” was a common theme in this first round of responses to the possibility of a new national park that would interpret the story of atomic weapons.

Not all media commentary regarding the proposed park was negative, and local responses were usually more positive. For example, in a column for the *Los Alamos Monitor*, Jay Miller responded to the notion that a new park would purely be a celebration of the bomb. Miller, taking a stance reminiscent of earlier statements made by veterans’ groups during the dispute over the Bradbury’s Public Forum Wall, sees a positive image for Los Alamos, noting its role in limiting additional world wars and its contributions to nuclear science:

> But this isn’t about the bomb and it isn’t about honoring the Manhattan Project. It is about the incredible effort our country put forth to remain free and the scientific advances made by unlocking the secrets of nuclear energy.58

As the park bill made its way through the legislative process over the next several years—presented in committee hearings, debated on the floors of the House and Senate, and finally included in the public lands package in the 2015 National Defense Authorization Act— similar arguments for and against the park were raised.59 Some of the most passionate antipark sentiments were expressed by Congressman Dennis


Kucinich. His comments were not just antinuclear in nature, but also targeted out-of-control science in general, a similar fear of technology underlying some of the nuclear anxiety expressed in Santa Fe activist Gregg Mello’s 2011 critique. Kucinich stated:

We then decided that all of our problems in humanity could be solved by technology, that the bomb then was put in place of reason, that the bomb was put in place of diplomacy, that the bomb was put in place of talking with each other and settling our differences. No, the bomb then became the metaphor for how technology rules over humanity. We're captives of our own machines. . . .

Where does this stop? We cannot honor this technology. We cannot celebrate ingenuity that was used to put all of humanity at risk. We have to begin to reassess who we are as human beings and ask ourselves whether or not we have essentially reached the limits of our ability to develop technology which we can control.

And it's not only about nuclear weapons. When you learn that the globe itself is experiencing tremendous upset because of the human activity, when you learn that science can now create genetically modified organisms that can change the nature of food. As a matter of fact, life itself can be changed through cloning. We act as these mini gods who can endlessly tinker with our planet and life itself and then name parks after it. No.60

Park proponents included the congressional delegations from Washington State, Tennessee, and New Mexico. Introducing the bill to a fiscally conservative Congress and knowing that the National Park Service was already struggling to manage its existing park infrastructure, House and Senate supporters repeatedly argued the merits of the continued DOE ownership of park properties and the heritage-tourism dollars that would come with the passage of the Manhattan Project park bill, alluding to the “heads in beds”

that would be spending money locally at hotels and in area restaurants and bring additional jobs and economic growth.

Today, on the ideological battleground of the founding of a new park, opposing camps are already beginning to muster, ready to argue the significance of the first atomic bombs to our collective memory. This study demonstrates that the park-making process will transform the current national laboratory properties into formal sites of public memory, and interpreting the meaning of the Manhattan Project’s history will be both a necessary and complicated part of the park’s creation process. It is clear from examples of past contested exhibits, public displays, and memorials that, if permitted, Los Alamos’s wartime history will continue to serve as a lightning rod for impassioned debate.

In letters sent to Ambassador Caroline Kennedy several days before the passage of the park legislation, the mayors of Hiroshima and Nagasaki expressed concerns about the park’s future interpretation of the atomic bomb and its use, urging that the story of the effects of the bombings on the people of Japan should be told and that the park should not glorify the development of nuclear weapons.61 Will the establishment of a new park focusing on the Manhattan Project and its places be seen as a celebration of the bomb’s creation, as feared by the mayors, or will it be understood as a way to engage the public in a dialogue about the first atomic weapons and their lasting impacts? Who will

61 Mayor Kazumi Matsui, "Letter from the Mayor of Hiroshima to Ambassador Kennedy, December 17, 2014" (On file with the Department of Interior, National Park Service); Mayor Tomihisa Taue, and Chairman Kazuo Genjo, "Letter to H.E. Ms. Caroline Kennedy, Ambassador of the United States of America to Japan, from the Mayor of Nagasaki and the Chairman of the Nagasaki City Council, December 9, 2014" (On file with the Department of Interior, National Park Service).
ultimately control the content of the park narrative, and which groups will have the power
to put political pressure on the National Park Service so that their respective visions of
the past will be incorporated into the official narrative? Most importantly, will the
overpowering controversy surrounding the wartime use of the bombs effectively eclipse
the site-specific meanings of the remaining places and landscapes of the bomb that were
included in the park legislation?

In the chapters that follow, the places and landscapes of Los Alamos’s Project Y
are revealed as more than simple, one-dimensional sites of protest. This examination of
local stories of place and their larger scientific and social themes serves to free narratives
that have long been sidelined by seventy years of debate. Putting aside the controversy of
the bomb and looking at its history through a study of the built environment results in a
greater understanding of the challenges faced by the Los Alamos workforce. Looking at
associated sites, whether nearby in New Mexico or at locations across the country, helps
to illuminate untold stories of the people and institutions that played vital roles in the
Manhattan Project. If one can only hear the language of controversy, then all other ways
of communicating about historical events are effectively muzzled. At Los Alamos, with
its contested spaces of the bomb, an interpretive focus on controversy would render much
of the local history of the Manhattan Project mute.

The creation of the Manhattan Project National Historical Park will involve the
restoration and interpretation of significant historic places. Through historical research
and an examination of the landscapes and built environment of these remaining wartime
spaces, new voices will emerge to contribute to a more inclusive history of World War II
and ultimately result in a fresh interpretation of the Manhattan Project that both embraces and looks beyond the contested history of the bomb.
Fig. 2.1. The *Enola Gay* airplane was used to drop the first atomic bomb on the Japanese city of Hiroshima in August 1945. The planned 1995 *Enola Gay* exhibit generated powerful emotional responses and pitted veterans’ groups and others against the Smithsonian Museum in a battle over the exhibit’s interpretive content.

Fig. 2.2. The Children’s Peace Statue, shown here in downtown Santa Fe, was first proposed by Albuquerque school children and then taken up as a national project with the goal of placing the finished statue on county land in Los Alamos. The peace statue triggered a debate over public memorials that seek to interpret the historical use of nuclear weapons.
Fig. 2.3. The Bradbury Science Museum is the public face of LANL and was the site of the long-running controversy over access to the museum’s Public Forum Wall and control over interpretive content related to the use and legacy of the bomb.

Fig. 2.4. The surplus store, known as “the Black Hole,” was the center of operations for Ed Grothus’ “Doomsday Stones” project, an effort to place an antiwar memorial in Los Alamos.
Mankind’s successful transition to a new age, the Atomic Age, was ushered in July 16, 1945, before the eyes of a tense group of renowned scientists and military men gathered in the desertlands of New Mexico.


Although the master narrative of the development of the world’s first nuclear weapons has typically focused on their controversial use at the end of World War II, upcoming park- and place-making efforts will result in a more inclusive story that will acknowledge underrepresented histories at the three Manhattan Project park sites. Not surprisingly, the scientific and technological stories of the bomb will be an essential part of the new national park narrative. Likewise, the site-specific histories of the Manhattan Project—including currently neglected stories of local workers and displaced communities—will be brought to light when the social history of the making of the bomb is interpreted for national audiences.

The history of the Pajarito Plateau before it was appropriated for the top-secret war effort is a valuable local context that not only relates to the origins of the Manhattan Project in New Mexico but also has ties to Oak Ridge and Hanford’s origin stories. Each Manhattan Project community has similar stories of displacement and loss, sentiments that are still expressed by the uprooted residents and their descendants today. The wartime installations at Oak Ridge, Hanford, and Los Alamos have founding stories that involve the appropriation of entire communities, their homes, schools, fields, churches, and cemeteries. These stories have been overlooked in the standard telling of the atomic
bomb narrative. At Oak Ridge and Hanford, the appropriated lands were valuable to project planners for their proximity to major sources of hydroelectric energy necessary to run the immense production plants, which included the Tennessee Valley Authority and Columbia River dams. The land at Los Alamos was valuable for its perceived isolation and uninhabited nature. Ironically, the displaced local populations at all three areas were recruited as workers at the plants and secret laboratories, a practice that started during the war and continues today.

At Los Alamos, over thirty families owned area homesteads at the time the government appropriated much of the plateau. The very place of the modern laboratory and town, situated on former homestead fields, still holds significance for the descendants of the original, primarily Hispanic homesteaders, serving as a symbol of a traditional way of life that no longer exists. As a cross-cutting interpretive theme, the story of displacement will surely be taken up by the National Park Service as it begins the process of developing the park’s overall narrative. Lands on the plateau that were used during the Manhattan Project were also occupied in the prehistoric past by Pueblo peoples who were the ancestors of modern-day Pueblo groups living in the Rio Grande Valley. During Project Y, local populations represented a valuable workforce, and nearby Pueblo and Hispanic villagers were recruited to work at Los Alamos to support the war effort, both in the townsite and at the technical areas.

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The wartime history of the development of the world’s first atomic weapons, however, has overshadowed much of the earlier history of the region. Not surprisingly, one of the plateau’s most undertold historical narratives relates to the period from the late 1500s, with the Pueblo abandonment of the plateau, to 1942, with the arrival of the wartime Manhattan Project. Any interpretation of Project Y will have to establish its origins beginning with the pre-Manhattan Project history of the plateau. The local residents who were caught up in the events of the 1940s are also important characters in this national story of meaning and memory, a story whose significance is still unfolding.

They Came with Cameras and Logbooks

In late 1942, they came to the plateau: appraisers, assessors, and surveyors—military men with cameras and logbooks. Their visits are preserved in grainy black and white photographs taken during the cold month of November. Ashley Pond, now a landscaped park located in present-day Los Alamos, was just a slip of water encircled by low grass. The photographic images show winding, two-track roads leading out of constricted canyons; a lone log bridge providing safe passage for a car crossing one of the many small streams (fig. 3.1). The mountains in the photographs stand in stark contrast to the big New Mexico sky and the plateau’s deep, steep places.

These men were looking for the ideal spot to build a secret wartime scientific laboratory, code-named Project Y, and this corner of the West was high on the shortlist of possibilities. David Hawkins, chief wartime historian of the project, described the government’s selection criteria this way:

64 Project Y was also known as Site Y.
First, there would be need of a large proving ground, with a climate suitable for outdoor work in winter. Second, the site would have to be remote from both seacoasts and the possibility—at that time not negligible—of attack. . . . In the light of the military security policy which prevailed at the time, inaccessibility was a deciding factor in favor of this location.65

Hawkins also emphasized the need for secrecy and isolation, citing the plateau’s imposing cliffs and its limited access routes as effective natural barriers. To Hawkins, keeping Project Y workers and secret information in was almost as important a consideration as keeping unauthorized people out.66

The Pajarito Plateau during the early 1940s met most of the requirements on the government’s checklist. It was located away from the coastal regions of the country; it was remote and lightly populated.67 Surprisingly, the lack of essential infrastructure, such as a reliable water system and a nearby railroad, were weaknesses that seem to have been


66 Ibid. The *Manhattan District History* was commissioned by General Groves during the war to document activities at many of the areas around the country supporting the Manhattan Project effort. The history includes thirty-six total volumes, which are organized into separate books. These volumes have been reviewed, redacted as necessary, and recently released by the Department of Energy as an online resource (https://www.osti.gov/opennet/manhattan_district.jsp). Some of the *Manhattan District History* sections pertaining to Los Alamos were assembled in a separate report by David Hawkins entitled *Manhattan District History, Project Y, The Los Alamos Project*, vol. 1, which was drafted during 1946-1947; however, its contents were classified and access was restricted. Hawkins’s work was later released as part of a two-volume unclassified Los Alamos report in 1961 with volume 2 authored by Edith Truslow and Ralph Carlisle Smith (LAMS-2532). The 1961 report was finally published in 1983 as David Hawkins, Edith C. Truslow, and Ralph Carlisle Smith, *Project Y: The Los Alamos Story*, The History of Modern Physics, 1800-1950, vol. II (Los Angeles and San Francisco: Tomash Publishers and the American Institute of Physics, 1983).

overlooked by the laboratory’s planners, who placed isolation and inaccessibility above all other site selection considerations.

Appropriating the land was the next step. To the decision makers residing in the far away New York offices of the Manhattan Project, the Pajarito Plateau appeared to be a sparsely populated wilderness located in the farthest reaches of the country. Instead, the plateau in 1942 was a vibrant place frequented by Hispanic homesteaders, Anglo ranchers, railway tourists, and the sons of eastern elite.68 The planners of the laboratory, while not finding the hoped-for degree of isolation at Los Alamos, did appreciate the presence of two large ranches—properties with modern conveniences such as telephones and toilets and main buildings and outbuildings—that had space immediately available for use both as housing and rudimentary laboratories. Even the log cabins hurriedly left behind by the Hispanic farmers and ranchers who had homesteaded the land were potentially usable buildings in support of Project Y’s scientific mission.69 Like the creation stories of its sister Manhattan Project laboratories at Hanford and Oak Ridge, tasked to create in large-scale factories what would be gram-scale quantities of fissile material by war’s end, Project Y has its own creation story of displaced peoples and lost communities—a story displaced in turn by the overpowering narrative of the creation and use of atomic weapons.

68 Generally, see Judith Machen, Ellen McGehee, and Dorothy Hoard, Homesteading on the Pajarito Plateau, 1887-1942 (Los Alamos, New Mexico: Los Alamos National Laboratory, 2012).
**Homesteading on the Pajarito Plateau**

Formal homesteading on the plateau began in the late 1880s when, in 1887, Juan Luis Garcia filed the plateau’s first homestead application—one that eventually led to a “patent” or formal land title. Many of the plateau homesteaders were northern New Mexicans who lived in year-round residences located in the Rio Grande Valley. To claim land on the Pajarito Plateau, Hispanic American farmers followed the homesteading process first established by the Homestead Act of 1862. Homesteaders on the Pajarito Plateau filed the greatest number of claims from 1911 to 1917, and, following national trends, claim applications peaked in 1913. By the late 1930s, approximately thirty-six individuals had patented claims under the Homestead Act or related legislation, such as the “in lieu” process that allowed for federal land exchanges instead of residency on the land.

The claims that the homesteaders carved out on the Pajarito Plateau were not the neat squares created by the grid system across the Midwest. Rather, faced with the plateau’s rugged topography, their claims most often followed the natural contours of the land. The homesteaders were dry-land farmers, primarily growing beans but sometimes cultivating small fields of wheat and corn (fig. 3.2). The mesa-top soil was shallow, and

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70 This section contains excerpts from a previously published history of homesteading, of which the author is primary co-author: Machen, *Homesteading on the Pajarito Plateau.*

71 Juan Luis Garcia, "Homestead Entry Record 2727, General Land Office Homestead Patent Files," (Santa Fe Land Office homestead records, available at U.S. Forest Service Office, Santa Fe, New Mexico. Copies available at Los Alamos National Laboratory or at the Los Alamos Historical Museum Archives, Los Alamos, New Mexico).


crops often failed when there was not enough rain or when cut worms or wild rabbits plagued the delicate seedlings. Each spring, the farmers made the day-long wagon ride to the plateau, bringing store-bought supplies, home-canned goods, and a few farm animals, such as pigs, chickens, rabbits, and milk cows. The homesteaders came from the nearby settlements of San Ildefonso, Pojoaque, El Rancho, and Española. Many were related by birth or marriage; in some cases, relatives lived in adjoining homesteads or in close proximity to one another. Typically, the farmers worked their patented lands during the spring and summer months while keeping homes in the valley and living there the rest of the year.74

Notable exceptions to this seasonal model of land use included a few permanent ranches such as the Los Alamos Ranch School, located in the area of present-day downtown Los Alamos, and Anchor Ranch, located on land now occupied by the national laboratory (fig. 3.3). Both ranches were established through the purchase of adjoining or nearby land originally patented through the homesteading process.75

The homesteading period on the plateau (1887–1942) was an outgrowth of an earlier undocumented use of the Jemez Mountains by local Hispanics for cattle grazing and farming activities. Land ownership caused no change to the Iberian custom of seasonal migration up to the plateau and higher Valles Caldera areas during the growing and grazing seasons and back down to the valley during the winter months. Homesteaders continued to practice self-sufficient subsistence living as it had been practiced in northern

74 Santa Fe Land Office Records for Homestead Entries, "General Land Office Homestead Patent Files; Machen, Homesteading on the Pajarito Plateau.
75 Santa Fe Land Office Records for Homestead Entries, "General Land Office Homestead Patent Files; Machen, Homesteading on the Pajarito Plateau.
New Mexico since the coming of the Spanish—building their own homes, growing their own food, and existing almost entirely without access to markets. The pattern changed only by its adaptation to new legislation that required ownership as a prerequisite for using the land. Turning the new rules into an opportunity, homesteaders patented the very lands they had used historically for grazing and farming.76

Economically speaking, homesteading on the Pajarito Plateau was a survival strategy used by Hispanics to supplement the subsistence living they practiced on their farms in the Rio Grande Valley. Ownership of this land gave them the means to augment their income with cash crops, to feed their stock during the summer months, and to take advantage of the plateau’s resources such as lumber, game, and wild edible plants. Homesteading proved to be an especially critical safety net during the Depression years, when cash jobs were scarce.77

**Government Appropriation**

This mainly seasonal and loosely communal way of living came to an abrupt end in late 1942 when the U.S. government appropriated the plateau for its secret atom-bomb project. Over the fifty-five years that homesteaders had farmed the plateau, nineteen of the homesteads passed down through the original families and were still in the hands of those families when the army began appropriating the properties at the end of 1942; twelve of the nineteen were still owned by the original patentees. The remaining

76 Machen, *Homesteading on the Pajarito Plateau.*

77 Generally, see Marta Weigle, ed. *Hispanic Villages of Northern New Mexico: A Reprint of Volume II of the 1935 Tewa Basin Study with Supplementary Materials* (Santa Fe, New Mexico: The Lightning Tree-Jene Lyon Publisher, 1975); Machen, *Homesteading on the Pajarito Plateau.*
homesteads had been sold to other area residents or had become part of Anchor Ranch or the Los Alamos Ranch School.⁷⁸

When the homestead era began on the Pajarito Plateau in 1887, Grover Cleveland was serving his first term as president of a United States whose economy was in great part still agricultural. Only thirty-eight states had been admitted to the Union. New Mexico was not one of them; it had been a territory of the United States since 1850 and did not achieve statehood until 1912. When homesteading abruptly came to an end on the Pajarito Plateau in December 1942, Franklin Delano Roosevelt was president of a United States that had become highly industrialized and was in the midst of a global war. In that span of fifty-five years, the world had changed irrevocably, and with it the way of life the homesteaders once knew on the Pajarito Plateau.

**Scientific History: The Manhattan Project and Project Y**

The story of the places of Project Y that are being proposed for preservation and interpretation would be meaningless without the political and scientific context of the atom bomb’s creation, arguably the most significant (and terrifying) technological development of the twentieth century.⁷⁹ Describing the basic scientific chronology of

⁷⁸ Homestead statistics compiled by Dorothy Hoard and based on Santa Fe Land Office records, U.S. Bureau of Land Management records, and Sandoval County records. Excel spreadsheet on file at with the Cultural Resources Management Team, Los Alamos National Laboratory, Los Alamos, New Mexico.

Project Y, making connections with the histories of the sister sites at Hanford and Oak Ridge, and illustrating how the park properties at the Los Alamos embody key events in the roughly three-year history of the Manhattan Project will be critically important interpretive tasks for the National Park Service.80

The genesis of Los Alamos’s Project Y can be found in events that occurred well before the first army personnel surveyed the land and dispossessed its residents, and well beyond the borders of the United States in war-torn Europe. The story of the wartime laboratory originated with the creation of the Manhattan Engineer District (MED) and the start of a World War II arms race spurred on by the fearsome question of who would get the bomb first, Germany or the United States.

In 1939, physicist Albert Einstein sent a letter to President Franklin Roosevelt advising him that Germany may have started work on developing the atomic bomb.81 As early as April 1940, top scientists in the United States identified the possibility of using uranium-235 in an American weapon.82 However, problems or challenges existed: the research efforts of universities and industry needed to be coordinated, and a process to

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80 The Department of Energy properties included in the legislation represent key events in the timeline of the scientific history of Project Y and the Manhattan Project. Photographs of the buildings and structures being considered for inclusion in the new park are included as figures in this chapter and are specifically identified with an underlined title.


82 Hoddeson, Critical Assembly, 19. Note: this is a multi-author work with varying levels of collaboration throughout; however, for the sake of expediency, all citations from Critical Assembly will be referenced using “Hoddeson” or “Lillian Hoddeson” in the text and footnotes. Specific authorship or collaborations are noted in footnotes at the beginning of chapters within Critical Assembly itself.
produce sufficient fissionable materials—uranium-235 and plutonium—needed to be developed. In 1941, President Roosevelt gave approval to pursue the development of an atomic bomb, and initial research was supported by the government’s Office of Scientific Research and Development (OSRD). In September 1942, General Leslie Groves ultimately came to head the MED; he, in turn, chose Oppenheimer to coordinate the design of the bomb.  

A single research and design facility, isolated and secret, was proposed. This would enable top American and European scientists and engineers to work together to complete this daunting task. A site had to be chosen and the search began in the fall of 1942. Major John Dudley eventually recommended Jemez Springs, New Mexico, but Oppenheimer rejected the site because of its valley setting. Oppenheimer, who had visited the Pajarito Plateau as a young man and was familiar with the Los Alamos Ranch School, suggested it instead.

The precursor to the ranch school, H. H. Brook’s Los Alamos Ranch, was a private land holding on the Pajarito Plateau formed by the consolidation of several homesteaded parcels. Brook sold his ranch in 1917 to Ashley Pond Jr., who had moved to New Mexico from Detroit to recover from typhoid fever. To direct the boys’ preparatory school that Pond established on Brook’s former ranch, Pond hired A. J. Connell, a ranger with the Forest Service. In turn, Connell hired an enthusiastic faculty of young men,


84 Los Alamos National Laboratory, "Los Alamos National Laboratory: A Proud Past, An Exciting Future (Special Issue)," Dateline: Los Alamos, 1995, 7; Hoddeson, Critical Assembly, 58.
mostly graduates of eastern colleges. The school recruited boys from the East whose parents wanted a good academic education in a rugged outdoor setting for their sons.85

The ranch school had been in operation since 1918, and the twenty-seven school buildings with numerous outbuildings could very easily support the small-scale facility Oppenheimer originally had in mind.86 On November 25, 1942, the War Department approved the appropriation of the Los Alamos Ranch School and, on December 7, 1942, notified the school.87 The War Department acquired additional lands from nearby government agencies, mostly Forest Service lands, and from the predominantly Hispanic homesteaders.88

With the graduation of the last class of the Los Alamos Ranch School in 1943, the Pajarito Plateau was poised on the brink of change. A scientific revolution was in the making.

Creating a Wartime Laboratory

The first Project Y scientific facilities were purposely established at existing ranches located on the Pajarito Plateau, including the Los Alamos Ranch School and Anchor Ranch. However, additional housing and research areas were required to provide the literal foundations for the scientific and engineering work needed to design and build

88 Manhattan Engineer District, "Book VIII Los Alamos Project (Y), Volume 1 - General," in *Manhattan District History* (Circa 1944-1946), S2-S3.
the world’s first atomic weapons. Construction at the project’s Main Technical Area, located at the former ranch school, began almost immediately after the government made the decision to appropriate the plateau.89

With a suitable site selected, Oppenheimer and his staff moved to Los Alamos to begin work. The recruitment of some of the country's best scientists and the construction of technical buildings were top priorities.90 All that remained was the selection of the University of California to operate the Los Alamos site under contract with the U.S. government.91 The initial plans for the early laboratory, as envisioned by Oppenheimer and others, included a scientific staff of about a hundred employees along with a support staff of administrative, technical, and shop employees. The number of Los Alamos residents, however, would eventually swell to more than eight thousand by the end of 1945, and the first Los Alamos workers included university and government scientists and other technical workers recruited from all across the country (fig. 3.4).92

A small but important contingent of European scientists, known as the “British Mission,” was also part of the early Los Alamos workforce. Their presence in Los Alamos was formalized in 1943 by the Quebec Agreement, which established an official nuclear relationship between England and the United States. Many of the twenty “guest” scientists from England were in fact refugees from the war-ravaged countries of Germany, Russia, Denmark, Poland, and Czechoslovakia, and were not actually British

89 Ibid., S3-S6.
91 Hoddeson, on page 66 of Critical Assembly, notes that the signing of the University of California contact on April 20, 1943, was the official founding of the scientific laboratory.
citizens. Regardless of their origins, members of the British Mission worked in a variety of Los Alamos groups, held management positions as group and section leaders, and were fully integrated into all aspects of Los Alamos life. British Mission scientists included James Tuck, Niels Bohr, James Chadwick, Otto Frisch, Rudolf Peierls, J. Carson Mark, William Penney, and P. B. Moon. Some of these scientists, like Tuck and Mark, would stay on at Los Alamos after the war.93

The Albuquerque District Office of the Corps of Engineers started planning the layout of the wartime laboratory as early as December 1942. Standard Army construction procedures were in force, and the first priority was the construction of technical and office buildings located near Ashley Pond.94 Early Los Alamos resembled a military post. The Main Technical Area, which started actual operations in early 1943, was fenced and separated from the rest of town. Only specially badged workers were allowed inside the guarded laboratory area (fig. 3.5).95

**Critical Ingredients: Fissile Material for the Los Alamos Weapons**

When President Roosevelt approved the establishment of the Manhattan Project on December 28, 1942, he authorized the construction of facilities that would ultimately produce the fissile material—uranium-235 and plutonium—essential to the weapons designed at Project Y.96 By December 1942, plans for the development of the Clinton

93 Szasz, *British Scientists and the Manhattan Project: The Los Alamos Years*, 148-149. Also, see this work generally for a good summary of the British Mission’s role in the Manhattan Project.


95 Ibid., 4.

96 Fissile or fissionable material, such as uranium-235 and plutonium, is heavy radioactive material that can be split or fissioned by fast neutrons. The fission of heavy elements is
Engineer Works (code-named Site X) in Oak Ridge, Tennessee, were already well underway. Other important facilities associated with the Manhattan Project included the Metallurgical Laboratory in Chicago and the Hanford Engineer Works in Washington State (code-named Site W). On December 2, 1942, scientists in Chicago working under the leadership of Enrico Fermi achieved the first self-sustained nuclear chain reaction. The chain reaction occurred when fissionable material in the “pile”—in this case uranium—released additional neutrons during the fission process, thereby stimulating a repetition of the fission reaction. Fermi’s demonstrated production pile design would later be recreated at Oak Ridge.  

During the next two years, the preparation of fissionable materials would be conducted on a parallel time line at Oak Ridge and Hanford. The separation of uranium-235 from uranium-238 could not be done using a chemical process. Oak Ridge was tasked with the development of two physical separation processes: gaseous diffusion separation and electromagnetic separation (fig. 3.6).  

Small quantities of plutonium for use at Los Alamos were first produced using the Oak Ridge pile. However, Hanford’s larger production reactors soon began producing the necessary volume of plutonium—in plutonium nitrate solution—for shipment to Los Alamos (fig. 3.7). The first plutonium-239 arrived at Los Alamos from Oak Ridge in the fall of 1943 (fig. 3.8). Larger gram amounts—first from Oak Ridge, then from

accompanying a relatively large amount of energy; this fission process is fundamental to the design of the atom bomb.

98 Los Alamos National Laboratory, Beginning of an Era, 25.
Hanford—started arriving early in 1944. The first kilogram of highly enriched uranium arrived from Oak Ridge in September 1944.\footnote{Ibid., 27-28.}

**From Theory to Reality**

Although the fission bomb was conceptually attainable, many difficulties still stood in the way of producing a usable weapon. Technical problems included assembling fissionable material into a supercritical mass (one that can sustain a fission chain reaction), timing the release of energy from fissionable material, and designing a device that would fit into a deliverable bomb casing. Nuclear material and high-explosives studies were of immediate importance.\footnote{Los Alamos National Laboratory, "A Proud Past, An Exciting Future," 8-9.}

Initially, one weapon design appeared to be the most promising: a "gun-assembled" weapon that could be designed to work with both fissile uranium and plutonium. The gun device was conceptually simple and involved shooting one subcritical mass at another at sufficient speed to avoid pre-detonation. Together, the two subcritical masses—two masses of fissionable material unable to sustain a chain reaction—would form a supercritical mass, releasing a tremendous amount of nuclear energy.\footnote{Hoddeson, *Critical Assembly*, 2.} Research in support of the gun-assembled design eventually led to the development of the Little Boy weapon (fig. 3.9). Because it was conceptually simple, Little Boy was never tested before its use at Hiroshima.

Scientists were less confident about the second weapon design that was eventually developed. The implosion or Fat Man design used shaped high explosives to compress a
subcritical mass of plutonium-239. Symmetrical compression would increase the density of the fissionable material and cause a critical reaction (fig. 3.10). This approach was much more difficult to perfect.\textsuperscript{102}

In order to achieve the wartime goal of researching, developing, and testing the first atomic bombs, the chemical and metallurgical properties of various nuclear materials had to be researched. One of the first tasks was to develop methods to purify the plutonium that would be coming to Los Alamos—first from Oak Ridge, Tennessee, and later from Hanford, Washington—changing it from a liquid solution into a usable metal form. Other early priorities of the radiochemistry program (the chemistry of radioactive elements) included the development of a neutron initiator for the first nuclear weapons and the preparation of materials for nuclear experiments.\textsuperscript{103} Necessary research on the physical properties of uranium and plutonium was conducted—especially research relating to metal alloys (mixtures of two or more metals).\textsuperscript{104}

While the radiochemistry program was developing processes for working with the as yet unreceived plutonium and uranium that would be used in the first bombs, other Los Alamos scientists conducted the first experiments on methods of plutonium purification using other elements as stand-ins. This work was conducted in D Building, a wooden laboratory building located south of Ashley Pond in the Main Technical Area. Initial plutonium research, metallurgy, and World War II plutonium-core production were

\textsuperscript{103} Nuclear weapons rely on devices, known as “initiators,” to supply a source of neutrons that will quickly enhance the chain reaction at exactly the right moment.
carried out in this facility. The world’s first significant piece of plutonium metal was produced in a centrifuge at D Building in the spring of 1944.\footnote{Los Alamos National Laboratory, \textit{Beginning of an Era}, 28.}

Of the two earliest weapon designs, the gun method was easier to develop than the implosion method. Furthermore, Los Alamos scientists thought that both uranium and plutonium could be used with the gun design. The Fat Man or implosion design was recognized early on as a technically efficient approach but was primarily intended to be a back up to the gun device in case unexpected problems arose. Initial research on implosion was seen as more of an intellectual challenge. In 1943, Oppenheimer, confident in the success of the gun program, allowed a small number of scientists to pursue this alternative approach.\footnote{Hoddeson, \textit{Critical Assembly}, 67.} The laboratory’s main effort, however, was focused squarely on the development of the plutonium gun-assembled weapon, known as “Thin Man,” with much of the design and early testing being conducted at a remote technical area some four miles southwest of the Main Technical Area, located at the site of the former Anchor Ranch and designated Anchor Ranch Proving Ground (fig. 3.11).\footnote{Manhattan Engineer District, ”Book VIII, Volume 2 - Technical,” VII-2, VII-8.}

In 1944, a group of scientists working at remote Pajarito Site under Emilio Segrè determined that plutonium could not be used in the Thin Man design because the plutonium produced in nuclear reactors contained an isotope (plutonium-240) that released neutrons.\footnote{An isotope is an atom with the same atomic number as another atom, but with a different atomic weight.} This high-neutron background would cause the nuclear chain reaction to start prematurely if an assembly method as slow as the gun device was
The realization that plutonium could not be used in the gun device was the cause of a major reorganization at the laboratory in August 1944. Lillian Hoddeson, writing in her technical history of Project Y, describes Los Alamos’s response:

A crisis ensued. Groves, wanting to preserve the investment that had been made in plutonium production (hundreds of millions of dollars), ordered a plutonium bomb assembled by other means. The only possible alternative was implosion, an assembly explored thus far at Los Alamos only as a contingency. . . . As a result, Los Alamos was forced to turn its relatively small implosion program into a model “big science” effort involving hundreds of workers.110

Fortunately, the development of the uranium or Little Boy gun weapon was well underway. This allowed the laboratory to mobilize its limited resources and accelerate research on implosion in hopes of developing a plutonium weapon that could be used in addition to the uranium gun device (fig. 3.12).111

At least seven diagnostic testing methods were developed in late 1944 to study the inner workings of implosion; the greatest difficulties came from the need to document precisely not only what was happening during an explosion, but also to determine the exact timing of events (figs. 3.13–3.16).112

109 Los Alamos National Laboratory, Beginning of an Era, 21.
110 Hoddeson, Critical Assembly, 3.
111 Ibid., 128.
Final Testing and Delivery

Despite the myriad diagnostic techniques being used, uncertainties surrounding the implosion design necessitated a search for an appropriate test site for the implosion method. The Alamogordo Bombing Range in south-central New Mexico was selected, and a trial run involving one hundred tons of TNT was conducted at "Trinity Site" on May 7, 1945. This dress rehearsal provided measurement data and simulated the dispersal of radioactive products.\(^{113}\) The Trinity test, the culmination of “Project Trinity,” was planned for July and its objectives were “to characterize the nature of the implosion, measure the release of nuclear energy, and assess the damage” (figs. 3.17–3.19).\(^{114}\)

Concurrent airborne operations to test the deliverable weapons casings for the gun and implosion bombs were being conducted at Wendover Field in Utah. By June 1945, as part of “Project Alberta,” preparations for a staging area in the Pacific on the Island of Tinian were well underway (fig. 3.20). The world's first atomic device was detonated in the early morning of July 16, 1945, at Trinity Site in New Mexico. Little Boy, the untested uranium gun weapon, was exploded over the Japanese city of Hiroshima on August 6, 1945 (fig. 3.21). Fat Man was exploded over Nagasaki three days later on August 9, 1945 (fig. 3.22). The war with Japan was essentially over.\(^{115}\)


\(^{114}\) Ibid., 11.

\(^{115}\) Gosling, The Manhattan Project, 42, 50-54.
The Postwar Manhattan Project

Los Alamos’s role in the Manhattan Project did not conclude with the end of World War II. The refinement and testing of weapon designs continued at Los Alamos, and postwar weapons tests began in 1946 in the Pacific. General Groves remained in charge of the postwar Manhattan Project. His goal was to protect America’s nuclear supremacy and to continue operations at key facilities. Some of the fissile material production facilities at Hanford and Oakridge were shut down or put on standby, but research and development continued at Los Alamos. Groves tasked Los Alamos with the production of the country’s first atomic stockpile. Components would be produced at Los Alamos, but weapon assembly would be carried out at nearby Sandia Base in Albuquerque.  

Actual weapons testing continued during the tail end of the Manhattan Project with “Operations Crossroads,” a testing program that led to the detonation of two plutonium Fat Man-type bombs in the Pacific (fig. 3.23). On July 1, 1946, Shot Able was dropped from a B-29 airplane in the area of Bikini Atoll. The blast from Able sank three ships that were part of a target fleet of unmanned ships; two additional ships sank within twenty-seven hours after the test. Shot Baker was the second and final Crossroads weapons test. On July 25, 1946, Baker was detonated underwater—damaging empty ships, shooting water into the air, and leaving radioactive fallout in its wake. These tests inaugurated the formal U.S. atmospheric testing program that started in the spring of 


116 Ibid., 55.

1948 and continued in the Pacific and at the Nevada Test Site during the 1950s and 1960s.¹¹⁸

For all practical purposes, the termination of Manhattan Project activities in Los Alamos came in late 1946 with the creation of the Atomic Energy Act and the transfer, in January 1947, of all atomic energy activities from the MED to the newly created Atomic Energy Commission.

The ongoing debate over the meaning of the Manhattan Project has effectively sidelined local narratives associated with the social and scientific history of World War II. At Hanford, Los Alamos, and Oak Ridge the buildings, structures, and associated landscapes included in the park legislation are historical sites of memory and meaning, not just because of the role they played supporting the technology used to develop the world’s first atomic weapons, but also because of their profound effect on the local history of their respective regions. The histories of the park communities also include cross-cutting scientific themes that unite the sites, for without the massive effort to produce the fissile uranium and plutonium at Oak Ridge and Hanford, the Los Alamos metallurgy program would not have been able to manufacture the special projectiles, targets, and pits that are a vital part of atomic weapons. Yet, the interpretation of science and technology is only one part of the new park’s historical context, and each of the communities share silenced narratives of displacement and the permanent loss of home that, when viewed together, are central to the Manhattan Project’s origin story.

The scientific chronology of the Manhattan Project provides the general historical context for the wartime Los Alamos properties that have been recently identified as national sites of memory. It is no coincidence that the national laboratory properties listed in the park legislation reflect key events along the Project Y timeline, beginning with the use of the Pond Cabin in 1943 to support Emilio Segrè’s plutonium-chemistry experiments and ending with Louis Slotin’s postwar criticality accident in the laboratory building that bears his name today. The handful of buildings and structures that remain were purposely retained because of what they represent to the history of the bomb—they symbolize the key research and engineering activities, testing programs, and final assembly efforts. Taken as a whole, they embody the Project Y story. Individually, however, the remaining places are more than mere physical props used for illustrating a local timeline. Each of the remaining properties is part of the greater cultural landscape of World War II, and their future significance may very well be determined by their capacity to function as dynamic spaces and landscapes whose preservation and interpretation as park sites will promote a greater awareness of the underappreciated places, institutions, and people of the Manhattan Project.
Fig. 3.1. Government photos of Ashley Pond (top) and of an area road taken during the site selection process (above), circa fall 1942. Los Alamos, without knowing it, was poised on the edge of a major transformation in November 1942. The sleepy plateau community would soon be displaced by the wartime Manhattan Project.

Fig. 3.2. Displaced farmers were primarily local Hispanics from nearby Rio Grande Valley villages who had homesteaded the plateau land beginning in the late 1880s. The homesteads appropriated by the U.S. government represent a New Mexico tradition of seasonal farming and grazing that no longer exists.

(Photograph at right courtesy of the Los Alamos Historical Society Photo Archives)
Fig. 3.3. The Los Alamos Ranch School’s Fuller Lodge. The ranch school, a private prep school for the sons of eastern elites, was not immune to the wartime needs of the Manhattan Project. The school’s existing facilities—its residences, communal buildings, and outbuildings—were a contributing factor in the choice of Los Alamos as the site for the new scientific laboratory.

Fig. 3.4. Wartime Los Alamos was home to some of the world’s most famous scientists; without far-ranging recruitment, the Manhattan Project would not have achieved its goals. Norris Bradbury, John Manley, Enrico Fermi (front row); J. Robert Oppenheimer, Richard Feynman (second row), and others are shown here at a postwar Los Alamos conference.
Fig. 3.5. The Main Technical Area was one of the first sites constructed for use by Project Y and included laboratory and office spaces. The “tech area,” as it was known, was fenced and guarded to prevent unauthorized access.

Fig. 3.6. The Y-12 “Racetrack” at Clinton Engineer Works (Oak Ridge). The electromagnetic separation process used at “Site X” refined uranium-238 to produce the uranium-235 used in Little Boy.
Fig. 3.7. The B-Reactor, a plutonium production reactor at Hanford Engineer Works (Hanford), Washington. This Manhattan Project site, known by its code name “Site W,” provided the plutonium for the Fat Man bomb.

Fig. 3.8. The Pond Cabin (June 1943): Built in 1914 by Ashley Pond, Los Alamos Ranch School founder, the cabin was used to support Emilio Segrè’s plutonium-chemistry research at Pajarito Site. The work of Segrè’s Radioactivity Group lead to the July 1944 decision to discontinue work on the Thin Man weapon (the plutonium gun-device). The cabin was used later during the war to support firing tests related to implosion diagnostic research.
Fig. 3.9. Little Boy (above) was a gun-assembled design: one subcritical mass of fissile uranium was shot at another at close range inside the weapon. Thin Man, a gun-assembled design using plutonium, was an earlier unsuccessful prototype.

Fig. 3.10. Fat Man, the implosion design, was developed in response to the unsuitability of the Thin Man gun-assembled design, which drove the need for a second weapon type that could make use of the Hanford plutonium.
Fig. 3.11. **Gun Site (September 1943):** Birthplace of Little Boy and one of the earliest wartime test facilities at Los Alamos. The gun-assembled method was developed here, including initial work on the discontinued Thin Man design. The site includes three bunkered buildings, one WWII-era guard shack, and two gun emplacement areas. Internal components of Little Boy combat units were tested at the gun emplacements and test assembled in Gun Site’s Building 1. Little Boy unit L-11, developed at Gun Site, was dropped on Hiroshima, Japan, August 6, 1945.

Fig. 3.12. **S-Site High-Explosives Magazine (March 1944):** The last of the original S-Site buildings, this magazine represents the novel high-explosives technology developed by Los Alamos during the war in support of the development of the implosion weapon. The magazine also represents the danger inherent in high-explosives use and the special landscape of buildings, protective berms, walkways, and bunkers developed at S-Site to address this risk.
Fig. 3.13. **Battleship Bunker (September 1944):** Located at Pajarito Site, the bunker supported firing tests to study implosions using the magnetic method, which involved disruptions in a magnetic field during an explosion. The magnetic method was the only method that could be used on full-scale tests. It was used to collect data for the “Creutz test,” detonated on July 14, 1945, at Pajarito Site. The Creutz test was a copy of the Trinity device, minus the active material.

Fig. 3.14. **L-Site Firing Pit (October 1944):** The firing pit is one of the last remaining experimental test structures associated with the development of the Fat Man weapon. The pit was used to support the terminal observation method, which was the study of the physical remains of small-scale implosion tests known as assemblies.
Fig. 3.15. **K-Site Betatron, Cloud Chamber, and Control Bunker (October 1944):** This facility was built for the betatron method of implosion diagnostics. Donald Kerst was the leader of the group at K-Site. He was the inventor of the betatron machine and also designed Los Alamos’s “Water Boiler,” the world’s third reactor. The betatron generated gamma radiation at the moment of a test implosion, and a cloud chamber was used in an adjacent building to collect the data from the shot.

Fig. 3.16. **Q-Site Darkroom and Shop (October 1944):** This building supported the flash photography diagnostic method. High-speed photography was a key wartime tool used at Los Alamos to capture implosion data at Q-Site and other implosion test sites.
Fig. 3.17. V-Site (Spring and Fall 1944): Building 517 was built in May 1944 as a dedicated mockup facility to test early Fat Man combat unit designs even before the implosion design was finalized. Building 516, the High Bay, was built in late 1944. It was used to assemble the high-explosives sphere of the Trinity “gadget” several days before the Trinity test in July 1945.

Fig. 3.18. Concrete Bowl (September 1944): This experimental structure was built to support plutonium-recovery research. In the water recovery method, test shots were set off in a water tank on top of a tower using uranium as a stand in for plutonium. The residue from the test was recovered from a filter system at the bottom of the bowl to determine the percentage of recovery. The bowl, which was a 200-ft diameter scale model, was also used as a firing pad for other implosion mockup tests.
Fig. 3.19. Plans to test the Trinity gadget grew from concerns about the complicated nature of the implosion weapon’s design. Trinity Base Camp in southern New Mexico was a hub of activity as test preparations came to a head in July 1945.

Fig. 3.20. The Quonset Hut (June 1945): Final design work for the Fat Man weapon (trap-door design) was conducted in the Quonset Hut building. Fat Man units F31, F32, and F33 were preassembled here and flown from Kirtland field in Albuquerque to Tinian Island for final assembly. Unit F31 was dropped on Nagasaki, Japan, on August 9, 1945.
Fig. 3.21. “Little Boy,” detonated over the Japanese city of Hiroshima on August 6, 1945.

Fig. 3.22. Damage from Fat Man, detonated over Nagasaki, Japan, on August 9, 1945.
Fig. 3.23. Slotin Building (January 1946): Criticality research supporting Los Alamos’s postwar nuclear weapons program led to the death of Harry Daghljan at Omega Site in Los Alamos Canyon. As a result, critical mass studies were relocated to Pajarito Site’s Building 1. The Louis Slotin accident, involving an experiment known as “tickling the dragon’s tail,” exposed a group of workers in Building 1 to radiation on May 21, 1946. Louis Slotin died nine days later. Both fatalities led to major safety changes at scientific institutions throughout the country, and remote-operation facilities were constructed at Pajarito Site as a result of Slotin’s accident.
PART II.
INITIAL DESIGNS (1943–1944)
CHAPTER 4

THE POND CABIN:
WESTERN PLACES IN THE HISTORY OF THE NATION

However, a continuity of successive experiences, setting down layers of meaning, can, I suggest, result in an especially strong power of place—a psycho-geography, an “awareness” of the past . . . that is dynamic, handed down by people rather than recorded on the very stones, and is specific to a particular historic and political context.

Robert Bevan, The Destruction of Memory

With the passage of the Manhattan Project National Historical Park legislation comes the very real challenge of interpreting the meaning of the places and spaces associated with the creation of the world’s first atomic weapons. New histories will be written following current ways of thinking about the past. Varying degrees of importance will be assigned to events and people. Present sensibilities will affect the place-making process and determine specific historical periods of significance. The privileging of certain narratives over others will influence the way places are restored, interpreted, and appointed with artifacts and displays.

The Pond Cabin has been identified in the park legislation for its role in supporting key World War II scientific research, specifically for the short time it was used to support Emilio Segrè’s research. In 1943, a group of Los Alamos scientists under the direction of Segrè established a small laboratory in Pajarito Canyon on the Pajarito Plateau, New Mexico, to study the chemical properties of the new man-made element plutonium. The members of the plutonium chemistry group chose this out-of-the-way place so that the sensitive experimental work could be conducted away from the bustle of the wartime town of Los Alamos. In the isolation of Pajarito Canyon, Segrè and his
fellow scientists made the critical scientific discovery that plutonium, then being produced at great expense at industrial plants in Washington State, could not be used for the bomb design being developed at Los Alamos.119 Accessed by a dirt wagon road, Segrè’s remote laboratory was hurriedly thrown together; his research group used two abandoned log cabins acquired by the Manhattan Project. One cabin, built by the Forest Service in the late 1930s, housed the scientists’ equipment but no longer exists today. The second log cabin, built by Ashley Pond in 1914 and used by the plutonium chemistry group and laboratory security guards as an office and a place to sleep, is still standing.120

Upcoming decisions about the interpretation of the Pond Cabin’s significance may result in the development of a narrative that focuses narrowly on its use during the Manhattan Project as “Segrè’s Cabin.” In recent years, its significance has shifted away from an association with Ashley Pond, the ranch manager who built the cabin in 1914, to its use during World War II. According to a 2012 press release issued by the Atomic Heritage Foundation, a Washington, D.C.-based, non-profit organization that focuses on preserving atomic history, the Pond Cabin is the place “where Emilio Segrè researched the behavior of the recently discovered plutonium.” As for the cabin’s role in history, the press notice asserts that “Segrè’s work at the Pond Cabin was critical to the design of the ‘Gadget’ tested at Trinity Site and the first atomic bombs.”121 This emphasis on one brief

119 Los Alamos National Laboratory, Beginning of an Era, 21; Hoddeson, Critical Assembly, 3.
moment of history could serve to freeze the cabin’s meaning in time, overlooking its rich one-hundred-year-long history.

In the preservation and interpretation of nationally important historical sites, how are specific periods of historical significance determined and who decides which stories should be told? Pierre Nora, in “Between Memory and History,” suggests that sites of memory (les lieux de mémoire) should be able to take on new meanings through time. In the case of the Pond Cabin, which historical narrative should take precedence in the interpretation and physical restoration of the cabin for it to exist as one of Nora’s meaningful lieux de mémoire: its brief use as an office in support of the development of the world’s first atomic weapons; or the cabin’s broader role reflecting the history of the twentieth century in the West and the nation?

An examination of the history of the Pond Cabin and its landscape will demonstrate that this place is indeed a multilayered “site of memory” with a rich cultural history. From its first use in hunting and ranching operations during the early 1900s to its role during World War II and the Cold War supporting atomic science, the historical context of the cabin has both reflected and driven the trajectory of the country as a whole throughout the twentieth century. The history of the West in the nation is mirrored in

122 Nora, "Between Memory and History," 19.

123 Some of the material in this chapter has been previously published in two government reports written by the author and coauthored by other LANL employees (see McGehee et al. 2006 and McGehee et al. 2009). However, the historical accounts excerpted from these two reports and used herein were researched and written solely by the author.
the history of Pajarito Canyon and the Pond Cabin, and this narrative has been hidden by stories of the bomb.\textsuperscript{124}

\textbf{A Western Place—The Pajarito Plateau}

\textbf{Geology and Prehistory}

The landscape of northern New Mexico is typical of the American West; it is a quintessential western place because of its location, climate, geology, and prehistory. This is an arid and sparsely populated frontier region, and its use through the years has paralleled historical land-use patterns prevalent in the West, from commercial natural-resource exploitation beginning around the turn of the century to federal involvement in western land use during the 1930s and beyond.\textsuperscript{125}

Situated near the confluence of Pajarito Canyon and Threemile Canyon on the Pajarito Plateau, the Pond Cabin stands on land currently owned by the U.S. government within the boundaries of LANL. Ranging in elevation from 5,500 feet to over 10,000 feet above sea level and located at the base of the Jemez Mountains, the plateau was formed as a result of volcanic activity over one million years ago.\textsuperscript{126} Steep-sided canyons bisect

\begin{footnotesize}
\begin{enumerate}
\item \textsuperscript{124} The cabin can also be seen as a symbol of the history of the West in the twentieth century, one that touches on the historiographical scholarship of western history including “The West as a Place (Arid)” [Webb]; “The West as Uninhabited Frontier” [Turner]; “The Myth of the West” [Smith and Pomeroy]; The West as a Place of Environmental Exploitation/Conquest” [Worster, Limerick, and DeBuys]; “The Federal Government in the West” [Nash]; and “The Cold War/Atomic West” [Fernlund and Hevly/Findlay].
\item \textsuperscript{126} Los Alamos National Laboratory, \textit{Cultural Resources Management Plan for Los Alamos National Laboratory (Draft)} (Los Alamos, New Mexico: Los Alamos National Laboratory, 2012), 17-18, LA-UR-12-01693.
\end{enumerate}
\end{footnotesize}
the plateau, creating a series of roughly parallel, fingerlike mesas (fig. 4.1). The canyon walls are composed of soft, welded volcanic ash known as tuff, which was deposited in successive layers, each a slightly different hue of pale orange, cream, or tan. A land of frequent droughts, the plateau is carved by canyon-bottom streams, which flow intermittently depending on the vagaries of rainfall and spring snowmelt and eventually terminate in the nearby Rio Grande. Visitors to this area of northern New Mexico, perhaps expecting a more-treeless and -desert-like environment, often comment on the temperate climate, the green ponderosa, piñon, and juniper forests, and the diversity of animal life, for the plateau is home to deer, elk, coyote, and eagle alike.

Ashley Pond moved to Pajarito Canyon on the Pajarito Plateau in 1914 with his wife, Hazel Pond, and their children. In the same year, he built his small log and stone cabin for a library and office (fig. 4.2). Pond’s decision to develop this spot as the headquarters for the ranch known as the Pajarito Club was likely influenced by the presence of nearby bunkhouses and outbuildings left behind by previous landowners who arrived in the canyon during the late 1800s with the first development of the Ramón Vigil land grant as a leased cattle ranch.

However, the ranchers and lumbermen who came before Ashley Pond were not the first residents of the area. The natural setting of the sheltered canyon bottom at the fork of Pajarito and Threemile canyons, with its nearby spring and stream, has attracted human settlers to this part of the Pajarito Plateau for more than seven centuries,

128 Ibid., 11.
beginning with hunters and gatherers, who left behind chipped stone pieces that can be found today on the mesas overlooking the canyon.129

The south-facing cliffs of Pajarito Canyon, much warmer than the mesa tops during the winter months, were used by Puebloan groups as locations for multistoried houses built into the talus slopes and for shelters dug into the relatively soft volcanic tuff of the canyon walls (fig. 4.3).130 These purposely excavated “cavates,” as archaeologists call them, are thought to have been used variously as storage rooms and sacred ceremonial spaces. Reused by the Pond children as play forts and later visited by shepherders and wartime scientists alike, the prehistoric caves are still prominent features of the canyon’s western setting and landscape.131

Land Ownership, Boundaries, and Geopolitics

Mirroring other places in the Southwest, the Pajarito Plateau was still considered a fairly remote part of the country during the early years of the twentieth century, with few visitors braving the rough wagon roads and steep terrain to reach the plateau and traverse it. However, despite its relative isolation, the region was profoundly affected by various government mandates implemented in other parts of the West. Among them were the setting aside of federal lands to create National Park units and also to comply with the

129 Archaeological data courtesy of LANL Cultural Resources Management Team.
130 Ibid.
131 Based on the author’s own field observations, some of the cavates near the Pond Cabin show evidence of having been used as forts or shelters long after Pajarito Canyon was occupied by Ancestral Puebloan peoples. This reuse activity is suggested by the presence of nails of twentieth-century manufacture located just inside the cave openings for the purposes of securing a blanket or other form of door covering.
provisions of the Homestead Act.\textsuperscript{132} Other national developments experienced locally included the entrance of the railroad into the region. Northern New Mexico’s Denver & Rio Grande (D&RG) railroad, the “Chili Line,” established in the 1880s at the base of the plateau along the Rio Grande, brought in mass-market goods and stimulated a dramatic growth in local tourism.\textsuperscript{133} The economic and social impacts caused by U.S. involvement in World War I and the arrival of the Spanish flu of 1918 into the Southwest were also experienced locally.\textsuperscript{134}

Ashley Pond’s Pajarito Club headquarters in the bottom of Pajarito Canyon was historically part of the Ramón Vigil Grant, a former Spanish land grant (fig. 4.4). Like other old Spanish and Mexican land grants in New Mexico, the Ramón Vigil Grant has had a history rife with dispute and legal battles.\textsuperscript{135} The Spanish government originally granted the land to Pedro Sanchez in the 1700s. The boundaries of the grant included the Rio Grande to the east and the Jemez Mountains to the west, the tract covering much of the central part of the Pajarito Plateau. In 1860, clear title to the grant was given to Ramón Vigil, a Sanchez descendant who claimed eight out of eleven hereditary interests in the property. Vigil sold his claim to Padre Tomas de Aquinas Hayes in 1879.


\textsuperscript{133} Machen, \textit{Homesteading on the Pajarito Plateau}, 10-11, 14.

\textsuperscript{134} Fermin Vigil, "Homestead Entries No. 023589 and No. 589, General Land Office Homestead Patent Files," (Santa Fe Land Office homestead records, available at U.S. Forest Service Office, Santa Fe, New Mexico. Copies available at Los Alamos National Laboratory or at the Los Alamos Historical Museum Archives, Los Alamos, New Mexico).

Five years later, in 1884, Hayes sold the grant to midwesterners Winfield Smith and Edward Sheldon.\(^{136}\)

**Resource Exploitation—Lumber**

The Ramón Vigil Grant experienced the same patterns of land use as other western places during the early twentieth century, including large-scale industrial natural-resource exploitation.\(^{137}\) Landowners and entrepreneurs, many coming to New Mexico from other parts of the country, began constructing wagon roads and early routes for automobile travel that would eventually crisscross the Pajarito Plateau. Former forest lands to the north of the grant were opened for homesteading, and the plateau experienced a growth in small-scale farming and lumber operations along with sheep and cattle grazing.\(^{138}\) W. C. Bishop was one of the earliest entrepreneurs to lease the grant. Hailing from Texas, Bishop and his men arrived in northern New Mexico in the 1880s with a herd of more than three-thousand head of cattle. He chose the plateau area because cattle operations in West Texas were being restricted by the Texas state government due to overgrazing. Bishop established his ranch headquarters in lower Pajarito Canyon and was probably the first to realize the ideal nature of this location at the confluence of

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Pajarito and Threemile Canyons, a spot that would continue to be occupied on and off for more than a hundred years to come.\textsuperscript{139}

Lumberman Henry S. Buckman was another early lessee of the Ramón Vigil Grant. In 1898, Buckman, who came to the New Mexico from Oregon, leased the grant to cut and process timber.\textsuperscript{140} In order to transport his lumber to market, Buckman built a town and railroad depot on the east bank of the Río Grande in 1899. Although he abandoned his lumber operations after only a few years and vacated the state in 1902, Buckman left behind an important legacy in terms of plateau infrastructure. In addition to the town and D&RG railroad siding that bore his name, Buckman and his employee, local homesteader James S. Loomis, built a one-lane bridge across the Río Grande and a road that linked the railroad depot at the river to the high mesas of the Pajarito Plateau (fig. 4.5). One branch of the road led to the Ramón Vigil ranch headquarters in Pajarito Canyon and then up to Buckman’s sawmill, the “Buckman Set,” near present-day S-Site, a national laboratory technical area located at the base of the Jemez Mountains. Buckman Road, as it came to be known, provided later residents of the plateau with a way to transport cattle, sheep, cash crops, and timber to outside markets.\textsuperscript{141}

A dispute arose around the turn of the century with Henry Buckman’s first profitable use of the Ramón Vigil Grant. A group representing the remaining hereditary interests descending from Pedro Sanchez, the original Spanish grantee, filed suit citing

\textsuperscript{139} Machen, \textit{Homesteading on the Pajarito Plateau}, 11.
\textsuperscript{140} Dorothy Hoard, \textit{Los Alamos Outdoors} (Los Alamos, New Mexico: The Los Alamos Historical Society, 1993), 16.
\textsuperscript{141} Machen, \textit{Homesteading on the Pajarito Plateau}, 10, 12-14, 25-26; W. B. Douglass, "Ramon Vigil Grant, 1912" (Santa Fe, New Mexico: U.S. Surveyor General's Office, April 9, 1915); Hoard, \textit{Historic Transportation Routes} 2006, 19.
laws of inheritance. At the conclusion of the case, the judge ruled for the defendants, grant owners Winfield Smith and his new partner, a man named Fletcher. In 1908, the Ramón Land and Lumber Company, looking to cut timber on the land, contracted with Smith and Fletcher to purchase the grant (fig. 4.6). By 1910, it was clear that the Ramón Land and Lumber Company was struggling to pay the purchase price of over $50,000, as well as paying other creditors. The grant was offered for sale by the company’s bank, the U.S. Bank and Trust Co., in an effort to clear the debt, but the lumber company eventually defaulted on the contract sometime around 1911.

According to local writer Peggy Pond Church, B. S. Phillips formally incorporated the Ramón Land and Lumber Company on September 22, 1906. Phillips formed a partnership with Harold H. Brook, originally from Illinois. Other partners included Robert G. McDougall of Iowa, M. F. King of Keokuk, Iowa, J.W. Lowrie of Burlington, Iowa, and W.W. Johnston, also from Burlington. Citing a June 1907 entry from a diary kept by Mrs. Abbott, wife of Judge Abbott of the Ten Elders Ranch in Frijoles Canyon, Peggy Pond Church associates Mrs. Abbott’s reference to a “Phillips’

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143 The history of the Ramón Land and Lumber Company and its use of the Ramón Vigil Grant is based on published histories and from research notes found in the Los Alamos Historical Museum’s archives. Some of the sources contradict each other, and dates attributed to the founding and dissolution of the company should be considered approximate. See, Church Collection, "Peggy Pond Church Records and Research Notes,” Los Alamos Historical Museum Archives, Los Alamos, New Mexico.

144 H. B. Cartwright & Bro. et al. v. United States Bank & Trust Co.

145 Church Collection, "Peggy Pond Church Records and Research Notes," Box 28, Folder 25, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.
Mill” in Pajarito Canyon with her childhood memories of a sawdust pile at the Pajarito Club headquarters.146

While some of the land and lumber company’s directors may have been simply investors or speculators, the local partners worked hard to support the company’s primary purpose of harvesting, processing, and selling plateau timber. Robert McDougall was a partner in the Ramón Land and Lumber Company and was also a local homesteader, settling on his nearby claim just north of the Ramón Vigil Grant in early 1908.147 Harold Brook also homesteaded land on the plateau; his property, the Los Alamos Ranch, was located at present-day downtown Los Alamos.148

The ill-fated Ramón Land and Lumber Company was suspended in early 1911. Facing bankruptcy, the company transferred assets and stock to the U.S. Bank and Trust Company on February 16, 1911. The bank then took possession of all personal property and placed Harold Brook in charge of managing the Ramón Vigil Grant.149 Brook acted as interim manager of the Ramón Vigil Grant from 1911 to 1914 and continued to work on the land. The following excerpts from letters during this period from Brook to his fiancé Katherine (Cassy) Cross Brown illustrate the frustration he experienced while

146 Ibid., Box 28, Folder 5; Douglass, "Ramon Vigil Grant, 1912." Note: Douglass map (Fig. 4.4) shows a waterhole and the old site of a sawmill at the canyon confluence near the ranch headquarters area in Pajarito Canyon.
149 Church Collection, "Peggy Pond Church Records and Research Notes," Box 28, Folder 25, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.
simultaneously managing the grant’s failed lumber venture and his own homesteaded ranch:

[On Ramon Land and Lumber Co. letterhead from Buckman]

Saturday I went a round-about way to the ranch leaving Buckman in the morning. Sunday Mack and I went out both morning and afternoon horseback to look at some range and Monday I rode over to the southwest corner of the Grant and up to the upper mill, so that I have been in the saddle most of the last three days. Today we finished loading the last car of lumber out of Buckman so you can see that you are not the only ant in the hill. But I am not going to keep it up.


I have been working on my books all day and the boys have been loading. I wish to heavens I could get this job finished. One of my ‘humbres’ was down from the ranch for a load of feed yesterday and brought me a note from Mamma saying that she was sick and one from Mack, the foreman, saying, “For God’s sake come home.” He is getting swamped with the spring work. \(^{150}\)

The collapse of the lumber company demonstrated the tenuous nature of resource exploitation in the Southwest. Unprofitable for use as a timber enterprise, the grant would soon be purchased for other uses.

**Wealthy Easterners: The Myth and Lure of the West**

In 1914, the Ramón Vigil Grant was purchased by a group of Detroit business partners who were looking to invest in the myth and romance of the “Wild West” by developing a commercial guest ranch.\(^ {151}\) Dubbed the Pajarito Club and managed by

\(^{150}\) Brook, "Harold H. Brook Letters to Katherine Cross Brown (circa 1911 to 1914), File LAHM HS 42L," no page number, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.

\(^{151}\) According to historian Hal Rothman, on page 116 of *On Rims and Ridges* (1992), the investors included Roy Chapin, president of the Hudson Motor Company; Henry Joy, president of the Packard Motor Car Company; David Gray; and Paul Gray, all childhood friends of Ashley Pond.
Ashley Pond, a co-partner in the enterprise, the ranch was intended to be a place where wealthy easterners could experience the rustic western lifestyle of New Mexico and hunt the mountain lions and other big game animals that roamed the plateau (figs. 4.7–4.9).\textsuperscript{152} Almost immediately, Pond began to make much-needed improvements to the ranch’s buildings, including repairs to the former Ramón Land and Lumber Company’s headquarters building, a two-story affair that would become Pond’s home and the Pajarito Club’s main house. In addition to building his office cabin in 1914, Pond also built several small guest cabins to house any visitors to the ranch, which would later include newspaper editors, writers, and musicians.\textsuperscript{153}

In 1916, Pond asked Harold Brook and his wife, Cassy Brook (née Brown), to manage the ranch in Pajarito Canyon. In the same year, Pond’s association with the Pajarito Club came to an end. Pond quickly moved on to another local business endeavor, forming a partnership with Brook. He eventually purchased Brook’s ranch and established the Los Alamos Ranch School, a boarding school for the sons of wealthy easterners that combined a rugged outdoor education with college preparatory coursework.\textsuperscript{154} Two years after Pond left the ranch in Pajarito Canyon, the Pajarito Club ceased operating, perhaps due to drought—the canyon spring is said to have run dry—or perhaps due to the country’s involvement in World War I, with national energies and finances directed less toward western tourism and more toward the war in Europe.


\textsuperscript{152} Machen, \textit{Homesteading on the Pajarito Plateau}, 9.

\textsuperscript{153} Ibid., 18-19.

\textsuperscript{154} Ibid., 18, 44-49.
Whatever the reason, the Detroit partners sold out to local cattleman Frank Bond in 1918.  

**Spanish Land Grants and Villager Exploitation ("Partido System")**

The lands on the Pajarito Plateau were not immune to the real estate speculation and outright “chicanery” that was common in other areas of the West during the twentieth century. For example, land speculators from out of state bought local property using legal maneuvers made possible by the provisions of the Homestead Act, such as the “in lieu” provision for exchanging federal lands acquired through other, often-fraudulent means for lands opened under the Homestead Act.

Local businessmen also purchased traditional grazing areas in the Jemez Mountains. These former Spanish and Mexican land grants had entered the private domain as a result of land surveying and boundary marking practices born of the U.S. acquisition of territorial lands in New Mexico beginning in the 1840s. Grazing leases issued under the *partido* system and credit assigned through company stores led to the exploitation of local villagers who had ancestral ties to the former land grant areas, often with devastating results during the lean years of the 1930s.

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158 Weigle, ed. *Hispanic Villages of Northern New Mexico*, 213-222.
Historian Hal Rothman describes the *partido* system as a ruthless business practice that was set up to benefit the landowners, noting that “under Bond it amounted to little more than sharecropping.”\(^{159}\) Frank Bond controlled most of the available grazing lands so area shepherders had no alternative but to follow his rules. Rothman explains, “*Partidarios* had little choice. They took his sheep along with their own, and Bond assigned all cost and risk to [them].”\(^{160}\) In addition to leasing sheep from Bond, the shepherders had to buy supplies from his company store, often at prices above the going rate.\(^{161}\)

When the Pajarito Club failed in 1918, Frank Bond of Española, who had leased and later purchased the vast Baca Location ranch in the Jemez Mountains, bought the Ramón Vigil Grant. He planned to use the land grant and ranch facilities as a way station for the cattle and sheep that would be making the seasonal trek from the Española Valley to his high-mountain grazing areas, now part of the Valles Caldera National Preserve (fig. 4.10).\(^{162}\) Frank Bond had previously hired John Davenport as his range manager. Davenport, who was related to Bond, managed the leased Baca Location No. 1 (the Valle Grande area) as early as 1916 or 1917, continuing in that position after Bond purchased the Baca Location in 1919.\(^{163}\) Davenport described the practices of the Bond Company as

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\(^{159}\) Rothman, *On Rims and Ridges*, 128.

\(^{160}\) Ibid., 128-129.

\(^{161}\) Ibid., 129.


\(^{163}\) Rothman, *On Rims and Ridges*, 130.
part of a supplemental study included in the 1934 Tewa Basin Survey report, a Soil Conservation Service survey of the economic and sociological conditions at Hispanic and Native American villages in northern New Mexico during the 1930s:

The two largest sheep interests in the State have different practices in respect to the leasing of lands which they either own or control. The Bond Company makes it a practice to require each of its renters to own a varying number of sheep. An attempt is made to rent to each man a number equivalent to the number personally owned so that the sheep owned by the renter act as a guarantee for the return of the sheep rented to him by the Bond Company. (Statement of John Davenport.)

In an interview on file at the Los Alamos Historical Museum, Ben White recalled how he worked with John Davenport as Bond’s employee on the Baca Location. From 1916 to 1919, White lived on a ranch near the Valle Grande in the Jemez Mountains. He worked with Davenport as a wrangler of sheep and cattle, and remembered collecting grazing dues of one dollar a head from small farmers and ranchers who grazed their livestock on the Baca Location during the summer months:

These ranchers and farmers whose livestock were housed on the Baca came from communities as far away as Espanola, Pena Blanca, and Cuba. During their affiliations with Mr. Bond, credit would be extended for a period of an entire year. One additional enterprise of the Bond headquarters was the leasing of sheep. An example of this would be where a rancher would lease 100 ewes and the following spring return 50 lambs as payment, and in addition, to sell the wool from his total flock to Mr. Bond. He also was aware that in many cases, it was necessary for them to sell additional sheep or cattle as payment for credit extended to them at the Bond store in Espanola.

164 Davenport statement in Weigle, ed. *Hispanic Villages of Northern New Mexico*, 216.
165 Church Collection, "Peggy Pond Church Records and Research Notes," Box 29, Folder 13, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.
166 Ibid.
In 1918, John Davenport started working as range manager at the Bond Company’s newest acquisition, the Ramón Vigil Grant. Local wildlife ranger Homer Pickens recounted in a 1967 lecture that the Ramón Vigil Grant land was used by the Bond Company for their winter range for livestock (fig. 4.11). He stated that John Davenport worked for Bond but also farmed a bit:

They had this for their winter range for their livestock. And sheep camps down here where White Rock is and Pajarito Acres there. They wintered the sheep there. And when moisture conditions weren’t good, they took the sheep off into the river for the water every two or three days. In the winter time they don’t require much water.167

John and his first wife, Agatha Davenport, lived at the Ramón Vigil headquarters in Pajarito Canyon in one of the houses built by previous grant owners. According to researcher Peggy Pond Church, Agatha died on November 4, 1918. Although the cause of death was listed as pneumonia in the *Santa Fe New Mexican*’s article, Church ascribes the disease and Agatha’s death to the flu epidemic of 1918. Church also notes that Agatha was survived by her husband and a fourteen-month-old child. After Agatha’s death, John Davenport and Dick Boyd lived together at the ranch headquarters. Boyd was the son of John and Martha Boyd, who had purchased the nearby Ten Elders Ranch in Frijoles Canyon.168

John Davenport bought the former McDougall Ranch from James and Anna Lewis in 1922. According to Peggy Pond Church, Davenport’s sister George (Georgie)

167 Pickens, "Lecture to the Los Alamos Historical Society," 1 [side 2], Los Alamos Historical Museum Archives, Los Alamos, New Mexico.
168 Church Collection, "Peggy Pond Church Records and Research Notes," Box 27, Folder 3, Los Alamos Historical Museum Archives, Los Alamos, New Mexico; Rothman, *On Rims and Ridges*, 140.
came down with tuberculosis and moved to the Ten Elders Ranch that same year to recuperate. John Davenport and Dick Boyd were still living at the Ramón Vigil Grant headquarters at that time.  

In an interview with Peggy Pond Church and Dorothy Hoard, Homer Pickens mentioned that he stayed with John Davenport at the Ramón Vigil headquarters during the winter of 1930. He recalled that Davenport had built a windmill at the ranch headquarters near one of the old log houses that remained from the Pajarito Club era. The old two-story commissary building and other original ranch buildings were gone by then.  

In the mid 1930s, Frank Bond sold the Ramón Vigil Grant to the Soil Conservation Service, a government reclamation project born of the Depression. The Tewa Basin Survey report includes a discussion of the Ramón Vigil Grant at about the time the land was sold, and the report specifically mentions how the Bond Company had restricted local access the grant, which had traditionally been used for resource gathering: “Since the Bond interests took the grant, the use that the Spanish-American people have made of the Ramon Vigil Grant has been reduced to practically nothing. Prior to that, the Ramon Vigil Grant was becoming the chief source of firewood.”

169 Church Collection, "Peggy Pond Church Records and Research Notes," Box 27, Folder 3; Box 28, Folder 18, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.

170 Homer Pickens, "Interview with Peggy Pond Church and Dorothy Hoard, November 12, 1979," 20, Part I, M1987-1007-1-16, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.

171 Rothman, On Rims and Ridges, 199-200. The grant’s date of purchase by the Soil Conservation Service (or its predecessor agency) is variably given in several sources, either 1934 or 1935.

172 Weigle, ed. Hispanic Villages of Northern New Mexico, 63.
Federal Government in the West (1930s “Dust Bowl” and Depression)

Western patterns of overgrazing and drought conditions during the Dust Bowl era and economic suffering during the Great Depression led to federal intervention in New Mexico by way of national relief programs, such as the Works Progress Administration and the Soil Conservation Service, established under President Franklin D. Roosevelt (fig. 4.12).173

The Soil Conservation Service acquired the Ramón Vigil Grant from Frank Bond so that the land could be removed from active use. In a 1979 interview, Homer Pickens recalled that the Soil Conservation Service wanted to let the land recover from extensive overgrazing, but also allowed limited winter grazing on the grant even after Bond sold the land. When asked whether the Soil Conservation Service took the land from the Bonds, Pickens answered that “times were such that Bond sold it to the Soil Conservation Service and they began then to try to improve it.”174 Historian Hal Rothman describes the condition of the grant during the 1930s:

The grant was in abysmal condition. A half century of commercial use had resulted in overcutting, overgrazing, and poor distribution of animals on the range. Much of the easily erodible soil had washed away, and even immature timber was cut for firewood.175

174 Pickens, “Interview with Peggy Pond Church and Dorothy Hoard,” 4, Part I, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.
175 Rothman, On Rims and Ridges, 200.
Still under the control of the federal government, the Ramón Vigil Grant was transferred to the Forest Service from the Department of Agriculture’s Soil Conservation Service in February of 1939.\textsuperscript{176}

\textbf{Isolation and Research—World War II}

Western isolation coupled with fortress-like landscapes and few inhabitants made the plateau an ideal location for a secret wartime weapons laboratory, desirable also as a disposable and unimportant place in the event that anything went wrong. During the early 1940s, Pajarito Site’s remote canyon location led to its designation as a secure special nuclear-material research facility, a role that would continue long after the end of the Manhattan Project. Pajarito Site, known both as Pajarito Laboratory and as Technical Area (TA) 18, was first developed as a research area during the summer of 1943 by Emilio Segrè’s Radioactivity Group to study the spontaneous fission rates of plutonium, initially using cyclotron-produced plutonium and later using pile-produced samples from Oak Ridge.\textsuperscript{177}

Emilio Segrè spearheaded this early activity at Pajarito Site. He was a leading Los Alamos scientist and had been a protégé of Enrico Fermi in Rome before World War II. The Radioactivity Group used ionization chambers and amplifiers to study samples of plutonium and to determine counting rates from spontaneous fission (fig. 4.13). The instruments used in this work were extremely sensitive. This meant that

\textsuperscript{176} Ibid., 204.
\textsuperscript{177} Hoddeson, \textit{Critical Assembly}, 232-239; Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VI-6, VI-7; Farwell, "Oral history conducted by Lillian Hoddeson," Los Alamos National Laboratory Archives. Note: LANL is divided into discrete geographical areas known as technical areas or TAs.
Segrè and his scientists could not work at the main technical area near Ashley Pond. They sought a place far from ongoing work that might affect their instruments.178 The official *Manhattan District History* includes a reference to the group’s move to Pajarito Site:

“The Pajarito Canyon Field Station was set up several miles from Los Alamos in order to get away from the high radiation background associated with the wartime laboratory, and which would have masked completely the low counting rate from spontaneous fission.”179

Once at the canyon location, the scientists made use of the two remaining buildings located at the former Ramón Vigil Grant headquarters: the Pond Cabin, which was used as an office space; and a second log cabin built by the Forest Service, which was used for experimental work (fig. 4.14). Housed at Pajarito Site, they found the solitude they required. In a 1985 interview, Segrè recalled the isolated wartime laboratory in the canyon: “It was a most poetic place . . . we went there by jeep every day. There was a bed in it, somebody occasionally slept there.”180 The plutonium-chemistry research conducted at Pajarito Site by Segrè and others in his group revealed that plutonium could not be used in a gun-assembled weapon. This discovery led to the abandonment of the Thin Man design in July 1944 (fig. 4.15).181

In the summer of 1944, after Segrè’s team had completed its research, Group G-3 took over Pajarito Site, enlarged it, and used it as a proving ground for the magnetic

180 Segrè, "Oral history conducted by Lillian Hoddeson," Los Alamos National Laboratory Archives.
method of studying implosions. Several firing sites, intended for small- and medium-sized firing activities, were constructed to support the laboratory’s implosion research program. Each of the firing sites consisted of a firing pad and an aboveground bunker reinforced with steel plate, known as a “battleship.” Later in the war, an important full-scale test, the “Creutz” test, was conducted at one of the firing sites, which had been modified to accommodate the special experiment.¹⁸²

Recent research has revealed yet another facet of the Pond Cabin’s history during World War II. While not identified as one of Group G-3’s wartime facilities in standard historical sources, a newly declassified photograph clearly shows that the cabin was being used to support the July 1945 Creutz test and, judging from the presence of other huts located near the cabin, was likely part of a group of support buildings at Pajarito Site that functioned as makeshift sleeping quarters, office spaces, and storage spaces (fig. 4.16). According to a 1945 memo, the cabin was already known as “Mr. Young’s cabin,” having been adopted by Dwight Young for wartime use.¹⁸³

Implosion field-testing was abandoned before the end of 1945, and in April 1946, Pajarito Site became Los Alamos’s main area for critical assembly work. The decision to conduct critical assembly work in the canyon was directly related to Harry Daghlian’s death from radiation exposure at Omega Site in 1945. Critical assemblies were still operated by hand at Pajarito Site until Louis Slotin’s death in May of 1946. Like

¹⁸³ Shank, "Memo to Ed Creutz; Report on Safety and Procurement, Circa 1945," A-84-019, Box 50-34, Los Alamos National Laboratory Archives.
Daghlian, Slotin received a lethal radiation exposure from a critical assembly experiment.\textsuperscript{184}

\textbf{Science, Secrecy, and Security during the Cold War}

The growth of the West’s nuclear industrial complex from 1950s to 1980s, caused, in part, by Los Alamos’s World War II success in atomic weapon development, led to the expansion of Pajarito Site’s facilities and a dramatic change in the landscape of Pajarito Canyon (fig. 4.17).\textsuperscript{185} After Louis Slotin’s fatal accident, which occurred in the south wing of Building 1, all critical assembly operations were halted until safer facilities could be constructed.\textsuperscript{186}

Dwight Young was one of eight laboratory workers involved in the 1946 radiation accident and continued working at Pajarito Site long after World War II was over. From 1946 to 1952, Young resided in the Pond Cabin (fig. 4.18). Known as the “Hermit of Pajarito Canyon,” Young asked for permission to live in the cabin because he typically worked long hours at the site and living at the cabin was more convenient than commuting to the remote facility, especially during the winter months. He grew his own


vegetables in the canyon, and former site workers recalled that the smell of Young’s freshly baked bread often greeted them when they arrived for work in the morning.\textsuperscript{187}

By the time of Dwight Young’s departure, however, the site in Pajarito Canyon was being developed into a modern, high-security facility with concrete buildings, gates, fence lines, and guard posts. The Pajarito Site of the 1950s was no longer a place associated with the simple western lifestyle enjoyed by Young (fig. 4.19). In response to postwar advances in thermonuclear research and the need for new Cold War weapons designs, remote-controlled criticality experiment buildings called “Kivas” were built at Pajarito Site.\textsuperscript{188} Kiva 1 was built in 1947 at the former small firing site located on the west side of Pajarito Site. In order to provide a safe working distance for scientific staff, this new facility was constructed a quarter mile away from the control room in the east wing of Building 1. In 1952, additional workload required the addition of a central office building and a second Kiva building, located in lower Threemile Canyon. A third remotely controlled structure, Kiva 3, was added in 1960.\textsuperscript{189}

Several other science programs were carried out at Pajarito Site during the Cold War in addition to the weapons design work conducted by the Critical Assemblies Group. Established in the 1950s, Project Rover was a national-level program to develop nuclear reactors that could power a rocket in space. The Rover reactors were tested at

\begin{flushleft}
\begin{flushright}
\textsuperscript{188} The Kiva designation was changed to “Casa” in the 1990s because the appropriateness of using a Native American word to name the facilities—especially a term with ceremonial meaning—came into question.
\end{flushright}
\end{flushleft}
Los Alamos at very low power before being disassembled. The units were then shipped to the Nevada Test Site and reassembled at its Jackass Flats facility for final design tests.\textsuperscript{190}

In 1973, the U.S. government discontinued the Rover Program, and work at Pajarito Site was reprioritized. Criticality research at the site was expanded to include a new mission and new facilities supporting the DOE’s criticality safety training program.\textsuperscript{191} Pajarito Site during the final two decades of its active use also played a pivotal role in the development of verification technology for several nuclear treaties (fig. 4.20). Ironically, given its Manhattan Project origins, one of Pajarito Site’s last duties was to provide training for inspectors who worked for the International Atomic Energy Agency, an intergovernmental group whose mission is to verify that countries “use nuclear material and facilities only for peaceful purposes.”\textsuperscript{192}

**Historic Preservation Priorities: Which Story to Tell?**

The end of the Cold War in 1990 led to changes in the national laboratory’s mission and the subsequent closure of Pajarito Site. Reflecting national politics and changes in scientific research priorities at the nation’s weapons laboratories, most of the Cold War infrastructure at Pajarito Site has been demolished, and the preservation of select historic buildings has resulted in a new landscape reminiscent of the way the site


\textsuperscript{191} Los Alamos National Laboratory, *RFI Work Plan for Operable Unit 1093* (Los Alamos, New Mexico: Los Alamos National Laboratory 1993), 2-10, LA-UR-93-422.

looked during the early 1950s (fig. 4.21). In compliance with federal historic-preservation law, several historic properties have been identified for long-term retention at Pajarito Site, including three buildings that were in use during the Manhattan Project: the building where Louis Slotin’s 1946 accident took place; a wartime battleship bunker at a former firing site; and the Pond Cabin.193

Abandoned since Dwight Young’s exodus in 1952 but not forgotten, the cabin underwent a major restoration in the late 1980s. Today, following the closure of Pajarito Site, the Pond Cabin and its rustic wood furnishings receive few visitors (fig. 4.22). Nonetheless, the cabin is a well-known landmark and is listed in the New Mexico Register of Historic Places, primarily for its association with Ashley Pond and local Los Alamos history. The cabin has also been determined eligible for the National Register of Historic Places because of its association with Segrè’s plutonium-chemistry research, and its national standing has been highlighted in recent years, due to press coverage concerning the Manhattan Project National Historical Park legislation.194 The cabin also functions locally as a personal site of memory for the descendants of Ashley Pond, many of whom still live in New Mexico.195 In spite of the complex story of Pajarito Canyon, with visible reminders of its prehistoric and Cold War periods of occupation, the


cabin’s narrative span of more than one hundred years of western history continues to be overshadowed by the story of Emilio Segrè’s brief use of the cabin during the Manhattan Project.

The Pond Cabin, one of the atomic places whose historical significance is currently being debated in the search for public meaning and memory, is among the few remaining buildings left at the former top-secret Pajarito Site. In recent years, the national significance of the Pond Cabin has been associated with its brief use as a support building for Emilio Segrè’s plutonium-chemistry research. At present, however, the cabin stands empty. Most of the Cold War laboratory and office spaces built during Pajarito Site’s heyday have been demolished, leaving weed-choked gravel yards and concrete slabs in their wake. There are rusted “No-Trespassing” signs and daisy-chained locks on the main entrance gate, a stout chain-link fence protects the site from unauthorized visitors.

Pajarito Site is abandoned but not isolated. Listening to this place, there are bird sounds: the low cooing of the mourning dove and the noisy chatter of small winter birds. There are also the sounds of cars, streaming up Pajarito Road, hurrying west through the steep and winding cut in the cliff face to other national laboratory facilities with active missions and offices and meetings to get to on time.

Echoes of the past can also be heard by those attuned to the complex history of this place, for Pajarito Canyon has served as a mute witness to the plateau’s first inhabitants: the early nomadic groups moving across the land in search of game and the later Puebloan peoples living year round in communal, mesa top villages. In prehistoric

times, the plateau was a busy place, well-populated and intensely farmed; Tewa words, voiced by the ancestors of the modern Rio Grande Pueblo people, once echoed in the same canyons and cliffs where scientists worked on the bomb over 400 years later.

After the Pueblo occupation came the Spanish explorers, although no physical evidence has ever been found of their brief excursions into this part of the plateau. Turn-of-the-century cattle barons and lumbermen made their way to Pajarito Canyon once New Mexico territorial status had been achieved, purchasing the land, now platted and bounded as real property, from the descendents of the original Spanish land grant owners.

Like a geological process, layers of human history have been deposited here, and the narratives of this canyon are interwoven with the major American narratives of the nineteenth and twentieth centuries: the arrival of the railroad in the West; the Homestead Act; World War I and the flu of 1918; western tourism and big-game hunting; cattle and sheep ranching and overgrazing; the Dust Bowl; the Great Depression; President Roosevelt’s New Deal reforms and the creation of the Soil Conservation Service; and World War II and the Cold War.

Today, the history of the Pond Cabin and its place in Pajarito Canyon is inextricably bound to the few short years of the Manhattan Project, a national story that eclipses all other histories of Los Alamos. Although the Manhattan Project played a significant part in the story of Pajarito Site, the privileging of a few years of the cabin’s use over its more than one hundred years of western narrative effectively diminishes the cabin, its place, and its rich multilayered history. It is the entire span of the cabin’s history, including the wartime years, that brings relevance to our understanding of the history of New Mexico, the West, and the nation.
Fig. 4.1. The Pajarito Plateau, shown here in an aerial view, is a quintessential western place. Its arid landform of canyons and mesas was created over one million years ago by volcanic events. Its prehistoric populations farmed the area and lived in mesa-top Pueblo villages and cave dwellings, known as cavates (see LANL’s Cultural Resources Management Plan, 2012, for a detailed prehistory of the plateau).

Fig. 4.2. The Pond Cabin is imbued with over one hundred years of western history. It has experienced natural resource exploitation, including timber harvesting, and western cattle and sheep ranching (and overgrazing). It has been used to support western tourism, the federal government’s New Deal programs in the West, the development of the atomic bomb, and the Cold War’s military industrial complex.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)
Fig. 4.3. Pueblo ruins and cavate complexes (circa 1200 to 1500 AD) are located in the Pajarito Canyon area and are a defining landscape feature of the former ranch headquarters site where the Pond Cabin resides. They serve as reminders of the use of the plateau during prehistoric times.

Fig. 4.4. The land was once part of the Ramón Vigil Grant, a Spanish and later Mexican land grant. When Ashley Pond built the cabin in 1914, the land was in the private domain, and specific boundaries had been established through U.S. court proceedings and formalized in court and land office records.
Fig. 4.5. The place of the Pajarito Plateau experienced some of the same patterns of land use as other western places during the early twentieth century. Henry Buckman was an early lessee of the land grant, building the Buckman rail siding and a connecting road system on the plateau to support his lumber operations, circa 1898-1902.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)

Fig. 4.6. Continuing the use of the plateau for resource exploitation, the Ramon Land and Lumber Company owned the Ramón Vigil Grant from 1907 to 1911. The nearby Hawley Sawmill, shown here, represents small-scale lumber operations on the Pajarito Plateau during this period.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)
Fig. 4.7. Ashley Pond built his cabin, far right, as an office and library for the Pajarito Club, 1914-1916. The club’s use of the former Ramón Vigil Grant included the sport hunting of indigenous wildlife, such as mountain lions. The club catered to eastern elites who wanted to experience the myth of the Wild West. (Photograph courtesy of the Los Alamos Historical Society Photo Archives)

Fig. 4.8. Ashley Pond, shown here, would go on to found the Los Alamos Ranch School in what is now downtown Los Alamos. The isolated school, part college preparatory coursework and part outdoor lifestyle, enrolled the sons of wealthy easterners. The ranch school experience was seen as a way to turn boys into men. (Photograph courtesy of the Los Alamos Historical Society Photo Archives)
Fig. 4.9. A rare view of the interior of Ashley Pond’s library and office. The rustic cabin was appointed with a mix of expensive store-bought furnishings and traditional handmade western décor (woven rugs, an animal skin, and a stuffed squirrel).

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)

Fig. 4.10. Speculators and business men originally from out of the region bought up large areas of the West, including areas in northern New Mexico traditionally used by local Hispanic villagers for high-country, seasonal grazing. Sheep are shown here grazing at Frank Bond’s Baca Location (Valles Caldera) ranch, which was formerly part of Spanish and Mexican common land in the Jemez Mountains near the Pajarito Plateau.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)
The Ramón Vigil Grant was an attractive location for cattle and sheep ranching and grazing. The eastern edge of the grant abutted the Rio Grande, and lower elevation lands near the river were used as winter pasture. Local Hispanics could use the privately owned land to graze sheep following the provisions of the “partido system,” which meant that a part of the flock would be given to the landowner each year as payment for use of the land.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)

This July 1940 photo by Russell Lee shows a revetment built by the Soil Conservation Service in Chamisal, New Mexico. The Soil Conservation Service bought the Ramón Vigil Grant land from Frank Bond in 1934 in an attempt to let the land recover from overgrazing.

(Photograph from Library of Congress, U.S. Farm Security Administration, LC-DIG-fsa-8a29150)
Fig. 4.13. Emilio Segrè’s research group chose remote Pajarito Canyon for its important plutonium-chemistry experiments. In general, the Pajarito Plateau’s isolated western landscape and few year-round residents made it an ideal place for the Manhattan Project’s secret wartime laboratory.

Fig. 4.14. Scientists working for Segrè used a U.S. Forest Service cabin for their delicate experiments. The cabin was built at the site after the Soil Conservation Service transferred the land to the Forest Service in the late 1930s. The nearby Pond Cabin was used as an office and a place to sleep.
Fig. 4.15. Emilio Segrè’s group, shown here, was a diverse team of scientists and technicians. Small teams like this one worked at various laboratory and testing areas and made use of existing ranching- and homestead-era infrastructure whenever possible.

Fig. 4.16. After Segrè’s plutonium-chemistry research was completed, Pajarito Canyon was reused as a firing site for implosion research. Preparations for the July 1945 Creutz test are shown in the foreground; the Pond Cabin and other wartime support buildings are shown at the top of the image.
Fig. 4.17. Pajarito Site, shown in this circa 1950 aerial view, was developed after the war as an Atomic Energy Commission facility for remotely conducted criticality experiments in support of the Cold War’s new arsenal of nuclear weapons.

Fig. 4.18. Manhattan Project and Cold War scientist Dwight Young, the “Hermit of Pajarito Site,” lived in the Pond Cabin from 1946–1952. He was also a survivor of the 1946 Louis Slotin criticality accident.
Fig. 4.19. Additional laboratory infrastructure was added to Pajarito Site to support Cold War growth at Los Alamos. The criticality research facility, now known as TA-18, is shown here in a 1960s panoramic view.

Fig. 4.20. By 1991, TA-18 had reached its ultimate state of development. The site included three remotely controlled Casa buildings, formerly known as Kivas, which were each located at a safe distance from the main complex of buildings. By this time, the Pond Cabin, although abandoned for years, had been identified for long-term preservation as a historic property.
Fig. 4.21. DOE mission changes brought about by the end of the Cold War and the ban on testing nuclear weapons resulted in the shutdown of Pajarito Site as an active LANL technical area. Demolition of all but the most historic buildings was carried out; the site’s landscape is now reminiscent of the way the area looked during the early 1950s.

Fig. 4.22. The Pond Cabin, shown here in 2014, has been identified in the Manhattan Project National Historical Park legislation, signed into law in December of 2014. Pajarito Site’s new mission will now be one of public interpretation as part of the new park. The canyon’s history spans from prehistoric times through the end of the Cold War.
CHAPTER 5

GUN SITE AND THE ROLE OF THE NAVY IN THE DEVELOPMENT OF LITTLE BOY

If atomic bombs are to be added as new weapons to the arsenals of a warring world, or to the arsenals of nations preparing for war, then the time will come when mankind will curse the names of Los Alamos and of Hiroshima.

J. Robert Oppenheimer, October 16, 1945, Robert Oppenheimer: Letters and Recollections

Anchor Ranch Proving Ground, established in 1943, was one of the first Los Alamos technical areas developed for the design and testing of actual nuclear weapon prototypes. Here, from 1943 until 1945, scientists, engineers, and ordnance specialists carried out the repeated test firing of special naval guns that eventually led to the production of the combat unit known as Little Boy, detonated over the Japanese city of Hiroshima on August 6, 1945 (fig. 5.1). Associated first and foremost with the wartime use of atomic weapons against the people of Japan, this contested birthplace of Little Boy has other stories to tell. An examination of the architecture, landscape, and historical context of the proving ground reveals hidden histories that have been shrouded in controversy and obscured by government secrecy practices, including the little-known roles of the U.S. Navy, private industry, and universities in the development of the Little Boy weapon.

Today, some of the original Anchor Ranch Proving Ground facilities still remain. Several small earth-covered bunkers or “bomb proofs,” to use the proper ordnance term,

197 Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See specifically TA-8 records and drawings.
are located just west of Anchor Ranch Road in the heart of the present-day national laboratory. The proving ground’s two former gun emplacements are in ruins; traces of the gun mount locations and target areas exist in the field area located just south of the sheltered concrete buildings. The site is now known as Gun Site, a reference to its World War II origins and role in the development of the gun-assembled bomb.

The primary narrative of the Little Boy weapon centers on its deployment against the people of Japan, and Gun Site, as Little Boy’s birthplace, is inextricably linked to this event. Not only did Little Boy shock the world with its tremendous destructive power, it was also the first of a new type of weapon that generated lethal doses of radiation. For many, Gun Site will function as a site of memory; like one of Pierre Nora’s lieux de mémoire, it will speak directly to the public dialogue surrounding the events and aftermath of August 6, acknowledged each year as “Hiroshima Day.” However, to focus solely on the metanarrative of atomic controversy would unfairly reduce Gun Site’s interpretive story to a caricature, obscuring all other stories of place, including worker experiences and narratives of technical and scientific challenges. Many unheralded people and institutions located far from the mountains of northern New Mexico supported the manufacture and delivery of the Little Boy weapon, and this national story of wartime effort and exigency are often missing in the details of the Manhattan Project.

The memory and meanings of historical events can be lost in other ways besides being overshadowed by controversy. Unknown to many, the Navy, not the Army, was the key player in the development of the bomb dropped on Hiroshima.198 In addition to being

198 The argument that the Navy’s role during the Manhattan Project has been underrepresented in historical accounts is an oft-repeated theme in Al Christman’s biography of Navy captain William “Deak” Parsons: Al Christman, Target Hiroshima: Deak Parsons and the Creation of the Atomic
eclipsed by the events that brought World War II to a close, the central role of the Navy in the development of Little Boy, along with contributions by key naval facilities and personnel, has largely been obscured by government-mandated wartime and postwar secrecy that has limited access to Manhattan Project documents and has led to a loss of historical narrative.\textsuperscript{199} Social anthropologist Paul Connerton, exploring concepts of memory and forgetting in his book, \textit{How Societies Remember}, writes about the loss of national consciousness through purposeful acts of a central government or other entities of power:

\begin{quote}
A particularly extreme case of such intervention occurs when a state apparatus is used in a systematic way to deprive its citizens of their memory. . . . When a large power wants to deprive a small country of its national consciousness it uses the method of organised forgetting.\textsuperscript{200}
\end{quote}

The government control of historical information related to the top-secret Manhattan Project is not the deliberate act of organized forgetting that Connerton cites in his book, but the control of atomic secrets has resulted in an erasure of public memory that has effectively concealed the story of the Navy in the development of Little Boy and the contributions of other organizations that have been, up until now, effectively hidden in closed government archives.

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\textit{Bomb} (Annapolis, Maryland: Naval Institute Press, 1998). Christman documents Parsons’s contributions and portrays him as an unsung hero of the war.

\textsuperscript{199} Christman, in \textit{Target Hiroshima}, specifically mentions on pages 205 and 206 how the Smyth report’s lack of information related to weaponization efforts effectively obscured the story of Parsons’s ordnance work and the Navy’s contributions. The Smyth report was issued in 1945 and was the first unclassified document that detailed the history of the secret Manhattan Project. See Smyth, \textit{Atomic Energy for Military Purposes}.

Designing the Gun—1943

When research on an atomic bomb began at Los Alamos in the spring of 1943, the physicists whom Oppenheimer had recruited were optimistic that they could design and develop a military weapon, a gun-assembled bomb based on what was already known by military ordnance experts.201 Top Los Alamos scientists, such as Robert Serber, who summarized the known concepts of gun assembly in his April 1943 primer lecture, understood that the gun method was the most promising short-term design for assembling fissile material and producing a critical reaction.202

From the very beginning of the Los Alamos effort, project organizers knew that U.S. Navy ordnance experts would be essential to the design of the gun-assembled device. Originally, two guns were envisioned, one using uranium as the fissile material (the Little Boy design) and the other using plutonium (the Thin Man design). However, the details of ordnance theory, not to mention the specific design requirements for the special Project Y guns, were unfamiliar territory for most of the scientists. The researchers faced formidable challenges. To begin with, standard ordnance guns could not simply be adapted for use, so the guns would have to be designed from scratch. Further, no one had yet tried to create an explosion using pieces of subcritical fissionable material, and extensive testing of experimental designs would be necessary.203

Laboratory director J. Robert Oppenheimer was keenly aware of the need to work with ordnance experts to aid in the design of the gun-assembled weapons. He and

Richard Tolman, scientific advisor to General Groves and member of the National Defense Research Committee (NDRC), began developing a gun program as early as March 15, 1943. At the following month’s Los Alamos primer conference, Oppenheimer outlined how the primary scientific challenge would be developing a gun weapon to assemble plutonium. Once that problem could be solved, the follow-on development of a uranium gun-assembled weapon would be relatively easy to accomplish.

Early in the research and development process, Oppenheimer decided that gun firing experiments should be conducted at Los Alamos in order to test the special projectiles that would eventually be manufactured out of sub-critical configurations of fissile uranium and plutonium. Scientists working on the specific assembly details of the gun weapon would need to work with ordnance design experts during the initial phases of the project. They would also need to work side by side with ordnance engineers and technicians at the proving ground area where the experimental guns would be fired. For these reasons, Oppenheimer selected Edwin McMillan, Charles Critchfield, and Robert Cornog, physicists with applied science or engineering experience, to work on gun design and testing with the recruited ordnance men, many of whom came to Project Y from nonacademic backgrounds. Cornog, especially, was a boon to the project, for he had

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204 Hoddeson, *Critical Assembly*, 81.
205 Ibid., 76, 82-83.
research experience with 20-mm guns. Critchfield, as well, had worked with military guns and had experience with sabot configurations.207

Civilian Contractors and Government Laboratories

Outside contractors and government laboratories with previous experience developing conventional guns were critically important because their facilities could be used to manufacture and test various gun components in support of the Manhattan Project’s design process. Civilian weapons experts and private machine companies with long-standing wartime military contracts, some going back to the Civil War, were integral to the design and manufacture of the experimental guns used in the development of gun-assembled bomb.208 Richard Tolman recruited Edwin L. (E. L.) Rose of the Jones and Lamson Machine Company, Springfield, Vermont, as early as March 1943, quickly identifying his importance to Project Y (fig. 5.2). Writing to Oppenheimer, Tolman indicated that gun designers, such as Rose and Dr. L. T. E. “Tommy” Thompson of the Lukas-Harold Corporation Naval Ordnance Plant in Indianapolis, needed to be brought in right at the beginning to work with scientists who were starting to think about the physical requirements of the gun’s scientific components, size, weight, construction materials—the very scientists who would need these theoretical properties translated into design specifications that could be manufactured and then tested.209


Tolman also identified other key scientific institutions to support the initial phases of gun design. Charles Critchfield was asked to come to Los Alamos from the National Bureau of Standards. Working with Rose, he helped define an important design variable, that of the actual weight of the gun. Standard military guns were designed for repeated firings and were heavy due to their robust construction. E. L. Rose proposed using less steel in the Los Alamos designs because the gun tubes only had to withstand the stress of initial firing. The internal gun mechanism used in the final combat version of the weapons just needed to be fired once in order to assemble the subcritical components and detonate the weapon. The formerly secret Manhattan District History notes, “Rose showed that by the sacrifice of durability, a quite inessential property, the otherwise prohibitive size and weight of a large gun could be reduced to a point where, together with the target, it could be included in a practical bomb.”

Rose, Tolman, and other members of the initial gun design group focused on additional design criteria that had to be established during the first months of ordnance work, from the physical materials used in the guns and gun-barrel design specifications to more theoretical goals related to ballistics and ultimate firing performance, including projectile behavior both inside and outside the barrel. Speed and trajectory issues as well as construction standards were of utmost importance. In order to prevent predetonation during the plutonium assembly process, speeds of close to 3,000 feet per second were desired, a hypervelocity rate at the high end of what conventional guns could achieve using existing 1943 technology. The wartime history account of Project Y

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211 Hoddeson, Critical Assembly, 82-83.
noted that chemical purity and speed of assembly for the uranium gun-assembled design
“were attainable by known methods.” For the plutonium gun weapon, however, “the
requirements for purity and speed were both somewhat beyond the established range.”
The project organizers were optimistic, however, that “by rather heroic means they could
be met.”

**The NDRC, OSRD, and Universities**

The Manhattan Project is often held up as an example of what America can
accomplish through a singularly focused effort. However, this seemingly rapid
achievement was actually predicated on work conducted by military and civilian
scientists in the 1930s and early 1940s, including developments in electronics, radar,
aircraft design, and high-explosives research as well as advances in conventional
weapons designs and targeting instrumentation. In addition, without the preliminary work
conducted by universities and private companies under wartime contracts with the OSRD
and the organizational structure of government-supported science during the years before
the formal establishment of the Manhattan Project, many of the technological
achievement that came together at war’s end would not have been possible.

Relatively unknown today but vital to the war effort, several scientists with
previous experience in gun design and testing were recruited to work for Project Y, either

212 Manhattan Engineer District, "Book VIII, Volume 2 - Technical," I-17; Burchard, ed., *Rockets,
Guns and Targets*, 350.

213 The NDRC was formed in June 1940 from a previous committee given the task of researching the
properties of uranium (the Uranium Committee). The NDRC was a government body that,
through research contracts, also supported conventional wartime advancements in radar,
proximity fuses, rocketry, and anti-submarine warfare. In 1941, a new research organization, the
OSRD, was formed to focus on wartime science including atomic weapon research. The OSRD
was headed by Vannevar Bush who reported to President Roosevelt. The NDRC, headed by
James B. Conant, became an advisory group that made research recommendations. See Gosling,
The Manhattan Project, 6-9.
brought to Los Alamos directly or asked to support the gun research under contract with the OSRD. Joseph Hirschfelder, a ballistic expert and Tolman recruit, was working for the NDRC on the science of internal gun ballistics before coming to Los Alamos. His understanding of the physics of gun firing was invaluable to the success of the gun-assembled method. Los Alamos scientist Robert Brode was responsible for identifying the best methods for detonating the gun weapons using a multi-approach, fail-safe fusing system. Brode worked with the University of Michigan and Norden Laboratories under Section T OSRD contracts to develop the use of electronic designs as detonating methods.214

Other scientists not based in Los Alamos during the war were also recruited to support the development of the gun-assembled weapon, using their own institutions’ test ranges and laboratory facilities. These unsung contributors to the Manhattan Project included university physicists who had already been working on military contracts through the OSRD since the early 1940s. Among them was Everly Jack (E. J.) Workman of the University of New Mexico (UNM), who had wartime contracts related to proximity fuse research and hypervelocity gun design.215

Workman was the head of the UNM physics department during World War II. As early as 1941, UNM started working on OSRD military contracts, primarily through the university’s Research and Development Division founded by Workman and fellow UNM physicist Robert Holzer (fig. 5.3).216

One of UNM’s first OSRD projects involved work related to the design of the proximity fuse. As developed for use during World War II, the proximity fuse was a vast improvement over existing fusing systems in which bombs exploded on impact or were detonated with time-delay fuses. The proximity fuse that Workman’s New Mexico group and other institutions were developing determined distance to the target through the use of radio waves. Much of UNM’s work involved testing proximity fuse prototypes in the desert near Albuquerque, a test range that would later be used to support work on high-speed guns. According to historian Joe Chew, Workman’s testing area was quite unique:

For a time, the tallest wooden towers in the world stood on the desert between Albuquerque and the Sandia Mountains. Workman and his crew suspended airplanes between the two towers to serve as targets for proximity-fused shells.

While Workman’s group’s contributions to proximity fuse research led to wartime improvements in conventional weaponry, the group’s other OSRD research projects had direct connections to early design work for the gun-assembled Thin Man prototype and also to later Project Y endeavors, such as the Trinity Test, the delivery of Fat Man units to Tinian, and the deployment of the weapons against Japan. For example, E. J. Workman and his team had a Navy OSRD contract to test prototype hypervelocity guns

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Workman’s Trinity support, Fat Man delivery assistance, and B-29 study will be discussed in greater detail in chaps. 8 and 9.
to be used as antitank weapons. This same technology was sought by Project Y scientists, who needed high-velocity assembly speeds in the plutonium gun-assembled weapon, the ultimately unusable Thin Man design. Workman, working with another OSRD physicist, also studied the flight characteristics of the B-29 bomber to make specific recommendations for the combat planes that would be used for the Manhattan Project flight missions against Japan.

Many of E. J. Workman’s wartime projects were secret, but several Manhattan Project historical accounts do acknowledge the UNM Physics Department’s support of Project Y, for Workman’s UNM address was often used as a decoy mail drop for correspondence and scientific equipment, both large and small, which would be secretly redirected to Los Alamos. Information was also sent from Los Alamos to Albuquerque, and Project Y motor-pool drivers functioned as special couriers for these clandestine trips off the Hill. Mary Lehman, a member of the Women’s Army Corps (WAC), occasionally worked as a messenger, delivering secret dispatches at UNM when she was in Albuquerque:


222 Chew, *Storms above the Desert*, 10; Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-4; Hoddeson, *Critical Assembly*, 66; Captain W. S. Parsons, "Memorandum to All Ordnance Leaders and Dana Mitchell; Attention: All Secretaries; Subject: Negotiations with Certain Outside Activities to Obtain Engineering Assistance, Information, and Material, May 19, 1944," A-84-019, Box-6-4, Los Alamos National Laboratory Archives.
I would take an envelope down to the university in Albuquerque. I’d have to park on a certain street, a certain way and get out and lean against a certain part of the car and wait for somebody to come down the way, dressed a certain way and they would do certain things and then I would hand them the envelope or I would pick up the same way. . . . I never knew what was in them, I had no idea. But, something to do with their work, they were affiliated with the Albuquerque university.223

UNM’s wartime work is not common knowledge today, lost in the archives and hidden by security classification markings. However, E. J. Workman and fellow UNM scientist John Reinhart were publicly acknowledged in 1947 for their contributions to the war effort by General Omar Bradley.224 Buoyed by postwar contracts, Workman’s group prospered after the end of the World War II. The UNM research division continued to support military research in applied physics, but after a falling out with a new UNM president in 1946, Workman took much of his group and equipment, left the university, and went to the New Mexico School of Mines at Socorro. As its new president, he transformed the school into what is now present-day New Mexico Institute of Mining and Technology.225

Although OSRD research conducted by civilian contractors and university scientists like UNM’s Workman prior to the Manhattan Project effectively sped up the successful design of the gun-assembled weapon, the Navy’s leadership and its vast contributions, beginning with the designs of the first prototype guns used at the Anchor


224 According to Chew, the public ceremony occurred in Los Alamos on June 23, 1947. This was noted in Storms above the Desert on page 12, but no reference was given.

225 Chew, Storms above the Desert, 13.
Ranch Proving Ground, were responsible for the development and weaponization of Little Boy.

**Navy Involvement**

In historical hindsight, bringing Deak Parsons into the project during its earliest stages should be acknowledged as one of the key actions that led directly to the success of the Manhattan Project. This was a crucial turning point in the development of what would eventually be the Little Boy combat unit, for Parsons was to become the embodiment of naval involvement in the development of the gun-assembled weapon, its delivery to the Pacific, and its use against Japan. A master organizer, U.S. Navy officer, ordnance expert, and scientist in his own right, Captain William “Deak” Parsons was unquestionably one of the most valuable leaders of Project Y (fig. 5.4).226

In May 1943, Parsons, then stationed at Dahlgren Naval Proving Ground, was asked by General Groves to head the Ordnance Division and direct the work of naval gun specialists and civilian naval ordnance contractors on the design, testing, and manufacture of the gun-assembled weapon.227

In addition to the expertise that he personally brought to the Los Alamos project, Parsons, through his naval connections and wartime conventional weapons development work, recruited many members of the Los Alamos scientific and engineering staff, including several with U.S. Navy affiliations, such as Commander Frederick “Dick”

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226 See *Target Hiroshima* by Al Christman for an excellent biography of William “Deak” Parsons.
Ashworth and naval reserve lieutenant Norris Bradbury, who were to make significant contributions to the success of Project Y and to postwar Los Alamos.228

Reminiscing about the wartime years, Vice Admiral John “Chick” Hayward affirmed the important role the Navy played at Los Alamos: “In fact, rarely noted except by Groves, the key military players at Los Alamos all were naval officers. Beyond our little clan, the ‘gadgets’ were cloaked in secrecy—and confusion.”229 In Target Hiroshima, Christman also mentions Parsons’s recruitment of naval officers, noting that “Groves twitted Parsons about having a Navy bias in filling key positions. Although there was some truth to that, the main reason Parsons chose naval officers was that he had access to them through Admirals King, Purnell, Blandy, and George Hussey.”230 Christman attributes Parsons’s methods to the fact that he had no similar connections or influence that would allow the recruitment of army officers with technical or scientific credentials.231

Ashworth, boasting an academic background in physics, was an indispensable assistant to Parsons. Norris Bradbury, who would go on to play a vital role in the history of the Los Alamos laboratory as its postwar director, was recruited by Parsons in 1944 (fig. 5.5). Bradbury brought the much-needed combination of academic prowess and naval organization and direction to Project Y, having also worked on wartime science at

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229 Hayward and Borklund, Bluejacket Admiral, 132.
230 Christman, Target Hiroshima, 153-154.
231 Ibid., 154.
the Naval Research Laboratory prior to joining the Manhattan Project.\textsuperscript{232} Not just a liaison with naval officers and OSRD officials, Parsons readily worked with Project Y scientists and enlisted U.S. Navy personnel alike, sometimes relying on naval ordnance technicians, such as Thomas Olmstead, to keep the project’s scientists on task and on deadline during large-gun firing tests at Anchor Ranch Proving Ground.\textsuperscript{233}

Parsons, with his innate organizational ability and applied-science background, would take the lead on transitioning scientific theory from the blackboard to the bomb bay.\textsuperscript{234} According to Chick Hayward, Parsons’s practical approach gained him the support and approval of General Groves: “And the driver behind it all was, once again, Deak Parsons. He was the practical link to the theoretical scientists. He insisted that the end result had to be hardware. Otherwise, he said, anything they did was pointless. His impact on them was why Groves loved him.”\textsuperscript{235} Parsons was truly the point man who drove the engineering feats at Los Alamos.

Because of his previous connections with the Navy’s Bureau of Ordnance (BuOrd), Parsons was the logical Los Alamos point of contact for the design and manufacture of experimental guns. In fact, one of the civilian gun designers, Dr. L. T. E. Thompson, had worked with Parsons at the Naval Proving Ground as its technical director before Parsons left for Los Alamos.\textsuperscript{236} Parsons was also familiar with

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\textsuperscript{232} Hayward and Borklund, \textit{Bluejacket Admiral}, 120.
\textsuperscript{234} Hayward and Borklund, \textit{Bluejacket Admiral}, 132.
\textsuperscript{235} Ibid.
\textsuperscript{236} Burchard, ed., \textit{Rockets, Guns and Targets}, 19; Hayward and Borklund, \textit{Bluejacket Admiral}, 116.
\end{flushright}
E. J. Workman’s research at the UNM’s test range because of Workman’s earlier role in the Navy’s proximity fuse project.\textsuperscript{237}

BuOrd connections would also come to play with Parsons’s selection of George Chadwick as Project Y’s first lead gun engineer. Chadwick, who had been the BuOrd’s head engineer for many years, facilitated the production of the project’s first guns, which were built at the Navy Gun Factory in Washington, D.C. While still on the East Coast, Chadwick also worked with Project Y staff to design Los Alamos’s new proving ground. In late summer 1943, Chadwick decided not to come to Los Alamos after all but continued his work by setting up a separate gun design and fabrication office under contract with the University of Michigan. This facility was located in Detroit, Michigan, to draw on the city’s pool of machinists and technical workers and would later become known as the “Detroit Office” in the Manhattan Project’s coded correspondence.\textsuperscript{238}

Gun parts, including target and projectile assemblies were also manufactured in a Los Alamos machine shop. When quality issues arose over the locally made, small-scale assemblies needed to conduct the 20-mm gun tests, Deak Parsons stepped in and designated staff to work directly with shop personnel to ensure that the laboratory’s most important wartime work, that of designing the first atomic weapon, was appropriately prioritized.\textsuperscript{239}

\textsuperscript{237} Christman, \textit{Target Hiroshima}, 165.
\textsuperscript{239} Hoddeson, \textit{Critical Assembly}, 119.
Standard Navy Proving Ground Design: The Dahlgren Connection

Anchor Ranch Proving Ground

When Deak Parsons formally joined the Ordnance Engineering Division as its leader in June of 1943, he appointed key scientists to head the division’s groups. These were organized by the various tasks that would be crucial to developing a gun-assembled weapon—groups focusing on the development of instrumentation, fuses, and projectile components. According to the official Manhattan District History, “the seriousness of the problem of getting these fantastic guns made and proved called for a great expansion of personnel, facilities and liaison in the Ordnance Division.”240 Parsons’s first action as division leader was establishing the facilities needed to design, manufacture, and test experimental gun parts, including the development of a firing range, one of the earliest remote technical areas built to support Project Y. He selected Edwin M. McMillan to lead the effort to select the location for the range and oversee the construction of the proving ground infrastructure (fig. 5.6).241

Planned by McMillan with critical design input from U.S. Navy ordnance and gun-design experts such as George Chadwick, the proving ground’s layout was based on standard naval proving ground facilities in use during World War II. McMillan’s proving ground eventually became known as Anchor Ranch Proving Ground, Anchor Ranch West, or simply Gun Site.242

Many of Project Y’s field laboratories and firing sites were constructed several miles away from Los Alamos’s Main Technical Area to protect the civilian residents of the town from hazardous experiments involving high explosives and radioactive materials. The new proving ground was built on a small portion of the 322-acre Anchor Ranch, a year-round ranching operation acquired by the U.S. government for use by Project Y. The Anchor Ranch property, located south of the townsit area, included a variety of ranch houses and outbuildings, including an ice house, a main house and yard, a barn, and bunk houses.\(^{243}\) In fact, the selection of the Anchor Ranch area for the development of a remote ordnance proving ground was most certainly influenced by the presence of serviceable buildings and existing infrastructure like telephone lines and a water supply (figs 5.7 and 5.8).\(^{244}\)

**Early Facility Construction and Edwin McMillan**

In taking an early leadership role in the development of initial laboratory infrastructure and the hiring of project staff, Edwin McMillan was a logical choice to oversee the development of the new Anchor Ranch Proving Ground facilities.\(^{245}\) McMillan, working with Oppenheimer and others, helped identify the key technical details that had to be planned into the designs of the first Project Y laboratory spaces, turning the initial concepts into reality with the help of New Mexico-based architect W. C. Kruger and aided by the M. M. Sundt Company, primary construction contractor

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\(^{244}\) Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See TA-8 records and drawings.

for many of the Main Tech Area buildings and early housing areas. McMillan recalled working at Los Alamos during the first months of the project: “Later in 1942 and early in 1943 many things went on, not only the site and research planning, but ordering equipment. I remember writing out orders for machine tools to set up a large shop, something I really didn’t know much about.”246 Partnering again with Kruger and Sundt for the design and construction of the proving ground, McMillan turned to naval ordnance experts with ties to Dahlgren’s Naval Proving Ground for technical input regarding the specific layout and facilities needed at the Anchor Ranch site.247

**Dahlgren’s Influence**

The Naval Proving Ground facilities at Dahlgren, Virginia, exemplified the standard gun proving ground architecture in use during the war. Large-bore guns, many built at the Navy Gun Factory in Washington, D.C., needed to be test fired or “proved” prior to use by the military. Typical gun-test control buildings included reinforced-concrete bunkers, which could be freestanding but were often partially earth-covered or built into the natural terrain to afford additional protection during shots. At Dahlgren, gun tests were conducted at formal gun emplacements in front of bunkered areas; test shots were often fired over the nearby Potomac River, in a section of water with restricted access (fig. 5.9). The guns were mounted on various types of steel gun plates, some rounded and some rectangular, that were in turn bolted to concrete pads. The wartime gun test range at Dahlgren spanned close to a mile of shoreline and included massive catcher boxes constructed of concrete for tests that involved the recovery of spent projectiles.

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246 Ibid., 15-16.

Tests were observed remotely from the safety of the bunkerized buildings, and ships’ periscopes were occasionally used to view the shots.  

George Chadwick brought an invaluable contribution to the project through his experience designing and testing guns for the Navy, lending his knowledge of Dahlgren’s proving-ground layout to the design of Project Y’s new test range, which, according to the project’s official wartime history, was constructed “along more or less established lines.” This was the type of practical, applied knowledge that Oppenheimer desired, having recognized early on that the gun-assembled weapon would need to draw upon more than just theoretical concepts alone to be a success. Other Navy influences can be seen in the some of the new proving ground’s staffing choices. Thomas Olmstead worked at the Anchor Ranch facility, having come to the project as a naval ordnance technician with direct knowledge of the working and firing of naval guns. As noted in *Critical Assembly*, Olmstead was respected by Project scientists even though he was just a technical worker:

One of the most important additions to test-site personnel was Naval Ordnance Technician Thomas Olmstead, the only one there with experience in loading and firing large-bore cannon. Robert Wilson recalls Olmstead as “a colorful person . . . a member of the Black Powder Society . . . someone who thrilled me in conversation, a regular guy in an irregular way.” Critchfield recalled recently that Olmstead was the only person with enough sense to plug his ears prior to a shot.

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248 Observations from research visit to Dahlgren, Virginia, in February 2015.
251 Hoddeson, *Critical Assembly*, 117.
Specific Design Elements: the Landscape of Gun Site

The Anchor Ranch Proving Ground included standard military ordnance facilities, which would have seemed familiar to the naval ordnance workers at the site. However, the new proving ground was certainly a unique feature on the Los Alamos landscape, and understanding the layout and function of Gun Site is critical to its future interpretation as a special place of memory, one which will represent the importance of naval ordnance technology and other themes of safety and security during the Manhattan Project.

Completed in 1943, three concrete “bombproof” buildings were built into a ravine and were designed to be partially underground. Placing the buildings lower in the ravine allowed for gun emplacements to be positioned above the roof level of the control building (fig. 5.10). This novel proving ground layout lessened the hazards associated with firing the high-alloy tubes in free recoil. The facility eventually grew to include several small square, pyramid-roofed support buildings known as hutments, a guard tower, and a rectangular storage building, located on the slight rise located north and above the concrete bunkers.252

Two gun emplacements were located above the bunkers in a field area to the south that had been cleared of vegetation. Each gun emplacement included a wooden shed or garage-like building, which was mounted on rails (fig. 5.11). The wheeled buildings, with openings on their western ends, could be moved away from the guns

252 Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-8; Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. Note: many of the drawings and photographs referenced in this section were compiled in a LANL compliance report written to support a restoration project at Gun Site. See Kristen Honig, Crocker & Associates, Ken Towery, John Ronquillo, Kari Garcia, and Ellen McGehee, Historic Preservation Assessment and Recommendation Report for the Gun Site Restoration Project (Los Alamos, New Mexico: Los Alamos National Laboratory, August 7, 2008), LA-UR-08-05177.
during shots, and, then, using a truck to tow them forward or alternately using a hand-crank system, the buildings could be moved to cover the guns. This arrangement protected the guns from the elements and also kept away from view when not in use.253

Each gun emplacement had at least one catcher box and a poured concrete slab with heavy duty bolts to hold the steel gun plates. Catcher boxes, constructed of wooden timbers and filled with either sand or sawdust, were essentially target areas and firing-stops all in one (fig. 5.12). If everything went well during a shot, the catcher boxes served as the ultimate collection areas for the experimental projectiles; once recovered, the projectiles would be sectioned and their interior components evaluated against ordnance performance criteria.254 The data collected during the tests provided information about how well the projectiles held up after having been subjected to the heat and pressure of firing and the shock of impact.


The catcher boxes were located in close proximity to the guns because target distances were meant to approximate the length of the finished weapons. In both the Thin Man and Little Boy designs, the projectile only had to travel the short distance from the firing end of the weapon to the target case at the unit’s opposite end.\textsuperscript{255}

Anchor Ranch Proving Ground’s gun emplacement area was accessed from the north-south running Anchor Ranch Road by several tributary roads, one of which led directly from the front of the bunkered control building to the gun emplacements above. This roadway was closed during test shots and a wig-wag gate located just west of the main control building was used as a safety measure to control access.\textsuperscript{256}

Gun firing tests were observed from a wooden periscope tower that had been built against the front face of the main control bunker. The clearing of vegetation near the gun emplacements served several purposes: it limited the risk of a fire starting from gun misfires, which scattered shrapnel as far as seventy feet away, and also gave those observing the tests from the safety of the bunker a clear view to the gun emplacements unencumbered by pine trees and other tall vegetation. Sirens announcing the upcoming firing tests and sirens sounding the all clear provided an overarching backdrop to the proving-ground operations. In retrospect, the entire layout of the proving ground was


\textsuperscript{256} Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center; Los Alamos National Laboratory, "Photographic Collections," Los Alamos National Laboratory Archives and Records Center. See specifically TA-8 photos, records, and drawings.
functionally determined, driven by the all-encompassing need for Project Y staff to view the hundreds of test shots in safety.\textsuperscript{257}

The concrete bomb proofs themselves were built to withstand the shock of the repeated firing of the naval guns. Following standard U.S. Navy ordnance design criteria in spite of the temporary architectural specifications of most of the Los Alamos wartime construction, the massive bunkered buildings were designed with quality materials and built to last, employing the highest standard of reinforced, cast-in place, board-formed concrete construction, with most support walls and the roof at least two-feet thick. Being built partially underground meant that the buildings’ roofs had to be robust enough to support several feet of earth cover, which was held back in some places with retaining walls and a high parapet at the roof edges.\textsuperscript{258}

Designated as Building 1a when first built, the central bunker building was used as a laboratory and shop during the war. Here, at the heart of the proving ground facility, scientists, technicians, shop workers, and naval ordnance specialists worked together to ultimately complete the final design and assembly preparations for Little Boy. The main bomb proof, much larger that its two support bunkers, extended slightly more than twenty feet into the hill slope. A hub of activity, the building not only contained the control room, from which the shots were remotely detonated and observed and where scientific instrumentation was housed, it also had a large shop space for assembling test components and for fitting key parts into Little Boy combat unit casings, which would

\textsuperscript{257} McMillan, "Early Days at Los Alamos," 18.

\textsuperscript{258} Ibid., 17-18; Edwin M. McMillan, "Anchor Ranch Range - Ballistic Report Index No. 1 (September 17, 1943 to February 24, 1944), n.d.," A-84-019, Box 46-27, Los Alamos National Laboratory Archives; Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See TA-8 records and drawings.

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eventually be delivered, along with some of the internal parts tested at the proving ground or manufactured elsewhere at Los Alamos, to Tinian Island in the Pacific. A roll-up, garage-type door served as the main entry into the shop room, which had sound-proofed walls, likely built to protect the sensitive instrumentation located in the adjacent control room.259

The tall periscope tower—twice the height of the building—loomed over the bunker complex (fig. 5.13). Used primarily as an observation post to view the tests from afar and to ensure that personnel were not near the emplacements during the firing tests, the structure was designed with rudimentary periscope technology: like a child’s milk carton view finder, the tower’s interior shaft was made light-tight and painted black, and a rectangular window the size of the shaft opening was built into the front wall of the control room allowing a forward-facing view into the tower’s periscope viewing mirrors, which were adjusted to view the emplacements that were above and behind the building. Interior stairs located at the base of the wooden tower led to the periscope’s crow’s nest, which could also be accessed from the earthen-covered roof of the main control bunker. Several detonation systems were incorporated into the facility’s design to allow for safe firing once everyone was in the bunkers.260

A paved walkway extended from the bunker to the gun emplacements, and a system of buried cables also extended from the main bunker to the field area to simultaneously trigger the guns, any associated armored high speed cameras, such as


microflash, Fastax, and Naval Proving Ground projectile cameras, and other diagnostic equipment located at the emplacements that would allow the researchers to follow projectiles using continuous microwaves.\textsuperscript{261} To process the camera film, a darkroom was set up in a small space just off the main control room area at the west end of the main bomb proof.\textsuperscript{262}

Adjoining the control building to the east and sharing a common face, a smaller concrete bunker was constructed as a separate space with no direct access to the main bunker facility. This two-room building originally contained a diesel generator and associated duct system. Although the location for the new gun test range was chosen in part due to its proximity to the former Anchor Ranch and its rudimentary utility services, many of the early outlying facilities relied on diesel-powered generators to meet their electrical power needs. Its position at the proving ground as a support building is evident by its location outside the tall security fence; with the installation of the fence line at the juncture between the two buildings, the diesel generator building was effectively fenced out of the formal boundaries of the proving ground, perhaps allowing easy access for repair or plant operations personnel without the “need to know” clearance required to view the top secret weaponization work being conducted at Gun Site.\textsuperscript{263}

\textsuperscript{261} Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-9; Los Alamos National Laboratory, "Photographic Collections," Los Alamos National Laboratory Archives and Records Center. See TA-8 photographs.

\textsuperscript{262} Honig, \textit{Gun Site Restoration Project} August 7, 2008, 3, 5; Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See TA-8 records and drawings.

A third bunker, located just west of the main bunker complex, was initially used for materiel storage. Because the wartime gun tests required some sort of ignition charge with cordite being the explosive of choice, a fortified and separate magazine-type building was a logical addition to the Anchor Ranch Proving Ground facilities. This small but robust two-room bunker, with its dramatic, concrete boat-tail retaining wall, likely housed hazardous materials, including the explosive charges and natural uranium (tuballoy) used during the proving ground operations.264

A test site for top-secret guns and an eventual workshop for the assembly of the prototype Little Boy combat units, Gun Site was constructed to be one of the most secure areas at the wartime laboratory. Not only were the proving ground facilities located far from town and within the main security area, manned and patrolled by the military guards, but buildings and gun firing operations were enclosed within a stout board and batten fence—the so-called “no peek” or “peep-proof” fence, which protected all activities from view (fig. 5.14).265

A guard shack for security was located high above the enclosure on a tower and lent a prison-yard feel to the proving ground. Guard posts, such as those at Gun Site, were scattered across the Los Alamos landscape, placed where additional checkpoints were needed. They were built on skids and did not have permanent utilities. The shacks were small, typically no more than six feet wide and about eight feet high, had heating stoves, and were often connected to nearby phone and electrical lines. In fact, wooden

265 Manhattan Engineer District, "Book VIII, Volume 1 - General," 6.52; Francis Birch, "Memorandum to W. S. Parsons; Subject: Security at Anchor Ranch, October 21, 1944," A-84-019, Box 4-1, Los Alamos National Laboratory Archives.
guard shacks were often moved from site to site depending on the changing security
priorities of the wartime laboratory.266

**Experimental Guns and Weapons Casings: Designs and Tests**

**Naval Gun Factory**

The critically important role of the Navy did not end with the recruitment of naval
ordnance experts and the design of the Anchor Ranch Proving Ground. Navy staff
designed the experimental guns used at Gun Site, which were built at the Naval Gun
Factory in Washington, D.C. (fig. 5.15). The first guns were ordered from the Navy in
September of 1943 but did not arrive until March 10, 1944. During the waiting period,
personnel at the proving ground conducted practice tests, perfected gun testing
operations, and established high-speed photographic techniques for documenting the test
data.267

**Thin Man**

One of the easiest and most cost-effective ways for scientists to demonstrate
“proof of principle” is to start with scaled-down experiments.268 At Los Alamos,
scientists centered their initial efforts on the development of the plutonium gun-
assembled weapon. Known as Thin Man, this weapon design presented several scientific
hurdles, including developing a gun device that could fire at assembly speeds close to
3,000 feet per second in order to avoid predetonation (fig. 5.16). To achieve

266 Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory
Records Center; Los Alamos National Laboratory, "Photographic Collections," Los Alamos
National Laboratory Archives and Records Center. See records, photographs, and drawings for
TA-8.


hypervelocity, existing Navy methods were incorporated into early designs, and the scientific staff conducted experiments using smaller-scale, easy-to-acquire guns, especially during the early months of experimentation when the larger guns were being manufactured at the Naval Gun Factory.²⁶⁹

Using 20-mm antiaircraft guns and 3-inch naval guns, Charles Critchfield, a physicist and group leader with previous experience with ordnance research, started testing initiators, targets, and special projectiles at reduced scale, anticipating that the design could be brought up to full-scale once successful designs had been identified.²⁷⁰ This early work was an essential first step in taking the scientific theory and moving it into the realm of applied physics and engineering.

Although 20-mm gun firing was primarily carried out under controlled laboratory conditions in an annex of B Building at the Main Technical Area with outdoor tests conducted in Sandia Canyon, test firing of 3-inch guns at the Anchor Ranch Proving Ground began as soon as the facilities were built, even in the absence of the special Navy guns (fig. 5.17). Preliminary timing and target tests in support of the Thin Man design were conducted using solid steel projectiles as stand-ins well before the Los Alamos scientists had identified the key materials needed to build Thin Man’s experimental projectiles. Other early ballistics tests examined gun firing trajectories using yaw cards that would show the vertical and horizontal flight path of projectiles. Projectile flight and

²⁷⁰ Ibid.
ballistics data were also collected using remotely operated high speed cameras set up near the gun emplacements in armored housings.\(^{271}\)

In order to increase the velocity of projectiles for the Thin Man design, naval ordnance experts and other ballistics engineers experimented with the use of sabots, essentially a space-filling insert in a gun tube that allowed smaller projectiles to be loaded into larger-bore guns (fig. 5.18).\(^{272}\) Using sabots to achieve higher velocities in guns was not a new concept. The U.S. military, through numerous OSRD contracts, had been testing hypervelocity gun designs during the early years of World War II as part of its efforts to improve the effectiveness of armor-piercing, antitank guns. Once propelled through the gun tube, the sabot would drop out and the lighter, smaller projectile would continue at a greater velocity than if it had been shot out of a gun with a smaller diameter bore. In a related method, a smaller projectile would be encased in wrapping material that would allow it to fit in a larger-bore gun. The outer layer of the projectile would then be stripped off during the firing process, allowing the smaller, inner projectile to attain a higher velocity. Fortunately for Oppenheimer and Parsons, Charles Critchfield’s previous ordnance experience included working on gun experiments using sabot and stripper technology.\(^{273}\)


\(^{273}\) Ibid., 350, 402; Hoddeson, *Critical Assembly*, 84.
Little Boy: ‘No Need For Speed’

In July of 1944, as a result of research conducted earlier by Emilio Segrè’s Radioactivity Group, the gun design was determined unsuitable for use with plutonium (see chap. 4).\textsuperscript{274} With the Thin Man weapon scrapped, the crisis of 1944 was born. At Gun Site, work continued on a gun-assembled design using uranium-235. Eventually known as Little Boy, this new weapon design would remain untested until its first combat deployment.\textsuperscript{275}

In spite of its unusable design, the months of Thin Man component and ballistics testing at Los Alamos meant that much of the design work related to the development of the Little Boy weapon was already well advanced by the summer of 1944. Oppenheimer responded to the plutonium crisis in dramatic fashion by reorganizing the wartime laboratory, including the team working on gun-assembled weapons.\textsuperscript{276} Important Navy contributions continued during the summer and fall of 1944, a critical developmental period for the engineering work required to transition Little Boy prototypes into weaponized combat units. Francis Birch, a naval officer and scientist, was placed in charge of the group tasked with Little Boy’s final design and component testing. According to \textit{Critical Assembly}, Birch was an excellent choice to usher the uranium gun-assembled weapon through to completion:

Birch had a mature, unflappable personality that made the gun group one of the laboratory’s most smoothly operating groups. A Harvard geophysicist, Birch had an extensive background in physics, electronics, and mechanical design. At Los Alamos he had been a member of the


\textsuperscript{275} Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-10, IX-1.

\textsuperscript{276} Ibid., IX-1, IX-2.
instrumentation group headed by Kenneth Bainbridge, with whom he had worked at MIT. The MIT experience served him well, since most of the gun work from August 1944 involved testing and instrumentation.277

The Little Boy design would certainly be easier to configure into a deliverable weapon because, using Oak Ridge’s uranium-235, assembly speeds could be much slower, around 1,000 feet per second.278 A fact rarely mentioned in the standard telling of the Manhattan Project story, Little Boy’s special gun barrel—the central core of the final combat unit—was manufactured at the Naval Gun Factory in Washington, D.C. Working on the design of gun tubes and using calculations provided by Los Alamos, Carlton Green, a top Navy BuOrd gun designer, had already determined the caliber of Little Boy by August 1944 (fig. 5.19). Uranium production efforts at Oak Ridge and uranium metallurgy research at Los Alamos were starting to produce the desired results that would ensure that enough of the uranium-235 would be delivered so that it could be cast into the necessary projectile and target shapes. Additionally, detailed specifications related to the gun weapon’s initiator design and firing set up (including its propellant and fusing systems) were also close to being finalized.279

Robert Brode, one of the key players in the successful design of Little Boy, was given the task to develop the method used ultimately to detonate the bomb from the airplane. The fusing system was complicated and was designed with several redundant methods, including barometric switches and clock switches. In order to trigger remotely a detonation, Brode, working in partnership with the University of Michigan and Norden

277 Hoddeson, *Critical Assembly*, 250.
Laboratories, also pursued improvements in electronic circuitry. His fusing work, so critical to the long-range detonation of the weapon, resulted in an overdesigning of Little Boy’s components. Hoddeson, in *Critical Assembly*, notes Brode’s approach to fuse design:

> To help respond to the reliability requirement and altitude consideration, Brode developed a “philosophy of fuzing” in line with the strategy of using overlapping approaches. The philosophy called for backups for every component and circuit. When Brode put a fuze in a bomb, he expected it to work.280

By March of 1945, Commander Birch’s gun group, aided by outside contractors and the U.S. Navy, had essentially completed Little Boy’s design. With no time to lose, the group turned its engineering efforts to planning the details of Little Boy’s overseas delivery and ultimate aircraft deployment in a weaponized combat unit.281

**Prototype Casings and Drop Tests**

Naval support for the design and weaponization of the gun-assembled weapon extended well beyond the place of Los Alamos and the landscape of Gun Site and its gun-firing operations. As an example of the urgency driving the development of the gun-assembled weapon, the military, using the Naval Proving Ground airfield at Dahlgren, Virginia, began aerodynamic drop tests of a Thin Man prototype casing as early as August 1943, when Los Alamos was just beginning its Thin Man assembly and ballistic tests at Anchor Ranch’s proving ground and had yet to determine the weapon’s interior design and final exterior dimensions. Additional tests of the prototype ballistic cases were

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280 Ibid., 260.
281 Ibid., 249-250, 258.
conducted at Wright Field, Ohio, and, later, at Muroc Army Air Base in the California desert.\footnote{282}

A photograph taken on December 4, 1943, in an airplane hangar at Dahlgren, Virginia’s Naval Proving Ground, shows a crude bomb, with a thin pipe for its body and a nose fairing made of wood (fig. 5.20). An important piece of historical documentation, this photograph was, until recently, hidden from view in access-restricted government archives. The sewer pipe bomb, as it was nicknamed, was one of the very first Thin Man models, essentially just an approximate size and shape built to test the aerodynamic properties of the weapon’s combat casing. According to accounts, the first air drops were spectacular failures: the sewer pipe bomb dropped from the plane in a flat spin.\footnote{283} Soon afterwards, during January and February of 1944, loading tests of Thin Man and Fat Man models were conducted at Wright Field in Ohio. These early “fit tests” were necessary because the B-29s chosen to carry the heavy and awkwardly shaped bombs would need to have their bomb bays modified before additional drop tests could be conducted. Captain Deak Parsons, still very much involved in all aspects of the gun-assembled weapon design, traveled to Ohio to inspect the retrofitting of the B-29s and to check on design issues involving the loading of the Thin Man prototype. According to Christman, writing in \textit{Target Hiroshima}, “when Parsons learned that the suspension lugs for the Thin Man would have to be remade, he left for Dayton to investigate the problem personally.”\footnote{284}

\footnote{282} Norman F. Ramsey, "History of Project A," 2, A-84-019, Box 22-2, Los Alamos National Laboratory Archives.\footnote{283} Ibid., 2-3; Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-36.\footnote{284} Christman, \textit{Target Hiroshima}, 141.
Due in part to Wright Field’s location away from New Mexico, aerodynamic tests of the bomb mockups—using the earliest Thin Man and Fat Man designs—were moved to Muroc, beginning in March. Later, after the abandonment of the Thin Man design in the summer of 1944, more fully realized combat cases for the Little Boy and Fat Man designs would be drop-tested at the Navy’s Salton Sea and Inyokern proving ground facilities in California. The main fleet of specially modified B-29 airplanes were based at an airfield at Wendover, Utah, code-named “W-47” or “Kingman.”

Wendover, the airfield base for the 509th B-29 squadron that would eventually be based on Tinian, became the hub for final weaponization test activities, especially the practice loading and dropping of countless mockups, first testing the aerodynamic properties of the casings in flight and then testing each weapon’s complex internal components, such as detonators and fusing systems, using some mockups loaded with high explosives and others filled with inert materials.

Prototype tests of the Thin Man weapon were discontinued as soon as the plutonium gun-assembled design was abandoned. At the same time, Little Boy drop tests were accelerated, and by the fall of 1944, the newly organized gun group was focusing on the flight testing of near-final Little Boy combat units, with a focus on actual component testing to confirm the performance of the projectile and target systems along with the firing systems that allowed detonation at a preset altitude. The Los Alamos scientists and technicians whose wartime contributions have been overshadowed and ignored were

assigned to this final weaponization phase and made frequent trips from New Mexico to Wendover Field.\textsuperscript{287}

**Final Little Boy Design, Assembly, and Delivery**

By early 1945, the Little Boy design was well on its way to being frozen. With help from the Los Alamos gun group, the U.S. Navy, and other unsung organizations, interior components and the combat unit’s exterior shape and size had been finalized. Navy commander Francis Birch, still leading the design efforts and assisting Parsons with final deployment details, began to question the weapon’s safety during actual combat use and, in so doing, developed an alternate assembly method that would involve arming Little Boy in the bomb bay of the B-29 after the airplane had taken off. Birch designed a removable breech plug that could be loaded into the gun-assembled weapon without its essential cordite charge. An in-flight procedure, replacing the charge along with the removable plug would have to be performed by the flight’s weaponeer. Although this maneuver would need to be carried out in tight quarters inside a flying aircraft, Birch’s new approach would effectively arm the bomb in the air and make the mission safer for the pilot and crew (fig. 5.21).\textsuperscript{288}

Other safety and security concerns arose as the mission date became a reality. What if the uranium weapon were to somehow end up undetonated in the waters of the Pacific, perhaps due to an aborted take-off? Would ocean water inside the Little Boy casing bring the subcritical masses to a critical reaction (fig. 5.22)? What about the

\textsuperscript{287} Ramsey, "History of Project A," 7-9, Los Alamos National Laboratory Archives.

\textsuperscript{288} Ibid., 6-7; Hoddeson, *Critical Assembly*, 262-263; Christman, *Target Hiroshima*, 186-187.
neutron-reflecting potential of human bodies—would the body mass of the crew also create a criticality risk?\textsuperscript{289} According to Christman, for security reasons Parsons had secret orders to ditch the bomb undetonated if the \textit{Enola Gay} were to be damaged during the mission; fearing risk of capture with the bomb intact, the aircraft would have to be ditched in a high-velocity suicide dive if the weapon would not disengage from the bomb bay.\textsuperscript{290}

June of 1945 was a busy month. B-29s, flying out of Wendover, continued their practice runs using the China Lake test ranges. As preparations for the Japanese mission accelerated dramatically, naval involvement in the Manhattan Project never waned. Chick Hayward recalled that Captain Deak Parsons made a stop at Inyokern during June to check on the new high-explosives casting facility, also traveling west in June to make arrangements for the Navy’s U.S.S. \textit{Indianapolis} to ship some of the most valuable Little Boy parts to Tinian.\textsuperscript{291} Meanwhile, in the same month, Project Y metallurgists began the manufacturing of the full-scale projectile and target set up to be used in one of the Little Boy combat units.\textsuperscript{292}

In a parallel effort, Little Boy weapon parts were tested at the Anchor Ranch Proving Ground for use in the Hiroshima combat units. In fact, the target case known as “old faithful” was tested several times at the proving ground and worked so well at

\textsuperscript{289} Hoddeson, \textit{Critical Assembly}, 258, 348.
\textsuperscript{290} Christman, \textit{Target Hiroshima}, 183.
\textsuperscript{291} Hayward and Borklund, \textit{Bluejacket Admiral}, 137.
\textsuperscript{292} Hoddeson, \textit{Critical Assembly}, 265.
Los Alamos that it was used in the L-11 unit detonated over Hiroshima. Working in the main bunker at the gun firing range, Los Alamos staff preassembled the combat units in preparation for the Tinian mission, fitting interior components into their respective, individually numbered combat cases, ensuring that nothing was left to chance when the cases’ contents were disassembled for shipment and then reassembled on Tinian (fig. 5.23).

In July of 1945, the parts for the L-11 Little Boy unit were shipped in containers that had been welded to the deck of the Indianapolis. These included the uranium-235 projectile and the combat case. Commander Birch flew to Tinian on one of General Groves’ C-54 “Green Hornets” along with Little Boy’s uranium target. By August 2, all of L-11’s internal parts had been reassembled in its combat case on Tinian, including the projectile, initiator, target, fusing system, and unloaded removable breech plug.

**Unearthing Missing Historical Narratives: Giving the Navy Its Due**

Deak Parsons, U.S. Navy officer and Oppenheimer’s right-hand man, not only oversaw the final delivery of the weapons and related equipment to Tinian, he supervised the assembly of the L-11 combat unit and was the weapons officer on the Enola Gay, arming the Little Boy weapon in the air before it was detonated over Hiroshima, Japan.


Known today as one of the most-important members of the Project Y staff and vital to the deployment of Little Boy, Parsons’s key role was not immediately understood after the Hiroshima mission. Rather, Colonel Tibbets and the rest of *Enola Gay*’s crew received the bulk of the attention by the press and by Army officials.\(^{297}\)

Historian Al Christman explains that the Navy snub continued beyond *Enola Gay*’s initial reception after its bombing run on August 6, and was the result of the deliberate government control of the Manhattan Project’s top-secret information related to the design and development of Fat Man and Little Boy. Government officials were concerned that many of the technical details of the gun-assembled weapon, in particular, were too sensitive to release in the Smyth Report, the public document put together soon after the war’s end outlining the military and scientific efforts to develop the first atomic weapons. Key details regarding the Navy’s role in the development of Little Boy and the wartime contributions of naval personnel and facilities were deliberately left out of the report, resulting in a loss of historical narrative that, even today, still influences the collective public memory of the Manhattan Project.\(^{298}\)

The success of the uranium gun design was a direct result of the research and testing done at Gun Site by a team of civilian and military physicists, engineers, and technicians, including naval contractors and ordnance staff, some based in Los Alamos and many others working at universities, machine shops, and naval facilities. Naval ordnance experts designed the Thin Man and Little Boy guns. Gun tubes and breech mechanisms were fabricated at the Naval Gun Factory in Washington, D.C. Other gun

\(^{297}\) Hayward and Borklund, *Bluejacket Admiral*, 139.

\(^{298}\) Christman, *Target Hiroshima*, 205-206.
parts were machined at the Detroit naval ordnance shops. Gun tests, including proof-firing tests and aerodynamic tests of prototype casings, were conducted at the Navy’s Dahlgren Naval Proving Ground, which also served as the model for the proving ground layout at Anchor Ranch Proving Ground, the hub for gun-assembled weapon design, testing, and assembly work at wartime Los Alamos.

Later in the war, naval high-explosives production facilities at Yorktown, Virginia, and McAlester, Oklahoma, were called upon to produce the large amounts of high explosives needed to support the development of the Fat Man weapon. To supplement the technical casting work conducted at S-Site in Los Alamos, the Naval Ordnance Test Station (NOTS) at China Lake began construction of a production line for Fat Man high-explosives lenses in 1945 (see chap. 6).\(^{299}\)

Additional U.S. Navy facilities located in the San Francisco area supported the final delivery phase of the Manhattan Project, which was led by Deak Parsons and code-named Project Alberta (see chap. 9). The Navy’s Port Chicago ordnance depot was tasked with storing the hazardous shipments of live pumpkin bombs and explosive detonators arriving by rail and then loading the high explosives and other equipment onto Victory Ships at its riverside pier for delivery across the Pacific to the base on Tinian.\(^{300}\)


The Navy’s Mare Island Navy Yard and its Hunter’s Point facility both supported the final delivery of sensitive weapons components. At Mare Island, just north of San Francisco, weapons parts underwent tropical packaging in building 627-A to protect the delicate materials from humidity and the effects of the salt air. 301 Making the ultimate sacrifice on its return from Tinian Island, the Navy’s U.S.S. Indianapolis, leaving from Hunter’s Point, carried the Little Boy’s projectile and ballistic bomb casings onboard as part of its last mission, at the cost of the ship and most of its crew. 302

The wartime history of the creation and delivery of Little Boy, which includes the role of the Navy and the contributions of unheralded workers and institutions, has been overshadowed by the specter of Hiroshima and lost in the historical fog of wartime security and postwar secrets. The Navy’s contributions are missing from the public record of the Manhattan Project, and its role in the development of the Little Boy weapon has gone unrecognized. Only a few naval facilities that supported the Manhattan Project remain today. Some, such as Mare Island’s building 627-A, have been torn down. At the places that still exist, such as the World War II ordnance-storage magazines and rail

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301 Parsons, "Memorandum for Major General L. R. Groves; Subject: Overseas Shipment of Mechanical, Electronic, and Explosive Gadget Components," Los Alamos National Laboratory Archives; Lockridge, "Memorandum to All Concerned; Subject: Group O-7 Responsibility for Liaison and Coordination," Los Alamos National Laboratory Archives; Lockridge, "Memorandum to All Concerned; Subject: Shipping Instructions for Special Items," Los Alamos National Laboratory Archives.

system at Port Chicago, present-day site workers are often unaware of any historical association with the Manhattan Project story.\textsuperscript{303}

The control of secret documents, though understandable in the past and still relevant today, has effectively erased the Navy’s role in the development of Little Boy. However, an examination of the place of Gun Site, its specialized architecture, and landscape has unearthed little told narratives and unknown contributions. At Gun Site, a place of national significance and indisputably one of Pierre Nora’s \textit{lieux de mémoire}, future place-making and park-making will restore the connections between Little Boy and the Navy, along with the contributions of other underappreciated individuals and institutions whose wartime efforts have been diminished by controversy and shrouded in secrecy.

\textsuperscript{303} Observation from research visit to Military Ocean Terminal Concord (MOTCO), former Port Chicago, in February 2014.
Fig. 5.1. Photo showing the aftermath of the bombing of Hiroshima. Los Alamos’s Gun Site (Anchor Ranch Proving Ground), birthplace of the Little Boy weapon, will forever be associated with the atomic bomb’s controversial use against the Japanese people during World War II.

Fig. 5.2. Views of the Jones and Lamson Machine Company, Springfield, Vermont; upper factory (top) and lower factory (bottom), both circa 1917. A little-known Manhattan Project support institution, this company and its chief designer, E. L. Rose, assisted wartime gun weapon design that lead to the development of the Little Boy weapon.

(Photographs courtesy of Vintage Machinery.org)
Fig. 5.3. E. J. Workman was a UNM professor and wartime head of the physics department who led a secret program that supported military weapon development programs during World War II, including NDRC contract work for the Manhattan Project and Project Y.

(Photograph courtesy of the New Mexico Tech Skeen Library)

Fig. 5.4. Navy Captain William “Deak” Parsons, ordnance expert from Dahlgren Naval Proving Ground, played an essential role in the ultimate success of the Manhattan Project. At Los Alamos, he was responsible for the gun-weapon program that resulted in the development of Little Boy. He also led final weaponization and delivery efforts and served as weaponeer aboard the *Enola Gay*.
Fig. 5.5. Norris Bradbury, the second Los Alamos laboratory director after J. Robert Oppenheimer, was another scientist with connections to the Navy. Recruited by Parsons, he would make valuable contributions both to the scientific efforts and to the overall management of the wartime laboratory.

Fig. 5.6. Scientist Edwin McMillan worked with Navy ordnance experts from the Naval Proving Ground at Dahlgren, Virginia, to design a standard proving ground for research related to the gun-assembled weapon. Anchor Ranch Proving Ground, the result of McMillan’s efforts, is now known as Gun Site.
Fig. 5.7. Anchor Ranch Proving Ground was sited near Anchor Ranch (main house shown here). The ranch was a multibuilding private holding that was appropriated by the Manhattan Project. The displacement of local residents is a common theme among the three communities that will be part of the new Manhattan Project National Historical Park.

Fig. 5.8. A view of the Anchor Ranch bunk house cellar being used for the production of early radiographs. In the initial stages of Project Y, while new facilities were being constructed at the Los Alamos townsie and at the remote testing areas, every available building was put to use.
Fig. 5.9. One of Dahlgren’s gun lines and bomb proofs today (above). Gun Site’s wartime landscape was influenced by the design of the Dahlgren Naval Proving Ground, including its catcher boxes (upper left) and gun emplacements complete with steel gun mounts (upper right).

Fig. 5.10. Anchor Ranch Proving Ground aerial view, 1946. Each gun emplacement was covered by a movable garage structure. The catcher boxes contained sawdust or sand. Two of the three catcher boxes can be seen to the right of the garages.
Fig. 5.11. The movable garages at Gun Site were built to cover the guns when they were not in use in order to protect them from the elements and also to hide them from view.

Fig. 5.12. Catcher boxes, shown here in a 1944 drawing, were built to contain or “catch” the special projectiles that were being fired at close range as part of the tests of prototype Thin Man and Little Boy gun-assembled weapon designs.
Fig. 5.13. The periscope tower at Gun Site was used to remotely view the firing tests from the safety of the main concrete control bunker or “bomb proof.” The periscope was also used to make sure that no workers were in the area when the guns were being fired.

Fig. 5.14. A no-peek or “peep-proof” fence was constructed around the entire Anchor Ranch Proving Ground due to a concern that the test devices were starting to resemble actual combat units.
Fig. 5.15. Gun tubes being manufactured on the floor of the Naval Gun Factory in Washington, D.C. (now the Washington Navy Yard). The gun tubes used in the Thin Man prototype and the Little Boy weapon were manufactured at the Naval Gun Factory. Special test guns used in early ballistic tests at Los Alamos’s Gun Site were also made here.

(Photograph courtesy of Naval History and Heritage Command)

Fig. 5.16. The Thin Man plutonium gun device at Anchor Ranch Proving Ground’s southern gun emplacement. The Thin Man design was abandoned because it was unsuitable for use with plutonium.
Fig. 5.17. Project organizers made use of a readily available gun, the 20-mm Hispano-Suiza (shown here at the Washington Navy Yard museum) to conduct small-scale firing tests related to the gun-device’s initiator.

Fig. 5.18. A larger-bore gun, one of the early experimental guns built by the Naval Gun Factory for high-velocity ballistics tests at Anchor Ranch Proving Ground.
Fig. 5.19. The Little Boy design incorporated the fissile uranium produced at Oak Ridge, Tennessee. Internal components shown here at one of the gun emplacements were tested repeatedly at Gun Site during the war.

Fig. 5.20. The Navy airfield at Dahlgren, Virginia, also supported early aerodynamic tests of rudimentary combat cases. The first Thin Man test units were dubbed “sewer pipe bombs” because the mock gun tube was actually made from a sewer pipe. The unit in this 1943 photograph at Dahlgren had a wooden nose fairing piece. Drop tests of weapon casings were also conducted at NOTS, Inyokern, California.
Fig. 5.21. Navy commander Francis Birch (left) with Little Boy unit L-11. Birch was responsible for the design of an in-flight arming system as a last-minute safety precaution.

Fig. 5.22. A water immersion test of a Little Boy test unit using stand-in material is being conducted in this photo. Little Boy’s uranium parts were a liability; a supercritical reaction would result if they were immersed in water. Ultimately, the recommendation was made to crash land with Little Boy instead of jettisoning it into the ocean in the event of mission failure.
Fig. 5.23. Two Little Boy combat casings inside the shop room in the main bunker building at Anchor Ranch Proving Ground (unit L-8 in foreground). Duplicate casings and non-fissile components were sent to Tinian from Los Alamos. To ensure quality control, internal components were test-assembled in specially numbered casings prior to being disassembled and shipped to the Pacific.

Fig. 5.24. The Enola Gay and crew. Navy captain Deak Parsons was the weaponer aboard the Enola Gay during the Hiroshima bombing mission. Many of the Navy’s contributions to the development of the Little Boy weapon have been overshadowed by the controversy over the weapon’s use against Japan.
PART III.
THE IMPLOSION PROBLEM (1944)
CHAPTER 6

HIGH EXPLOSIVES AND THE SPECIAL LANDSCAPES OF PROJECT Y

We try to understand the past by reading its traces on the landscape, entering into a dialogue with it, like the fortune-teller studying the coffee grounds in the demitasse cup.

Eleni Bastéa, *Memory and Architecture*

Specially constructed landscapes can be analyzed in much the same way as historical sources. A study of the high-explosives landscape and associated architecture of S-Site, built during the Manhattan Project to support the development of the Fat Man weapon’s complicated design, reveals past patterns of land use and speaks to themes of danger and risk amid the pressures of war. An examination of worker memoirs and reminiscences also discloses some of the same themes and provides a glimpse into the wartime world of high-explosives work.

Today, a lone, partially earth-covered building is located at the end of a short stretch of driveway within the modern laboratory’s high-explosives area, still known as S-Site. Small, with a usable space of slightly more than two hundred square feet, the view of the building from the main road is really the building’s back end. Its nondescript entrance, sheathed in old-style asbestos shingles, is centered between wooden wing walls that help contain the grass-covered earthen berm encircling the building on three sides.304

Once inside, not much of its wartime story is revealed. The old World War II magazine

304 Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See records and drawings for TA-16.
stands empty now, but the reinforced concrete walls and concrete flooring are still solid. Its roof, built of wood to serve as an easy path upwards for the force of an accidental explosion, is still in remarkably good shape (fig. 6.1).

This is Los Alamos’s last wartime high-explosives magazine. Built in 1944, it is so small it could fit into a conference room at one of the present-day national laboratory’s office buildings. To those with little knowledge of the wartime role of S-Site, the building appears to be an insignificant support structure rendered obsolete by the passage of time and the Cold War-mandated construction of more-modern facilities for the development of an arsenal of warheads stockpiled against a Soviet foe. However, the magazine is not just a remnant of a once-vast complex of high-explosives buildings; rather, it is a physical embodiment of the tremendous casting and machining efforts required to develop Fat Man’s intricate system of high-explosives lenses. It stands alone today as a resilient symbol of one of the key technological accomplishments of the Manhattan Project and represents a landscape of high-explosives work incorporated with the safety measures that this dangerous technology demanded.

The development of high-explosives casting technology at Los Alamos during the Manhattan Project was essential to the creation of the Fat Man implosion weapon. In order for new high-explosives techniques to be researched and tested, a manmade landscape of buildings, roads, and protective structures was constructed at the remote southwestern edge of the wartime laboratory. Most of S-Site’s original landscape is  

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305 Ibid.
gone today. In its place is a network of Cold War-era high-explosives buildings that only
echo the setting, feeling, and layout of their wartime origins.\textsuperscript{307} In spite of these changes,
the history of S-Site and its high-explosives landscape is a key part of the Project Y
narrative. Nonetheless, due in part to the challenge of interpreting the technical and
scientific details of the implosion story, S-Site has been relegated to a minor role in the
popular accounts of the Manhattan Project. The high-explosives magazine’s story has
also been overshadowed by the controversy of the bomb and by the more well-known
areas at Los Alamos that represent the history of Project Y—nearby places with intimate
connections to the Trinity gadget and the Little Boy and Fat Man bombs; wartime sites
that have been branded as the very birthplaces of the combat units deployed against the
Japanese people.

Cultural meaning and memory reside in physical landscapes, even those that have
changed over time. Landscapes, when studied and experienced firsthand, can be
appreciated as historical sources in the same way that memoir accounts and archival
documents tell about the past. Eric Sandweiss, writing on the meaning of cities and the
capacity for their landscapes to inform the historical narrative, acknowledges, however,
that understanding the relationship between place, meaning, and memory can be a
challenge: “The problem facing the historian, as it faces anyone seeking to activate the
latent memory residing within urban landscape, is not to peel away the representation . . .
but to be aware of its role as a trigger of memory and cultural meaning.”\textsuperscript{308} An

\textsuperscript{307} Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory
Records Center. See TA-16 records and drawings.

\textsuperscript{308} Sandweiss, "Framing Urban Memory: The Changing Role of History Museums in the
American City." 27.
examination of S-Site’s lost landscape using 1940s aerial photos, historical images, and archived drawings and maps reveals some of its intrinsic meanings. The landscape’s associated themes of safety, wartime urgency, and risk may not trigger latent memories in the generations born after World War II, but they may provide the framework for new memories formed from experiencing the very places and spaces of the bomb.

The memoirs and oral histories of Special Engineer Detachment (SED) recruits who worked at S-Site reveal similar themes of danger and expediency and validate worker stories that have been overlooked in the rush to publish accounts written by and about the scientific luminaries of Project Y.309 Voices and images from the past provide a connection to the real human experience of war and serve to supplement the bomb’s technical history with a more approachable social history that will give meaning to those seeking to understand the complexity of Los Alamos’s wartime contributions and legacy. Linking the human story to the physical experience of place adds richness and meaning to the history of the Manhattan Project beyond the polarizing debate over the controversial use of the bombs.

**Responding to the Crisis of ’44**

To understand the meaning of a historical landscape, one must understand its historical context. S-Site’s landscape of high-explosives research and development was hastily constructed in response to Emilio Segrè’s discovery that the properties of plutonium made it unsuitable for use in the Thin Man gun-assembled weapon being

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designed at Gun Site. Segrè’s finding resulted in a major reorganization at Los Alamos during the summer of 1944. In response to the plutonium crisis, the wartime laboratory rapidly expanded both its workforce and its facilities to develop the implosion method eventually used in the Fat Man weapon. S-Site was to become one of the most important of these new research areas; its casting facilities would eventually produce the high-explosives core of the new plutonium bomb.310

The implosion design uses shaped high explosives to compress symmetrically a subcritical mass of plutonium-239.311 By rapidly compressing plutonium, the density of the fissionable material increases and results in a critical reaction. This approach was difficult to perfect. A major problem facing the Los Alamos scientists was that the military’s existing capabilities for high-explosives performance were well below what was needed to develop a perfectly symmetrical implosion.312 The solution was to develop new formulations of high explosives that could be cast in a series of geometric shapes. These shapes, known as lenses, were used to focus the shock wave and uniformly compress a sphere of subcritical plutonium. To ensure the symmetrical inward explosion, the cast lenses were ignited by a series of detonators fired simultaneously around the entire sphere of high explosives.313

311 High explosives are energetic materials that involve a high-speed combustion process known as detonation, which is derived from chemical reactions. High explosives are explosives with energies higher than TNT. Timothy R. Neal, "AGEX I: The Explosives Regime of Weapons Physics," Los Alamos Science, no. 21 (1993); John B. Bzdil, Tariq D. Aslam, Rudolph Henninger, and James J. Quirk, "High-Explosives Performance," Los Alamos Science, no. 28 (2003).
313 Hoddeson, Critical Assembly, 3, 168-169.
The development of high explosives at S-Site became one of Project Y’s most important wartime tasks. The need for hundreds of lenses, both for proof testing and for combat units, drove the hurried construction of S-Site’s multibuilding casting complex (figs. 6.2 and 6.3). Another problem facing the scientists was the lack of established methods for casting shaped pieces of high explosives. S-Site’s high-explosives experts eventually developed a casting process using a powdered formulation of TNT that was melted in a kettle to produce a molten liquid. After the high-explosives mixture was poured into a mold, it was carefully cooled and allowed to solidify. In order to control the cooling conditions, the molds were jacketed to allow for the introduction of different temperatures of water to cool the castings so that air bubbles or cracks would be minimized (fig. 6.4). Lenses were then checked for imperfections using X-ray screening and then final machining and other surface preparations took place.\(^{314}\)

Once the technical problems associated with casting high explosives were eventually overcome, the S-Site facility produced about twenty thousand usable castings over an eighteen-month period. Over one hundred thousand pounds of high explosives were used per month during S-Site’s peak operation, and several types of high-explosives materials were used in the casting process: Composition B; Torpex; Pentolite; Baronal; and Baratol.\(^{315}\) The development of diverse and complex engineering methods relating to high-explosives research was a primary accomplishment of the wartime laboratory.

\(^{314}\) Larry Hatler, "Notes regarding information pertaining to the history of high-explosives development at LANL, 2003," Cultural Resources Management Team, Los Alamos National Laboratory, Los Alamos, New Mexico.

\(^{315}\) Composition B or “Comp B” is TNT combined with British-invented Research Department Explosive or RDX.
S-Site

S-Site Origins
The location, origins, and wartime history of S-Site are contributing elements to the historical context and meaning of this unique Manhattan Project landscape. S-Site, which is still in operation today, is located due south of the Anchor Ranch facilities, home of Gun Site (see chap. 5). What is now S-Site was part of a Spanish land grant given to Pedro Sánchez in the 1700s. The grant remained within the Sánchez family for over one hundred years. In 1860, Ramón Vigil obtained confirmation of title from the U.S. Congress to most of the original Sánchez Grant; ownership of the Ramón Vigil Grant later passed into other hands (see chap. 4).316

S-Site, also known as Sawmill Site, was named for a large pile of sawdust from previous lumber operations in the area (fig. 6.5).317 In the late 1890s, the owners of the Ramón Vigil Grant leased their timber rights to Henry S. Buckman, the first to harvest trees on the grant. To transport lumber from the Pajarito Plateau to the nearest railroad, Buckman built a road from his sawmill to the railway siding along the Rio Grande that bore his name.318

S-Site History
S-Site was developed as the wartime laboratory’s principal high-explosives area between the winter of 1943 and the spring of 1944. Construction of the first S-Site high-explosives buildings began in December 1943.319 However, S-Site was not the first

316 Machen, Homesteading on the Pajarito Plateau, 22.
318 Machen, Homesteading on the Pajarito Plateau, 12-14, 22, 30.
casting area developed during the war at Los Alamos. Seth Neddermeyer, a member of Parsons’s early ordnance group, was interested in the fledgling concept of implosion—the inward-directed explosive force that could be used to compress subcritical fissile material such as plutonium. He conducted some of his first rudimentary experiments with high explosives and metal cylinders at a small firing site on South Mesa, which is located just across Los Alamos Canyon from the downtown Los Alamos area (fig. 6.6).³²⁰

**Growing Pains**

The wartime laboratory’s first small casting plant, built to support Neddermeyer’s early research into the implosion idea, was established in October of 1943. Initially believed to be small-scale effort, this site, which came to be known as Anchor Ranch East, was constructed across the road from the Anchor Ranch Proving Ground.³²¹ Following the Los Alamos philosophy of redundant systems, Oppenheimer had encouraged Neddermeyer to pursue the implosion idea. According to historian Lillian Hoddeson, scientists had initially discussed the concept of an implosion-assembled weapon during the summer of 1942, but it was Neddermeyer who first suggested its specific use at Los Alamos in the spring of 1943. In *Critical Assembly*, Hoddeson notes that the apparent success of the gun design allowed for the small-scale exploration of other weapon designs:

> Even though many fission constants were poorly determined and the accuracy of approximations was generally low, Los Alamos physicists were confident that a reasonably efficient gun bomb could be built. Acceptance of the gun as a workable assembly lent optimism to the entire

project. As a fallback, Oppenheimer established a small research effort under Seth Neddermeyer to explore implosion assembly.\(^{322}\)

The early facilities at Anchor Ranch East included its main casting building, temporary hutment buildings, and high-explosives bunkers—all protected by earthen berms and connected to each other by walkways and covered passageways (fig. 6.7).\(^{323}\) With crowded conditions compounded by the presence of extremely hazardous operations, friction between Neddermeyer’s group and the proving ground group quickly developed. Most conflicts arose over the shared use of Anchor Ranch Road, which was often closed during gun-firing tests. High-explosives leader George Kistiakowsky summarized the situation in a May 1944 memo to Captain Parsons, head of the Ordnance program:

> The Anchor Ranch is seriously crowded with firing sites, and it appears to be impossible to introduce a really 100% safety technique without interfering with its activities to such an extent that the program of both the gun and the H. E. projects will be severely handicapped....Instructions to personnel as to what to do in case of each warning signal should be posted in all buildings. Also, there should be large signs on all roads leading to Anchor Ranch which may read as follows: “Sound of the siren indicates impending danger; turn back or take cover immediately.”\(^{324}\)

Even before the major shift to implosion work after Project Y’s August 1944 reorganization, Neddermeyer’s casting facilities at Anchor East had been identified as unsuitable, and plans to relocate the high-explosives casting operations to a new complex

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\(^{322}\) Hoddeson, *Critical Assembly*, 67.


known as S-Site had been made as early as the fall of 1943. S-Site, known alternately as Site S in the early days of Project Y, started limited high-explosives operations in May of 1944. Although implosion was not yet identified as the crucial second weapon design, S-Site was developed to cast the special high-explosives shapes needed in an implosion-assembled weapon.

Oppenheimer and the other Project Y leaders supported this promising research as part of their organizational strategy of multiple solutions for important scientific and technical problems, especially since the Los Alamos Project had yet to come up with a proven weapon design that could be used with plutonium. The importance of implosion research to the project was evident in the fall of 1943 when Oppenheimer recruited high-explosives expert George Kistiakowsky to help design the new S-Site casting plant (fig. 6.8). “Kisti,” as he was known, initially worked with Seth Neddermeyer as a consultant, coming to Los Alamos as a full-time member of Project Y to support implosion research by February of 1944, and leading the project’s effort by April of the same year. According to Target Hiroshima’s author Al Christman, even the small-scale focus on the implosion concept in early 1944 required additional production and design requirements that involved not only Project Y engineers but also challenged the capabilities of the Detroit office’s machine shops:

At the same time that Chadwick was pressing production of the full-scale bomb models, he also had to arrange the manufacture of hundreds of small hollow metal spheres . . . and scores of full-scale spheres for Neddermeyer and Kistiakowsky’s implosion experiments. New data called for constant

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326 Hoddeson in Critical Assembly (pages 5, 9, and 10) also makes note of the strategy of redundant solutions and the importance of engineering efforts during Project Y.
327 Hoddeson, Critical Assembly, 130, 139.
modifications of designs. Everything produced was unconventional, pushing Parsons’ engineering group and Chadwick’s Detroit office constantly into unexplored technology.  

Early S-Site facilities included an office building, a steam plant, a casting house, storage magazines, and high-explosives preparation buildings. Because of construction and equipment delays, S-Site operated only on a limited basis by the spring of 1944. By July, Oppenheimer officially confirmed that the plutonium, which came in research quantities from the Oak Ridge graphite pile and which eventually would be produced in production quantities at Hanford’s B-Reactor, could not be used in a gun-assembled weapon. In response, the Thin Man design was dropped and the wartime laboratory shifted its focus to implosion research, a massive reorganization during the summer of 1944 that involved the hiring of additional staff and the construction of new firing areas and scientific laboratories, including a major expansion of the high-explosives facilities at S-Site.

As an indication of the project’s organizational capabilities and the speed of wartime construction, S-Site became operational on a larger scale in August of 1944, just one month after Oppenheimer’s announcement. By late 1944, close to a dozen more technical areas had also been constructed to test-fire the high-explosives castings. Relatively small-scale in comparison to the facilities at the Main Tech Area and S-Site, these implosion diagnostic sites dotted the landscape of the plateau area south of the main

328 Christman, Target Hiroshima, 143.
330 Hoddeson, Critical Assembly, 240-243. Note: the Oak Ridge pile is also known as the X-10 graphite reactor.
townsite and consisted of isolated groupings of buildings and firing sites located in wooded areas accessible only by primitive dirt roads (see chap. 7).\textsuperscript{331}

By 1945, with a workforce driven by wartime urgency, a high-explosives lens system had been successfully developed that could be used in the Fat Man implosion weapon. This work was accomplished by much trial and error and included the creation of new chemical formulations of high explosives, refinement of the casting process, development of exploding bridge wire detonator technology at nearby Two Mile Mesa site, and repeated test firing of the experimental high-explosives lenses, starting with small-scale castings and assemblies and finally scaling up to full-size lenses.\textsuperscript{332} Even with this massive effort, by war’s end, S-Site was only able to produce a few sets of high-quality, full-scale lenses for use in the Fat Man devices tested at Pajarito Site and Trinity Site, and the Fat Man high-explosives weapon assemblies sent to Tinian (see also chaps. 8 and 9). This was due, in part, to several changes in the Fat Man weapon design that resulted in new, last-minute lens specifications.\textsuperscript{333}

**Designing High-Explosives Areas—Safety Considerations**

To produce the cast lenses, the leaders of Project Y constructed S-Site according to existing safety guidance that had been developed by the U.S. Army following several devastating accidents involving high-explosives storage, manufacture, and transport

\textsuperscript{331} See, generally, Los Alamos Scientific Laboratory, "Technical Area Structure Location Plans," Los Alamos National Laboratory Records Center.

\textsuperscript{332} Manhattan Engineer District, "Book VIII, Volume 2 - Technical," XVI-16-XVI-18.

\textsuperscript{333} Ramsey, "History of Project A," 6-7, Los Alamos National Laboratory Archives.
operations.\textsuperscript{334} The landscape of the S-Site high-explosives area speaks to its guiding framework of safety: it was deliberately created and carefully designed. Even though operations at Los Alamos during the war were conducted with a driving sense of urgency, high-explosives hazards were well known by the workforce and by the leaders of Project Y.\textsuperscript{335}

**Army Standards**

In response to pre-World War II safety concerns, the U.S. Army established standards for the various protective structures that routinely house high explosives, including the identification of safe distances between high-explosives facilities. In general, architecture was designed not just to protect other workers from accidental explosions but also to direct the explosive blast in a specific direction, away from nearby operations. Many of the military ordnance areas built according to Army standards were also designed with internal rail networks for safe local transport and for temporary railcar storage of high explosives. Massive igloo structures were typically sited next to the rail lines and were intended for long-term storage of high explosives, detonators, or ammunition (fig. 6.9). The Army set standards for the size of igloos and their construction techniques, for protection against lightning strikes and fires, for protection

\textsuperscript{334} Large-scale accidents involving high explosives were not unknown, such as the 1917 explosion at Halifax, Nova Scotia. U.S. Army safety protocols were established in 1928 after a major explosion occurred in 1926 at the Picatinny Arsenal, a naval ammunition depot in New Jersey. A major wartime accident involving high-explosives occurred at Port Chicago, California.

against “sympathetic” explosions (in which an explosion in one magazine sets off an explosion in neighboring magazines), and for the maintenance of magazines.336

Following the Army’s safety protocol, high-explosives storage magazines were built of reinforced concrete. Often designed with roofs that were built to release pressure in the event of an accidental detonation, every aspect of their construction reflected the need to minimize hazards to surrounding areas (fig. 6.10). Earthen berms at the sides of the magazines were designed to dampen the force of a potential explosion from nearby facilities, while the shape of the magazines directed the force of an accidental explosion upward rather than outward, thus decreasing the chance of causing chain-reaction explosions at adjacent magazines.337

Furthermore, the amount of explosive material stored in each magazine was limited, as was the distance between magazines. The U.S. Army Department of Ordnance issued standards in 1941 mandating that bunkers be located no closer than four hundred feet apart. Designs for large groupings of magazines were also considered in the standards. Magazines were to be located in such a way as to provide eight hundred feet between aligning buildings in offset parallel rows.338 However, even this distance could

vary depending on the amount of explosives allowed within a particular magazine and how far that magazine was placed away from roads, highways, or other buildings.\textsuperscript{339}

\textbf{A Temporary Landscape of Expediency}

The Manhattan Project landscape at S-Site speaks to the urgency of war and to the workforce’s singularly focused goal of developing the new and terrible weapons that would bring World War II to an end. S-Site’s high-explosives complex, although designed following the Army safety regulations of the day, was an expedient solution to a rapidly developing wartime priority. Unlike the military’s permanent ordnance depots and arsenals, many of S-Site’s facilities were hastily constructed and built according to temporary design standards.\textsuperscript{340}

\textbf{Expedient Construction}

The addition of new infrastructure to support Project Y began as soon as General Groves made the decision to develop a wartime laboratory at remote Los Alamos. Awarded an Army Corps of Engineers’ construction contract in late 1942, the M. M. Sundt Company began to build the Main Technical Area’s laboratory buildings in early 1943. W. C. Kruger, architect, and Elmo Morgan, engineer, both based in New Mexico, developed some of the first plans for the new technical facilities located around Ashley Pond at the site of the former Los Alamos Ranch School. Kruger also drafted plans for

\textsuperscript{339} Goldie, "Notes from informal interview," Cultural Resources Management Team, Los Alamos National Laboratory, Los Alamos, New Mexico.

\textsuperscript{340} Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See records and drawings for TA-16.
the remodeling of some of the log and stone ranch school buildings that were to be repurposed for Project Y’s use.341

Construction was continuous throughout the war years. Ed Wilder, writing in a memoir account about his wartime work, described S-Site’s phases of construction, noting that “there was continuous planning and construction of new buildings until just before Trinity day.”342 Many of the early laboratory designs were based on standard military building plans that were felt to be unsuitable for scientific use by the Project’s scientists, who were arriving in Los Alamos just as the initial wartime laboratory was starting to take shape. This led to an immediate conflict between the Sundt Company, the scientists, and the Army. In Critical Assembly, Hoddeson notes this early tension at Project Y:

Numerous difficulties prevented Sundt from completing the work on schedule. . . . Last-minute modifications were often requested verbally by the scientists. The scientists wanted what seemed to them to be obvious improvements, regardless of contractual problems. But unless the Corps of Engineers accepted the buildings according to the original specifications, the contractor was held accountable.343

This fundamental schism between the Army’s desire to build facilities quickly and the scientists’ need for technically adequate work spaces continued well into the middle of 1943. R. R. Wilson, tasked with checking on the status of construction projects, recalled his frustration with military staff overseeing the construction of wartime Los Alamos:

343 Hoddeson, Critical Assembly, 62.
It was mostly a question of who was in charge—they or we. The army people had clearly been completely in charge of construction for the six months when no scientist was to be seen at Los Alamos. Naturally, they expected to continue in that manner even after we arrived. On the other hand, much of the time what they were building made no sense to them because they had no idea of what we were doing. We would insist that we knew what was right. They tended to ignore us majestically, for after all they held the cards, namely, they supervised the people doing the construction.344

In S-Site’s high-explosives area, wooden buildings were quickly thrown together, using stock floor plans that were not always the most practical designs for Project Y’s research and development work.345 Some of the wartime construction materials did not meet the standards for work with high explosives. For instance, wood is porous enough to absorb high-explosives powder, making it almost impossible to remove the residue from walls and other wooden surfaces.346 Wooden buildings, however, were built at S-Site because they were expedient construction and were not intended for use after the war. In another example, massive earthen structures were built up against the poorly constructed wooden walls of temporary wartime buildings (fig. 6.11). The earthen berms imposed not just structural stress on the buildings, but also provided a way for moisture from rain and snow melt to pass directly through the soil to the unprotected wood, causing rapid structural deterioration.

Unlike permanent high-explosives manufacturing and storage areas constructed elsewhere, S-Site was designed without an internal rail transport system. Lacking a

346 Bill McCormick, LANL S-Site employee, retired, personal communication with author.
nearby commercial railroad as well, explosives shipments were trucked to Los Alamos
over the poorly maintained roads of the time (fig. 6.12). WAC Mary Lehman described
how she and the other motor pool drivers transported high explosives to the project over
the back road through the Jemez Mountains via the town of Jemez Springs:

We would go down and pick up explosives in a truck, come in the back
way because it was too dangerous to come in the front way with it. . . . It
was a bad road then, dirt all the way in. It was pretty rough. We’d have an
MP in front riding with me and then two in the jeep in front and two in a
jeep in back. We’d go down and pick up these shipments. I don’t really
know what they were. I knew they were explosives.347

Rapidly constructed in response to the implosion crisis, S-Site supported vital
wartime engineering and testing. While its buildings might have been somewhat
improvised, S-Site’s high-explosives research and development work was critically
important to Project Y’s success. The hurried design and construction of the high-
explosives area, however, speaks clearly to the unrelenting pressure of war.

Other Manhattan Project High-Explosives Facilities

The S-Site facilities were considered a temporary wartime solution and somewhat
unsafe to work in when compared to the military ordnance areas elsewhere at the time.348
During the war, a high-explosives facility, known as the Salt Wells Pilot Plant, was being
constructed at Inyokern, California, to mirror the lens-making work at S-Site, effectively
protecting the newly developed implosion technology by having essential high-

Museum Archives, Los Alamos, New Mexico.

348 The production of full-scale lenses and other high-explosives operations at S-Site were shut
down after the war, in part due to the unsafe nature of the buildings. See Manhattan Engineer
explosives capabilities in more than one place. Admiral Chick Hayward, in his memoir, recalled a visit by Project Y’s Deak Parsons to Inyokern, where Hayward was stationed during the war:

Deak stopped by that month to check on their rehearsals out of Wendover and our rocket and bomb-lens progress at Inyokern, ending the month in San Diego to arrange for shipment of the Little Boy to Tinian on the cruiser *Indianapolis*.350

In addition to the new casting plant at Inyokern, existing military ordnance plants and storage depots supported Los Alamos’s wartime high-explosives operations and included facilities at Port Chicago, California; Yorktown, Virginia; McAlester, Oklahoma; Bruceton, Pennsylvania; and Ft. Wingate, New Mexico. Together, these ordnance areas produced the conventional high-explosives-filled pumpkin bombs test-dropped on Japan in the final days of the war, provided the bulk high explosives refined at S-Site, and stored the detonators and other high-explosives components being shipped to and from Tinian.351 The Salt Wells Pilot Plant was operational in late 1945 and was used as a transitional facility after World War II to support the larger volume production of high-explosives castings that were needed for the first stockpile of Cold War nuclear weapons.352

350 Hayward and Borklund, *Bluejacket Admiral*, 137.
S-Site’s High-Explosives Landscape

Specific Safety Standards and Layout at S-Site

An exploration of the types of buildings constructed at S-Site to support wartime casting operations uncovers a landscape that embodies danger and risk. The layout of S-Site and its high-explosives architecture, both today and during the Manhattan Project, reflect the need for careful planning when personnel worked with highly dangerous materials. Isolated from the main townsite and established away from other wartime facilities, the lens-making plant was designed with physically separated areas or “lines” with distinct functions that supported the high-explosives casting process (fig. 6.13). Buildings were specifically designated for raw materials processing and high-explosives chemistry research. S-Site also included separate groupings of buildings for high-explosives storage, casting work, X-ray inspection of finished lenses, and final machining and preparation work. Each stage in the process included a certain degree of risk.

Wilder, writing about his experiences as a SED, recounted that workers at S-Site knew the hazardous nature of the work: “[S-Site] was on the south side as far away as possible from the rest of the Project. We believed that this was because of the danger involved in what we were doing. The personnel at S Site was almost completely military. We also believed that this was because the work was too dangerous for civilians.”

Project Y high-explosives buildings were somewhat unique compared to the standard military ordnance facilities of the day. Due to the heightened wartime pressure to complete the second bomb design in record time, facilities normally designed for

permanence out of reinforced concrete were often recreated at Los Alamos in more temporary fashion. However, following ordnance plant practices established to control risk, high-explosives quantities were carefully monitored. Only the amount necessary for the casting process was allowed in casting rooms; excess high explosives needed for upcoming operations were stored nearby within each line of buildings in magazines or “rest houses,” but at a safe distance.\(^{355}\)

Storage magazines and bunkers, both large and small, were spread across the S-Site landscape. Deliberately placed in areas away from the main casting and machining operations in an attempt to minimize risk, the magazines were used to store the high explosives needed to support the casting process. For additional high-explosives storage, two remote magazine areas, Magazine Area A and Magazine Area B, were constructed to the south of S-Site (fig. 6.14). These magazines stored bulk materials that were not immediately needed.\(^{356}\)

Without a rail system, the movement of high explosives, whether in bulk, powder, or finished shape, was a dangerous task. High explosives were trucked between sites using an internal road system or hand carried between buildings (fig. 6.15).\(^{357}\) Concrete sidewalks were built between the facilities at each functional grouping of buildings and these were often enclosed to provide protection from the elements. Massive wooden


\(^{356}\) Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center; Los Alamos National Laboratory, "Photographic Collections," Los Alamos National Laboratory Archives and Records Center; Los Alamos Scientific Laboratory, "Technical Area Structure Location Plans," Los Alamos National Laboratory Records Center. See TA-16 records, photographs, and drawings.

\(^{357}\) Hull, *Rider of the Pale Horse*, 60.
barricades were also constructed at some of the high-explosives areas where hazardous work was conducted in buildings that were located in close proximity to each other (fig. 6.16).\textsuperscript{358}

The high mountains of New Mexico brought other hazards to the wartime high-explosives operations: the region experiences some of the most frequent summer thunderstorms in the nation. As a result, lightning protection systems were designed into the early S-Site facilities, including lightning rods on the buildings and additional lightning arrester systems consisting of wires suspended above the buildings on poles with grounding wires leading to the ground.\textsuperscript{359} During lightning storms, S-Site workers would leave the processing areas and wait in nearby bunkers specifically designed as personnel shelters. These bunkers were also used as smoking areas because spark-producing devices and open flames, including cigarettes and matches, were banned from the high-explosives work spaces (fig. 6.17).\textsuperscript{360} McAllister Hull was one of the young SEDs recruited to work at S-Site and was well aware of the thunderstorm safety protocol. In his autobiography, however, he described how he would often ignore the standard safety rules and continue working:

A warning system alerted us to approaching thunderstorms, which are a daily occurrence in New Mexico in spring and summer. The safety rule was to shut down casting when the storm was coming our way and wait it out in a nearby bombproof shelter. I thought the heavy copper spikes sticking up every few feet along the crest of our building and anchored to pits of copper sulfate for good conduction were safe enough; so when the call came, I simply closed the shades of the casting building, and we

\textsuperscript{359} Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See TA-16 records and drawings.
\textsuperscript{360} Oppenheimer, "Project Safety Manual," 28-29, Los Alamos National Laboratory Archives.
continued work. Whenever a storm hit us directly, the lightning display was enough to keep my colleagues inside anyway.\textsuperscript{361}

For safety reasons, steam boilers provided heat to the rooms, and steam and hot water were used as part of the production work and to clean high-explosives powder or residue from the buildings. A network of overhead and above ground steam lines, encapsulated in silver insulation, dotted the wartime landscape in the S-Site high-explosives area (fig. 6.18).

The dry air of Los Alamos was also a cause for concern—static electricity could also set off the delicate high explosives. To combat this phenomenon, non-sparking flooring was used in high-explosives work areas. Hubbelite, a commercially available, red, spongy, nonconductive flooring, was a common feature at S-Site. Applied to concrete floors in a roller-applied coating, this flooring also protected against sparks from dropped tools. Special Crouse-Hinds electrical fixtures, including all lights and outlets, were installed in the wartime buildings. Not designed to withstand an explosion but, rather, designed not to explode or spark themselves, these explosion proof or EP fixtures were ubiquitous throughout S-Site (fig. 6.19).\textsuperscript{362}

Unlike other Project Y facilities, high-explosives processing buildings often featured special entrance doors made of copper. In general, the number of door openings in processing buildings was also reduced to control air movement and dust, even in large, multifloor buildings. Some of the temporary wartime buildings, designed from standard military plans, were modified after initial construction to meet the needs of the high-

\textsuperscript{361} Hull, \textit{Rider of the Pale Horse}, 61-62.

\textsuperscript{362} Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See records and drawings for TA-16.
explosives operations. For example, at S-Site’s full-scale lens casting facility most of the outside doors were boarded up soon after the building was constructed to control access and the limit air currents that might cause powdered high explosives to go airborne (fig. 6.20).

During actual operations, outside areas were controlled to prevent unauthorized entry. Wig-wag road blocks were used to manage vehicle and pedestrian traffic around some of the operations buildings. 363 Specific protection designs included blow-out walls and roofs, which were purposely constructed of weaker materials that would give way first during an accidental explosion, allowing the blast energy to follow a predetermined path.

Earthen berms, built within free-standing retaining walls or next to buildings, were also part of the high-explosives landscape. Designed to protect buildings and workers from explosions, the berms were an engineering solution that allowed a series of high-explosives operations to be conducted in closer proximity than would otherwise be allowed. In the event of an accidental explosion, berms would protect neighboring workers but not the workers involved in the actual accident. As an additional safety measure, enclosed walkways between buildings were designed with abrupt turns, not in straight lines, to deflect explosive shock waves and prevent an explosion at one end of a corridor from setting off an explosion at the other end. 364

363 A wig-wag road block consists of an arm-bar gate restricting access to operational areas, which is usually counterbalanced to stay in an upright position when not in use.

World War II Narratives: Interpretive Themes of Risk and Ingenuity

S-Site’s Manhattan Project landscape clearly illuminates the risks of working with high explosives, but the voices of military recruits also reinforce the meanings revealed in the landscapes of the bomb. Memoir accounts by SEDs who worked at S-Site in the wake of the plutonium crisis reflect some of the same themes of safety, urgency, and risk. Ed Wilder was a SED who not only prepared the high-explosives sphere for the Trinity test but also helped assemble the Fat Man unit dropped on Nagasaki, Japan, as part of the Tinian Island assembly team. Wilder’s personal experiences at S-Site highlight how high-explosives workers balanced risk against the pressure of wartime conditions. In his memoir account, Wilder described how he and his fellow recruits routinely dealt with safety issues when working around high explosives:

Several times the explosive detonated instead of burning. The man in charge of the burning ground, and who ignited the HE, could speak clearly under normal conditions, but when he was excited he stuttered. Once when the burning ground exploded with a terrific bang, I hurried there to see if anyone was hurt. I met him driving away from the burning ground. He stopped me and said “everything is all right, the burning ground just blew up,” but it took about three minutes for him to say it.

365 Several memoir accounts have been written by military personnel who were stationed at Los Alamos during the war. Other oral histories have been collected by the Los Alamos Historical Society and the Atomic Heritage Foundation; however, a comprehensive study of the Project Y military experience has yet to be produced. See Ralph C. Sparks, Twilight Time: A Soldier’s Role in the Manhattan Project at Los Alamos (Los Alamos, New Mexico: The Los Alamos Historical Society, 2000); Paul Numerof, In August 1945 (Los Alamos, New Mexico: Los Alamos Historical Society, 2006); Val Fitch, "The View from the Bottom," Bulletin of the Atomic Scientists 31, no. 2 (Feb 1975); Hull, Rider of the Pale Horse; Wilder, Jr., "Appendix: Early S-Site Experiences."

Recruited to help develop the implosion weapon, technicians and engineers were given the job to develop the high explosives for Fat Man at S-Site, often through the seemingly endless repetition of small-batch manufacturing and testing. These young men—the average worker at Los Alamos was around twenty-seven years old—often worked long hours with extremely hazardous materials in under less than ideal conditions.\(^{367}\) McAllister Hull also worked at S-Site and recalled that it was “remote from where people from the Lab lived and most of them worked. This was also for safety reasons. If there should be an accident with the explosives that were all over S-Site, the principals in the Townsite would not be injured!”\(^{368}\) When he arrived at Los Alamos, Hull was all of twenty-one years old.\(^{369}\)

Taken together, the S-Site memoir accounts both reflect the challenges faced by the implosion problem and the danger inherent in high-explosives work and hint at themes of resourcefulness, hard work, and youthful recklessness and play in the face of the exigency of war. Project Y military memoirs and associated oral histories warrant additional study to identify interpretive themes and to bring to light the overshadowed worker experiences of the WACs, SEDs, and regular Army personnel stationed at Project Y.

An examination of the deliberately created landscape of wartime S-Site provides an understanding of the risks inherent in high-explosives work. The design and layout of

\(^{367}\) Hull, *Rider of the Pale Horse*, 61.

\(^{368}\) Ibid., 27.

\(^{369}\) Ibid.
the buildings speak to the need for safety protocols dictated by lessons learned from past accidental explosions. Furthermore, temporary construction practices and wood-frame high-explosives facilities tell the narrative of wartime urgency and of a country singularly focused on the goal of winning the war in Europe and in the Pacific, a patriotic fervor that few today have ever experienced. Workers’ memoirs also reinforce the themes of danger, expediency, and the need for safety.

S-Site remains the center for high-explosives research and development at today’s national laboratory. With the exception of one lone and inactive high-explosives magazine, all of the Manhattan Project high-explosives buildings have been torn down, replaced by Cold War doppelgangers constructed out of the reinforced concrete that permanent high-explosives buildings warrant. The high-explosives lines were rebuilt during the late 1940s and early 1950s and, with their unpainted concrete walls and flat overhanging roofs, have a mid-century-modern industrial look.370

Some of the Cold War high-explosives lines have been shuttered or torn down in recent years, but the core high-explosives work at Los Alamos still continues, albeit on a smaller scale, and includes many of the same processes that were first developed during the Manhattan Project: the formulation of new high explosives; the production and machining of special designs; and the examination—using radiographic (X-ray) methods—of the finished high-explosives pieces to assure a quality product prior to testing (fig. 6.21).371


371 Generally, see MacRoberts, "General S-Site Description," Cultural Resources Management Team, Los Alamos National Laboratory.
Key natural features of today’s high-explosives landscape, altered only somewhat by the Cerro Grande Fire that swept through S-Site in May of 2000, include undisturbed islands of Ponderosa Pine forest punctuated by cleared grassy fields near the building areas. S-Site was, and still is, isolated from the administrative center of the laboratory. It is a quiet place where herds of elk often roam undisturbed within the relative security of the fenced-off laboratory land, visiting S-Site in large numbers during the spring calving season and the fall rut (fig. 6.22).

Many of the same man-made elements that were part of S-Site’s wartime landscape can be seen today, from security fences and gates, to the system of unstriped paved roads that crisscross the high-explosives area. Earthen berms and barricades, used during the war as protective structures, are still commonly seen on the landscape, although the wooden retaining walls of Project Y have now been replaced by robust, Cold War-era metal structures. Steam is still used today both to heat S-Site’s buildings and to support high-explosives operations, and vestiges of former wartime and early Cold War above-ground steam lines, wrapped in shiny silver insulation, can, even now, be seen near some of the S-Site buildings.

Like their Manhattan Project antecedents, most of the Cold War high-explosives lines are characterized by interconnecting, covered walkways that allow for the safe movement of high explosives from adjacent rest houses to the each lines’ central processing buildings (fig. 6.23). In fact, many of today’s landscape elements, from protective berms to covered walkways with their zig-zag alignments, are the mirror images of wartime structures, just replicated in modernized and more-permanent forms.
While S-Site’s wartime landscape is gone, the S-Site of today provides an interpretive opportunity, not just as a means to discuss the Cold War legacy of the Manhattan Project, but as a window to the past, for the feeling, setting, and layout of the postwar S-Site clearly harkens back to its Project Y origins. Using the present as a way to understand the meaning of past landscapes will illuminate the overshadowed story of the development of high explosives and highlight the importance of wartime S-Site to the Project Y story.
Fig. 6.1. S-Site high-explosives storage magazine. Front view. This is the last of the original S-Site high-explosives facility built during the Manhattan Project to solve the challenge of how to cast lenses for the plutonium implosion weapon. The unique layout of the high-explosives area reflected existing Army regulations regarding safety during World War II.

Fig. 6.2. Early S-Site casting building. A vast complex of wooden buildings was hastily constructed south of the Los Alamos townsite for the express purpose of developing new methods to produce shaped lenses using cast high explosives.
Fig. 6.3. Early S-Site building interior. New formulations of high explosives were investigated during the war at special buildings designed specifically to support this hazardous work. The first efforts involved small-scale test castings. Finished shapes were checked for imperfections using radiographic (X-ray) methods.

Fig. 6.4. View of the interior TA-16-27. This building was a hub of large-scale casting activity during the war and after. The casting stations used specially adapted commercial candy kettles to melt the high explosives so that the molten mixture could be poured into molds and cooled as part of the casting process.
Fig. 6.5. The large S-Site high-explosives area was built on the former Ramón Vigil Land Grant. During the early twentieth century, this part of the Pajarito Plateau was used for cattle and sheep grazing and timber harvesting. The Project Y technical area was named S-Site for “Sawmill” Site. The name was inspired by a large pile of sawdust left behind by earlier lumber operations.

(Photography courtesy of the Los Alamos Historical Society Photo Archives)

Fig. 6.6. Seth Neddermeyer was one of the first Los Alamos scientists to pursue the study of implosion, an inward explosive force. Some of Neddermeyer’s early attempts to crush cylinders using high-explosives charges are shown here.
Fig. 6.7. Anchor Ranch Proving Ground was not the only facility developed in the old Anchor Ranch area. A separate grouping of buildings and test areas was built to the east and across the road from Gun Site. Known as Anchor Ranch East and seen in this 1946 aerial view, the site was home to early casting research related to implosion. Crowded conditions here resulted in the construction of S-Site.

Fig. 6.8. George Kistiakowsky was a Ukrainian-born high-explosives expert recruited to lead the implosion program at S-Site after plutonium was recognized as being unsuitable for use in a gun-assembled weapon. The new plutonium weapon design, Fat Man, required a complicated high-explosives core.
Fig. 6.9. The former Port Chicago ordnance area in the San Francisco Bay Area was a shipping point for wartime high explosives and also served as a temporary storage area. Port Chicago igloos (right) are representative of standard military high-explosives storage facilities. Port Chicago’s port and inland areas were connected by an internal rail line for ease of transport.

Fig. 6.10. Magazines and other high-explosives storage buildings were part of the S-Site wartime landscape. Army safety protocol drove the layout of facilities with rules for safe distances and maximum loads of high explosives. Protective earthen berms and blow-out walls and roofs were standard safety features. Magazine Area A was located away from the main S-Site area and included a row of small storage magazines. An example is shown above.
Fig. 6.11. Expedient wartime construction at S-Site and other high-explosives handling areas resulted in poor design decisions, including placing earthen berms directly up against the walls of wood-frame buildings (V-Site’s building TA-16-515 is shown above).

Fig. 6.12. The undeveloped roads in the remote laboratory areas could present a transportation challenge. High explosives were moved between wartime sites in trucks and jeeps. Hazardous materials were also delivered to Los Alamos over fairly primitive 1940s-era New Mexico roads.
Fig. 6.13. During the war, S-Site was constantly expanding operations. Specific processing functions were often co-located in physically distinct areas or “lines.” A new casting building complex, with associated walkways, rest houses, and other safety features, was constructed in 1945 to support the production of full-scale, high-explosives lenses for the last minute tests and the final combat units (top center).

Fig. 6.14. Magazine Areas A, center, and B, lower right, were located to the south of S-Site, close enough to access, but far enough away to store surplus high explosives and other hazardous items at a safe distance. This separation of work areas is a characteristic landscape detail related to the risk of handing high explosives.
Fig. 6.15. A group of military men at S-Site. Many who worked with high explosives were SEDs. At S-Site, high explosives were moved between areas in vehicles or hand-carried between buildings.

Fig. 6.16. Wartime barricades were constructed to protect workers from accidental explosions in neighboring buildings. Some of the high-explosives areas were designed with interconnected buildings for increased efficiency of operations. However, this type of layout also presented increased risk to the workers.
Fig. 6.17. Some of the bunkers located near buildings, like this one at S-Site, were designated as personnel shelters for use during thunderstorms. Some bunkers were identified as smoking areas because smoking was not permitted anywhere near the high-explosives operations.

Fig. 6.18. Steam lines were a characteristic landscape feature at S-Site, both during the Manhattan Project and the Cold War. The steam lines provided heat for the building and were also used to support the high-explosives processing activities.
Fig. 6.19. Examples of interior safety features at S-Site. Crouse-Hinds EP electrical switches were designed to be spark and explosion proof (left). Copper doors (right) were common in high-explosives processing buildings, such as the one shown here inside the TA-16-27 full-scale casting building.

Fig. 6.20. High-explosives buildings were often designed from standard military plans. Often these designs had to be modified to meet the functional requirements of hazardous operations. At one of S-Site’s casting buildings, TA-16-27, exterior doors were boarded up to limit access and reduce unwanted air flow into the main casting room.
Fig. 6.21. While some of the Cold War high-explosives complexes or “lines” have been torn down since this photograph was taken in 1990, the remaining Cold War facilities still represent the special high-explosives landscape that was deliberately created with safety in mind to minimize operational risks.

Fig. 6.22. S-Site today retains a setting and feeling that hearkens back to its wartime roots. Herds of elk often frequent the forested area, which is isolated from the rest of the current national laboratory and the town of Los Alamos.
Fig. 6.23. Covered walkways protect workers and high explosives from the elements. As a safety measure, practiced today and during the Manhattan Project, high explosives not immediately being used are stored in nearby “rest houses,” which are accessed via special paths or walkways. Covered walkways were constructed in a zig-zag configuration so that a blast wave from an accidental explosion would not travel in a straight path directly to an adjacent high-explosives area, potentially triggering another explosion.
CHAPTER 7

ENGINEERING THE BOMB: IMPLOSION TESTING, A WORKFORCE SHORTAGE, AND THE WOMEN OF PROJECT Y

The real difficulty with the implosion bomb project was that at the start there were no known experimental methods to determine how perfect—and, if not, then why not—were the implosions of smaller experimental charges that were fired in many configurations and observed by a variety of methods invented in the $X$ and the $G$ divisions.

George B. Kistiakowsky, “Trinity – A Remembrance”

In the past, whole groups of people—women, enlisted military, local workers, minorities—have been excluded from the standard telling of Manhattan Project history, and stories have often focused on the accomplishments of a few famous men, resulting in a misrepresentation of the complexity of the Los Alamos experience. The historical emphasis on a handful of Nobel Prize-winning scientists has also obscured the contributions of nonscientists and technicians and the vital role of engineering and testing that was key to the success of Project Y’s wartime mission.

In an iconic Los Alamos photograph, Frances Dunne, wearing a silk bomber jacket, leans over to set an explosives charge. Her hair is carefully styled, with bows framing her face; her pants are cuffed in the fashion of the day and her nails are neatly polished. In this black and white image, she appears delicate and, above all, feminine—not at all the stereotypical image of an Army technician working in Project Y’s hazardous and remote high-explosives areas (fig. 7.1). Like other U.S. war-production factories of the time, the Los Alamos project recruited women to support the technical needs of

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372 Portions of the chapter were included in UNM Master’s thesis: McGehee, "The Women of Project Y".
World War II. While some female technicians came to Los Alamos from New Mexico communities, others were part of the WAC, or, like Dunne, had previous experience working at war plants.

With recent research documenting the role of women at other Manhattan Project facilities, the wartime contributions of technical and support workers are slowly being acknowledged.\(^{373}\) The exclusion of the average worker from the narrative has also constituted a genuine loss of communal memory. However, according to anthropologist Paul Connerton, historical interpretation can rectify this loss. He notes that “the practice of historical reconstruction can in important ways receive a guiding impetus from, and can in turn give significant shape to, the memory of social groups.”\(^{374}\)

The omission of the nonscientist from the narrative impacts the telling of stories related to important technological advances critical to the development of the implosion weapon. The complicated design of Fat Man required not just the construction of a new high-explosives area, staffed primarily by SEDs, but also the invention and testing of high-speed detonator technology and the development of new ways to understand the inner workings of implosion. The vital role of engineering in the creation of the first atomic bombs, with its strategies of repetitive testing and diverse methods of problem-solving, is presented in Lillian Hoddeson’s *Critical Assembly*, first published in 1993.\(^{375}\)

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375 Hoddeson, *Critical Assembly*, 4-11.
Today, however, this mostly technical story of American ingenuity is relatively unknown, its details obscured by scientific terminology and hidden in closed archives. The remaining places that represent this history—Pajarito Site’s Battleship bunker, the firing pit at L-Site, the small bunkers at K-Site that supported Donald Kerst’s betatron research, and Q-Site’s darkroom building—are included in the park legislation, but are relatively unknown to the general public. Like the high-explosives magazine at S-Site, these buildings and structures have been overshadowed by the wartime buildings that, as the birthplaces of the bombs, symbolize the controversial use of atomic weapons against the Japanese people.

At Los Alamos, the history of the Manhattan Project must include the voices and experiences of all workers, not just the top scientists and military officers. In fact, the development of the first atomic weapons during World War II would not have been possible without hands-on work by engineers, machinists, and other technical workers, including the women of Project Y. Engaging the stories, technologies, and places of the implosion diagnostic effort will add meaning to the underrepresented narratives of these workers and their historical workplaces.

**A Complex Design**

In July of 1944, Project Y was reorganized to solve the implosion problem. The Fat Man design was complicated and required new technology that would rely on engineering methods and repetitive testing for its development. The success of the implosion weapon was ultimately related to the diversity of problem-solving strategies.376

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used at Los Alamos, from the dedicated use of at least twelve outlying technical areas for implosion testing to the development of more than a half dozen diagnostic methods to study the inner workings of implosion.377 The crisis of 1944 not only drove the need for new facilities and new scientific and engineering approaches to tackle the complex implosion design, but resulted in the need for more technical workers, including women and a special army detachment of men selected specifically for the Los Alamos project, most with backgrounds in engineering, chemistry, mechanical, and high-explosives work.378 When faced with the unsuitability of plutonium for use in the gun device, the concept of implosion was made into a reality because the laboratory used every means at its disposal: Los Alamos drew upon its technical knowledge, its ability to procure resources, and its hardworking and creative workforce to solve the implosion problem.379

The Importance of Applied Physics and Engineering

The major accomplishment of Project Y was the actual production of the first fission devices—a feat of engineering design, manufacturing, and testing that transitioned a theoretical concept to a weaponized reality.380 Scientist Robert Serber, in his introductory lectures known as “the Los Alamos Primer,” acknowledged this when he said that the laboratory’s principal mission was the production of “a practical military weapon.”381

377 Hoddeson, Critical Assembly, 139-156, 268-281.
378 See McGehee, "The Women of Project Y".
379 Hoddeson, Critical Assembly, 248.
380 Ibid., 4-5.
381 Serber quoted from ibid., 69. See also, Serber, The Los Alamos Primer, 2.
Fortunately, much of the theoretical basis for atomic weapons was well known by the time Oppenheimer started assembling his team of scientists in early 1943. Henry Smyth, in his postwar history of the Manhattan Project, stated that top scientists were familiar with the general principles related to atomic bombs and chain reactions before Los Alamos was established.\footnote{Smyth, \textit{Atomic Energy for Military Purposes}, 29-30, 43-44, 73-74, 209.} Downplaying the role of fundamental scientific research, scientist Richard Feynman went even farther, characterizing the wartime scientific effort as a meager one: “All science stopped during the war except the little bit that was done at Los Alamos. And that was not much science; it was mostly engineering.”\footnote{Richard P. Feynman, "Surely You're Joking, Mr. Feynman!" \textit{Adventures of a Curious Character} (New York and London: W. W. Norton & Company, 1997), 108.}

Specific scientific and engineering details still had to be worked out, however, for chemical, metallurgical, and other technical problems abounded.\footnote{Los Alamos National Laboratory, "A Proud Past, An Exciting Future," 9.} Further work was needed on many aspects of weapons design including the key areas of critical mass, instantaneous assembly, methods of detonation, and effects of tamper.\footnote{Tamper is an internal component of the atom bomb and serves to reflect neutrons. The presence of tamper material delays the expansion of the exploding material and makes the explosion more energetic. Smyth, \textit{Atomic Energy for Military Purposes}, 213.} In response to these and other research problems, diverse and complex engineering methods were developed relating to detonator, initiator, and high-explosives research. Rigorous testing practices were followed, and, in many experiments, key components were tested to failure in order to understand the minutest of design flaws.\footnote{Generally, Manhattan Engineer District, "Book VIII, Volume 2 - Technical."}

Project Y staff used many different problem-solving strategies to accomplish the technological feats associated with the development of the first atomic weapons. Many of
these methods were variations on the “trial and error” approach and were not based on thorough analysis—traditional analytical methods would not produce the rapid results needed under the strict time deadlines. To speed along the design process further, a fundamental Los Alamos concept was the practice of working simultaneously on multiple solutions for any given problem.387

The Need for Diagnostic Facilities

The importance of engineering methods is best illustrated by Los Alamos’s response to the plutonium crisis of 1944 and the need to develop an alternative weapon design quickly. Mostly unknown today—their stories obscured by scientific terminology and still-classified details—a number of technical areas were constructed in remote locations away from the Los Alamos townsite for the sole purpose of building and testing components associated with the design of the implosion weapon. Dotting the mesa tops and located at the ends of two-track dirt roads, many of these new test sites were hastily built field laboratories made up of a storage hutment or two, firing areas, associated control bunkers, and, occasionally, office and shop buildings.388

These new technical areas were staffed with small crews of scientists and technicians, whose primary assignment was to develop ways to verify that the high-explosives assemblies were producing the desired inward explosion necessary to symmetrically compress the plutonium at the core of the Fat Man weapon (fig. 7.2). In late 1943, to support early small-scale implosion tests conducted on cylindrical shapes,  

388 See Los Alamos Scientific Laboratory, "Technical Area Structure Location Plans," Los Alamos National Laboratory Records Center.
various Los Alamos groups were given the task of developing diagnostic methods to see inside an explosion. Early strategies included a diagnostic technique developed by the Explosives Research Laboratory (ERL) at Bruceton, Pennsylvania, which involved photographing the insides of the cylinders during at test using Bruceton’s “high explosive flash light” method. At Los Alamos, at least seven diagnostic techniques were ultimately developed to document how well implosion worked: terminal observation; magnetic method; counter X-ray; electric pin; flash photography; betatron; and RaLa (radiolanthanum).

Mostly abandoned and inactive, only a few of these former implosion diagnostic facilities remain at Los Alamos today. Listed in the national historical park legislation, but largely unknown to the general public, they symbolize the all-encompassing effort required to solve one of the greatest scientific and engineering challenges facing the wartime laboratory. Once interpreted by the National Park Service, the remaining implosion diagnostic areas will become public sites of memory representing the technology born of World War II that was rapidly developed to design the implosion weapon and that is still used at the modern national laboratory to support verification of the U.S. nuclear stockpile.

390 Critical Assembly describes these diagnostic techniques in detail on pages 139-156 and 268-281.
The Magnetic Method

Lower Pajarito Canyon was the location for several different scientific projects during the Manhattan Project. Emilio Segrè’s Radioactivity Group first used Pajarito Canyon in the summer of 1943 to study samples of plutonium and determine counting rates from its spontaneous fission. The work conducted at Pajarito Site by Segrè and others led to the abandonment of the plutonium gun-type design in July 1944. Soon after, as the development of the plutonium implosion weapon drove the need for new testing areas, firing sites were built at Pajarito Site to study high-explosives shots using the magnetic method.

By the fall of 1944, Segrè’s group had moved to another facility, the East Gate Laboratory, located away from the hustle and bustle of Pajarito Canyon, which now had a new mission related to the development of the implosion weapon. According to the official Project Y history produced shortly after the end of the war, the move was a beneficial one for the Radioactivity Group: “This change had the advantage of a much shorter commuting distance, and also of avoiding close contact with new high explosive firing sites, as the test area of the implosion program expanded toward Pajarito Canyon.”

As early as the summer of 1944, two small firing sites were built at Pajarito Site to study high-explosives tests using the magnetic method. The basic principle involved producing a static magnetic field around a test assembly. Recording equipment would then document the changes in the field that were produced by the inward motion of

393 Ibid., XII-3.
imploding metal. This diagnostic method gathered important information about the velocity and other characteristics of an implosion.\textsuperscript{394}

**Early Experimentation (1943–1944)**

Los Alamos physicist Joseph Fowler is credited with coming up with the idea for the magnetic method. By the end of 1943, Fowler’s group was in the final stages of developing this new diagnostic technique and, by January of 1944, the first test shot using the magnetic method was conducted.\textsuperscript{395} Initially, Fowler and his team had trouble with some of data recording equipment, and this problem, according to the *Manhattan District History* account, “held up final proof of the method until spring.”\textsuperscript{396} Photographic equipment, including a 35-mm camera, was eventually used to capture the test data measured by an oscilloscope, a key piece of instrumentation employed in the experiments.

The team had considerable success documenting the timing of implosions, and by the summer of 1945, the data from the magnetic method was on par with other methods.\textsuperscript{397} George Kistiakowsky, who was by then the head of the explosives research efforts at Los Alamos, felt that the magnetic method’s initial design phase was complete, and with its success in determining the velocity and final radius of collapsing spheres, the method had the potential for use with other diagnostic methods that were producing

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\textsuperscript{396} Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-30.

\textsuperscript{397} Hoddeson, *Critical Assembly*, 156.
information about the symmetry of implosions.\footnote{Ibid.} The Project Y volume of the

*Manhattan District History* notes the status of the magnetic method in August of 1944. Coordinating this method with other diagnostic methods, such as the X-ray, RaLa, and betatron methods, was a primary goal, along with adapting its use to the study of jets and to larger-scale tests.\footnote{Manhattan Engineer District, "Book VIII, Volume 2 - Technical." *Critical Assembly* defines jets as “tongues or knives of molten material squirting ahead of the collapsing main shell envelope” (page 140). Jets were occurring during implosion tests and were a concern because they affected the symmetry of the inward explosion.}

Driven by the plutonium problem and the need to develop a deliverable implosion weapon, Project Y managers reorganized the wartime laboratory and formed groups now formally dedicated to the use of diagnostic methods to understand how well test explosions were working. Edwin McMillan was selected to head the Magnetic Method Group (G-3) in August of 1944.\footnote{Hoddeson, *Critical Assembly*, 272.} Although McMillan formed four sections of the group, it would be J. L. Fowler, working at a site called “South Mesa Extension,” who would make the most progress through the late summer and fall. The other sections were primarily focused on developing techniques for coordinating the magnetic method with other existing methods, such as the RaLa experiments at Bayo Canyon and the X-ray experiments at P-Site.\footnote{Ibid., 273.}

**Developing Pajarito Site for Magnetic Method Tests**

By December of 1944, Pajarito Site in lower Pajarito Canyon was developed as a proving ground for the magnetic method. Group G-3 took over the site—formerly used by Segrè’s group, enlarged it, and constructed several firing sites. One firing site,
constructed near today’s Casa 1 facility, was used for experiments involving small explosive charges of a few pounds (fig.7.3). A second site, located near present-day Casa 2, was called the medium or intermediate firing site. It was established for charges of several hundred pounds.\footnote{S. Kershaw, W. Marley, and Sgt. Williams, "Memorandum of Discussion on 2 May 1945: Hazards for Shake-Test on Two-Mile Mesa, May 2, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives. Note: The Casa 1, Casa 2, and Casa 3 criticality experiment buildings were historically known as “Kiva” buildings 1 through 3, respectively.}

Both firing sites were located in the canyon bottom close to the former Ramón Vigil Grant headquarters area. Each site had a main control building, which was a partially aboveground battleship bunker, and a designated firing area or pad. In addition to control bunkers, at least one of the firing sites included a “submarine” building housing a generator and a battery building.\footnote{Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center; Los Alamos Scientific Laboratory, "Technical Area Structure Location Plans," Los Alamos National Laboratory Records Center. See records, drawings, and site plans for TA-18.} The reinforced-concrete battleship buildings, so-called because the ends of the bunkers were bow-shaped and shielded with steel plate, housed the delicate equipment used to collect data from each test shot, and protected the workers who set off the shots.\footnote{Los Alamos National Laboratory, "Photographic Collections," Los Alamos National Laboratory Archives and Records Center. See TA-18 photographs.}

The magnetic method firing sites at Pajarito Canyon, under the direction of Edward Creutz, were constructed away from other Project Y test sites because of concerns about electromagnetic background that might interfere with the magnetic method’s results.\footnote{Hoddeson, \textit{Critical Assembly}, 273.} However, when experiments were begun at Pajarito Site, stray signals from the test’s electric detonators and other electrical “noise” from the test itself were
caused the magnetic record to be corrupted. Fortunately, instrumentation work conducted at Los Alamos’s Main Technical Area had led to improvements in the test’s diagnostic equipment, and, eventually, the Pajarito proving ground staff were able to better understand the results of their experiments. According to the official Project Y history, “new results were obtained when it became possible to ‘purify’ the magnetic records and interpret their details. It was found that several reflected shock waves from the metal core could be recognized. The intersection of detonation waves also produced reliable signals.”

At the beginning of 1945, test results were beginning to provide useful information about the process of implosion, and the new implosion diagnostic mission at Pajarito Site was in full swing. The focus over the next months would be the continued test firing of small- and medium-sized high-explosives assemblies. Pajarito Site researchers, however, were still experiencing electromagnetic background readings and poor quality data caused by interference from the explosives tests themselves.

Prior to the Trinity test in July of 1945, a full-scale test of a high-explosives assembly, known as the “Creutz” test, was conducted at Pajarito Site to support final diagnostic checks of the Trinity gadget’s experimental design (see chap. 8). This test was conducted at Pajarito Site because the magnetic method was the only diagnostic technique developed for use with full-scale implosion assemblies. All magnetic method firing tests, however, were discontinued at the site by the end of 1945, with the group

407 Hoddeson, Critical Assembly, 273.
being dissolved on January 1, 1946. The magnetic method itself was only used after January to supplement the RaLa tests in Bayo Canyon.408

Two battleship bunkers are all that remain of Pajarito Canyon’s wartime firing sites. Built in 1944, the bunker buildings were constructed of cast-in-place, reinforced concrete. Today, the best example of the two is being preserved for interpretation and is proposed for inclusion in the Manhattan Project National Historical Park, which will be established by the end of 2015. The bunker sits partially underground, with concrete steps leading to a sunken, blast-resistant steel door.409 Unlike the high-explosives bunkers at S-Site, this building is not enclosed in a protective earthen berm; its concrete roof and sides are exposed to view (figs. 7.4 and 7.5). At both bunker locations, the firing sites and associated battery and submarine buildings have long been removed—making way for Cold War research priorities and related infrastructure.

L-Site (Terminal Observation)

In response to the 1944 implosion crisis, several diagnostic techniques were developed in quick succession, each established at a separate field test facility. The terminal observation method was one of the earliest used to study implosions. As part of terminal observation, Project Y workers would detonate a small-scale assembly of high-explosives, approximating the scaled-down center section of a Fat Man-type bomb. After each assembly was detonated, researchers would collect the remains of the experimental shot to evaluate the success of the implosion test. Seth Neddermeyer’s early implosion

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work in 1943 relied extensively on this relatively crude diagnostic method. Later, terminal observation experiments focused on the performance of high-explosives lenses. Scientist Lilli Hornig recalled in a 1986 interview that she worked with Walter Kauzmann and Henry Linschitz on data analysis, but was not part of the field team: “We used steel plates that must have been maybe 8 x 12 inches. . . . You mark on the plate where you put the explosive, when you detonate the thing, the wave travels more or less as it is supposed to, and you get an imprint.”

The Terminal Observation Group (X-1B) developed L-Site in the fall of 1944 as one of the new implosion diagnostic test areas. Located northeast of the S-Site high-explosives area, L-Site’s original facilities included a firing pit, a personnel shelter, a storage building, and two high-explosives storage magazines. At L-Site, test assemblies were detonated in the site’s firing pit. Given the designation L-4, the hexagonal firing pit was built of heavy timber (fig. 7.6). Capped with an eight-foot-square steel lid, the sides of the pit were designed with three-quarter-inch steel plate to protect the structure from explosive blasts. L-Site was abandoned in 1953, and in 1960, all remaining structures, with the exception of the firing pit, were destroyed. Several similar firing pits were constructed at Project Y in response to the crisis of 1944. However, the L-Site firing pit is the only one that still remains.

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410 Hoddeson, Critical Assembly, 146.
411 Lilli S. Hornig, "Interview with Dr. Lilli Hornig, June 25, 1986," Transcription of Tape, TR-86-026, Los Alamos National Laboratory Archives.
412 Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center; Los Alamos Scientific Laboratory, "Technical Area Structure Location Plans," Los Alamos National Laboratory Records Center. See site plans for TA-12 and records and drawings for TAs 12 and 67.
Located out of sight on a little-used gravel road, the firing pit stands alone on its small earthen mound (fig. 7.7). Most of the current laboratory’s workforce have never seen this Manhattan Project experimental structure; few today even understand the significant role it played in the development of the Fat Man weapon.

**K-Site (Betatron)**

By early 1945, the facilities at K-Site were supporting the betatron diagnostic method used to collect data on the implosion of spheres. Small in scale compared to the high-explosives operations at nearby S-Site, K-Site was staffed by a handful of scientists and members of the Army’s special engineers. Val Fitch, former SED, recalled his experiences supporting some of the technical aspects of Project Y: “During the fall and winter of 1944 I became familiar, first hand, with the speed of propagation of detonations, Kerst’s betatron at ‘K site,’ and the design and construction of better oscilloscopes for recording timing information.”\(^{413}\)

At K-Site, a 15-MeV betatron machine (gamma ray source) was used in conjunction with a cloud chamber. The diagnostic procedure involved the detonation of a test implosion between two of the buildings, one housing the betatron equipment and the other housing the cloud chamber and associated recording equipment. The betatron method was similar to using flash X-ray as a diagnostic tool. However, this method used more-penetrating gamma radiation from accelerating electrons to examine denser objects. The betatron radiation created a record in a cloud chamber after passing through a test implosion. Flash X-ray, betatron, and magnetic method data would eventually be

\(^{413}\) Fitch, "The View from the Bottom," 45.
combined to provide some of the best information about the inner workings of implosion.  

The K-Site complex included several small heavily reinforced concrete buildings, including a control building, the betatron building, and the cloud chamber building. Like the high-explosives buildings at nearby S-Site, the K-Site buildings were covered with earthen berms for added protection against the test-shot shrapnel. The two main diagnostic buildings were aligned nose to nose on opposite sides of a firing pad. Modified to support later high-explosives research, the buildings were in use during most of the Cold War and are, today, part of an active firing site (figs. 7.8–7.10).  

Donald Kerst

K-Site was named for Donald (D. W.) Kerst, inventor of the betatron machine (fig. 7.11). John Manley, writing about Los Alamos’s early days, recalled betatron research at the University of Illinois carried out before the war by Don Kerst and fellow physicist Robert Serber:

A major event was the success of Kerst, the experimentalist, working with Serber, the theorist, on betatron acceleration of electrons. Kerst’s lab was next to mine and one night in July 1940 I heard a shout of glee from Don. I dashed in and found a Geiger counter near his little table-top machine responding merrily to the gamma-rays from the two million electron volts inside the glass doughnut.  

Manley also played an important role in recruiting Kerst for Project Y. As early as 1943, the betatron machine and its inventor were seen as important Manhattan Project scientific assets. Manley was asked to convince Kerst’s employer, the University of Illinois, to allow him to leave the university to support the weapons work at Los Alamos. Kerst eventually joined the project in late summer 1943. In an article for the Bulletin of the Atomic Scientists in 1974, Manley recalled his assignment: “Even after I was in residence at Los Alamos I was given a special recruiting task. It became evident that to explore certain problems of critical mass assembly for the bomb, the high energy radiation from a betatron would be most useful, perhaps essential. Obviously the person to depend on for this was the betatron inventor, D. W. Kerst.”

Scientific Equipment and Wartime Priorities

Acquiring Kerst for the Los Alamos project was a much easier task than acquiring an actual betatron machine to use at K-Site (fig. 7.12). Luckily for Los Alamos, General Groves had requested the highest priority level for the acquisition of materials during the war, with the Manhattan Project eventually receiving the AA-1 rating by the summer of 1944—a rating usually reserved for military production facilities such as aircraft plants and shipyards. The University of California procurement office, located in downtown Los Angeles, was used to funnel procurement requests from Project Y staff to various suppliers. Deliveries of scientific equipment were often sent to Los Alamos by way of the UNM, which had wartime connections to the Manhattan Project through its OSRD

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417 Ibid., 45.
418 Hoddeson, Critical Assembly, 65.
contract work directed by physics department head, E. J. Workman.\textsuperscript{419} Unable to have a betatron machine built in time, project organizers identified a 15-MeV betatron machine being fine-tuned at the University of Illinois that was destined for use at the Rock Island Arsenal. Using the might of the AA-1 rating, the equipment was diverted to Los Alamos and installed at K-Site along with Donald Kerst and his group.\textsuperscript{420}

**Q-Site (Flash Photography)**

High-speed photography techniques were developed by Project Y scientists to study the detonation waves produced by experimental high-explosives lenses. The Flash Photography diagnostic method made use of high-speed cameras, developed from technology similar to that used in motion picture cameras of the day. High-speed cameras developed by Los Alamos’s Instrumentation Group were important tools used to record implosion data such as velocity and symmetry at wartime implosion test areas (fig. 7.13).\textsuperscript{421}

At Q-Site, built in 1944, small-scale cylinder implosions were studied with a rotating-prism camera (fig. 7.14). Terminal observation experiments were also conducted at the site. Wartime facilities included a control building, high-explosives magazines, firing chambers, and a shop and darkroom building. Many of the early implosion field laboratories were originally constructed to focus on one specific diagnostic method, but

\textsuperscript{419} Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-4; Parsons, "Memorandum to All Ordnance Leaders and Dana Mitchell; Attention: All Secretaries; Subject: Negotiations with Certain Outside Activities to Obtain Engineering Assistance, Information, and Material," Los Alamos National Laboratory Archives.


several of the later field sites, like Q-Site, with its co-located Flash Photography and Terminal Observation experimental areas, were designed to conduct experiments using a combination of diagnostic methods.\textsuperscript{422}

Numbered Q-6, the original dark room and shop building is in active use at today’s Q-Site, which still functions as a firing site. No longer supporting high-speed camera operations, the small, wood-frame building is used primarily for its restroom facilities and general storage space. The wooden building, quickly built as a temporary wartime facility, is clad with its original asbestos shingles and has vintage windows lining its north face—a facility out of sync with the Cold War setting of the current firing site (fig. 7.15).\textsuperscript{423}

### A Workforce Shortage

The diversity of problem-solving techniques that led to the successful test of the implosion device—represented today by the four remaining implosion diagnostic facilities—were supported by a burgeoning workforce, over twenty times larger than original estimates. Project leaders had initially surmised that Los Alamos’s wartime workforce would not exceed 300 people.\textsuperscript{424} By the end of 1943, however, approximately 500 laboratory employees were working at the project, and the town’s population had

\textsuperscript{422} Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See TA-14 records and drawings.

\textsuperscript{423} Ibid. See drawings and records for TA-14.

\textsuperscript{424} Truslow, Non-scientific Aspects of Los Alamos Project Y, 40.
risen to 2,000.425 Army historian Edith Truslow estimated that Los Alamos’s onsite population had reached over 5,500 people by the end of 1944. Truslow’s postwar account lists an estimated population of 8,200 in 1945, and a population as high as 10,000 in 1946.426 The Army, the University of California, the U.S. Civil Service, and various construction contractors were the main employers during the wartime years at Los Alamos.427

Although Project Y is well known for its Nobel Prize-winning cadre of physicists and mathematicians, most of the workers supporting the hands-on production, assembly, and testing research were technicians, specially recruited for their qualifications as machinists, explosives workers, engineers, draftsmen, and the like (fig. 7.16). Without the SEDs, WACs, and civilian men and women whose names have been overshadowed by the names of world-renowned scientists, the theory of the bomb could not have been transformed into a deliverable weapon for use during wartime.

**SEDS**

Army SEDs assigned to Los Alamos—who were usually young engineers, not scientists—worked in testing and diagnostic areas to support the development of the first weapons (fig. 7.17). SEDs often had undergraduate degrees and were fresh out of college; they were specifically recruited to work alongside the project’s civilian scientists in the

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425 Marjorie Bell Chambers, “Technically Sweet Los Alamos: The Development of a Federally Sponsored Scientific Community” (Ph.D. Dissertation, The University of New Mexico, 1974), 68. Note that “population” is not the same as “workforce.”

426 Truslow, *Nonscientific Aspects of Los Alamos Project Y*, 101. Although no total workforce numbers have been published, numbers in Truslow’s *Manhattan District History: Nonscientific Aspects of Los Alamos Project Y* and Hawkins’s *Project Y* suggest that about 6,000 military and civilian personnel were working at Los Alamos by the end of the war.

427 Ibid.
laboratories and field research areas. Val Fitch recalled how he was assigned to work with British scientist Ernest Titterton on the first day he arrived at Los Alamos and was given the task of working on an implosion diagnostic problem:

On arrival at the Tech Area the first morning I was immediately assigned to work in the group of Ernest Titterton, a young English physicist who had been heavily involved in the radar program in Britain and who was one of the roughly 20 member British Mission to Los Alamos. His group (another SED, Russell Lowry, and two civilian technicians, Gilbert Mathis, and Calvin Linton) was largely concerned with the fast timing measurements of detonation phenomena. My first job was to build a mixing circuit for measuring the degree of simultaneity of several independently initiated explosive shock waves.428

Fitch, unlike some SEDs who felt that they were underappreciated as technical workers because of their army status, enjoyed working at the wartime laboratory. He would later be assigned to the remote testing areas, supporting detonation research and working at K-Site with Donald Kerst’s betatron team to record the timing of implosions.429

The Women of Project Y

The engineering effort to produce the first bombs required a large workforce with a diversity of specialized skills and not just a handful of Nobel laureates. This need for workers became more pronounced with the realization that an alternate design (i.e., implosion) would be required to produce a fission weapon using plutonium. To help meet the needs of Project Y, women with scientific and technical backgrounds were actively recruited for their unique qualifications or skills.

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428 Fitch, "The View from the Bottom," 44.
429 Ibid., 45.
Women contributed to the scientific successes of the laboratory and to the development of the town of Los Alamos. As scientists and technicians, women helped design and build the first atom bombs. As nontechnical workers, they provided the administrative and operational support that kept the scientific laboratory running. As community workers and social organizers, they made the wartime community work. Regardless of their backgrounds or their contributions, as women of the 1940s they experienced many of the same gender and sociocultural issues, balancing wartime work commitments with the societal expectations of the day.

**WACs**

Of the more than six hundred women who worked at Los Alamos, approximately 40 percent were members of the Women’s Army Corps or WAC.\(^{430}\) The WACs played an important role in the history of Project Y, supporting basic laboratory functions and also participating in and contributing to the technical and scientific needs of the Project. Scientist Charles Critchfield noted the importance of the SED and the WAC to the Los Alamos mission:

> Groves had arranged that . . . we could have a testing proving ground. But we didn’t have the hands to do it . . . . But then the General got this idea of a special engineering detachment and of course, Women’s Army Corps. That way we got a lot of enlisted people here who had scientific training, most of them were in engineering or physics or chemistry. Those were our working staff for the field work and for the laboratory work and also for other things like secretaries and service work and telephones, things of that sort came from the military. It couldn’t have worked without that.\(^{431}\)

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\(^{430}\) Truslow, *Nonscientific Aspects of Los Alamos Project Y*, 105. WAC names were also found in files from the LANL archives; 239 individual names have been identified thus far.

At Los Alamos, WACs were assigned to jobs that were traditionally performed by men, such as working as motor-pool drivers and supply clerks. The Los Alamos WACs were housed locally in barracks and worked both in the town site and behind the Technical Area fence in a variety of technical and nontechnical jobs (fig. 7.18). Some of the WACs were college graduates and a few held graduate degrees—most had above average abilities and educational backgrounds. WAC Edith Haag remembered being given a battery of tests prior to being sent to Los Alamos: “I came to find out later that my tests had indicated my IQ was so and so and that’s what they wanted. I passed all the tests with what they required, plus my education was pretty good for back in 1944.”

Originally brought to Los Alamos to serve as clerical workers or to work on basic jobs, WACs worked in a diversity of occupations including phone operators, babysitters, librarians, hospital technicians, clerks, and Post Exchange (PX) and commissary workers. Those employed as computer specialists, technicians, or scientists worked within the security areas, often handling classified material.

**Wives and Other Recruits**

Scientist and Los Alamos organizer Edward Teller set forth a plan for Project Y wives as early as December of 1942: “Generally it is planned that technical secretarial jobs and other jobs making living conditions better at Site Y, will be open to the wives of

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433 Truslow, *Nonscientific Aspects of Los Alamos Project Y.*
the scientists." Los Alamos wartime resident Rose Bethe recalled that Robert Oppenheimer had also thought about the roles of Los Alamos women, as early as the initial planning phases of the project in 1942. A topic of importance to Bethe, both she and Oppenheimer independently came to the conclusion “that it would be very difficult for women . . . unless they also worked in the laboratory in some form or other or had some kind of occupation that took them out of the house." In her 1946 account, librarian Charlotte Serber described the actual hiring process as a relatively easy one:

For the working wife, the actual process of being hired in was not very complicated. It entailed filling in a multitude of forms, getting a pass to the Tech Area, listening to a speech on security, hearing an oversimplified version of working conditions on the Hill, and getting her salary set. Working conditions included forty-eight hours to the work week, two weeks of vacation with pay, sick leave, one day off a month for a shopping trip to Santa Fe, maids available through the Housing Office, and a nursery school for her children.

The initial conditions facing the military and university organizers of Project Y were daunting. Rebecca “Beckie” Diven, who had been recruited for the project in January of 1944, recognized the growing numbers of WACs and civilian women coming to Los Alamos: “It was just a steady influx where they had underestimated the help that


435 Rose Bethe, "Oral History conducted by Paul Henriksen, November 19, 1986," Transcript of Taped Interview, 2, TR-86-045, Los Alamos National Laboratory Archives.

was needed to get the job done.”

Anna Mae Gillespie, a dorm matron at Los Alamos during the war, recalled that the town and laboratory “needed help, whatever they could get, whether it was man or woman.” She felt that the reason for the worker shortfall had to do with the sheer volume of work to be done. Gillespie also mentioned that some of the jobs were not suitable for certain employee categories, citing an example of soldiers who “didn’t work [in] the commissary.”

Writing in 1946, historian Edith Truslow noted that the overseas deployment of military personnel limited the availability of skilled military workers, leading to an initial and unplanned reliance on civilian workers:

The original plan was to use military personnel, with only a minimum of civilians, to keep housing requirements minimal and to provide better security. As the Project grew and as military personnel were urgently needed in combat areas, it became more and more difficult to obtain skilled tradesmen from the ranks of enlisted personnel. Therefore, it was necessary to supplement the organization by hiring civilians.

In order to recruit local civilians, existing personnel policies had to be changed. Lt. Col. J. M. Harman of the Army Corps of Engineers, in an attempt to keep the population down, actively recruited resident women and children for the wartime workforce. To make working at the laboratory less of a hardship to local residents, he petitioned his supervisors in New York in early 1943 to waive the additional assessment.

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439 Truslow, Nonscientific Aspects of Los Alamos Project Y, 23.
of monthly rent when members of the same family were employed by the project.\footnote{Ibid., 59.}

Local teenagers were also recruited to work at the laboratory, both from Los Alamos and from nearby communities. Bette Brousseau, a local high school student, worked part-time during the war in the supply and procurement group.\footnote{Bette Brousseau, "Oral History, Remembering Los Alamos: World War II, February 1, 1992," 5, M1992-112-1-39, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.} Jo Ann Foley, another high school student, started working in the supply group when she was fifteen years old. Her future husband, another local teenager, also worked at the wartime laboratory:

Yet in ’45 almost all of us worked in the Labs. Harry Allen, who was head of supply for the Lab . . . they wanted something for us to do. So they said, well, we’ll hire all the teenagers to work at the Lab. So I was 15 and I worked at the Lab. I worked for the Supply. I typed equipment descriptions on small cards to big cards and this sort of thing. My husband worked in the mail office.\footnote{Jo Ann Peters Foley, "Oral History, Remembering Los Alamos: World War II, January 18, 1992," 12, M1992-112-1-32, Los Alamos Historical Museum Archives, Los Alamos, New Mexico.}

In late 1945, the hiring of students became an issue with the local military administration. Major William Campbell sent out a Post circular to the residents of Los Alamos stating that it had come to his office’s attention that “children of Los Alamos School have been employed part time by the Recreation Department, Post Exchange, and other Sections.” Responding to this employment practice, Campbell established a requirement that school-aged children were to obtain permission from the school superintendent prior to working “in any section or division of this Post.”\footnote{Major William C. Campbell, "Post Circular No. 90, Employment of School Children, October 11, 1945," A-84-019, Box 4-3, Post Circular, Nos. 69-130, 7/4/45-1/3/46, Los Alamos National Laboratory Archives.}
Project organizers might not have initially envisioned a diverse labor force at Los Alamos, but the realities of war compelled them to recruit local men, women, and children to supplement the military and scientific workers. Civilians, whether Los Alamos residents or from the surrounding villages, worked in technical and nontechnical jobs that were vital to the actual production of the first atomic weapons. The need for this larger workforce was directly related to the unsuitability of plutonium for use with the gun-type design. The development of the new implosion design was labor intensive, requiring the extensive testing of explosives lenses and detonator systems; this was an effort that would employ a large number of civilian workers with a diversity of skills, such as machinists, technicians, and procurement and supply workers. Norris Bradbury, Project Y scientist and postwar laboratory director, noted that “machinists, technicians, and truck drivers were as essential to the project as scientists.”444

**Female Scientists and Technicians**

Female scientists were an important part of Project Y’s workforce. With degrees in physics, mathematics, and chemistry, these women had the prerequisite educational backgrounds to make valuable contributions to the scientific mission of the laboratory. By working on the entire gamut of scientific and technical “problems,” they played a key part in Los Alamos’s eventual success. Women working as scientists at Los Alamos were experts in a variety of fields, including reactor design and research, neutron scattering, and molecular spectroscopy. Working as physicists and chemists, they characterized nuclear elements, solved problems relating to Fat Man and Little Boy designs, helped to

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determine the critical mass of fissile materials, and answered physics questions related to the inner workings of the atom bomb.\footnote{See, generally, McGehee, "The Women of Project Y".}

Female technicians designed and tested explosives components, from high-explosives lenses to the detonators that triggered the explosive charges. Mathematicians and computer technicians generated data that could be used to simulate weapons performance. Hospital staff and members of the medical group contributed to the health of townsite residents and employees alike. Biochemists and medical technicians developed monitoring procedures and established safe exposure limits, creating one of the country’s first radiation health programs.\footnote{Ibid.}

**Women and the Implosion Problem**

Most of the female scientists and technicians working at Project Y supported research in physics, mathematics, chemistry, and medicine. However, close to sixty women had technical expertise that supported other aspects of the project. Many of these women worked in X-Division on some aspect of the “implosion problem.”\footnote{Ibid.}

Miriam White Campbell was studying to be an architect at the University of Illinois when the war broke out. Campbell, a member of the Los Alamos WACs, worked as an engineering draftsman behind the Tech Area fence. Her drafting skills were invaluable to the project because few people at the time had experience doing technical drafting in support of physics applications. Campbell was assigned to work with physicist James Serduke on a project under the leadership of Captain Parsons in the Naval Ordnance department. She drew classified schematics and worked on the drawings for

\footnote{Ibid.}
the Little Boy weapon, producing isometric “cut out” perspectives that showed all of the bomb components at once.448

Charlotte Serber was the laboratory’s technical librarian. She worked under laboratory director Robert Oppenheimer and established Los Alamos’s first scientific and technical library, located in the Main Technical Area. As group leader of A-Division’s A-5, she supervised a small team of librarians and administrative assistants who managed Project Y reports and other classified and unclassified materials in T Building’s document room and vault (fig. 7.19).449 Serber recalled that the working conditions behind the Tech Area fence were initially disappointing. Laboratory facilities “had a cluttered, disorderly, academic air” and the offices were “incredibly dirty, overcrowded, and badly equipped.” However, she also recalled that the disappointment over the dreary working conditions was eventually replaced by an enthusiasm inspired by the work and by fellow workers: “It is quite an experience, after all, to be an integral part of a top-secret Project with an Army X-priority, particularly when you find yourself working side by side with the top-flight scientists of the world.”450

Rose Bethe, the Project’s first housing office director, went to work in the Main Technical Area after taking maternity leave. She was originally assigned to work as an assistant to scientist Bruno Rossi who was designing circuits. At first, her job with Rossi


450 Wilson, Standing By and Making Do, 57-58.
was “a great disaster” because Bethe did not know physics and did not have a background in circuitry. She remembered that “the thing he wanted me for was to make up model circuits and you know he would sketch something on a piece of paper and say ‘Now this one needs such a kind of resistor and that one needs this kind of impedance.’ I didn’t know what the words were, I didn’t know what the things were.” Bethe eventually worked on a project that was more in line with her knowledge and skill level—she processed data from cloud chamber events, reading images and correlating the data into curves for Rossi to interpret.

Local Hispanics were recruited to support Project Y, including women who worked with hazardous materials in the remote technical areas and in the townsitelaboratories near Ashley Pond. Technician Annie Lujan was assigned to the Main Technical Area. A native of northern New Mexico, she was a member of Los Alamos’s Chemistry and Metallurgy Division during the war. She worked in the counting shack and operated radiation monitoring equipment, including Geiger counters. Lujan was a radiation technician. She took air samples from D Building and monitored employees as they left the plutonium labs at lunchtime or at the end of the day, usually taking additional employee nasal swipes in the afternoons. To monitor the plutonium in the air, Lujan and her fellow workers would remove the building's air filters. “We used to take them every day, take them down and . . . put them in the chamber, in the counter, and check for radiation.”

451 Bethe, "Oral History conducted by Paul Henriksen," 6-7 Los Alamos National Laboratory Archives.
Lydia Martinez, whose family had homesteaded in the Los Alamos area before
the war, worked with detonators at one of the outlying technical areas. She checked the
quality of finished detonators, working “at a microscope all day where [she] inspected
those parts to make sure the diameter was the right diameter.”

Martinez and other members of her family decided to work at the wartime laboratory out of economic
necessity because “there was no other work around here except farming” and “when the
government took over, they were essentially without work.”

Frances Dunne

Many civilian and military technicians and engineers worked at the high-
explosives testing areas located away from the Main Tech Area. Frances Dunne was
assigned to a team that field-tested small-scale implosion devices, the only woman at
Los Alamos in that capacity. An unlikely recruit, Dunne was a fashion model in the
1920s and 1930s in New York City. She worked in fashion shows and in advertising,
including modeling for the billboard campaign known as “the girl with the Pepsodent
smile.” A singer, she also toured with Guy Lombardo and his band. Dunne came to the
Southwest in 1935, buying a ranch in Romeroville, near Las Vegas, New Mexico.

Dunne had first developed her mechanical abilities by helping her brother on
projects when she was younger. Originally intending to join the WACs, she worked with
Charlie Boyd at the Santa Fe Air Field instead and studied mechanics, working on Ryan

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454 Ibid., 6.

PT planes. Dunne then left New Mexico to work as a mechanic in Tucson and San Diego, returning to New Mexico to work on B-24s at Kirtland Field. Her connections with W. C. Kruger, whose company was the main architectural and engineering firm at Los Alamos, led her to the project. George Kistiakowsky, head of the Project Y high-explosives program, hired her on the spot largely because of her small hands and her experience as an aircraft mechanic. Dunne would eventually work at Los Alamos through the end of the Manhattan Project.456

Arriving at Los Alamos in February or early March of 1944, Dunne worked on smaller-scale bomb assemblies fired with “tuballoy” (natural uranium) used in the place of the active material (such as plutonium or enriched uranium) (fig. 7.20). She first worked as an explosives technician in group T-4 and then in Kenneth Bainbridge’s X-Division group (X-2) in Kistiakowsky’s division with a crew of SED tech sergeants that she considered to be “her boys.” Dunne and the rest of the crew set off experimental shots at several outlying technical areas—at Two Mile Mesa’s water tank shots, at the R-Site firing points, and at the sandpile firing sites in Bayo Canyon, which were five-foot high experiments with tuballoy in the center. She also worked on primacord detonator tests in the S-Site area with Richard Frey.457

Working at the firing areas was a dangerous job. Dunne handled all types of high explosives and was once hit on head by a piece of tuballoy shrapnel. Her crew also supported air drop tests during which they hid behind thick tables that were used as

456 Dunne, "Oral History, Remembering Los Alamos: World War II," 2, Los Alamos Historical Museum Archives, Los Alamos, New Mexico; Marino, "This Lady is a Jaguar at Heart," D-1.
shielding. Dunne worked with the first mockups of Fat Man weapons at V-Site and other areas. In her oral history account, she credits Bill Stewart with saving her life when a bomb mockup that was being lifted into a truck fell on her when the cable on the hoist unwound. Stewart pushed her sideways out of the way and in the process her ankle was broken (fig. 7.21). Acknowledging the importance of her manual dexterity, she recalled that she was back to work soon after the accident, wryly stating, “the hands again.”

Supporting some of the final phases of the project, Dunne was on a dry-run trip to Trinity, when a gadget mockup was driven to the test site down the back roads to Albuquerque and points south in the middle of the night. She remembered that “the boys” took it down on a C-2 truck because they needed to show the others how to load it.

Dunne also recalled working with Captain Davalos of the Los Alamos security force (G-2). However, even with her connections, she was not immune to scrutiny. Because she had lived in New Mexico before the war, Dunne was well known in Santa Fe and, for this reason, requested an escort to take her on trips out of town so that her friends would be less likely to ask her questions about her work in Los Alamos. She knew that she was being followed when she left town because of the technical nature of her work and her knowledge of the implosion weapon design.

458 Frances Dunne, "Memorandum to Commander Bradbury; Subject: Entry to "S" Site thru North Gate, June 20, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives; N. E. Bradbury, "Memorandum to Captain Frank P. Ross, MP Detachment; Subject: Personnel Authorized to Enter V-Site, June 21, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.
460 Ibid., 10.
461 Ibid., 11.
In her oral history, Dunne recounted how she was looked after by her dorm matron, Ethel Armstrong, who was an old friend. She also noted that her crew of SEDs supported her when she was out at the firing sites: “they waited on me hand and foot.” She recalled that she was comfortable working with men because she was very close to her brother and did not mind being one of the few female civilian technical workers.462

In spite of her support network, Dunne wanted to quit the project sometime during the winter of 1944, but Kistiakowsky said she could not leave because she knew too much. He then told her that she was working on a bomb to end the war. Speaking to Los Alamos Historical Society researchers in 1992, she recalled what he had said to convince her to stay: “So Dr. Kistiakowsky said at that time, when I went in to quit, he said, ‘You see what we are doing has never been done before, it’s never been done. When we drop that bomb, the war is over.’ I said, ‘Well, let me out of here and get back to work.’ Cause I wanted to work for the war.”463

Frances Dunne’s wartime experiences and the experiences of other female scientists, technicians, and support staff working at Los Alamos not only illustrate the socio-cultural challenges faced by women during the 1940s, but also provides an understanding of the opportunities that resulted from their participation in the Manhattan Project, for them and for future generations of women.

Stories of round-the-clock high-explosives testing at remote Project Y facilities may not hold the drama of the Trinity test or engage the public in the longstanding

463 Ibid., 3-4.
controversy over the use of nuclear weapons, but lesser-known, micro histories of the Manhattan Project are crucial to understanding the breadth and complexity of this world-changing event. An examination of Los Alamos’s remaining wartime research areas and firing sites has uncovered narratives of civilian technicians and enlisted personnel that will supplement the traditional interpretation of Manhattan Project history, one that has focused solely on key events and the famous, household names of the project: Oppenheimer, Groves, Fermi, Bethe, Parsons, Teller.

The development of a new national historical park will entail the development of new historical narratives, predicated in part by today’s cultural sensibilities. Highlighting stories related to Los Alamos’s response to the implosion problem will provide a greater appreciation of the role of applied science, the development of various engineering and scientific methods, the practice of repetitive testing, the use of parallel and often overlapping approaches to problem solving, and the need for critical resources—both materiel and personnel—in the development of the first atomic weapons.

Understanding the science and architecture of Los Alamos’s remaining implosion test areas will not only underscore the critical role these types of facilities played in solving the complex challenges of the implosion design, but will allow for an opportunity to link wartime developments in flash radiography and high-speed data collection to modern Los Alamos technology and facilities that support the nation’s nuclear stockpile stewardship program today.

Casting a wider narrative net reveals the experiences of the thousands of workers, not just the top scientists, who supported the Manhattan Project in Tennessee, New Mexico, Washington State, Ohio, Virginia, Michigan, California, Utah, and
elsewhere across the country. Focusing on all types of workers, including the SEDs toiling at Los Alamos’s remote firing sites and the female technicians, like Frances Dunne, assembling small-scale high-explosives tests, exposes the complex story of the birth of the bomb. Concentrating place-making efforts at the diverse collection of buildings and structures of Project Y that will be part of the national historical park at Los Alamos doubly serves to preserve both the remaining architecture and landscape of atomic spaces and the experiences of an underrepresented workforce whose contributions are tied to the specific historical contexts of place. The inclusion of other stories and stories of “the other” into the narrative of the Manhattan Project adds richness and character to this nationally significant history and augments the dynamic meaning of Los Alamos’s wartime sites of memory.464

464 For a discussion of the concept of “the other” see Carolyn Gallaher, Carl Dahlman, Mary Gilmartin, Alison Mountz, and Peter Shirlow, Key Concepts in Political Geography (London and Los Angeles: Sage, 2009), 328-338.
Fig. 7.1. Frances Dunne worked at firing sites and set up high-explosives charges before a shot was fired (shown here at R-Site). Although not many women worked in the remote technical areas as high-explosives technicians, they did contribute in all areas of the wartime laboratory, from scientists and transport drivers to typists and laundry workers.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)

Fig. 7.2. Project Y staff are shown here at P-Site, one of the remote technical areas developed in response to the challenge of developing a new plutonium implosion weapon. Diagnostic methods were developed to see inside explosions and collect data on the effectiveness of prototype Fat Man designs.
Fig. 7.3. This 1946 aerial shows a view of the small firing site at Pajarito Site (lower center). Three firing sites were developed in the lower Pajarito Canyon area for the study of implosion using the magnetic method.

Fig. 7.4. Front view of the “Battleship” bunker located at the former small firing site area at Pajarito Site. This concrete building housed the instrumentation for magnetic method tests and served as a shelter for personnel.
Fig. 7.5. Side view of the “Battleship” bunker at Pajarito Site showing its steel nose plate. The bunker is being preserved for interpretation as part of the new Manhattan Project National Historical Park. The history of applied physics and engineering is an important and underrepresented narrative of the Manhattan Project along with the associated stories of the people who worked at these technical sites.

Fig. 7.6. The L-Site firing pit supported implosion studies using the terminal observation method. Located on a mound and constructed with timber and steel, the pit is topped with an eight-foot-square steel lid. This structure is the last remaining example of the firing pits used during Project Y for scientific experimentation.
Fig. 7.7. Also included in the new park legislation, the L-Site firing pit is located along a little-used side road at the national laboratory. The wartime history of this facility has been obscured due to its remote location and the technical nature of the work conducted at the site.

Fig. 7.8. The control building at K-Site supported implosion firing tests using a betatron machine and associated cloud chamber. K-Site remained an active facility during the Cold War, and the wartime buildings were converted for other uses. Located deep in the heart of the top-secret national laboratory, K-Site has been inaccessible to visitors, and its place in the historical landscape of the Manhattan Project has been overlooked.
Fig. 7.9. The betatron building at K-Site housed Donald Kerst’s 15-MeV betatron machine, one of the first of its kind in the world. The bunkered building, although empty, still retains much of its setting and feeling and contributes to the story of Project Y through its architecture of applied science and engineering.

Fig. 7.10. K-Site’s cloud chamber building was the location for the scientific equipment that was used to record the data from each implosion test. High explosives were detonated on a pad between the betatron and cloud chamber buildings. At the moment of detonation, the betatron would emit gamma radiation, and images of the explosion would be recorded in the nearby cloud chamber.
Fig. 7.11. Scientist Donald Kerst was the inventor of the betatron and also developed the Los Alamos Water Boiler reactor, known as LOPO, which was constructed at Omega Site in the bottom of Los Alamos Canyon.

Fig. 7.12. Donald Kerst, lower right, is shown in a 1942 photograph working on his first betatron machine at the University of Illinois. The varied contributions of scientists like Kerst and other site workers were essential to the success of the Manhattan Project.
Fig. 7.13. Morris Patapoff was one of the scientists given the task of developing and testing photographic techniques to record high-explosives tests. The story of the flash photography method of implosion diagnostics is little known. The preservation and interpretation of the darkroom building at Q-Site, one of the remaining wartime properties identified in the Manhattan Project park legislation, will allow these underappreciated narratives to be understood by a wider national audience.

Fig. 7.14. Using high-speed cameras to document implosion and other tests at Project Y led to developments that were applied during the Cold War to document atmospheric tests at Nevada Test Site and elsewhere. Some of these wartime cameras still exist and are important physical reminders of the technical tools used to support Manhattan Project research. A high-speed camera is shown here during wartime use in a concrete bunker, which served to protect the delicate equipment during a firing test.
Fig. 7.15. Several rooms in the former darkroom building at Q-Site are still being used to support firing operations today. Many of the national laboratory’s technical areas were first constructed during the Manhattan Project; some, like the older firing sites and the S-Site high-explosives area, have current functions that mirror their wartime origins.

Fig. 7.16. Much of the important machining work for prototype components was conducted locally. Los Alamos machinists worked side by side with the scientists and engineers who were designing the parts for the new weapons, often without finalized plans. Skilled workers were essential to the rapid development of both Little Boy and Fat Man. Their contributions have gone largely unnoticed.
Fig. 7.17. SED members, shown here, were not part of the regular military assigned to Los Alamos. These special high-explosives technicians and engineers were recruited to work closely with Project Y’s civilian scientists and were responsible for much of the actual engineering, testing, and assembly of the first atomic bombs.

Fig. 7.18. Los Alamos WACs were also key members of the Project Y workforce. WACs supported the Manhattan Project and included scientists, technicians, drivers, secretaries, clerks, and telephone operators in their ranks.
Fig. 7.19. Administrative staff supported the scientists located in the Main Tech Area. Charlotte Serber, Los Alamos’s technical librarian, is shown here with her staff (bottom row, center). The librarians were given the important task of managing both unclassified and classified documents.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)

Fig. 7.20. Frances Dunne was a high-explosives technician who had access to many of the top-secret places of Project Y. She worked as an airplane mechanic before coming to Los Alamos and was recruited for her expertise and also for her small hands. Her oral history account gives voice not only to the women of the Manhattan Project, but also provides a greater appreciation for the working conditions experienced by female technicians.
Fig. 7.21. Activities at firing sites and in areas with high explosives were dangerous for all workers. Frances Dunne escaped serious injury on several occasions during her time at Los Alamos. This photograph shows Dunne at the Gomez Ranch Site on Two Mile Mesa after her ankle was broken during a job that involved handling a heavy bomb mockup.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)
PART IV.
FINAL TESTING, DELIVERY, AND LEGACY (1945–1946)
CHAPTER 8

V-SITE AND THE TREK TO TRINITY: RECLAIMED, NEGLECTED, FORGOTTEN, AND CONTESTED SPACES OF THE BOMB

I remember especially I. I. Rabi, Fermi, and Bacher, each staring intently into the darkness. Then came the last minute countdown with the switch to automatic time out. Finally, the brilliant flash of an ever growing sphere was followed by the billowing flame of an orange ball rising above the plain.

Boyce McDaniel, “A Physicist at Los Alamos”

No one who saw it could forget it, a foul and awesome display.

Kenneth Bainbridge, “‘All In Our Time’: A Foul and Awesome Display”

Some of Project Y’s remaining historical areas have been variously claimed, recreated, and reinterpreted, but others have been neglected, forgotten, or contested. Recent historic preservation and place-making efforts has not only resulted in the recouping of lost narratives and lost places, but historical connections between Los Alamos and the Trinity Site are slowly being restored as part of the park-making process.

Several potential park properties supported the full-scale test of the implosion device and are being considered for development as formal park sites. A key event in Manhattan Project history, the detonation of the world’s first atomic device, occurred on July 16, 1945, at 5:29:45 a.m., Mountain War Time. However, the planning efforts for the test, code-named Trinity, began months before that auspicious morning in southern New Mexico. The “trek to Trinity” is a little told story of the Manhattan Project that will

grow in importance when the new park is established. V-Site, the concrete bowl, and Pajarito Site played supporting roles in the Trinity narrative, but their stories have yet to be acknowledged as a cohesive whole, and, to date, the buildings, structures, and areas have been variably preserved and interpreted. V-Site, one of the most well-known places of the bomb, has been restored, and selected aspects of its wartime history have been interpreted through the use of outdoor interpretive signage. However, other Los Alamos places and events associated with the Trinity test, such as the concrete bowl and the Creutz test at Pajarito Site, remain neglected and forgotten. Furthermore, the very place of the Trinity test, located far away from Los Alamos for wartime security and safety reasons, is still contested today, its story distanced from the Project Y narrative.

Now that the places of the bomb will be preserved as part of the Manhattan Project National Historical Park, how will the process of formal place-making further reinstate the vanished places of Project Y and their currently obscured meanings to the master historical narrative of the Manhattan Project? Moreover, will the nature of these places change once they are restored and made “park ready” for public visitation?

Writer Pierre Nora cautions that the very act of historical preservation brings historical loss as well. In his article, “Between Memory and History,” Nora poignantly describes sites of memory as “moments of history torn away from the movement of history, then returned; no longer quite life, not yet death, like shells on the shore when the sea of living memory has receded.” If, following Nora’s observation, the Manhattan Project buildings at Los Alamos may lose some of their raw story-telling ability once they have been recreated as national sites of memory and made accessible to the public,

466 “Nora, "Between Memory and History," 12.
with formal visitor services, landscaped grounds, walkways, and interpretive panels, does the potential loss of historical integrity outweigh the loss of collective meaning if these places are allowed to be demolished by neglect?

**Reclaimed and Recreated: V-Site—
the “Mock-up” Site and Home of the Gadget**

In response to the national historical park legislation, V-Site and other Manhattan Project facilities planned for greater public access will undergo additional repair and restoration projects to bring them to park-ready status. *Birthplace of the Trinity gadget*, the nickname for the implosion test device, V-Site was used as the primary field site for the assembly and component testing of the first prototype Fat Man weapons. Located in a separate fenced enclosure inside the historical S-Site high-explosives area, V-Site has long been acknowledged as one of the most significant Manhattan Project historical sites in the entire DOE complex.\(^\text{467}^\) It has been recognized as nationally significant by the Atomic Heritage Foundation, the Energy Communities Alliance, and Congress. The DOE has identified V-Site as one of its Signature Facilities of the Manhattan Project, and it has been formally declared eligible for the National Register of Historical Places. In addition, the Department of Interior has acknowledged that V-Site is a key facility for inclusion in the Manhattan Project National Historical Park and a potential National Historic Landmark.\(^\text{468}^\)


V-Site has also been the focus of a major restoration project, which has included the rehabilitation of existing infrastructure and the restoration of missing architectural elements (fig. 8.1). This repair project, driven in part by the deteriorated condition of the site, was given priority status because of the property’s elevated historical status as the atomic birthplace of the Trinity device tested in July of 1945. At V-Site, past restoration efforts have effectively preserved not only its connection with the Trinity test, but additional archival research associated with historic preservation work at the site has revealed hidden details related to its wartime history.

**Reclaiming V-Site: Site History and Restoration**

Constructed in 1944, V-Site was specifically developed for use as an assembly site for the first mockups of the Fat Man weapon. These early designs were prototype assemblies that approximated the final shape and weight of the central high-explosives sphere and combat casing. When V-Site began operations, many of the technical challenges of implosion were just being worked out. Even though the “Mock-up Site” (its original designation) was located within the larger S-Site high-explosives area, it was always intended to be a separate operational area during the war. Its dedicated mission

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was to assemble experimental parts into a deliverable weapon that could be deployed by the military, effectively bridging the gap between theory and ultimate wartime use.\footnote{Bernard Waldman, "Memorandum to N. F. Ramsey; Subject: Mock-Up at Site S, May 2, 1944," A-84-019, Box 22-1, Los Alamos National Laboratory Archives; Bernard Waldman, "Memorandum to G. B. Kistiakowsky; Subject: Mock-Up Area, October 30, 1944," A-84-019, Box 22-1, Los Alamos National Laboratory Archives.}

V-Site has long been associated with one of the most significant historical events of Project Y. During the week of July 9, 1945, the Trinity device’s high-explosives sphere was assembled in the high-bay building at V-Site. The specially prepared, shaped pieces of high explosives were put together in the device’s metal sphere and readied for transport on a truck to Trinity Site for the July 16 test.\footnote{N. E. Bradbury, "Memo - To: Personnel Concerned, Subject: TR Hot Run, July 9, 1945," 1-2, A-84-109, Box 16-6, Los Alamos National Laboratory Archives.}

Abandoned after several decades of use, V-Site, against all odds, is still an important presence in the S-Site area at today’s national laboratory. At the height of wartime work, the V-Site complex included six wooden buildings: a main high-bay assembly building with an adjacent boiler building (buildings 516 and 517); two shop and laboratory buildings; a covered storage area; and a warehouse building (fig. 8.2).\footnote{Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center; Los Alamos National Laboratory, "Photographic Collections," Los Alamos National Laboratory Archives and Records Center; Los Alamos Scientific Laboratory, "Technical Area Structure Location Plans," Los Alamos National Laboratory Records Center. See TA-16 and TA-25 photographs, records, site plans, and drawings.} The V-Site facilities were typical of Project Y’s wartime construction at remote research sites and in the townsite’s laboratory and residential areas. This expedient construction typically included hastily constructed wooden buildings clad with asbestos shingles or wood siding.\footnote{Manhattan Engineer District, "Book VIII, Volume 1 - General," 5.11-5.12.}
After the war, V-Site was modified to support high-explosives research, including new casting operations in both the high-bay and warehouse buildings, and given the numerical designation TA-25 to go along with its V-Site designation. The warehouse, a large wooden building destroyed by the Cerro Grande fire in 2000, was extensively remodeled after the war to support both postwar casting and radiography work. Fully operational until the early 1960s, V-Site was later used for intermittent storage and then abandoned.475

During the 1990s, the few remaining Project Y buildings at S-Site were evaluated for demolition, and most of them were eventually destroyed. V-Site, however, was spared because of its historical significance and relatively low risk of high-explosives contamination. In 1999, the DOE agreed to restore V-Site, one of the first Manhattan Project preservation projects of its kind. The national laboratory submitted a Save America’s Treasures grant proposal, which was approved in early 2000, and was considering a path forward for the eventual preservation of the six-building V-Site complex when, in May of 2000, the Cerro Grande fire swept through the area, burning four of the buildings to the ground.476

That the six V-Site buildings were still standing in the spring of 2000, right before the devastating Cerro Grande fire, is fairly remarkable. The wooden buildings had received little to no maintenance between their abandonment in the 1960s and their removal from the demolition list in the 1990s, when discussions began regarding their preservation.

476 Isaacson and McGehee, "Restoring V-Site," 14-16.
eventual restoration. As an interim preservation measure, due to imminent roof failure, many of the V-Site buildings were covered with black plastic sheeting to minimize water intrusion until the roofs could be repaired or replaced.

Several factors probably account for the fact that the two most significant buildings at V-Site did not burn when the fire passed through the area, even though the wooden high-explosives assembly buildings were almost sixty-years old. The fire moved through the site rapidly from west to east, and buildings 516 and 517 were protected by earthen berms on their western flanks. These former blast-protection structures functioned as direct barriers between the fire and the buildings. Although the heat of the fire was upwards of 1,000 degrees F, and sparks from the nearby burning buildings could certainly have ignited the two buildings after the initial wall of fire moved through the area, the plastic sheething on top of both buildings effectively served as an additional protective barrier.

Following the fire, the two remaining buildings were restored to preserve the place of V-Site and the story of V-Site’s significance. Restoration work began in December 2005, with major rehabilitation activities completed by June 2006. Using original building drawings, a reconstructed entrance gate and a section of the wartime “no-peek” security fence was added to V-Site in 2007. Following the restoration work,


478 The temperature of the fire at V-Site was estimated based on the melted aluminum, iron, and steel present. Fire-related observations are the author’s own from her work evaluating V-Site, both before and after the fire.

479 Isaacson and McGehee, "Restoring V-Site," 15-16.
three park-service-style interpretive panels were added that describe the site’s overall significance, the effects of the Cerro Grande fire, and the details of the major repair and restoration work carried out at the site (fig. 8.3).

The restoration of V-Site has not only preserved its association with the initial assembly of the Trinity gadget, it has served as a stimulus for additional historical research that has revealed details about V-Site’s original function as the Mock-up Site. This story of V-Site’s role in the weaponization of the Fat Man bomb is a valuable supplement to the site’s historical association with the Trinity test, one that speaks to the complicated preparations that supported the design and deployment of the first atomic weapons.

**Unearthed Narratives: The “Mock-up Site”**

V-Site was built for a singular purpose—to take implosion science and weaponize it for delivery in an airplane. The country was at war, and all of the Manhattan Project’s efforts were culminating at Los Alamos to focus on the completion of one final goal, that of a deliverable atomic bomb. Beginning in the spring of 1944, mockups of the Fat Man implosion weapon received diagnostic testing at V-Site to ensure that key components could withstand cold temperatures and vibration.\(^{480}\) The facilities at V-Site were meant to approximate field conditions for members of the Los Alamos assembly team, who also practiced on inert Fat Man assemblies under controlled conditions at a laboratory building near Ashley Pond.\(^ {481}\)

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\(^{481}\) Most archival documents cite Delta Building as the location, but Wilder, on page 111 of his memoir account “Early S-Site Experiences,” mentions Gamma Building as the practice assembly building located in the downtown Main Technical Area.
The original V-Site or Mock-up Site was situated on the eastern edge of S-Site’s high-explosives research and development area. The earliest site plans show a lone high-explosives storage magazine located to the west of V-Site’s main compound. The site’s open courtyard and central loading pit are depicted within an encircling “no-peek” fence. Serving as a prototype for the as-yet-unplanned Tinian facilities, V-Site’s loading pit is shown surrounded by Marsden matting, a metal surfacing used for the construction of wartime runways, perhaps to replicate the potential surface of a Pacific Island airstrip.482 Historical documents note that weapon prototypes were cooled in V-Site’s pit to test how Fat Man’s more sensitive electrical components would respond to the unheated conditions of an aircraft’s bomb bay.483 Vibration or “shake” tests were conducted in an apparatus that approximated the configuration of a B-29’s bomb bay; this mobile device was also used in tandem with the site’s C-2 wrecker truck to practice the loading and unloading of full-weight prototype bombs (fig. 8.4).484

V-Site’s first building, today’s TA-16-517, was built along the west side of the fenced compound, its distinctive triangular shape and encircling earthen berm clearly


indicated on early drawings. The remote workshop building faced east, away from S-Site operations and workers. Its side walls were robustly constructed to function as berm support walls, but its front wall was less sturdy—specifically designed to blow out in the event of an accident explosion. The small workshop building, as originally equipped, included a workbench along its south side with a small wood stove located in the opposite corner. The SEDs and scientists at the Mock-Up Site worked with live high explosives. This was extremely hazardous work and, because of the danger, access to V-Site during this time was restricted to only a few members of the Project Y workforce.

In order to make more room for assembly operations, V-Site was expanded in late 1944. Building 517 was modified into a boiler room to support work in the new high-bay assembly building built immediately adjacent to the former workshop. An earthen berm was built on the west side of the assembly building, known today at TA-16-516, and, at the same time, the berm encircling building 517 was modified to make room for the new construction. A December 1944 memo directing the construction of the assembly building at V-Site specified that the high-bay doors be of sufficient size to accommodate the boom arm of the C-2 wrecker used to move the fully loaded high-explosives spheres.

487 Ibid. See records and drawings for TA-16 and TA-25.
488 Bradbury, "Memorandum to Captain Frank P. Ross, MP Detachment; Subject: Personnel Authorized to Enter V-Site," Los Alamos National Laboratory Archives; Wilder, Jr., "Appendix: Early S-Site Experiences," 108.
within the fenced confines of the courtyard area. The V-Site assembly building was constructed with an overhead I-beam crane, but with its two-thousand-pound weight limit, the crane was inadequate to support a full-weight Fat Man prototype, which weighed close to ten thousand pounds. Other buildings were added inside the enclosed courtyard: a long, open storage shed at the east side of the compound and two shop and storage buildings along the south side. A larger warehouse building was also added to the site but was built outside of the fenced compound to the west of buildings 516 and 517.

The new shop buildings supported the special finishing work necessary to protect the cast high-explosives lenses being assembled into their spherical configurations inside a supporting duraluminum shell. Imperfections on the lenses often needed to be ground down, and various coating and felting methods were also developed to protect the surfaces of the lenses. Machining new chemical formulations of high explosives was risky work. The presence of EP fixtures inside the buildings and remnants of Hubbelite non-sparking flooring in front of the assembly building and at the former shop and storage building locations indicate that high-explosives preparation and assembly work was conducted in all of the buildings.

In mid 1945, final Fat Man design and assembly work was moved to a Quonset hut building at Trap Door (TD) Site. This move happened for several reasons: the work space was inadequate at V-Site for final Fat Man weaponization work and the team

490 Captain W. S. Parsons, "Memorandum to Kistiakowsky, Bacher, Bainbridge, Ramsey; Subject: Development of Tests of Fat Man Assembly, December 12, 1944," A-84-019, Box 22-1, Los Alamos National Laboratory Archives.


working on final preparations for the Trinity test needed V-Site to be the dedicated assembly facility for the gadget device.\textsuperscript{493} The mockup assembly and component testing at V-Site led to an understanding of proper high-explosives handling and loading procedures. Researchers also conducted experiments at V-Site to determine whether the B-29s planned for weapon delivery would need to be modified to include heated bomb bays.\textsuperscript{494} In addition, much of the initial implosion research had been conducted on small-scale high-explosives assemblies to speed up the development of near-final design specifications.\textsuperscript{495} Although this strategy would eventually prove successful, the project’s small-scale designs had to be enlarged to full-scale prototypes in order to support the military’s weapon-delivery program, which was being developed in parallel to Los Alamos’s research efforts. As the plans to test the gadget device at Trinity began to solidify, so did the need to verify that all of the key components could fit in the device’s full-scale, high-explosives casing. In addition to fit-testing, the shake-testing activities at V-Site and other nearby areas ensured that the physical transport of the gadget to southern New Mexico and the similarly planned transport of the weaponized units from Los Alamos to the Pacific could be conducted safely.\textsuperscript{496}

\textsuperscript{493} N. E. Bradbury, "Memorandum to Messrs. Dow, Kershaw, and Warner; Subject: Transfer of V Site Activities to 2-Mile Mesa, May 5, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives; N. E. Bradbury, "Memorandum to D. Dow, and Capt Reid; Subject: Additional Magazine Construction at 2-Mile Mesa, May 25, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.

\textsuperscript{494} Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-37.

\textsuperscript{495} Hoddeson, \textit{Critical Assembly}, 137.

\textsuperscript{496} Schaffer, "Memorandum to Comdr. N. E. Bradbury; Subject: Test Schedule - T.D.H.E. 1561 Unit, Mod. III m. Charges," Los Alamos National Laboratory Archives; Bradbury, "Memo - To: Personnel Concerned, Subject: TR Hot Run," Los Alamos National Laboratory Archives; N. E.
Not only has the restoration of V-Site contributed to the discovery of a previously unknown history, it has resulted in the reclaiming of the site’s significance and themes related to the importance of weapon design and engineering, information that will be used to supplement the National Park Service’s interpretation of V-Site.

**The V-Site Narrative: Reclaiming Significance and Themes**

V-Site is the most visited of the “behind the fence” historical areas, although it is not open to the general public. As part of its post-fire stabilization and restoration, the site has undergone landscaping upgrades, including the addition of replicated architectural elements (fig. 8.5). While not up to park-ready standards, V-Site has the appearance of a place that is being deliberately preserved and interpreted for visitors.

Additional research into the history of this well-documented site has unearthed hidden histories and themes, and, for those allowed to visit the site, these new stories have contributed to a deeper understanding of V-Site’s importance as a national place of memory. However, this was not always the case and, indeed, the very narrative of this place and its perceived value and historical significance has evolved greatly since the 1990s. Although acknowledged locally for its role in the assembly of the Trinity gadget, the details of V-Site’s use during World War II were not widely known until recently. At first, even its association with the Trinity test was downplayed. Some historians felt that that the real accomplishments of Project Y were primarily intellectual in nature, and that the places of the bomb were of lesser significance. When the other abandoned and

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Bradbury, "Memorandum to Personnel Concerned; Subject: Testing of Trap-Door Assemblies, June 6, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.

497 Isaacs and McGehee, "Restoring V-Site," 16.

498 Roger Meade, LANL Historian, retired, personal communication with author.
deteriorating wartime high-explosives facilities at S-Site were being evaluated for
demolition, V-Site, too, was being considered for demolition and rumored to be too
contaminated with high explosives to save, regardless of its historical significance.499

Nevertheless, by the late 1990s, V-Site’s narrative had become firmly associated
with its role as “birthplace of the gadget,” even though the gadget was only partially
assembled in Los Alamos. However accurate, it would be this narrative association that
would eventually be responsible for the removal of V-Site from the demolition list, its
identification as an endangered site at the turn of the millennium, and its eventual path
toward restoration and long-term preservation.500

Following recommendations from New Mexico state historic preservation
officials, the site’s narrative grew to include the effects from the Cerro Grande fire. A
deliberate decision was made not to rebuild the four buildings that were completely
destroyed; rather, the national laboratory chose to interpret the skeletal remains of the
former warehouse and radiography building and to discuss not only the effects of the fire
at V-Site but its impacts on the laboratory and town.501

After restoration, additional historical research revealed a more complex narrative
at V-Site. Details relating to the site’s role as the Mock-up Site prior to its use to support
the Trinity test have been identified through the study of original drawings and
declassified documents from the laboratory archives. Names of specific V-Site workers
have been identified, and a greater understanding of the functioning of the site and its

499 Generally, see McGehee, 28 “S-Site” Properties 1995; Cynthia Kelly, "Preserving the
Manhattan Project," American Physical Society

500 Kelly, "Preserving the Manhattan Project".

501 Isaacson and McGehee, "Restoring V-Site," 16.
associated testing and loading structures and equipment is now emerging. Specific details related to the weeks and days before Trinity test have also been revealed through archival research.

Even though the site has been altered by fire and by restoration work, experiencing the actual place of V-Site, with its isolated location and protective earthen berms, still provides a physical sense of the site’s narrative of risk. Other remaining aspects of the site, such as its intimate setting and feeling, reinforce the theme of the hands-on nature of the Project Y experience. Like the nearby high-explosives workers at S-Site who were casting the special lenses, V-Site workers dealt with danger on a daily basis, constantly weighing the need for high-explosives safety against the urgent deadline to build the bomb and end the war.

V-Site’s work spaces were small and simply furnished in their heyday, and the buildings at V-Site today still tell the story of a tabletop-scale workforce, vastly different from the thousands of workers supporting the massive uranium and plutonium plants at Oak Ridge and Hanford. The remaining rustic places at V-Site speak to a small number of workers laboring around the clock to develop a technologically sophisticated weapon of mass-destruction in simple wooden buildings, an irony not lost on most visitors.

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502 Dunne, "Memorandum to Commander Bradbury; Subject: Entry to "S" Site thru North Gate," Los Alamos National Laboratory Archives; Bradbury, "Memorandum to Captain Frank P. Ross, MP Detachment; Subject: Personnel Authorized to Enter V-Site," Los Alamos National Laboratory Archives; Oppenheimer and Parsons, "Transfer of V-Site from Group O-2," Los Alamos National Laboratory Archives; Bradbury, "Summary of Discussion with Ramsey on Transfer of V Site," Los Alamos National Laboratory Archives.


Security is also an important part of the V-Site narrative that can be experienced today, from the site’s replicated no-peek fence built to block views of combat units ("bombs with fins and box-tails") to stories about security guards under strict orders to grant entry only to workers named on special access lists. Documents unearthed from the archives reveal that while most of the scientists, engineers, and technicians allowed into V-Site were men, at least one woman, Frances Dunne, who was a small-scale assembly specialist, worked at V-Site.\(^{505}\)

Besides its specially guarded entrance, code names and other security policies also served to protect the secrets of V-Site and the nearby high-explosives areas. The designation “S-Site” or “Site S” (for Sawmill Site) was given to the high-explosives area because of a sawdust pile from prewar sawmill operations. V-Site’s wartime designation was chosen not for “Victory” but as a replacement for its earlier designation of Mock-up Site, the ill-considered name given to the area when it was first established in 1944. Unearthing the specific details of V-Site’s wartime history has been made more difficult today because of the site’s status as a high-security area during the war. In fact, only one World War II-era photo of V-Site has ever been identified, that of two military engineers standing next to a Fat Man prototype mounted in the shake-test apparatus over the V-Site loading pit.\(^{506}\)

V-Site’s stories and historical themes are often interpreted by national laboratory staff as part of the visitor experience. The buildings and remaining site structures themselves also communicate the site’s history, from its protective earthen berms to its

\(^{505}\) Bradbury, "Memorandum to Captain Frank P. Ross, MP Detachment; Subject: Personnel Authorized to Enter V-Site," Los Alamos National Laboratory Archives.

\(^{506}\) See Fig. 8.4.
simply constructed wooden buildings. Further, V-Site is populated with the ghosts of wartime and postwar workers whose penciled telephone numbers and calculations—faint traces of humanity—can still be seen on interior walls. More so than the dense technical descriptions of wartime science and engineering, it is this human narrative of V-Site, regardless of the recent changes to the site from fire and restoration, that bridges the empty spaces of the present to the inhabited places of the past.

Neglected: The Concrete Bowl and the Plutonium Recovery Story

While V-Site has benefited from priority repair work and its stories are being told, other wartime buildings and structures at Los Alamos have yet to garner similar levels of national recognition. For example, the concrete bowl experimental structure located at Two Mile Mesa Site has been essentially ignored and allowed to deteriorate. Moreover, in today’s prevailing Trinity narrative, the Los Alamos story of plutonium-recovery research, including the role of the concrete bowl, has been overshadowed by the story of the steel containment vessel known as “Jumbo,” which was only one of several recovery strategies developed by Project Y scientists and engineers. By failing to interpret the complete response to the challenge of plutonium recovery, key themes associated with the history of the Manhattan Project at Los Alamos, such as the wartime laboratory’s practice of exploring multiple parallel solutions to solve key design problems, have been overlooked. Restoring and interpreting Project Y’s experimental areas and firing sites will, in turn, restore breadth and complexity to the story of the bomb.
Plutonium-Recovery Experiments at Two Mile Mesa

As early as March 1944, the laboratory leadership began to consider a test of the implosion weapon, complete with active material. As the implosion design was starting to look like a feasible, and more importantly, deliverable weapon system, test preparation efforts intensified. Searching for a nearby but remote area, Project Y managers chose the Alamogordo Bombing Range in southern New Mexico in September 1944.\textsuperscript{507} Back at Los Alamos, due to concerns about the complexity of the gadget design and the possibility that the field test would fail and result in a conventional explosion, an area of Two Mile Mesa had been chosen to develop methods for recovering plutonium.\textsuperscript{508} Fissile radioactive materials (such as uranium-235 and plutonium) were so rare during World War II that scientists needed to conserve every bit they could for use in the first atomic weapons.\textsuperscript{509} If the atomic reaction "fizzled," the high explosives used in the bomb would spread the prized radioactive material to the winds.\textsuperscript{510}

The first plutonium-recovery facilities at Two Mile Mesa Site, located several mesas south of the town of Los Alamos, were constructed in 1944. Early buildings and structures were rough field installations and included bunkers, a control building, and a

\begin{itemize}
  \item \textsuperscript{509} Fissile or fissionable material, such as uranium-235 and plutonium, is heavy radioactive material that can be split or fissioned by fast neutrons. The fission of heavy elements is accompanied by a relatively large amount of energy; this fission process is fundamental to the design of the atom bomb.
  \item \textsuperscript{510} Ferenc Morton Szasz, "The Tale of the "Other" Jumbo," \textit{Journal of the West}: 70.
\end{itemize}
shop building. A large concrete experimental structure, also located to the east of the main Two Mile Mesa facilities, was built by October of 1944 to support plutonium-recovery operations (fig. 8.6).\textsuperscript{511} The concrete bowl, as it is now known, was designed “for experiments of recovery when a gadget [bomb] is immersed in an elevated tank of water.”\textsuperscript{512} Left alone and neglected for over seventy years, the bowl has deteriorated, and weeds and trees dot its concrete surface. The large, two-hundred-foot-diameter bowl, once used as a scale-model experimental area, is now a watering hole for deer, elk, and other wild animals. Included in the park legislation, the concrete bowl today is a very visible remnant of Manhattan Project experimentation and, if preserved and interpreted, would not only support the Manhattan Project story of plutonium recovery, but also provide a vital link between the histories of Los Alamos and the Trinity Site.

The concrete bowl is a unique experimental structure, consisting of a sloping, ground-level concrete pad, poured in sixteen pie-shaped wedges, with a drain located near its center. The original design for the circular structure was too elaborate and would have been too time intensive and costly to build. By reducing the diameter from three hundred to two hundred feet and reducing the thickness of the central area of concrete from twenty-four inches to twelve inches, Los Alamos scientists produced a more cost efficient and practical design.\textsuperscript{513}

\textsuperscript{511} Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See records and drawings for TA-6.
\textsuperscript{512} Monthly Report for September 1944, Section X-2A, "October 1944," A-84-019, Box 62-5, Los Alamos National Laboratory Archives.
The bowl structure supported the water-recovery method, one of several plutonium-recovery experiments. Beginning in late 1944, researchers conducted test shots containing tuballoy (natural uranium) in the bowl. A scale-model test assembly was suspended in a redwood water tank on a fifty-foot-high tower located in the center of the bowl (fig. 8.7). When the device exploded, fragments of uranium metal (used as a stand-in for plutonium) were stopped by a 50 to 1 ratio of water to high-explosives mass.\footnote{Manhattan Engineer District, "Book VIII, Volume 2 - Technical," XVI-19.} The shots contained up to ten pounds of explosives and up to five hundred gallons of water.\footnote{L. W. Creamer, "Interviews with W.H. Meyers and A.D. Van Vessem, Los Alamos National Laboratory Memorandum M-7-92-0421, ER ID Number 15037, August 9, 1992," 2, Cultural Resources Management Team, Los Alamos National Laboratory.} After the explosion, workers washed down the bowl and filtered the water to recover the metal shot fragments. These water-recovery experiments continued until the spring of 1945.\footnote{McGehee, \textit{Engineering the Bomb} 2004, 24, 27; Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See TA-6 records and drawings.}

The wartime laboratory ultimately decided against using the water-recovery method for the Trinity test because it was not feasible to scale the project up to the size required for the test of an actual atomic bomb.\footnote{Creamer, "Interviews with W.H. Meyers and A.D. Van Vessem, Los Alamos National Laboratory Memorandum M-7-92-0421, ER ID Number 15037," 2 Cultural Resources Management Team, Los Alamos National Laboratory.} Additional plutonium-recovery experiments involving the sand-recovery method were also conducted on Two Mile Mesa, where scientists stationed in a control bunker fired irradiated copper at a sand pad located to east of the bunker. However, early tests of the sand method at Two Mile Mesa Site did not work. According to Manhattan Project veterans Walt Meyers and Al Van
Vessem, “the short half-life of the radioactive material made accurate analysis of the
recovered material impossible.”518 Later, while water-recovery tests were being
conducted in the concrete bowl structure, other sand-recovery experiments were
conducted at Bayo Canyon, located to the north of the Los Alamos townsite (fig. 8.8).519

Trinity Test Director, Kenneth Bainbridge, in his memoir about the Trinity test,
recounted some of the plutonium-recovery work conducted at Los Alamos during the
months before the test:

The uncertainty of how well a plutonium implosion would work, if at all,
dictated the requirement for a test and studies of recovery methods by
confinement of the explosion under earth, water, or by enclosure in a steel
vessel called Jumbo. . . . An underwater test with an inert uranium-cored
bomb was made at one of the mesa sites one night. A spectacular
fireworks display of burning uranium was our reward. The uranium
recovery did not meet the predicted yield. The water and earth
confinement studies were abandoned except for smaller-scale examination
of effects in harbors or on land.520

Jumbo and the Jumbinos

Disappointed with the results of the sand-recovery experiments and concerned
about the ultimate practicality of the water-recovery method, scientists ultimately decided
to proceed with a third recovery method, physical containment. Using this method, the
Trinity test device would be placed inside Jumbo, a large steel containment vessel.
Today, Jumbo’s narrative of construction and delivery to Trinity Site has overshadowed
all other accounts of plutonium-recovery research.

518 Ibid., 1.
Museum Archives, Los Alamos, New Mexico.
520 Bainbridge, "'All in Our Time': Prelude to Trinity," 44.
Los Alamos scientists and engineers played an important role in the design of Jumbo. Scaled-down tests of various containment vessels, nicknamed “jumbinos,” were conducted on Two Mile Mesa. The vessels were being designed to contain a conventional high-explosives blast (and the plutonium) in the event of a test failure. The first designs were spherical in shape and were tested in a pit on the mesa; however, none of the spherical vessels withstood the early high-explosives blasts. The vessel design was then modified to a cylinder form with cast concrete ends, whose performance during tests led to the final design of the full-scale Jumbo (fig. 8.9). As part of physical containment research, scientists also used the nearby concrete bowl to conduct shake tests of jumbinos in 1945.\textsuperscript{521}

With the success of the jumbino tests, Los Alamos commissioned Babcock and Wilcox Steel Corporation of Ohio to build the full-scale Jumbo vessel. Twenty-feet long, weighing approximately 214 tons, and taking three months to build, Jumbo was the world’s largest pressure vessel of its time. Transporting Jumbo from Ohio to New Mexico proved to be a difficult task (fig. 8.10). The steel vessel traveled by rail to Pope’s Siding near Socorro, New Mexico, where it was unloaded onto a sixty-four-wheel trailer and hauled the remaining fifteen miles to Trinity Site. Test director Bainbridge recalled the day of Jumbo’s arrival:

The next day Jumbo was due to arrive. I drove Dick Tolman over the desert to greet our black elephant at the siding at Pope, the 5 by 6 by 8 foot shelter station on the Santa Fe. Soon the train came into view, an engine and tender, flat car, Jumbo on its special massive car, followed by another flat car, and the caboose housing the security men, guards, and train men.

Security had ordained that a huge tarpaulin be strapped over Jumbo and down to the sides of the car. . . . Jumbo represented to many of us the physical manifestation of the lowest point in the Laboratory’s hopes for the success of an implosion bomb. It was a very weighty albatross around our necks. . . . We decided to put Jumbo 800 yards north by west away from Point Zero on the chance we wouldn’t use it but could if necessary.\textsuperscript{522}

In spite of these elaborate and costly preparations, Manhattan Project scientists chose not to use Jumbo in the final days leading up to the test—they feared that placing the bomb inside of Jumbo would drastically affect the measurements and could make for a larger fireball than desired. Instead, the scientists placed Jumbo on a twenty-foot-high tower structure near the blast to see how the vessel would be affected by the explosion.\textsuperscript{523}

In his memoir, Bainbridge described Jumbo’s design and ultimate abandonment, including the use of Jumbino models to determine the vessels ultimate size and shape:

Roy Carlson was recruited to work with Bob Henderson on the design and procurement of Jumbo. Optimum design and tests of small models defined a steel bottle 25 feet long by 12 feet diameter with 15-inch walls, weighing 214 tons. This unit could have contained the explosion in the event of zero nuclear energy release. Loaded on a special 120-ton flat car, the total weight was equal to that of one of the larger locomotives on the Santa Fe line. . . . Jumbo stayed with us as a possible confinement method until a few weeks before July 16, 1945. All the plutonium recovery methods were abandoned finally.\textsuperscript{524}

In part to justify the tremendous expense of Jumbo, the Army “tested” the unscathed vessel a few years later with an explosive blast generated by several five-hundred-pound bombs. Jumbo, with its ends blown off, still resides near ground zero

\textsuperscript{522} Kenneth Bainbridge, "'All in Our Time': A Foul and Awesome Display," \textit{Bulletin of the Atomic Scientists} 31, no. 5 (May 1975): 43.

\textsuperscript{523} Szasz, \textit{The Day the Sun Rose Twice}, 36-37; Hoddeson, \textit{Critical Assembly}, 365, 367.

\textsuperscript{524} Bainbridge, "'All in Our Time': Prelude to Trinity," 44.
Popular with tourists who visit Trinity Site, Jumbo represents the story of plutonium recovery and remains a symbolic reminder of the myriad engineering efforts that supported (both successfully and unsuccessfully) the development of the atomic bomb.

At Los Alamos, the concrete bowl represents the same story of plutonium recovery. Its preservation and interpretation will not only illustrate Los Alamos’s trek to Trinity and its ties to Jumbo, but will also inform park visitors about the other plutonium-recovery methods developed by Project Y scientists, reinforcing the theme of problem solving and further illustrating the importance of scale modeling to the success the Manhattan Project. The narrative of Los Alamos’s plutonium-recovery experiments highlights Project Y’s ability to mobilize both the creative energy of its workforce and the material resources of the nation.

**Forgotten: The Creutz Test—Last Minute Plans**

Located in Pajarito Canyon, the Creutz test, detonated on July 14, 1945, was the first full-scale test of the implosion design, minus the plutonium pit. A final systems check of the components of the Trinity gadget, the Creutz test—named after Edward Creutz, leader of the magnetic method proving ground at Pajarito Site— was a failure, or so it seemed. Today, the story of the Creutz test has been forgotten, lost to the needs of postwar secrecy and security. Until recently, the scientific details of the test and even its

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The precise location at Pajarito Site have been hidden in inaccessible archival documents.\textsuperscript{526} The story of the Creutz test and its association with the Trinity test will likely be explored as part of the National Park Service’s interpretation of the Battleship bunker, one of the buildings listed in the new park legislation that supported wartime experiments to understand the inner workings of implosion. As part of upcoming restoration, preservation, and place-making at Pajarito Site, relatively unknown narratives—such as the story of the Creutz test—will be restored to their rightful places in the Manhattan Project timeline.

In 1945, Pajarito Canyon was chosen as the site of the full-scale Creutz test because the area had already been developed for implosion tests using the magnetic method.\textsuperscript{527} George B. Kistiakowsky, the leader of the high-explosives group, was not happy with the proposed Creutz test. Writing about his wartime experiences, Kistiakowsky recalled that “to add to our troubles, a short time before Trinity Oppenheimer decided, over my objections, to go ahead with a certain test by the $G$ division, requiring a complete duplicate set of full-sized castings. They planned to explode at Los Alamos a ‘Chinese’ copy (that is, minus only the plutonium) of the Trinity charge in their experimental installation, designed for a ‘magnetic observation’ method.”\textsuperscript{528}


\textsuperscript{527} Creutz, \textit{Full-Scale Implosion at Pajarito} (unclassified notes), August 10, 1945, VII-3, XV-7, XV-8; Manhattan Engineer District, "Book VIII, Volume 2 - Technical; Hoddeson, \textit{Critical Assembly}, 273, 327.

\textsuperscript{528} G. B. Kistiakowsky, "Trinity - A Reminiscence," \textit{Bulletin of the Atomic Scientists} 36, no. 6 (June 1980): 20.
Although Project Y scientists had created multiple implosion diagnostic techniques, the magnetic method was specifically designed for larger explosives charges, including full-scale assemblies mimicking the final explosives configuration that would be used in weaponized Fat Man units. While this diagnostic method could be used with full-scale tests, the magnetic method was not planned for use at the Trinity test. The test of the gadget at Trinity Site in July 1945 was meant to replicate all details of the Fat Man weapon, including its metal case, which was not compatible with the magnetic method.\textsuperscript{529}

As originally scheduled, the first full-scale tests of the final high-explosives lens designs and configurations were to be conducted in mid April 1945, including a full-scale test of a gadget-type assembly at Los Alamos using natural uranium as a stand-in for the plutonium fissile material that would be used in the actual Trinity gadget. Known as the Creutz test, this experiment and the Trinity test were delayed because of difficulty acquiring the full-scale lens molds from off-site manufacturers.\textsuperscript{530}

The production of full-sized, quality castings was becoming an issue, and adding another full-scale test was putting additional pressure on S-Site’s high-explosives lens production capabilities. In his Project Y memoir, Kistiakowsky described his last-minute preparations in support of both the Trinity and Creutz tests:

Well, we just did not have on hand enough fault-free castings to assembly two spherical charges and the casting of enough more would take too long to meet Washington’s deadline. The problem was beyond our control because additional casting equipment on order had not been delivered in time to Los Alamos. But many tests had taught us that air cavities distorted the propagation of a detonation wave and had to be avoided at all costs. In some desperation, I got hold of a dental drill and, not wishing to ask others to do an untried job, spent most of one night, the week before

\textsuperscript{529} Manhattan Engineer District, "Book VIII, Volume 2 - Technical," XV-8.
\textsuperscript{530} Ibid., XVIII-11.
the Trinity test, drilling holes in some faulty castings so as to reach the air cavities indicated on our x-ray inspection films. That done, I filled the cavities by pouring molten explosive slurry into them, and thus made the castings acceptable. Overnight, enough castings were added to our stores by my labors to make more than two spheres.531

The Creutz test was eventually detonated in Pajarito Canyon five hundred feet west of the medium firing site’s battleship building (figs. 8.12–8.14).532 The high explosives were provided by S-Site and assembled at the firing site. One of the few photographs taken of the test preparations includes a serious looking Kistiakowsky peering into the partially assembled high-explosives sphere (fig. 8.15).533

The goal of the experiment was to duplicate the Trinity test as closely as possible. However, in addition to using a surrogate for the plutonium pit, metal components had to be removed from around the Creutz test’s high-explosives charge. For this reason, the test’s Comp B and Baratol explosive lenses were assembled in a three-quarter-inch plastic case. According to unclassified information from LA 346, the classified report of the test, the case had been ordered by Kenneth Bainbridge close to a year prior.534

Cameras, both high-speed and 35-mm, were used to photograph the test data at the time of the shot. A high-speed Marley camera, developed by William Marley of the British Mission, documented the detonation of the charge. Working with Marley, several other members of Group G-11 set up the camera near the medium firing site’s battleship bunker, which was used as the control building for the shot. The successful Creutz

533 Creutz, Full-Scale Implosion at Pajarito (unclassified notes), August 10, 1945.
534 Ibid.
explosion created a huge hole in the canyon floor, and, afterwards, shrapnel from the shot was collected.\textsuperscript{535}

**Failure and Redemption: The Ten Dollar Bet**

Data from the recording instruments, however, initially suggested that the velocity of the full-scale Creutz test was too slow and that the Trinity test would be a failure.\textsuperscript{536}

Kistiakowsky, who at this time was in southern New Mexico preparing for test of the gadget, received the news of the test results on Saturday morning, the day before the Trinity test:

> On Saturday morning the big disaster was upon us. A telephone message came from Los Alamos that the $G$ division’s “magnetic method” group found their charge’s implosion so faulty that they anticipated the failure of the bomb at Trinity. Everybody at headquarters became terribly upset and focused on my presumed guilt. . . . At another point Oppenheimer became so emotional that I offered him a month’s salary against ten dollars that our implosion charge would work. . . . Sunday morning another phone call came from Los Alamos, this one with better news. Hans Bethe, head of the theoretical physics division, had spent Saturday analyzing the theory of the magnetic experiment. He concluded that the instrumental design was such that even a perfect implosion might produce oscilloscope records similar to those observed. So we were back at square one and I was forgiven at headquarters.\textsuperscript{537}

Fortunately, Hans Bethe had discovered that the misleading test records were the result of ionization of the air inside the assembly setup during the implosion shot that effectively slowed the data flow and, in turn, indicated a slower velocity than expected. A reexamination of the data indicated that the Creutz test was not a failure after all.\textsuperscript{538}

\textsuperscript{535} Ibid.

\textsuperscript{536} Hoddeson, *Critical Assembly*, 327.

\textsuperscript{537} Kistiakowsky, "Trinity - A Reminiscence," 21.

\textsuperscript{538} Hoddeson, *Critical Assembly*, 327.
Kistiakowsky was redeemed and Oppenheimer later paid him his ten dollars from the bet.539

The little known tale of the Creutz test and of Kistiakowsky’s redemption speaks to the uncertainty surrounding the implosion design, its complicated nature, and its potential for failure. Project Y scientists not only saw the need for the Trinity test before Fat Man’s overseas deployment, they also developed plutonium-recovery methods in anticipation of a possible failure of the Trinity test. The previously undocumented Creutz test is an important date on the timeline of Los Alamos’s trek to Trinity, serving as the final weapons check for the Trinity gadget.

Contested: Commemorating Trinity Site

Trinity Site, while not included in the Manhattan Project National Historical Park legislation, is representative of the current struggle over the meaning of the bomb and its places. The gadget’s journey from V-Site to Trinity was completed when the world’s first atomic device was successfully exploded in the early morning of July 16, 1945. This is a pivot point in world history; like December 7 and September 11, the public memory of this date will forever be associated as a precise moment in time when a paradigm shift occurred in the way contemporary human existence was understood.540

The history of the Trinity test has not been forgotten, but the places and spaces of the site are effectively lost to the public all the same. The Department of Defense, now and in the past, has been reluctant to allow Trinity Site to be formally considered for

national park status. While the Trinity test was the world’s first atomic detonation and the culmination of Project Y’s scientific work developing the implosion weapon, Trinity Site, located within the secure White Sands Missile Range in southern New Mexico, is a contested and complicated space today. It is both a National Historic Landmark, which is an acknowledgment of its importance to the people of the United States, and a place that is restricted to public access for most of the year.

Trinity Site is not listed in the Manhattan Project National Park legislation and was purposely excluded from the park study at the request of the Department of Defense.\textsuperscript{541} This was not the first time, however, that the military and the National Park Service have parted ways over the status of Trinity Site. Historian Ferenc Szasz has documented past conflicts involving the commemoration and preservation of Trinity Site in several of his published works and notes that the National Park Service began considering the site’s formal establishment as a national monument as early as the fall of 1945.\textsuperscript{542}

Excluding the place of Trinity Site from the Manhattan Project National Historical Park does not exclude it from the Manhattan Project narrative. Although they are managed by different government agencies, New Mexico’s atomic spaces share the same scientific parentage and, like siblings, tell each other’s stories. The plutonium-recovery problem that culminated in the Jumbo containment vessel is a Los Alamos

\textsuperscript{541} Early discussions at public meetings highlighted the widespread interest in including Trinity Site in the park legislation; however, landowners had the final say in allowing if their properties could be included. For more on the park study process, see National Park Service, \textit{FONSI} September 2010; National Park Service, \textit{Draft Special Resource Study/Environmental Assessment} November 2009.

\textsuperscript{542} Szasz, \textit{The Day the Sun Rose Twice}, 162-171; Szasz, "The Impact of World War II on the Land: Gruinard Island, Scotland, and Trinity Site, New Mexico as Case Studies," 27.
narrative, but the massive steel body of Jumbo, with its ends blown off, greets visitors to Trinity’s “ground zero” during the missile range’s twice-annual public open house. Trinity is Los Alamos history and its site, however far removed from the Pajarito Plateau, should be considered one of Los Alamos’s wartime technical areas, a true part of Project Y.

Even though the story of the Trinity test is well known, the gadget’s path from V-Site to Trinity is less so. The preservation of V-Site and the interpretation of its role in developing the gadget will strengthen and preserve the direct link between the two places, informing public memory by recreating historical ties that have been severed by politics, physical distance, and the passage of time.

**From “V-Site” to “TR”**

In early 1944, J. R. Oppenheimer and George Kistiakowsky asked Kenneth Bainbridge to support not only the development of the implosion weapon but to head the group that would be responsible for planning a full test of the experimental device known as the gadget, a project that would be fully implemented in March of 1945. This request from the leader of Project Y and from Kistiakowsky, who was head of the wartime explosives division and technical lead for the implosion weapon design, was driven by a very real concern that the implosion weapon might not work, especially in a full-scale arrangement.\(^{543}\) Complicated components, many developed within months of the proposed test, all had to work in perfect synchrony in order for the test of the implosion device to be a success, and a failure at Trinity Site would blow much of the world’s


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supply of plutonium to the four winds. The concrete bowl recovery experiment, Jumbo (the steel confinement vessel), and Pajarito Site’s last minute Creutz test were the children of these concerns.

As part of Project Trinity, code-named “TR,” establishing the location of the test site and planning the necessary support facilities were tasks of paramount importance. The possible areas under consideration in the spring of 1945 included southern Colorado, Padre Island in Texas, an area in the Mojave desert, the California Channel Island area, and several locations in northern, central, and southern New Mexico. Using a cover story that the scientists were government workers conducting water surveys, several scouting trips were made to desert regions in New Mexico.544 UNM’s wartime use of test ranges south of Albuquerque also provided cover for Los Alamos scientists who posed as associates of Professor E. J. Workman.545 Some test-site areas were ruled out because prospective locations had to allow for the delivery of Jumbo. Bainbridge recalled that “the next trip explored the region to El Morro and south of there. It was clear that Jumbo could not be brought into the plateau desert on account of some steep grades surrounding the area and the poor and narrow roads leading from the railroad.”546 Ultimately, Project Trinity planners chose a location southeast of Socorro and set up their base of operations (fig. 8.16). In early July 1945, after months of preparation, Project Y scientists were ready to deliver the gadget device and its key components to the Trinity test site for final assembly.

544 Bainbridge, "All in Our Time': Prelude to Trinity," 44, 45.
545 Section X-2D, Selection of Test Site, "1944," A-84-019, Box 69-15, Los Alamos National Laboratory Archives.
546 Bainbridge, "All in Our Time': Prelude to Trinity," 45.
On July 9, 1945, Los Alamos scientist Norris Bradbury wrote a memo outlining the final planning steps leading up to the delivery of the gadget, which was to leave V-Site at 12:01 a.m. on Friday, July 13, 1945, arriving at its “TR” destination by noon of the same day. Following the established Project Y strategy of leaving little to chance, the eventual Trinity “hot run” on July 13, was preceded by a series of dry-run preparations carried out even before Bradbury’s July 9 memo, including a July 2 practice drive to Trinity Site with a full-weight replica of the gadget to test loading and unloading operations and the hoisting of the device to the top of the tower.

Boyce McDaniel was a member of the transport team for the Trinity gadget. He recalled that “the plutonium core for the bomb had been sent down by a guarded caravan. I remember Phil Morrison rode down to the site with us. He was carrying the initiator with him . . . which was to be mixed on implosion to produce the triggering neutrons.” McDaniel described how the plutonium core was assembled with its initiator in the McDonald ranch house and then taken to the tower at the test site. When McDaniel arrived at the site, the high-explosives sphere, which had left V-Site in the early morning of July 13, was already in the tent under the firing tower (fig. 8.17):

There, in the center, under the 100 foot tower, we found a tent set up with the partially assembled implosion device inside. It was in the shape of a

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547 Bradbury, "Memo - To: Personnel Concerned, Subject: TR Hot Run," 2 Los Alamos National Laboratory Archives.

548 N. E. Bradbury, "Memorandum to Messrs. Morrison and Holloway; Subject: Tamper Sphere Requirements, June 22, 1945," A-84-019, Box 2-10, Los Alamos National Laboratory Archives; N. E. Bradbury, "Memorandum to Harry Allen; Subject: Transportation of Inert Sphere to Trinity on 2 July, June 23, 1945," A-84-019, Box 16-8, Los Alamos National Laboratory Archives; N. E. Bradbury, "Trinity Assembly (Most favored version) (Both dry & hot run), June 25, 1945," A-84-019, Box 16-8, Los Alamos National Laboratory Archives.

five foot diameter sphere, and was made up of explosive lens sectors shaped like watermelon plugs, all pointed toward the center. The shell was incomplete, one of the lenses was missing. It was through this opening that the cylindrical plug containing the plutonium and initiator was to be inserted.550

Ferenc Szasz, in *The Day the Sun Rose Twice*, chronicled the events of the Trinity test in great detail. Once the plutonium pit was inserted into the gadget, the entire sphere was lifted to the top of the tower and lowered on an upper platform (fig. 8.18). Shielded from sight, the final-assembly preparations—installation of the detonators, firing unit, and firing cables—were slowly completed over the next few hours (fig. 8.19). All that remained was the arming of the final firing switches and the detonation of the test to complete the world-changing journey that had begun back in Los Alamos over a year before (fig. 8.20).551

Trinity Site, although not part of the new national historical park, will always be a significant part of the story of the Manhattan Project. As a place of public memory, the test site today is primarily associated with successful detonation of the first atomic device, and many of its historical ties with Los Alamos’s Project Y have been severed. However, the inclusion of places like V-Site, the concrete bowl, and Pajarito Site within the new Manhattan Project National Historical Park will restore the story of the trek to Trinity Site by building upon common narratives to bridge the distance between Los Alamos and White Sands.

550 Ibid., 43.
On the eve of the park, some of the Manhattan Project-era facilities located “behind the fence” have been repaired and restored while others have been neglected and abandoned. Still others at Los Alamos have been lost to public memory because details about their use have been veiled in secrecy. In addition, a key associated site, not listed in the park legislation, is managed by another government agency with a separate federal bureaucracy that has limited the interagency development of a comprehensive Project Y narrative in New Mexico.

The process of creating sites of national memory will restore lost histories and restore severed connections between Los Alamos and other important atomic places, such as the Trinity Site. The creation of formal park boundaries at the national laboratory will also change the current character and landscape of the wartime areas and introduce an aspect of deliberately manufactured memory. Once designated as official park sites, many of the Los Alamos buildings and landscapes will be cleaned up, stabilized, and made “park ready.” New infrastructure will be constructed at the park sites to allow for safe access and for interpretive purposes so that the stories of these individual places can be linked to the local story of Project Y and to the national story of the Manhattan Project. Like Pierre Nora’s sea shells on the shore, there will be a loss of living memory—an artificiality—that will come with park-making and preservation.

The alternative, however, is the permanent loss of the very places of the bomb, and for those areas that are not currently being maintained, the park-making process will most certainly halt their demolition by neglect. If carried out in a careful and thoughtful way, the development of these buildings and structures as public places will not only
involve their physical rehabilitation but will result in their intellectual rehabilitation as essential components of the Manhattan Project’s national historical narrative. The preservation of V-Site, the concrete bowl, and Pajarito Site as formal park sites will result in a greater interpretive connection among the three areas behind the fence at the national laboratory and between Los Alamos and the Trinity Site. The historical threads linking these areas have been broken, and individual stories of place have been poor substitutes for the powerful web of connectivity that comes from developing a narrative across the laboratory landscape and beyond the boundaries of DOE ownership.
Fig. 8.1. Major restoration work was conducted at V-Site, which is one of the most significant Manhattan Project properties listed in the national historical park legislation. The berm wall had failed (shown above); it and other architectural elements were either repaired, replaced, or recreated.

Fig. 8.2. V-Site is located in the bottom center of this aerial photograph taken in late 1946. The small grouping of buildings was constructed specifically as an assembly area for early bomb mockups. Wartime construction at Los Alamos was hurried and often poor quality, reflecting the temporary nature of most mobilization architecture.
Fig. 8.3. After the restoration of V-Site was completed, the national laboratory installed three interpretive signs in the area. The panels include information about the World War II history and significance of the site, the effects of the Cerro Grande fire, and the restoration project.

Fig. 8.4. The shake test apparatus was built to approximate the loading bay of a B-29 airplane. Using it, weapon mockups could be moved around V-Site’s inner, fenced courtyard. A loading pit was also built at the site for handling practice and for conducting temperature tests on the Fat Man prototypes.
Fig. 8.5. This section of no-peek fence line at V-Site was reconstructed from original drawings on file with the national laboratory’s engineering records group. As Project Y’s first assembly facility, V-Site was one of the most top-secret areas at the wartime laboratory.

Fig. 8.6. The concrete bowl, center, is a prominent feature of the Los Alamos landscape in this 1946 aerial photograph. The experimental structure, two hundred feet in diameter, was a scale model, which if used at Trinity Site, would have been much larger. The bowl was built for plutonium-recovery research. Scientists were concerned that the Trinity test would fail and much of the world’s supply of plutonium would be lost in a conventional explosion.
Fig. 8.7. Special tests were fired in the concrete bowl. For each shot, high explosives and stand-in materials were detonated in the water tank on top of the tower. After the explosion, water containing material from the test would drain into the bowl’s filter system. The concrete bowl tells an important engineering and testing story that connects the history of Los Alamos to the history of Trinity Site. Unfortunately, the structure’s historical significance has been overlooked in the past.

Fig. 8.8. Frances Dunne was an explosives technician who supported a variety of firing tests. She is shown here working on a sand shot in Bayo Canyon, located northeast of the townsite area. The several types of plutonium-recovery experiments devised to solve the Trinity test’s potential “fizzle” problem are excellent examples of the problem-solving practices of the wartime laboratory.

(Photograph courtesy of the Los Alamos Historical Society Photo Archives)
Fig. 8.9. Jumbinos were small-scale containment vessels tested as part of the Jumbo development process. Spherical shapes were designed and tested first (left); later, cylindrical shapes were tested (right). Repetitive testing was a core engineering technique that allowed Los Alamos scientists to solve many of the unique technological challenges related to the development of the world’s first atomic bombs.

Fig. 8.10. Jumbo was a 214-ton, steel containment vessel delivered directly from its manufacturer to the desert location of Trinity Site in southern New Mexico. Although never used for its intended purpose, the vessel was designed to contain a conventional explosion should the Trinity gadget “fizzle” or fail to produce an atomic explosion.
Fig. 8.11. Jumbo was not used in the Trinity test and was positioned away from ground zero. After the test, military personnel were instructed to “test” the expensive containment vessel. Explosives positioned at either end succeeded in producing the damage seen today. Los Alamos scientists argued that because the vessel was designed to withstand a central explosion, this informal test was not proof that Jumbo would have been a failure.

Fig. 8.12. The Creutz test in Pajarito Canyon was an important last minute system’s check of the Trinity device. Mirroring most of the technology used in the gadget, including its full-scale high-explosives core, the Creutz test was detonated during the early morning hours of July 14, 1945.
Fig. 8.13. The diagnostics used to document the Creutz test involved developing a magnetic field around the test device. For this reason, a plastic case was substituted for the metal case that was used for the Trinity gadget. Images of this little-known test and its experimental set up at Pajarito Site have just recently been authorized for public release.

Fig. 8.14. Photographs showing the damage from the Creutz test have been used to verify the test’s location at Pajarito Site. A battleship control bunker that supported the magnetic method tests is listed in the national historical park legislation. Its historical context, which will be interpreted for site visitors in the future, will include the lost story of the Creutz test.
Fig. 8.15. George Kistiakowsky was the head of the Project Y high-explosives program. He was confident that his special high-explosives lenses would work as designed and was reluctant to conduct the last-minute Creutz test. He is shown here, at left, observing the test’s set up at Pajarito Site.

Fig. 8.16. Project Trinity’s main headquarters or “base camp” was established away from the test area. Staffed by regular military, SEDs, and scientists, Trinity Site was a hub of activity in the months before the test in July. Personnel devised and built diagnostic infrastructure and viewing areas so that the results of the test could be documented.
Fig. 8.17. Members of the Los Alamos assembly team are shown here in the tent at the base of the Trinity tower. The gadget’s plutonium core was inserted into the device’s spherical case in the tent; its main high-explosives charge, however, was preassembled at V-Site. The device’s fully loaded sphere was transported to Trinity Site on July 13, 1945.

Fig. 8.18. The Trinity gadget was an experimental device and not a weaponized combat unit like the Fat Man and Little Boy bombs. It was detonated on top of its test tower and not dropped out of an airplane like the atomic weapons used against Japan.
Fig. 8.19. The Trinity gadget underwent final assembly of its detonators and firing system on the tower’s platform high above the desert floor. Trinity Site today is open to the public several times a year at the discretion of the active missile range. Its location on Department of Defense land hours away from Los Alamos has effectively severed some of the historical connections between the two Manhattan Project areas that were so closely associated during World War II.

Fig. 8.20. The Trinity test was detonated on July 16, 1945. For many at Los Alamos, this was the final achievement of several years of effort. However, the real challenge was the combat use of the weaponized versions of the Fat Man and Little Boy designs. Project Alberta, the program to deliver the weapons for military use, had been carried out as a parallel effort to Project Trinity, and the success of the Trinity test spurred on final mission planning in the Pacific.
CHAPTER 9

THE FAT MAN QUONSET HUT AND OVERSHADOWED NARRATIVES OF FINAL DESIGN, ASSEMBLY, AND DELIVERY

The object of Project A was to assure the successful combat use of an atomic bomb at the earliest possible date after a field test of an atomic explosion and after the availability of the necessary nuclear material. This object was very effectively accomplished.

Norman F. Ramsey, “History of Project A”

With the success of the Trinity test in July 1945, the end of World War II is almost a footnote in Los Alamos’s Manhattan Project narrative. But Los Alamos played a role, a vital one, in the final design, assembly, and delivery of the actual weapons used in combat. The importance of military logistics and planning and the role of unheralded support institutions are important themes associated with the history of the concluding months and days of the war, especially the story of the massive effort to transport personnel and bombs to the island of Tinian in the far away and war-torn Pacific theater.

Narratives of the Manhattan Project’s final planning efforts, at Los Alamos, in Utah, in California, and elsewhere in the United States, are largely unknown today, masked by the larger story of the deployment and legacy of atomic weapons. Most historical accounts of Project Y describe the general timeline of work at Los Alamos leading up to the July 16 test of the Trinity gadget and then shift immediately to the dropping of the bombs in early August, selectively focusing on the final days of the war.

Historian Adrian Forty, writing about war memorials and public memory, addresses the phenomenon of selective commemoration: “But it is surely an inevitable feature of memorials—and this is true not only of war memorials, but of all
commemorative artefacts—that they permit only certain things to be remembered, and by exclusion cause others to be forgotten."\textsuperscript{552} While not one of Forty’s static sites of historical memory, the vast story of the parallel-planning effort by Manhattan Project personnel and the American military that resulted in the weaponization, final assembly, and wartime use of the first atomic bombs has been lost through the same selectiveness of historical interpretation.

**Initial Fat Man Weaponization: V-Site and the Main Tech Area**

The narrative of the assembly and delivery of the atomic weapons used against Japan has been overlooked through the process of selective storytelling. Locally, this underappreciated history begins with the previously undocumented use of Los Alamos’s V-Site in May 1944 to mockup the first prototype weapons and ends in July of 1945 at Los Alamos’s Quonset Hut assembly building, with the production of Fat Man’s preassembled sphere, used in the F31 combat unit dropped on the Japanese city of Nagasaki.

The assembly story starts with V-Site, a small grouping of buildings located at the edge of S-Site’s high-explosives area. At V-Site, not only were full-scale prototypes assembled with high explosives and mechanically shake-tested to verify safe methods for transport, but inert mockups were used to practice loading and unloading techniques.\textsuperscript{553} Temperature tests were also conducted at the site to replicate the conditions in an unheated bomb bay. This first, little-known use of V-Site is described in Project Y’s


\textsuperscript{553} Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-37.
official wartime history, only recently released to the public as a near complete set of volumes:

The intervening time [between March and June of 1944] at Los Alamos was devoted to a number of activities: the analysis of the first Muroc data, the planning of a functional mock-up of the plane and bomb-suspension for handling, loading, shaking and cold tests, and construction of a site (V Site) for this work; investigation of the need and possibility of heating equipment for the B-29 bomb bay.554

V-Site had its own loading pit, one of the first of its kind developed specifically for the loading of the heavy Fat Man and Little Boy combat units into transporting aircraft. To further mirror the airfield experience, a metal frame on wheels was built to replicate the bomb bay of a B-29. The designers of V-Site even installed metal runway matting in the compound to duplicate the anticipated field conditions on temporary Pacific island airstrips.555 V-Site’s C-2 wrecker truck, essentially a mobile heavy-duty crane, was standard military issue and its use was anticipated at Wendover and at an undetermined Pacific base of operations (fig. 9.1). The wrecker truck was used to move the fully loaded units, both live and inert, around the compound and was used as a crane inside V-Site’s assembly building. In fact, the building’s high bay doors were specifically designed to accommodate the boom arm of the C-2.556

Separate from its role as a mockup site for early weapon models, V-Site was also used as early as December 1944 to practice assembling complete setups of shaped high-

554 Ibid.
556 Parsons, "Memorandum to Kistiakowsky, Bacher, Bainbridge, Ramsey; Subject: Development of Tests of Fat Man Assembly," Los Alamos National Laboratory Archives.
explosives lenses.\textsuperscript{557} According to Norman Ramsey, who served as one of Deak Parsons’s deputies for Project Alberta, V-Site was being used from the fall of 1944 to the spring of 1945 for “numerous physics and engineering tests on complete units . . . initially under the direction of the Delivery Group and of Bernard Waldman and later after the formation of Project A under Bradbury and Warner”\textsuperscript{558}

Assembly practice sessions with live explosives were conducted at remote V-Site for several reasons: to replicate field conditions and also as a safety measure. Teams also practiced assembly techniques using inert mockups at the Main Tech Area’s Delta Building.\textsuperscript{559} Here, close to the town’s residents, engineering problems could be worked out under controlled conditions. Through repeated sessions at both locations, assembly procedures were taught to the Los Alamos teams that would be responsible for the final assembly of the weapons at war’s end.

Information gleaned from the critically important assembly and loading practice at V-Site and at the Main Tech Area during 1944 and 1945 was used at Wendover to support the handling and assembly of prototype combat units drop-tested in Utah and

\textsuperscript{557} New Bldg at V-Site Available, "December 29, 1944," A-84-019, Box 68-1, Los Alamos National Laboratory Archives; H. Linschitz, "Memorandum to Comdr. N. E. Bradbury; Subject: Study of Gadget Assembly Techniques, March 31, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives; Lt. W. F. Schaffer, "Memorandum to All Concerned; Subject: H.E. Assembly at V Site, March 29, 1945," A-84-012, Box 2-12, Los Alamos National Laboratory Archives.

\textsuperscript{558} Ramsey, "History of Project A," 8, Los Alamos National Laboratory Archives.

\textsuperscript{559} H. Linschitz, "Memorandum to Comdr. N. E. Bradbury; Subject: Gadget Assembly Practice Delta Bldg., May 18, 1945," A-84-019, Box 48-11, Los Alamos National Laboratory Archives.
California, and, later, in the actual assembly and loading of bombs during the practice runs and final Japanese bombing missions originating from Tinian.  

**Drop Tests and Pumpkins—Air Fields, Test Ranges, and California’s Project Camel**

**Initial Drop Tests – Aerodynamics**

Dahlgren

Assembly preparations at Los Alamos were important, but the design and production of weapons casings was also critical. There would be no way to deliver the bombs to their intended targets in Japan without actual combat units that could be dropped and detonated from military aircraft. On August 13, 1943, the first drop test of a very crude Thin Man prototype was conducted at a test range at the Dahlgren Naval Proving Ground in Virginia, a history known only to a few. The skinny wooden model, built to roughly approximate the shape of the weapon at 14/23 scale, was soon upgraded to a full-scale metal design tested later in California at Muroc Army Air Base.

Remarkably, Thin Man prototypes were not the only bomb casings tested in 1944. Preliminary Fat Man casings, crude shapes that just barely approximated the size and shape of an implosion weapon, were also tested (fig. 9.2). Lagging behind the Thin Man

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560 Norman F. Ramsey, "Memorandum to Comdr. F. Birch; Subject: Supervision of Gun Assemblies, March 28, 1945," A-84-019, Box 2-10, Los Alamos National Laboratory Archives; R. S. Warner, Jr., "Memorandum to Mr. N. F. Ramsey; Subject: H.E. Blocks for Training Purposes, April 23, 1945," A-84-019, Box 2-10, Los Alamos National Laboratory Archives. Scientists, engineers, and technical workers, both civilian and military (SEDS), would fly from Los Alamos to Wendover and elsewhere to assist with high-explosives assembly training and to document the results of drop tests. Some of these same men were members of the Fat Man assembly team on Tinian.

561 Ramsey, "History of Project A," 2, Los Alamos National Laboratory Archives.

562 Ibid. See Fig. 5.20 (the “Sewer Pipe” bomb).
gun weapon program, the implosion program was still a fledgling endeavor in mid-1943, and was, according to historian Lillian Hoddeson, “a small, informally run, backburner effort of a handful of researchers surrounding the reserved Seth Neddermeyer.” By late 1943, Neddermeyer’s group was working closely with George Kistiakowsky of Bruceton, Pennsylvania’s ERL, but many details related to implosion were still being worked out. Although the first small-scale casting facilities at Anchor Ranch East were operational in late 1943, substantial progress on the design of an implosion weapon would not occur until much later when expanded high-explosives facilities at S-Site became fully operational in the fall of 1944. However, to support the efforts of Project Y’s weapons delivery group, which was working in parallel with weapons-development groups, scientists at Los Alamos identified preliminary dimensions for a Fat Man prototype as early as the fall of 1943, well before the implosion design was final. Norman Ramsey, in his “History of Project A,” recalled how the first prototypes got their names:

In order that the aircraft modifications could begin, two external shapes and weights were selected by Parsons and Ramsey as representative of the current plans at Site Y. . . . For security reasons these were called by the Air Forces representatives the “Thin Man” and “Fat Man” respectively—the Air Forces officers tried to make their phone conversations sound as if they were modifying a plane to carry Roosevelt (the Thin Man) and Churchill (the Fat Man).

In late November 1943, in response to the unique sizes of the prototype weapons, Army Air Force personnel at Wright Field, Ohio, began the process of readying a prototype B-29 airplane that could carry them. In January of 1944, new full-scale models

563 Hoddeson, Critical Assembly, 129.
564 Ibid., 380.
of the earliest Thin Man and Fat Man designs manufactured by George Chadwick’s Detroit operations—some of them full-weight—were used to determine the appropriate configuration of special B-29 bomb bays, which would need to be modified to accommodate the seventeen-foot-long Thin Man and the fifty-nine-inch-diameter Fat Man. In addition to their awkward shapes, the bombs were heavy, with Fat Man weighing over 9,000 pounds when fully loaded.

**Muroc**

After the B-29 bomb bay modifications were made at Wright Field, drop testing operations were moved to Muroc Army Air Base in California. At Muroc, with its important but underrepresented narrative of air support operations, the weaponization partnership between Project Y scientists and the military would have it true origins. In March of 1944, the first tests of the full-scale Fat Man and Thin Man casings manufactured out of the Detroit office were begun (fig. 9.3). Unfortunately, during an early test run, one of the Thin Man prototypes damaged the transporting B-29 aircraft; the damage had to be repaired and a second round of Thin Man and Fat Man combat-casing drop tests was delayed until June of 1944 (fig. 9.4).

This delay was fortuitous because developments at Los Alamos during the summer of 1944 would affect the designs of both the Thin Man and Fat Man weapons. Fat Man design changes focused on improvements to the high-explosives case. The new

568 Ramsey, "History of Project A," 4, Los Alamos National Laboratory Archives.
569 Ibid.
570 Ibid., 4-5.
design, Y1560, and its successor, Y1561, used significantly fewer bolts and made assembly easier. The Thin Man weapon, however, was abandoned completely in August of 1944 once Los Alamos scientists working at remote Pajarito Site confirmed that plutonium could not be used in the Thin Man design. The August reorganization of Project Y resulted in the development of the Little Boy weapon, a much shorter gun-assembled design, which would not need the double-length bomb bay constructed for Thin Man.

**Expanded Air Operations – New U.S. Facilities**

**NOTS**

By the summer of 1944, Los Alamos’s weapon-prototype drop tests were expanded to include the Sandy Beach test range near Salton Sea in California, and by early 1945, special drop tests were being conducted by Project Camel at Inyokern’s NOTS test ranges. NOTS first became operational in 1943 to support proving-ground activities associated with wartime rocket-program work being conducted for the Navy by the California Institute of Technology. Later, the Inyokern facilities would become part of the Manhattan Project’s Project Camel, a joint Caltech and Navy operation. The military test ranges and university research areas in California would prove invaluable for their support of early weapons-design tests and later tests of full-scale combat units and

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571 Ibid., 5-6; Manhattan Engineer District, "Book VIII, Volume 2 - Technical," VII-38. The earlier version was designated “1222” and contained 1500 bolts.


573 Ramsey, "History of Project A," 7, Los Alamos National Laboratory Archives.

574 Christman, *Target Hiroshima*, 155.

575 See, generally, Manhattan Engineer District, "Book VIII, Volume 3 - Auxiliary Activities - Chapter 2 - Project Camel."
their internal components, including the critical electronics required to detonate the weapons.

In addition to supporting drop tests, NOTS’s facilities and area contractors supported the production of pumpkin units, including the loading of pumpkin casings with inert materials. Construction of a new high-explosives plant, mirroring Los Alamos’s high-explosives casting operations, was begun during the later part of the war, and, according to the official *Manhattan District History*, was to function “as a standby in case of disaster to the Los Alamos S Site plant.”

Project Camel resources were also tapped to support the massive logistical effort required to establish a Pacific base of operations for the final deployment of the Los Alamos weapons. Beginning in the spring of 1945, NOTS staff designed and constructed a model building for the final assembly of the Fat Man and Little Boy combat units. Project Y military planners—not wanting to leave anything to chance—designed, built, and tested the special assembly building in the California desert before sending the plans and construction materials to the Pacific. With only a few modifications, the building built at Inyokern was replicated at Tinian.

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578 G. A. Galloway, "Memorandum to N. Ramsey; Subject: Inspection of the Destination Assembly Building Now Built at Inyokern, May 16, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.
Wendover

By October of 1944, the 509th squadron’s fleet of B-29s was operating out of Utah’s Wendover Air Field, making drop tests at Inyokern’s Karacot Valley the same month. Wendover, code-named “W-47” or “Kingman,” quickly became the new hub for the Little Boy and Fat Man drop tests that had previously been launched from Muroc in the California desert. As headquarters for the 509th Composite Group, Wendover would play a significant role in the planning efforts related to the ultimate use of atomic weapons against Japan. Lt. Colonel Paul Tibbets, who had previous experience flight-testing B-29s at New Mexico’s Alamogordo Air Base and elsewhere, was selected to lead the 509th. Chick Hayward, writing in his memoir account, recalled the arrival of Tibbets and his crew members:

They’d arrived in October 1944, with fifteen B-29s. . . . In training they used dummies we’d made in the shape and weight of the two bombs. They dropped these so-called “pumpkins” at isolated Karacot Valley, a spot picked because Fat Man had such a distinct shape that we didn’t want it dropped where people could see it.

While initial inert drop tests carried out by the B-29 squadron had supported aerodynamic research focusing on the physical designs of the casings, Tibbets’s group began conducting live tests as the drop-test program matured. In a live test, Fat Man

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579 Hayward and Borklund, Bluejacket Admiral, 132; Ramsey, "History of Project A," 7, Los Alamos National Laboratory Archives.
580 See, generally, Robert Krauss and Amelia Krauss, eds., The 509th Remembered: A History of the 509th Composite Group As Told by the Veterans That Dropped the Atomic Bombs on Japan (Buchanan, MI: Robert Krauss, 2010); Ramsey, "History of Project A," 7-9, Los Alamos National Laboratory Archives.
582 Hayward and Borklund, Bluejacket Admiral, 132.
583 Campbell, The Silverplate Bombers, 43-45.
pumpkins were filled with high explosives to more closely approximate actual bombing runs. Weighing over five thousand pounds, the pumpkin bombs were similar in design to standard blockbusters, conventional bombs developed for use in World War II that contained several thousand pounds of high explosives. Pumpkins, produced by Project Camel at NOTS, were also similar in size to the Fat Man final combat-unit mockups, but distinguishable by their orange color and three-node nose configuration, which contained impact fuses (fig. 9.5).

According to assembly specialist Harlow Russ in his account in *509th Remembered*, Wendover’s location along a rail line made for convenient transport of the inert and live pumpkins. Pumpkin production was a separate project from the Detroit office’s production of ellipsoids and box tails for Fat Man mockups and combat units. This little known but important narrative of planning and logistics involved the participation of diverse and far-flung support organizations, including military ordnance plants, private industry, and secret university research projects. The pumpkin program was under the control of Project Camel; pumpkin casings were manufactured at California and Michigan factories and sent to Inyokern and Oklahoma’s McAlester Army Ordnance Plant by rail for filling, making their return trips by rail to Utah for drop testing or, later, to California’s Port Chicago for use by the 509th at Tinian.

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584 Christman, *Target Hiroshima*, 167; Hayward and Borklund, *Bluejacket Admiral*, 132. Chick Hayward notes that the pumpkins dropped at Inyokern weighed closer to 10,000 pounds.


In a rarely documented mission to prepare for actual combat conditions in the Pacific, Manhattan Project planners sent members of the 509th to Cuba’s Batista Field for special training in early 1945. The several months of sea-level flight runs in a tropical environment gave the B-29 crews valuable experience that would be put to use later under the actual conditions of the Pacific theater. Closer to home, bomb drop tests and practice target runs originating from Wendover Field in Utah continued during the spring of 1945. The Salton Sea and Inyokern test ranges in southern California continued to serve as the primary B-29 target areas.\textsuperscript{587}

The important partnership formed between the scientists and the military to weaponize Little Boy and Fat Man continued with Los Alamos teams traveling to Wendover to observe drop tests, supervise the assembly of the test units, and train their local counterparts.\textsuperscript{588} Information from the tests was collected at the target areas and analyzed at Wendover. Val Fitch, recruited to work at wartime Los Alamos as a SED, described his time at Wendover:

Early in the spring of 1945 with my fellow SED, Bud Lang, I went to Wendover, Utah, where the B-29 crews were in training. The trip from Kirkland Field in Albuquerque to Wendover in a badly limping B-17 was, to understate the situation, hair-raising. At the Utah airbase we were engaged in a testing program involving practice bombs which were dropped on targets in the Salton Sea in southern California. Another part of our group was in the target area to receive the telemetry data. . . . We were setting up our little laboratory in a Pacific hutment on the edge of the airfield at Wendover assisted by the Air Force officer who was to supervise the continuation of the test after our departure.\textsuperscript{589}


\textsuperscript{588} Christman, \textit{Target Hiroshima}, 153.

\textsuperscript{589} Fitch, "The View from the Bottom," 45.
During the spring and summer of 1945, Wendover became the main support center for Los Alamos’s final weapon readiness efforts. In order to prepare Fat Man test units, an assembly area was established for Wendover’s ordnance crew to load the combat-type casings with high-explosives castings, detonators, and related instrumentation. The air field was also the operational base for an essential group of C-54 aircraft that supported the transport of Manhattan Project personnel and the delivery of equipment.\footnote{Russ, \textit{Project Alberta}, 31; Manhattan Engineer District, "Book VIII, Volume 2 - Technical," XIX-6, XIX-8, XIX-10.}

**Final Pacific Preparations**

**Tinian and Iwo Jima**

Overshadowed by the story of the weapons’ ultimate use, the effort to establish a Pacific headquarters to conduct final assembly and delivery operations is largely ignored in the standard history of the Manhattan Project. By June of 1945, construction of the 509th base of operations on Tinian Island was well underway, and, by July, the assembly facilities were ready (fig. 9.6).\footnote{Ramsey, "History of Project A," 10, 12, Los Alamos National Laboratory Archives.} With the arrival of assembly team personnel from Los Alamos, additional military crews, and the B-29s themselves, operations at Tinian in support of the atomic bomb project began to intensify in June and July. The sea transport of high-explosives-filled pumpkins had started in May, and these conventional weapons, once they were arrived on Tinian, were stored on the island awaiting deployment in July’s final bombing runs.\footnote{Christman, \textit{Target Hiroshima}, 175; Campbell, \textit{The Silverplate Bombers}, 75.}
Continuous planning and preparation efforts carried out by the military were essential to mission success, and drop tests of Fat Man pumpkins and Fat Man and Little Boy mockups were conducted by the Tinian-based B-29 crews during the days leading up to the Hiroshima mission. According to Christman, pumpkin drops began in earnest on July 20, 1945, when “twelve high-explosive Pumpkin missions were flown. In all, sixteen B-29s dropped eighty tons of Pumpkins on primary targets, including oil refineries and industrial complexes. Another twenty-one B-29s dropped 105 tons of Pumpkins on secondary objectives and targets of opportunity.” Toward the end of the war, several Little Boy and Fat Man test units were assembled with full instrumentation and parts. Not to be confused with pumpkins, these mockups were identical to the final bombs in design and assembly but lacked the all-important fissile material.

As one last systems check—further evidence of the military’s emphasis on preparation and planning—a complete Fat Man mockup sans pit was drop-tested at Wendover on August 4, 1945. A fully loaded high-explosives sphere, assembled at the Quonset Hut at Los Alamos’s Two Mile Mesa, was flown to Wendover by B-29 by way of Albuquerque’s Kirtland Field, and served as confirmation of the Raytheon Model II detonator firing system, or X-unit, which had not been rigorously tested because of factory delivery delays. The Model II X-unit had been fired only a few times in a live test before its use in the Fat Man unit exploded over Nagasaki on August 9: during the


594 Christman, *Target Hiroshima*, 175.
Wendover drop test in the first week of August and during the last minute Pacific test of Fat Man unit F33 on August 8.\textsuperscript{595}

As part of mission readiness, the 509th also conducted key practice flights at the end of July. These missions not only involved last-minute bombing runs against Japanese targets, but also practice landings at Iwo Jima, which had an airstrip that could accommodate B-29s and an atomic bomb loading pit for emergency use.\textsuperscript{596}

**Oversea Logistics: Project Alberta**

Project Alberta (alternately “Project A” or just “Alberta”) was a critically important subproject of the Los Alamos effort that is underrepresented in the story of the Manhattan Project. Alberta, established at the same time as Project Trinity, had one goal: delivering the final Little Boy and Fat Man combat units to the Pacific for the U.S. military’s use against Japan.\textsuperscript{597} Los Alamos’s Deak Parsons was the leader of Project Alberta, which was, in its very essence, a true feat of engineering and organization. Christman, writing in *Target Hiroshima*, sums up why Captain Parsons was chosen to head the new project:

> Many of Parsons’ Alberta responsibilities were part of the ongoing operations of his Ordnance Division: converting nuclear devices into weapons with predictable ballistics; modifying aircraft to accommodate the bombs; coordinating a delivery plan with the Air Forces; supervising field tests of non-nuclear components and full-scale bomb models;

\textsuperscript{595} Ramsey, "History of Project A," 9, Los Alamos National Laboratory Archives; Manhattan Engineer District, "Book VIII, Volume 2 - Technical," XIX-5.


\textsuperscript{597} Ramsey, "History of Project A," 1, Los Alamos National Laboratory Archives.
developing fuzes to fire the bomb at the chosen altitude; planning the facilities and procedures for assembling the bombs overseas.598

Although Los Alamos’s Project Y personnel directly supported Project Alberta—assembling and, in some cases, deploying the physical manifestations of their three years of scientific research—Alberta was strictly voluntary. Each Los Alamos member of the project had to submit an application to be part of the team stationed at Tinian, code-named “Destination” or Site “O.”599 Key scientific and operations staff for Project A included both navy and civilian scientists. Norman Ramsey was Parsons’s deputy (fig. 9.7). Commander Frederick “Dick” Ashworth functioned as the primary liaison with the military and would later serve as the weaponeer on the Nagasaki mission. Other important project staff included Roger Warner and Lieutenant Commander Norris Bradbury, who were jointly responsible for overall Fat Man assembly, and Lieutenant Commander A. Francis Birch, who was the lead for Little Boy assembly. Specific Project Y staff were also responsible for the assembly of individual weapons components at facilities on Tinian, such as Fat Man’s detonators and plutonium pit, or were assigned other Tinian duties, including in-flight observations during B-29 test runs.600

One of Deak Parsons’s most important tasks was overseeing the final checks of weapon components, mostly carried out at Wendover in the spring and early summer of 1945, with important last-minute tests conducted at Los Alamos and during the final weeks at Tinian. He was also responsible for setting up a base of operations in the

598 Christman, Target Hiroshima, 162.
599 See, generally, Personnel - Hiroshima and/or Destination, "6/13/44 - 10/12/45," A-84-019, Box 22-3, Los Alamos National Laboratory Archives.
600 Ramsey, "History of Project A," 8, Los Alamos National Laboratory Archives.
Pacific, providing the Project Alberta workers with assembly facilities and all the necessary supplies required to support the deployment of the weapons. The production of indispensable parts, such as combat casings, detonating devices, and the fissile metal shapes used in the weapons, which were the culmination of years of production work at Hanford and Oak Ridge, was ongoing until the very last days of Project Alberta. Assuring the timely delivery of these parts represented a major effort, and much of the planning work was carried out by both Parsons and his deputy, Ramsey.601

To facilitate the delivery logistics, shipments of support equipment were designated as “batches,” and included everything from spare clothing to the modular buildings used to assemble the bombs. Most of these shipments, which also included over fifty live pumpkin bombs manufactured at McAlester, were arriving at Tinian on naval “Victory” ships originating from Port Chicago in the San Francisco Bay Area (fig. 9.8).602

The supply batches sent to Tinian included “kits” or single pre-planned shipping units that included everything needed for bomb assembly including specialized tools and parts.603 Boyce McDaniel, a Project Y SED, also described the kit concept in his World War II memoir:

After this work, I became engaged in the preparation of field kits, especially equipped for use in the West Pacific. These kits were to provide

601 See, generally, ibid.
602 Ibid., 10; Lauris Norstad, "Memorandum to C. Lemay; Subject: 509th Composite Group, Special Functions, May 29, 1945," A-84-019, Box 7-8, Los Alamos National Laboratory Archives; Parsons, "Memorandum for Major General L. R. Groves; Subject: Overseas Shipment of Mechanical, Electronic, and Explosive Gadget Components," Los Alamos National Laboratory Archives.
the bomb assembly group with all the equipment that one could conceive might be necessary to assemble and arm the bombs as well as to trouble shoot components.604

An assembly building prototype using kit materials was built at Inyokern in the California desert. This preparatory exercise, the “dry run-hot run” planning strategy seen time and again during the Manhattan Project, enabled Parsons and Ramsey to note design flaws and identify any missing equipment that should be included in the master list for each kit. As part of this fail-safe planning by Parsons, a backup assembly facility was even established at Iwo Jima, including the bomb loading pit tested during July 29 and July 31 practice missions using Little Boy unit L-6.605

By April of 1945, sea and air shipments began to arrive at Tinian. The Army Corps of Engineers was responsible for seeing that Project Alberta’s technical buildings were built in time, and, by July, Fat Man and Little Boy assembly buildings, high-explosives storage magazines, several additional shops and laboratory spaces, and Tinian’s two bomb loading pits were ready for use.606

To further distinguish between the various types of shipments, those designated “Bowery,” contained replaceable items. “Bronx” shipments were of the highest priority and contained irreplaceable items, such as the top-secret, priceless weapon components.607

605 Ramsey, "History of Project A," 10, Los Alamos National Laboratory Archives.
606 Christman, Target Hiroshima, 163.
**Bowery**

Although key “Bronx”-shipment components for the final Little Boy and Fat Man combat units were preassembled in New Mexico, other supporting weapons parts were produced by military research and ordnance facilities and by private companies under contract to the Manhattan Project. Many of these parts were stockpiled at Wendover for eventual “Bowery” shipment to Tinian. Duplicate weapons components were sent in each of the five batch shipments as insurance against loss during transport and the very real possibility of equipment failure in the remote Pacific. Some of the components were sent from the manufacturer directly to the Mare Island Naval Shipyard and the Port Chicago Naval Magazine, the two San Francisco-area naval facilities responsible for stockpiling and preparing Project Alberta’s batches for shipment to Tinian.

During the spring and summer of 1945, Bay Area military facilities, whose connections to the history of the Manhattan Project have been overlooked today, worked in tandem to support Parsons’s final bomb delivery project at Tinian. While most of Project Alberta’s supplies were sent by Victory ships that left directly from Port Chicago, some materials arriving by rail were transported to Mare Island for additional packaging or to Hamilton Field, north of San Francisco, for air transport (fig. 9.9). Equipment was also flown directly to Hamilton Field for eventual transport by ship.

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608 See, generally, Manhattan Engineer District, "Book VIII, Volume 2 - Technical; Manhattan Engineer District, "Book VIII, Volume 3 - Auxiliary Activities - Chapter 2 - Project Camel."


610 Lockridge, "Memorandum to All Concerned; Subject: Shipping Instructions for Special Items," Los Alamos National Laboratory Archives; Lockridge, "Memorandum to All Concerned; Subject: Group O-7 Responsibility for Liaison and Coordination," Los Alamos National Laboratory Archives; Campbell, *The Silverplate Bombers*, 75.

At an annex to building 627 at the Mare Island Navy Shipyard, sensitive Los Alamos weapons components were repackaged for Tinian’s tropical conditions (fig. 9.10). As part of planning for the delivery of material to the Pacific, Parsons visited the Mare Island facilities several times, also sending personnel to learn proper packaging techniques that could be applied at Los Alamos and Wendover to expedite shipments if necessary. In July 1945, Mare Island workers prepared Little Boy’s instrumentation and parts for sea transport by the U.S.S. *Indianapolis* (fig. 9.11). Veiled in secrecy and code-named “the Yard” or “627A” (after its building number), the project at Mare Island is little known today.  

The details surrounding Port Chicago’s role in supporting the final assembly and delivery of the atomic bombs used against Japan have also been buried in closed government archives and are underrepresented in the overall telling of the Manhattan Project story. Port Chicago Naval Magazine, located east of Mare Island, was a naval ordnance storage and shipping facility that supported Pacific operations during World War II. Code-named “TIJ” for “Three Igloo Job” or, alternately, “Kinne’s Place” for the facility’s Commander Kinney, Port Chicago was an important rail transport hub because batch shipments from Wendover and other supplies from the east could be sent directly to the Bay Area using commercial railway lines.

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612 N. E. Bradbury, "Memorandum to Lt. Col. Lockridge; Subject: Lt. Schaffer's Request for Clearance to Visit TIJ and 627A, June 23, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives; Peer de Silva, "Memorandum for Captain W. S. Parsons, USN; Subject: Code Designations for Use at Site Y, March 27, 1945," A-84-019, Box 5-9, Los Alamos National Laboratory Archives.

613 de Silva, "Memorandum for Captain W. S. Parsons, USN; Subject: Code Designations for Use at Site Y," Los Alamos National Laboratory Archives.
Wartime Port Chicago was a vast landscape of high-explosives igloos, railcar bunkers, and ship-loading facilities. A winding network of interior rail lines supported the entire site and allowed shipments arriving by commercial railroad to be transferred, via local rail spurs, directly to the inland areas for storage or to the pier area for more immediate loading. Some of Los Alamos’s high-priority items, such as Fat Man’s detonators, were stored in a group of three inland igloo bunkers (fig. 9.12). Pumpkin shipments arriving from the ordnance factory at McAlester, Oklahoma, were typically left packed in railcars and stored at the railcar bunkers near the piers until just before loading on Victory ships bound for Tinian (fig. 9.13). Christman, in Target Hiroshima, mentions the overseas shipment of pumpkin bombs from the California bay area: “By May 1945, Pumpkins were being shipped overseas at the rate of twelve to sixty a month, adding significant logistical problems at Mare Island and Port Chicago.”

**Bronx**

Important “Bronx” shipments started arriving in late July, including the fissile material manufactured at great expense at the Oak Ridge and Hanford production plants. Little Boy’s uranium-235 projectile and several combat casings arrived at Tinian on July 26, 1945, transported aboard the U.S.S. Indianapolis. According to various accounts, the uranium projectile was transported in a lead-lined, bucket-type container that was bolted to the ship’s deck for the duration of the voyage, which originated from

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614 Parsons, "Memorandum for Major General L. R. Groves; Subject: Overseas Shipment of Mechanical, Electronic, and Explosive Gadget Components," Los Alamos National Laboratory Archives.

615 N. E. Bradbury, "Memorandum to Lt. W. F. Schaffer, June 12, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.

616 Christman, Target Hiroshima, 167.

617 Hoddeson, Critical Assembly, 390; Krauss and Krauss, eds., The 509th Remembered, 162.
Having left Albuquerque’s Kirtland Field on July 26, three C-54 airplanes arrived at Tinian on July 28 and in the early morning of July 29 with the remaining uranium components and key project staff. Known as Green Hornets, these transports were used by the Manhattan Project as essential workhorse aircraft, shuttling Project personnel and materiel to and from Los Alamos, Wendover, Inyokern, and Tinian during the final months of the war. Little Boy’s non-fissile components and its detonating instrumentation were sent to the Pacific in redundant shipments, ensuring that enough parts were sent to assemble several units and as insurance against problems during final assembly. Little Boy’s gun tubes were produced at the Naval Gun Factory in Washington, D.C., its target cases manufactured at the Centerline Naval Ordnance Plant, and its explosive propellant—cordite—manufactured at Bruceton.

Fat Man’s fissile material, the plutonium core, was flown to Tinian in a C-54, leaving Kirtland Field on July 26 and arriving at the Pacific base on July 28. Three high-explosives spheres, their duraluminum cases preassembled with cast lenses at Los Alamos, were loaded into Wendover’s B-29s at the Albuquerque field in three separate airplanes on July 28. As originally planned, the Fat Man weapon was to be assembled at Tinian from boxed sets of cast lenses. Quality-control issues with the high-

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explosives lenses, which had only recently been produced at full-scale sizes, limited the number of “good sets” available for use during July and August of 1945. Full-scale sets were needed for the Creutz mockup test, detonated at Pajarito Site on July 14; the Trinity test, detonated on July 16; and the Fat Man mockup drop tests conducted at Wendover and at Tinian as final systems checks in the days before the Nagasaki mission.

Oppenheimer, following a suggestion by Kistiakowsky, decided that the final Fat Man high-explosives packages, built following the new trap-door design, would be preassembled at Los Alamos. Oppenheimer, following a suggestion by Kistiakowsky, decided that the final Fat Man high-explosives packages, built following the new trap-door design, would be preassembled at Los Alamos.623 Three assembled metal spheres, numbered F31, F32, and F33, were shipped in their ellipsoid cases, arriving at Tinian on August 2. Two of the high-explosives assemblies were shipped with their box tails and dummy X-units.624

Loading Pits and Assembly Buildings: Final Design, Delivery, and Use

The Manhattan Project’s monumental research, design, production, and testing effort came to a singularly focused conclusion during the months of July and August 1945. World War II histories typically skip from the successful Trinity test in mid-July of 1945 straight to the dropping of the assembled weapons on the Japanese cities of Hiroshima and Nagasaki in early August.

The Trinity gadget tested in July was really just an experimental device and not configured as a deliverable weapon. In fact, contrary to public perception, the test itself

623 N. E. Bradbury, "Memorandum to Lt. Schaffer and R. Warner; Subject: Trap Door Assembly, May 11, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.

was verification of a design that had already been readied for combat use and whose components were being sent to the Pacific well before July 16, 1945. What is missed in the standard Manhattan Project timeline is the several years of planning and execution that led to the military’s deployment of actual combat units.

In a parallel effort to Project Trinity, Project Alberta staff not only prepared the batch shipments to Tinian but also made several last-minute design changes to the Fat Man weapon, developed final assembly techniques, and supported dry and hot runs for the delivery of vital weapons components. Final assembly operations at Tinian had been carefully planned and were executed just a few short weeks after the successful Trinity test in southern New Mexico. While the Pacific base of operations was established by the summer of 1945, assembly- and airplane-loading protocols using bomb models had been practiced at various sites since late 1943, beginning at Dahlgren’s Naval Proving Ground. In addition to the numerous California and Utah drop tests that gave Tibbets’s B-29 crews hours of loading and bombing practice, Manhattan Project engineers and architects began designing assembly buildings, first, as supporting facilities for initial design work, and, later, as prototypes for the Fat Man and Little Boy assembly buildings built at Tinian.

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625 Ramsey, "History of Project A," 10, Los Alamos National Laboratory Archives.
626 Ibid., 9-10.
627 Ibid., 2.
628 Ramsey, "Memorandum for Colonel Kirkpatrick; Subject: Special Construction at Alberta," Los Alamos National Laboratory Archives.
V-Site – 1944

V-Site was first established as a separate facility to study mockups of early Fat Man weapon designs. Its loading pit, located in the center of the site’s fenced compound, was used to study environmental conditions anticipated during aircraft deployment (fig. 9.14). Building 516 at V-Site was constructed specifically to put together full-scale high-explosives assemblies. Built in the fall of 1944, the building’s extra-tall, high-bay doors were purposely designed to accommodate the crane boom of the C-2 wrecker truck used to move the heavy Fat Man models around the site.629

Wendover Loading and Assembly – 1945

In early 1944, the first modified B-29 airplane was sent to Muroc Army Air Base to conduct aerodynamic tests of early Thin Man and Fat Man bomb-casing designs. Home-based at Wendover Air Field in Utah, Tibbets’s fleet of B-29s were being flown to Inyokern, beginning in October 1944, for the loading and drop testing of Fat Man and Little Boy models.630 To support the Wendover missions, several B-29 loading pits were constructed at Inyokern’s air field (fig. 9.15).631

The 509th air operations at Wendover first focused on drop tests of inert bomb models. With the increased need to test instrumented mockups, Manhattan Project work at Wendover expanded to include high-explosives assembly operations (fig. 9.16). The high explosives loaded into test units at Wendover were shipped from facilities at

629 Parsons, "Memorandum to Kistiakowsky, Bacher, Bainbridge, Ramsey; Subject: Development of Tests of Fat Man Assembly," Los Alamos National Laboratory Archives. V-Site’s first full-scale weapon assembly practice was conducted in December 1944.


631 Ramsey, "Memorandum for Colonel Kirkpatrick; Subject: Special Construction at Alberta," Los Alamos National Laboratory Archives.
Los Alamos, McAlester, and Yorktown.632 Like V-Site, the Wendover assembly building functioned as a prototype for the final assembly building to be built at Tinian. The building, a metal Butler building complete with a non-sparking copper floor, was used by Wendover personnel until its disassembly after the war (fig. 9.17). Amazingly, the assembly building would later have a second life at Sandia Base, when postwar weapons assembly work was relocated from Wendover to Albuquerque (fig. 9.18).633

**Inyokern Prototype Assembly Building – April 1945**

After reviewing the merits of the Wendover assembly facility, another building design was developed as the model for the Tinian assembly buildings to be shipped as disassembled kits to the Pacific. Built at Inyokern, as part of Project Alberta’s planning efforts, the new design was air conditioned and constructed for use under tropical conditions (fig. 9.19). After a review of the prototype building, Project Alberta staff made a few suggested improvements that were incorporated into the final design and construction of the assembly buildings at Tinian (fig. 9.20).634

**Los Alamos’s Quonset Hut Assembly Building – June 1945**

The chronology of assembly buildings continues with Los Alamos’s Quonset Hut, one of the places of the bomb included in the national historical park legislation whose legacy as a national site of memory has been underappreciated in the past. At Los Alamos

632 Lt. W. F. Schaffer, "Memorandum to Comdr. N. E. Bradbury; Subject: Surface Cracking of F.M. Mod. I Castings from Yorktown, April 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives; Captain W. S. Parsons, "To: Ensign H. G. Greening, USNR; H.E. Castings for FM Assembly; Arrangements For, April 15, 1945," A-84-019, Box 2-10, Los Alamos National Laboratory Archives.


634 Galloway, "Memorandum to N. Ramsey; Subject: Inspection of the Destination Assembly Building Now Built at Inyokern," Los Alamos National Laboratory Archives.
towards war’s end, Project Y staff were focusing on design improvements to the implosion weapon itself. To support this effort, a new assembly area was constructed on Two Mile Mesa with a large Quonset Hut as its center of operations.

By the spring of 1945, conditions at V-Site were becoming overcrowded with assembly practice and preparation work for the Trinity test reaching a fever pitch of activity. The issue of work priorities at the new high-bay facility had first materialized even earlier, almost as soon as the building was first operational. In an internal memo, Project Y managers informed the workers at V-Site that other projects could be scheduled at the site but Fat Man assembly work came first.635 With the growing realization that additional weapon assembly facilities would be needed, plans were made to develop a new site at Two Mile Mesa for Fat Man weaponization work. An order was placed for a Quonset Hut-style assembly building at the end of May 1945.636 To further complicate final assembly and delivery plans, a variation in the Fat Man design that would allow a more efficient and safe assembly, known as the trap-door design, was being developed. Casting and assembly protocols were being updated to accommodate this change, which was so last-minute that some members of the assembly crews at Tinian had only trained on the previous design and were not aware of the change until the final weapons shipments arrived at the overseas base.637

Two Mile Mesa was chosen for the construction of the new Fat Man assembly building even though there were other groups in the area conducting high-explosives

635 Norman F. Ramsey, "Memorandum to G. B. Kistiakowsky; Subject: H.E. Assembly at V-Site, January 5, 1945," A-84-019, Box 22-1, Los Alamos National Laboratory Archives.

636 R. S. Warner, Jr., "To: Mr. N. F. Ramsey; 40 x 100 Strand Steel Building for Y, Reference NR-519, May 23, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.

637 Russ, Project Alberta, 40, 55-56.
experiments (fig. 9.21). During the late spring of 1945, shake tests of large-scale assemblies, close to 2.5 tons (5,000 pounds) of high explosives, were being conducted on Two Mile Mesa by Roger Warner (fig. 9.22).\textsuperscript{638} In July, Lieutenant W. F. Schaffer’s team loaded a trap-door assembly on a truck and drove it around for eight hours. Schaffer’s specific task at this late date was to understand how well the high explosives in the Trinity sphere would survive the long and bumpy drive to southern New Mexico.\textsuperscript{639}

Reflecting the forethought of Project Alberta organizers, the original purchase request was for a large metal Quonset Hut, similar to those being constructed at Tinian to support the war effort. The layout of the Quonset Hut building at the new TD-Site (“TD” for “trap-door”) was finalized in June of 1945, and trap-door design work and high-explosives assembly work was underway by the end of the month. Built on a concrete foundation, the building was a typical Pacific-style hutment; its building frame was arch-shaped and covered with silver corrugated siding (fig. 9.23).\textsuperscript{640} This building design was chosen because it could be acquired and built quickly. Furthermore, some crew members working in the building were being sent to the Pacific to carry out the final assembly of

\begin{footnotesize}
\textsuperscript{638} Kershaw, "Memorandum of Discussion on 2 May 1945: Hazards for Shake-Test on Two-Mile Mesa," Los Alamos National Laboratory Archives.

\textsuperscript{639} Bradbury, "Memo - To: Personnel Concerned, Subject: TR Hot Run," Los Alamos National Laboratory Archives; Furman, \textit{Sandia National Laboratories}, 68.

\textsuperscript{640} Warner, Jr., "To: Mr. N. F. Ramsey; 40 x 100 Strand Steel Building for Y, Reference NR-519," Los Alamos National Laboratory Archives; Lt. W. F. Schaffer, "Memorandum to Mr. N. F. Ramsey; Subject: SSAR 40' x 100' Utility Building, May 11, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives; Bradbury, "Memorandum to D. Dow, and Capt Reid; Subject: Additional Magazine Construction at 2-Mile Mesa," Los Alamos National Laboratory Archives; Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See TA-22 records and drawings.
\end{footnotesize}
the bombs dropped on Japan, and Project Y organizers, who almost never left anything to chance, were hoping to recreate overseas conditions as closely as possible.641

Unlike V-Site, the grounds near the Quonset Hut did not include a loading pit. By the summer of 1945, Project Alberta’s planners were entirely focused on Fat Man’s final design and assembly, and all loading details had already been worked out through laborious practice at Inyokern and Wendover. To facilitate movement of the large high-explosives assemblies in the building, the designers specified a crane that extended the entire length of the building and protruded out the front door (fig. 9.24). An area around the Quonset Hut was paved to provide an exterior space for safe handling purposes, and a movable A-frame and caliper system was designed that allowed the spheres to be suspended and rotated during assembly work inside the building (fig. 9.25).642

**Kirtland Air Field – July and August 1945**

To complete Los Alamos’s part in Project Alberta’s planning and delivery mission, the preassembled trap-door spheres had to be shipped to Tinian. Fat Man’s eleventh-hour design change necessitated the construction of bomb-loading facilities at Albuquerque’s Kirtland Field. In another example of the unheralded individuals and institutions that played a vital role supporting the Manhattan Project, E. J. Workman, head of the UNM physics department, was assigned the job of constructing a bomb loading pit at Kirtland Field of sufficient size to accommodate the Fat Man units being transported by the B-29s based at Wendover (fig. 9.26). Workman, leader of a secret

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641 Captain W. S. Parsons, "To: J. R. Oppenheimer; Assembly Building on Two Mile Mesa, May 22, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.

642 David Dow, "Memorandum to Major W. A. Stevens; Subject: Surface finishing for new installation at 2-Mile Mesa, June 26, 1945," A-84-019, Box 2-12, Los Alamos National Laboratory Archives.
UNM program that supported OSRD and Manhattan Project weapons-development priorities, also helped coordinate two dry runs that included the delivery of an inert Fat Man unit to Albuquerque for several practice sessions using the newly constructed bomb pit, a C-2 wrecker truck, and other specialized handling equipment. The dry runs also included the participation of B-29 airplanes flown to Albuquerque from Utah.643

As part of Project Alberta’s planning efforts related to the final hot run of the Fat Man spheres, the air crews practiced loading an inert mockup in a B-29 bomb bay and completed several fully loaded test flights. Workman was not unfamiliar with the flight characteristics of the Wendover airplanes because he had worked with B-29 crews in the past, having consulted with Tibbets at Alamogordo on initial design specifications for the special B-29s to be used on atomic missions. Rarely documented, Workman also collaborated on a special operations project that led to air strategy recommendations for the Little Boy and Fat Man combat missions against Japan in August 1945.644

UNM’s partnership role in the delivery of the atomic weapons dropped on Japan is largely unknown today. Compounding the selective nature of Manhattan Project

643 M. M. Bolstad, "Memorandum to Commander Bradbury; Subject: Kirtland Field Operations, July 2, 1945," A-84-019, Box 2-11, Los Alamos National Laboratory Archives; M. M. Bolstad, "Memorandum to Captain Larkin; Subject: Albuquerque Loading Report, July 13, 1945," A-84-019, Box 2-11, Los Alamos National Laboratory Archives; M. M. Bolstad, "Memorandum to Mr. Roger Warner; Subject: Handling of Units for Albuquerque Loading, July 16, 1945," A-84-019, Box 2-11, Los Alamos National Laboratory Archives; M. M. Bolstad, "Memorandum to Captain Larkin; Subject: Summary of Albuquerque Operation Schedule, July 23, 1945," A-84-019, Box 2-11, Los Alamos National Laboratory Archives; Captain W. S. Parsons, "To: J. R. Oppenheimer; Subject: Paraphrased Teletype Reference TA-1706 dated 16 June, June 18, 1945," A-84-019, Box 2-10, Los Alamos National Laboratory Archives. Workman’s equipment included a Cletrac (Cleveland Tractor M6-1; a crawler tractor used to position aircraft over pit); a C-2 wrecker; a C-6 hoist; and a C-1B putt-putt auxiliary power unit.

history—with its focus away from the plebeian story of planning and logistics—details of Workman’s efforts supporting the Manhattan Project are mostly contained in Project Y documents that have languished in inaccessible archives.

**Dry Run, Hot Run: The Importance of Logistics, Planning, and Support**

Beginning with the 509th’s drop tests in California and Utah in 1944, scientists and military personnel partnered on key planning efforts related to the assembly and use of atomic weapons, even before the weapons designs were finalized. An important planning strategy was to practice key activities in advance by conducting an operational “dry run” before carrying out the final “hot run.” For example, Project Camel’s Fat Man pumpkin program produced the live and inert test units needed for countless B-29 dry runs to prepare the squadron for its final air missions against Japan.\(^{645}\) At Los Alamos, as the Trinity test grew near, Project Trinity plans included a dry run covering all aspects of the test using a full-scale mockup with inert parts. This practice run was conducted the week before the final “hot run.”\(^{646}\) Dry-run shake tests of high-explosives spheres were also carried out at Los Alamos in preparation for the long drive to Trinity site along New Mexico’s 1940s-era roads.\(^{647}\)

Success at Tinian was the result of months of detailed planning by Project Alberta organizers that involved the acquisition and stockpiling of critical weapons parts and the

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\(^{645}\) Manhattan Engineer District, "Book VIII, Volume 3 - Auxiliary Activities - Chapter 2 - Project Camel," 2.24-2.25.

\(^{646}\) Bradbury, "Memo - To: Personnel Concerned, Subject: TR Hot Run," 1 Los Alamos National Laboratory Archives; Bradbury, "Memorandum to Messrs. Morrison and Holloway; Subject: Tamper Sphere Requirements," Los Alamos National Laboratory Archives.

\(^{647}\) Bradbury, "Memo - To: Personnel Concerned, Subject: TR Hot Run," 1 Los Alamos National Laboratory Archives.
construction of backup facilities. Project Alberta staff also relied on the practice of “dry runs” to ensure that “hot runs” would go smoothly. As part of Project Alberta activities at Los Alamos, additional shake tests of trap-door mockups were conducted in anticipation of possible rough handling by the military during transport and final loading at Tinian.\(^{648}\)

Los Alamos staff, assisted by Professor Workman’s UNM project team, conducted two dry-run trips to confirm the details of the overseas air transport of Fat Man units F31, F32, and F33.\(^{649}\)

To prepare for the final assembly of the weapons in the Pacific, a series of prototype assembly buildings was constructed, beginning with V-Site in 1944. At Inyokern in the California desert, the construction and verification of the final assembly building design in the spring of 1945 was a dry run for the construction of facilities on Tinian that were eventually used to assemble the Little Boy and Fat Man combat units.

At Tinian, B-29 crews conducted drop tests of full-scale Fat Man and Little Boy mockups and live pumpkins. These dry runs over the Pacific were preparation for the final hot runs over Japan in August of 1945. Leaving nothing to chance, Project Alberta organizers even orchestrated two dry-run tests of the emergency loading pit at Iwo Jima in late July.\(^{650}\)

\(^{648}\) Bradbury, "Memorandum to Personnel Concerned; Subject: Testing of Trap-Door Assemblies," Los Alamos National Laboratory Archives.

\(^{649}\) Bolstad, "Memorandum to Commander Bradbury; Subject: Kirtland Field Operations," Los Alamos National Laboratory Archives; Parsons, "To: J. R. Oppenheimer; Subject: Paraphrased Teletype Reference TA-1706 dated 16 June," Los Alamos National Laboratory Archives.

\(^{650}\) Ramsey, "History of Project A," 12, Los Alamos National Laboratory Archives.
The scientific development and controversial use of the atomic bombs is only half of the Manhattan Project story. The several years of parallel planning efforts to weaponize and deliver the bombs, along with the work performed by a diversity of private and public institutions to support their final deployment, is the hidden half of the story, one that illuminates overshadowed contributions.

Selectively ignored in today’s Manhattan Project narrative, this underappreciated planning and delivery project was the driving force that led to the end of World War II. Through place-making and preservation, the lost stories of those involved in Project Alberta’s massive organizational effort have been revealed. By preserving the very place of the Quonset Hut, additional historical relationships will also be preserved: wartime connections between Los Alamos and Wendover, Utah; between Los Alamos and Inyokern, California; between Los Alamos and the San Francisco Bay Area; and ultimately, between Los Alamos and the Pacific island of Tinian. The act of park-making at today’s national laboratory, with its mandate for enhanced public access and historical interpretation, will reinforce the importance of Los Alamos’s places of the bomb and will provide a better understanding of the complexity of the Manhattan Project’s contested memory and meaning.
Fig. 9.1. C-2 wrecker trucks were the work horses of the Manhattan Project in New Mexico, Utah, California, and overseas. This truck, on its way to Trinity Site, was used for construction support and also to move the heavy gadget device from its delivery truck to the base of the test tower. These trucks were invaluable mobile support vehicles that could be used in remote settings.

Fig. 9.2. An early Fat Man ballistic case at Wendover Field. The very first Fat Man shapes were even cruder approximations based on the likely diameter calculated by Los Alamos scientists well before any substantive progress had been made on the implosion design. Preliminary Thin Man drop tests were begun as early as December of 1943 and demonstrate the role that advanced planning played in the success of the Manhattan Project.
Fig. 9.3. Muroc Army Air Base, now Edwards Air Force Base, was the location of the first drop tests using a specially modified B-29 airplane during the spring of 1944. Thin Man and Fat Man ballistic cases are shown here.

Fig. 9.4. For Thin Man to be deployed as a weapon, B-29 loading bays would need to be modified to accommodate the length of the bomb. In a rare image, one of the early Thin Man prototype cases tested at Muroc was photographed inside a B-29’s prototype loading bay. The failure of Thin Man meant that a longer loading bay would not be necessary.
Fig. 9.5. Pumpkins were both inert and live dummy bombs that were used for bomb handling and loading practice as well as for drop tests. Pumpkins were dropped on bombing ranges in California and Utah and were also used for final practice bombing runs over Japan. Project Camel oversaw the production of pumpkins, which were distinct from the Fat Man test units that contained internal system components and high-explosives lenses. Pumpkins were orange and had three, not four, front impact fuses.

Fig. 9.6. Tinian Island in the Pacific was the headquarters for Project Alberta’s final deployment activities. Captain Deak Parsons and Norman Ramsey were essential planners who arranged for critical equipment, both large and small, to be sent to the island base. Although the airfield, left, was already developed, Project Alberta organizers had to build their own support and assembly area (right).
Fig. 9.7. Norman Ramsey, shown here in his Los Alamos badge photograph, was one of Deak Parson’s chief deputies. His involvement in Project Alberta’s final Pacific preparations began well before the project was officially established, with his support for the first Thin Man drop tests at Dahlgren Naval Proving Ground in late 1943.

Fig. 9.8. Logistics and redundant planning practices were essential to the success of Project Alberta, especially since all supplies and technical equipment had to be sent to the Pacific during wartime conditions. Project Alberta supplies, above, were sent to Tinian in a series of “batches,” some more important than others. “Kits” included everything needed for a specific job listed on one shipping manifest. This streamlined the delivery process.
Fig. 9.9. Hamilton Field in California was used to support air shipments to the Pacific and also as a receiving hub for materials flown to San Francisco’s Bay Area intended for delivery using Port Chicago’s Victory Ships. The role of California’s Army and Navy installations in Project Alberta has gone unnoticed in the history of the Manhattan Project. The Hamilton Field History Museum, shown here in 2014, interprets the history of the airfield but does not mention its role supporting Project Alberta.

Fig. 9.10. Mare Island Navy Shipyards was the location of top-secret work, which was conducted in building 627-A. The annex building, 627-A, no longer exists, but the large warehouse, building 627, is shown at right in a photograph taken in 2014. Due to concerns about the delicate nature of key weapons components, various items, including Little Boy components, were repackaged at Mare Island for the tropical conditions anticipated on transport ships and at Tinian.
Fig. 9.11. The U.S.S. *Indianapolis*, shown here before leaving for Tinian, delivered Little Boy’s uranium projectile and its combat case. The ship never made it back from its secret mission, and its story demonstrates the complexity of Project Alberta’s narrative of planning, delivery, and deployment.

Fig. 9.12. Port Chicago Naval Magazine, located northeast of Oakland on the south bank of Suisun Bay, was an important center for rail deliveries supporting Project Alberta. Shown here in 2014, Port Chicago’s inland area included a complex of igloos that were used to store wartime shipments of high explosives and detonators.
Fig. 9.13. Live pumpkins, some coming to California from McAlester, Oklahoma’s Naval Ammunition Depot, were also sent to Port Chicago by railcar. Pier-side railcar storage areas, like this one shown in a 2014 photograph, provided safe, temporary storage for shipments that were intended for immediate ship transport to the Pacific.

Fig. 9.14. V-Site was built in 1944 to support component and handling tests of the earliest mockups of the Fat Man implosion bomb. The drawing above shows the site’s centrally located loading pit, which was also used to conduct temperature tests on Fat Man systems to replicate conditions in an unheated B-29 bomb bay. Marsden metal-matting surfacing was also present at the site.
Fig. 9.15. Wendover Air Field also played an important but unheralded role in final delivery preparations. In addition to housing the 509th fleet of B-29s and serving as the headquarters for most of the drop test missions, Wendover facilities included several loading pits. One is shown here during the loading of a Little Boy test unit.

Fig. 9.16. Wendover Air Field also supported the field assembly of more advanced test units. To conduct this work, a special assembly building was built. A Little Boy test unit, shown here, is located inside the Wendover facility.
Fig. 9.17. The assembly building at Wendover also functioned as a preliminary model for the design of the final assembly buildings constructed at Tinian as part of Project Alberta.

Fig. 9.18. The Wendover assembly building was disassembled after the war and rebuilt in Albuquerque as part of the relocation of Wendover’s wartime activities to Sandia Base. The building above at Sandia is the next generation of assembly buildings, built after the war to support the early Cold War nuclear weapons program.

(Photograph courtesy of Sandia National Laboratories)
Fig. 9.19. Another Tinian assembly building prototype was constructed in the spring of 1945 at Inyokern’s NOTS (above, 2011). With just a few modifications, this building design was built at Tinian.

(Photograph courtesy of U.S. Navy)

Fig. 9.20. Several assembly building kits were sent to Tinian (shown here). The development and use of a series of prototype building designs, culminating with the construction of the final design in California prior to sending building materials to the Pacific, is yet another example of the planning efforts carried out as part of Project Alberta.
Fig. 9.21. Two Mile Mesa was designated as Los Alamos’s final assembly area for the new trap-door design of the Fat Man bomb. Located just south of other wartime areas supporting the Manhattan Project, the new TD-Site consisted of a Quonset Hut assembly building, lower right, and an adjacent storage building. Even though the design of the Tinian assembly building had already been finalized, Project planners left nothing to chance and trained the weapons assembly crew at Los Alamos under field conditions in building types already in place at Tinian.

Fig. 9.22. Tests were also conducted in the TD-Site area on Two Mile Mesa in preparation for possible rough handling during the gadget’s trip to Trinity and the transport of Fat Man’s preassembled high-explosives spheres to the Pacific.

(Photograph courtesy of Sandia National Laboratories).
Fig. 9.23. The Quonset Hut was designed and constructed in the final months of the war specifically for the assembly of high-explosives spheres intended for use in the Pacific. A new assembly building was built because V-Site was being used to support the assembly of the gadget for the July test at Trinity Site. The high-explosives sphere used in the Nagasaki mission, F31, was assembled in this building.

Fig. 9.24. As a top priority project, the Quonset Hut was ordered and built in the space of a month. The interior of the building was modified to support the top-secret assembly work, including the addition of an interior I-beam crane for the handling of the heavy Fat Man units. The crane is also shown extending from the front of the building in Fig. 9.23 above.
Fig. 9.25. To assemble the implosion combat units and handle the heavy cases, a movable A-frame and caliper system was devised that allowed the assembly team, which was made up of scientists and SEDs, to manipulate the high-explosives spheres. This type of handling equipment was sent to Tinian to support final assembly work.

Fig. 9.26. A loading pit was built at Kirtland Air Field to support last-minute plans to preassemble Fat Man’s high-explosives trap-door spheres at Los Alamos and ship them to Tinian via Albuquerque. E. J. Workman, head of UNM’s physics department, had been supporting Project Y and Project Alberta efforts since the beginning of the Manhattan Project and was given the task of building the loading pit and overseeing some of the preparations for the final “hot run” of Fat Man’s high-explosives components to the Pacific.
CHAPTER 10

CRITICAL ASSEMBLY AND THE SLOTIN PARABLE

The story of the discovery of how to release nuclear energy, and its application to making bombs capable of blasting, irradiating and burning out entire cities, is the great tragic epic of the 20th century.

Richard Rhodes, “Nuclear Options”

We were merely concerned with the project and the driving urge to get to our wartime goal as fast as possible.

Frederic de Hoffmann, “Pure Science in the Service of Wartime Technology”

Pulitzer-Prize winning historian Richard Rhodes is correct in his oft-repeated assertion that the story of the Manhattan Project is one of the great tragic epics of the modern era. That the narrative still resonates today, producing strong emotions some seventy years later, shows the importance of this story to the world. Every great epic has its heroes, and the tale of Louis Slotin and the accident that led to his death from radiation exposure has become firmly entrenched in the mythology of the Manhattan Project and in the history of the twentieth century. Louis Slotin is certainly a true tragic hero in the most traditional sense: a young warrior with special powers but with an underlying flaw; whose very actions led to tragic consequences, including self-sacrifice.

Remarkably, since 1946, Slotin’s death has continued to serve as a focal point for social reflection and response. His accident is a story that fascinates with its terrifying lesson of human imperfection in the face of godlike destructive power, a war story that
has continued to be interpreted by each generation in turn—in literature, poetry, film, television, opera, theater, and social media.651

Adrian Forty and Susanne Kuchler, editors of the collected essays The Art of Forgetting, have explored how societies both seek to remember and forget the tragedy of war through the process of constructing public memorials and forging collective meanings. In the case of World War II, there are historical events that many would like to erase from public memory. Like the Slotin accident, there are also events that have been appropriated by the public and whose meanings are no longer controlled or “owned” by state governments or institutions.

In separate essays in The Art of Forgetting, Alex King and Michael Rowlands discuss memorials to the war dead and the powerful theme of self-sacrifice, a common trope in the Slotin myth today. Foundational to the myth of the accident, Louis Slotin is portrayed as either an atomic martyr or a selfless hero.652 Michael Rowlands describes how the death of the individual functions to absolve the guilt of the societal whole:

The bearer of the gift (sacrificator) embodies pollution, sin or guilt and the act provides the means by which the social body is cleansed of these moral stains. Society, by surrendering its most valued quality, expiates its sin and cleanses itself as an act of renewal.653


Rowlands adds that “the dead are deified as part of that devotional logic in the sense that they become embodied in the idea of the collective.”654 If this is true in Louis Slotin’s case, then his continued portrayal as a tragic hero in the epic story of the Manhattan Project suggests that the mythology surrounding of his life and death will be part of public consciousness for years to come.

The need to create public war memorials stems from a search for meaning. According to Alex King, “the meaning of these deaths was predicated on the transformative power of self-sacrifice, and this transformation had to be realized in some concrete way if the deaths were to become meaningful.”655 Stories of sacrifice, therefore, become part of communal memory, and the places most associated with them become formal shrines. Following King’s line of analysis, the very place of Slotin’s accident may someday become a war memorial for future generations to find meaning in his act of self-sacrifice to atomic warfare. The Slotin building, therefore, will present one of the greatest interpretive challenges for the National Park Service when it begins to tell the stories of Los Alamos’s remaining places and spaces of the bomb.

As a parable about the dangers of radiation and nuclear weapons, Slotin’s accident will continue to resonate for as long as nuclear weapons are part of our reality. However, one must move beyond the controversy of the accident and look to the specific history of place to engage in a dialogue about the meaning of Slotin’s accident and the role that the accident building itself might play as a future site of national memory.

654 Ibid., 144.

Determining Critical Mass

The myth-making process has obscured the facts of Louis Slotin’s fatal accident, and additional details have been hidden in closed government archives. To understand Louis Slotin’s cultural legacy, both historically and today, it is important to understand the reasons for criticality research, the wartime safety culture, the influence of previous accidents, and the specifics of the accident that occurred on the afternoon of May 21, 1946 (fig. 10.1).656

Why Criticality Research

The first year at Los Alamos during the Manhattan Project was one of transition. Laboratory facilities were being built around the townsite’s Ashley Pond, technical staff were being recruited from universities and other scientific institutions, and the first weapon designs were being developed. Initial theoretical work focused on the design of several possible assembly methods, and T-Division scientists were given the task to calculate preliminary critical mass measurements for uranium and plutonium.657

According to Hoddeson, writing in Critical Assembly about this early work by T-Division, “the critical mass, which determines the size of the bomb, was the most vital piece of information in planning the delivery program. The value could affect the plans for plutonium and uranium production at Oak Ridge and Hanford.”658

T-Division’s early predictions related to critical mass needed to be verified through experimental means. One such experiment involved the development of the

656 Hoddeson, Critical Assembly, 341-342.
657 Ibid., 77.
658 Ibid.
world’s third nuclear reactor, known as the Water Boiler, which was built in Los Alamos Canyon at a new technical area called Omega Site (fig. 10.2). The Water Boiler reactor, operational by May 1944, contained a solution of uranium and water. Later criticality experiments, also conducted at Omega Site, involved solid subcritical assemblies in water, in drop tests, and surrounded by reflective blocks.

Omega Site, Tickling the Dragon’s Tail, and Harry Daghlian

Omega Site – May 1944
Donald Kerst, inventor of the betatron machine, came to the project from the University of Illinois to assist with implosion diagnostics using the cloud chamber and betatron method. However, he was initially asked to help with the design of the first reactor using the uranium-235 being produced at Oak Ridge, Tennessee. The Water Boiler, as it came to be known, consisted of a small stainless-steel vessel, filled with a uranium solution (fig. 10.3). Beryllium, placed around the reactor vessel, was used as a reflector, and additional shielding was put in place to protect the workers. The Los Alamos researchers were very confident that the system would achieve criticality so they chose Omega Site’s remote canyon location as a safety precaution.

While the earliest focus at Omega Site was on the operation of the first Water Boiler reactor, nicknamed “LOPO” for “Low Power,” a second adjacent building was quickly added for additional criticality experiments. By this time, two newly formed

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659 Los Alamos Canyon is also known as Omega Canyon; Omega Site was approved for development on August 19, 1943, according to Hoddeson (Critical Assembly, page 200).
661 McLaughlin, A Review of Criticality Accidents 2000, 74-75, 93, 104.
662 Hoddeson, Critical Assembly, 200.
groups were sharing the Omega Canyon facility: the Water Boiler Group, with its focus on reactor development, and the Critical Assemblies Group.\textsuperscript{663}

The wartime safety culture and several early accidents at Omega Site would go on to play an important role in the Slotin story. As a member of the criticality group, Slotin was fast becoming one of the world’s experts in the handling of subcritical uranium and plutonium.\textsuperscript{664} Foreshadowing the dangers of critical-assembly research for Louis Slotin and his co-worker Harry Daghlian, two criticality accidents occurred at Omega Site during the first half of 1945, one with significant exposures to three workers.\textsuperscript{665}

**The Dragon Experiment: January 18, 1945–February 11, 1945**

The Critical Assemblies Group arrived at Omega Site in mid-1944, and Los Alamos scientists began conducting experiments with critical amounts of active materials to explore key weapon-design parameters.\textsuperscript{666} Preliminary investigations also led to the development of safe-handling and fabricating procedures so that uncontrolled nuclear chain reactions could be prevented. An important experiment, known as “tickling the dragon’s tail” or just the “dragon,” investigated the properties of the fissile uranium being produced at Oak Ridge. The “Dragon” experiment created a controlled supercritical


\textsuperscript{664} The critical properties of uranium were first studied using small powdered amounts bound in plastic cubes and then in larger amounts in cast metal forms. Uranium hydride was also initially studied.

\textsuperscript{665} McLaughlin, *A Review of Criticality Accidents* 2000, 93; L. H. Hempelmann, "Memorandum to Files; Subject: Accident Report at Omega, July 6, 1945," A-84-019, Box 1-10, Los Alamos National Laboratory Archives.

reaction with only prompt neutrons.\textsuperscript{667} The Dragon experiment was also known as the “Drop” experiment, which was descriptive of its set up. Dropping a piece of uranium-235 hydride through a circular subcritical assembly of uranium, researchers could achieve an extremely brief moment of supercriticality using the prompt neutrons generated by the device.\textsuperscript{668} The experimental apparatus itself was really quite simple, resembling a miniature oil derrick (figs. 10.4 and 10.5).\textsuperscript{669}

Scientist Otto Frisch proposed the Dragon experiment in October 1944, and it was eventually carried out at the Omega facility in Los Alamos Canyon in three configurations from January through February 1945, achieving its first supercritical chain reaction on January 18. Frisch’s proposal was the origin of the term “tickling the dragon’s tail,” which is now commonly used to describe criticality experiments in general, including the other hands-on experiments conducted at Los Alamos during the Manhattan Project:

One of the more risky proposals I made was accepted, rather to my surprise. Richard Feynman said it was like tickling the tail of a sleeping dragon, and so it became known as the dragon experiment. It consisted in setting up an assembly made from a hydride of uranium-235 big enough to explode but with the central core missing so that it was safe. That central

\textsuperscript{667} Ibid., XV-3; Richard E. Malenfant, \textit{Experiments with the Dragon Machine} (Los Alamos, New Mexico: Los Alamos National Laboratory, 2005), 1, LA-14241-H.

\textsuperscript{668} McLaughlin, \textit{A Review of Criticality Accidents} 2000, 104. Uranium-235 hydride is a chemical compound of uranium-235 and the element hydrogen; Hoddeson makes note on page 210 that uranium-235 hydride was “being considered for use in a bomb because of its high concentration of neutron-moderating hydrogen” (\textit{Critical Assembly}).

core was then allowed to fall through the hole so that for a split second the conditions for a (rather mild) nuclear explosion existed.\footnote{Otto R. Frisch, "Somebody Turned the Sun on with a Switch,'" \textit{Bulletin of the Atomic Scientists} 30, no. 4 (April 1974): 18. According to Richard “Dick” Malenfant, Los Alamos scientist and long-time Pajarito Site worker, other criticality experiments, such as Slotin’s experimental set up, should correctly be called “Dragon-type” not “tickling the dragon’s tail.” Dick Malenfant, LANL Pajarito Site worker, retired, personal communication with author, June 2015.}

Frisch, writing in 1945, described part of the experiment’s standard operating procedure: “When the operator was sure that everything was ready for a drop (controls properly adjusted, no people near the system, etc.) he pressed the HWG (“Here We Go”) button, establishing a third path for the magnet current and enabling him to remove the latch and subsequently, by releasing the HWG button, to drop the slug.”\footnote{Otto R. Frisch, "Controlled Production of an Explosive Nuclear Chain Reaction, September 27, 1945 (LA-397)," in \textit{Experiments with the Dragon Machine, LA-14241-H}, ed. Richard E. Malenfant (Los Alamos, New Mexico: Los Alamos National Laboratory, 1945), 19.} A dangerous design, Frisch was not even sure that the laboratory’s scientific review committee would approve his plan.\footnote{Otto R. Frisch, \textit{What Little I Remember} (Cambridge: Cambridge University Press, 1979), 159.} In a 1945 report, he summarized the hazards of the experiment:

> All the operating and recording equipment was placed in a room about 40 ft away from the assembly and behind a 5-ft wall of concrete and earth. If (to assume the worst) the slug had got stuck at the center of the assembly, there would have been a rather inefficient explosion, probably equivalent to a few ounces of H.E. In this instance the control room would have afforded sufficient protection against the radiation, although it would have been advisable to leave it quickly before the active fumes had time to spread.\footnote{Frisch, "Controlled Production of an Explosive Nuclear Chain Reaction, September 27, 1945 (LA-397)," 20.}

As for the dangers of the supercritical reaction produced by the Dragon if all went as planned, Hoddeson, in \textit{Critical Assembly}, notes that “since the assembly was
supercritical for such a short time, the heat and radioactivity would not build up enough to prevent workers from handling the material.”

However, safety concerns were still paramount, and scientist Frederic de Hoffman recalled in his wartime memoir that the Omega Site workers had an emergency plan of sorts: “To give us an imaginary feeling of safety I can remember that we had a couple of cars parked just outside the building, pointing up the canyon, so that we could run for it if something should happen.” He also mentioned that the dangerous work at Omega Site was being conducted quickly because of the pressures of war, adding, “Nowadays, such an experiment would be conducted remotely with great respect! In those days, when speed was of the essence, we relied mostly on manual safety precautions.”

In order to generate additional neutrons during the Dragon experiment, Frisch’s group performed the drop portion of the experiment more than once. Each time, the uranium slug was manually brought back through the subcritical ring, which was opened up to provide the necessary distance between the two subcritical pieces to prevent an accidental critical reaction. This process of dropping the slug and quickly repositioning it at the top of the small test tower led to some anxiety among the researchers.

Writing in his memoir, de Hoffman described Enrico Fermi’s safety philosophy at the time. He recalled that “Fermi thought that humans were not likely to fail when faced

674 Hoddeson, *Critical Assembly*, 347.
676 Ibid.
677 Hoddeson, *Critical Assembly*, 347.
with risking their own lives, provided the danger was really visible.” Specifically, Fermi believed that automatic controls would result in a reliance on possibly faulty instrumentation instead of relying on manual safety controls that were understood by all of the scientists, especially when working on dangerous experiments. Although Fermi’s observation would later prove to be true in the context of the last Dragon experiment, the wartime practice of hands-on operations and manual safety controls would eventually result in disaster.

The Dragon experiment was always intended for a brief run because uranium was in such short supply that other researchers needed to use the fissile material that had been loaned to Frisch’s group. For this reason, some of the uranium had to be returned to the project’s metallurgists, and the third phase of the Dragon experiment used smaller amounts of uranium hydride metal. Frederic de Hoffman had been conducting research at Omega Site since May 1944 using data from the Water Boiler, along with fellow scientists Richard Feynman and Robert Serber. On February 11, 1945, de Hoffman and other group members were conducting tests with the Dragon to count delayed neutrons from the supercritical pulse produced by the assembly each time the uranium slug passed through the uranium ring.

In his memoir, de Hoffman described the criticality accident that brought about the end of the Dragon experiment:

678 de Hoffmann, "'All in Our Time': Pure Science in the Service of Wartime Technology," 42.
679 Ibid.
680 Hoddeson, *Critical Assembly*, 347.
Early one evening we first made a routine drop, which seemed to yield an unusually high burst of delayed neutrons, which delighted me because of the statistics. . . . When we checked the meter indicating the power of the burst it seemed quite low. In our enthusiasm to get good readings it seemed reasonable to adjust the Dragon to be even more critical, which we did. And the next drop was really a whopper! . . . Now we were in great consternation. The meters told us that the power achieved was still quite low and that we had not twitched the Dragon’s ‘tail’ very hard. . . . And then we saw what had happened. The daytime Dragon crew had switched the scale of the power meter. I can’t recall the accurate figures but we were probably two decades higher than we had been in all the experiments the previous nights.683

The researchers, shielded from the experiment by a concrete wall, had been relying on an instrument that had been improperly calibrated. The critical reaction achieved that day on the final drop resulted in enough damage to the experiment that the Dragon was discontinued. Frederic de Hoffman recalled that Louis Slotin was there the day of the accident, and that the researchers were very lucky not to have been injured:

“Quickly we ran to the other side of the wall and to the Dragon. . . . We had managed to melt the uranium hydride! I will never forget that uranium hydride has a relatively low melting point—or I might not be around to remember that evening.”684

**Omega Uranium Accident**

Another criticality accident occurred at Omega Site five months later, this time with significant but non-fatal radiation exposures to three scientists working on an experiment using fissile uranium in metal form. This little-known accident has been discussed in technical summaries of criticality accidents, but has never been described in

683 de Hoffmann, "All in Our Time": Pure Science in the Service of Wartime Technology," 43.
684 Ibid.
detail in histories of wartime Los Alamos. Specifics of the June 1945 accident have been buried in the archives, but, as presented below, the details speak to the dangers of critical assembly work and clearly demonstrate that the scientists working at Omega Site, including Louis Slotin, must have known about the risks they were taking with hands-on critical-assembly experimentation.

On June 6, 1945, when the Los Alamos laboratory was gearing up for the Trinity test and for overseas deployment of the Fat Man and Little Boy combat units, scientists were working at the Los Alamos canyon facility on a safety test using fissile uranium. The purpose of the experiment was to determine the risk from an accidental immersion of active material in water.

The assembly consisted of a spherical configuration of uranium metal in one-half-inch cubes and one-inch blocks placed in a larger tank. The metal sphere had been placed in a plastic box, and plastic filler material had been placed in the void to secure the assembly. The intent of the experiment was to bring the subcritical uranium mass just to criticality by slowly adding water to the tank. Unfortunately, there was a leak in the box and water started seeping inside. This caused the experiment to go supercritical, exposing the three scientists in the area to varying doses of radiation. The reaction was self-limiting because the heat of the assembly caused the water to boil within the box and limited the supercritical reaction. The accident is described in one of the volumes of the Manhattan Project’s official history:

687 McLaughlin, A Review of Criticality Accidents 2000, 93. The three involved in the accident received 66, 66, and 7.4 rep (a similar exposure term to rem). For comparison, Daghlian received
A large amount of enriched uranium, surrounded by polythene, had been placed in a container to which water was being slowly admitted. The critical condition was reached sooner than expected, and before the water level could be sufficiently lowered the reaction became quite intense. No ill effects were felt by the men involved, although one lost a little of the hair on his head. The material was so radioactive for several days that experiments planned for those days had to be postponed.688

Omega Canyon and Daghlian – August 1945

In what would be the last hands-on experiment conducted at Omega Site, Harry Daghlian, a long-time member of the Critical Assemblies Group, received a fatal exposure of radiation on the evening of August 21, 1945 (fig. 10.6). As Daghlian’s group leader, Louis Slotin would soon learn firsthand of the effects of high doses of radiation on the human body. Harry Daghlian, himself, was not inexperienced when it came to working on critical assemblies. In fact, he was a member of the plutonium pit assembly team at Trinity (fig. 10.7).689

The U.S. government now acknowledges the details of Daghlian’s fatal accident; however, at the time of his accident in mid-August 1945, the military had only just deployed atomic weapons against Japan, and national anxiety was building because news stories about the horrifying effects of radiation were starting to emerge.690 In response, Los Alamos effectively hid the details of Daghlian’s accident.691

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690 John Hersey, Hiroshima (New York: Alfred A. Knopf, 1946). John Hersey’s originally intended to write only one short article, but as the manuscript lengthened, he prepared four
In August 1945, Daghlian’s team was studying a subcritical sphere of plutonium metal that had been set into a small, square arrangement of tungsten-carbide bricks (fig. 10.8). The bricks were being used as a reflector to enhance the criticality of the subcritical plutonium. On August 21, working late at night, Daghlian was conducting the experiment by stacking bricks around the plutonium core. As part of the experiment’s safety protocol, he was controlling the critical reaction through the careful addition of tungsten carbide, one brick at a time. To monitor the status of the critical reaction, the research team at Omega Site had placed several instruments in the room, which gave both visual and audible indicators of the assembly’s approaching criticality.

According to Daghlian’s own account, when he moved the final brick over the experimental set up, he noticed that the addition of this last brick would make the assembly supercritical. The brick slipped from his hand and fell into the center of the experiment. While he was instinctively pushing the brick off the top layer with his right hand, he noticed a blue glow around the assembly. Moments after the criticality accident, Daghlian partially unstacked the bricks. He received a radiation exposure of approximately 510 rem and died twenty-five days later, on September 15, 1945. A security guard, Pvt. Robert Hemmerly, was the only other person nearby that night.

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691 William Engle, "Unsung Sacrifice of a Young Atom Scientist," The American Weekly April 7, 1946.


693 Paul Aebersold, Dr. Louis Hempelmann, and Louis Slotin, "Report on Accident of August 21, 1945, at Omega Site, August 28, 1945," 1-3, A-84-109, Box 2-2, Los Alamos National Laboratory Archives. Daghlian’s own account of the accident was incorporated into the report co-authored by Louis Slotin.

Seated at desk located twelve feet away with his back to the experimental setup, Hemmerly would receive a significant but not life-threatening dose.\(^{695}\)

In his wartime memoir, fellow group member Frederic de Hoffmann poignantly described speaking with Daghlian about criticality safety. The degree to which de Hoffmann’s memory was influenced by sentimental hindsight is unknown; however, his account does suggest that wartime researchers were sometimes lulled into complacency by the invisible nature of radiation exposure:

I was in the group at Omega Canyon which made critical mass measurements on uranium bomb assemblies by simulating spheres from small perfect metal cubes. Since we did all of this by hand, the danger was very clear but invisible. Those of us who were old hands felt impervious to the invisible danger. I am afraid that familiarity indeed breeds contempt of danger. I even remember a conversation with Harry Daghlian in which we worried about the safety practices of some new members of the group from Chicago—but we felt safe. We had a rule not to work alone at night and furthermore always to add the last uranium brick from the side. Harry Daghlian was alone at night and added the fatal brick from the top when it slipped from his hand. In retrospect, this could have happened to several of us.\(^{696}\)

Even though Louis Slotin and other members of the laboratory leadership acknowledged the danger of the Dragon-type experiment that led to Harry Daghlian’s death, criticality experiments continued at Omega Site until they were transferred to a new facility at Pajarito Site in April 1946.\(^{697}\)


\(^{696}\) de Hoffmann, ""All in Our Time": Pure Science in the Service of Wartime Technology," 44. (Italicized emphasis is in original text.)

Louis Slotin and the 1946 Pajarito Site Accident

The Early Cold War: A Driving Force for Criticality Research

Why were dangerous hands-on criticality experiments still being conducted in 1946, especially after the two near-miss accidents during the war and the one fatality in August 1945? Why did Louis Slotin, who sat next to Daghlian in the hospital as he lay dying and who wrote the account of Daghlian’s accident and death, continue with Dragon-type experiments after the war was over when the sense of urgency that had driven Los Alamos workers to take extreme risks with high explosives and radioactive materials no longer existed?

Although they were not working under the pressure of wartime conditions, Los Alamos scientists still felt that critical assembly work was essential to atomic weapon design priorities during the initial postwar years. The period from September 1945 to December 1946 was a transitional time in the history of Project Y and lacked the singular focus of Los Alamos’s wartime mission. However, Los Alamos was still under Manhattan Project administrative control, and, although many in the wartime workforce were making plans to leave, international Cold War tensions were already at work that would lead to the establishment of a permanent weapons laboratory at Los Alamos by the beginning of 1947.698

Norris Bradbury, the laboratory’s second director, persuaded some of the key Manhattan Project scientists and technical workers to stay in New Mexico in an effort to retain wartime knowledge related to the development and deployment of the first atomic weapons. The refinement of the Fat Man design was especially important during the late  

1940s. Essentially frozen in early 1945 to enable its use by the military at war’s end, the design of the implosion weapon dropped on Nagasaki was still relatively crude.\textsuperscript{699} For this reason, Los Alamos scientists set about making design improvements as soon as the war was over: not just internal component improvements but also design changes that would make the weapons safer for use by the military once the inevitable happened and atomic bombs became part of the United States’ Cold War stockpile of weapons.\textsuperscript{700}

The first peacetime atomic test series, dubbed Operation Crossroads, was carried out in July 1946 as a joint military and scientific effort and was an important postwar project that dovetailed with Los Alamos’s new mission for continuing weapons research activities, including the dangerous critical assembly work relocated to Pajarito Site. Conducted near Bikini Atoll in the Pacific, the tests included the use of derelict warships as targets. The U.S. Navy provided support ships and personnel for Crossroads, which was under the direction of Los Alamos veteran, now Navy commander, Deak Parsons. For Los Alamos’s part, scientists provided the weapons and instrumentation for Operation Crossroads and also monitored the results of the two tests.\textsuperscript{701}

Even though the Crossroads series was not intended to be a test of Los Alamos’s postwar design improvements and, in fact, made use of two Fat Man bombs that were nearly identical to the weapon used on Nagasaki, the atomic tests were important because they allowed Norris Bradbury to certify that Los Alamos, and by extension the

\textsuperscript{700} Ibid. See, in particular, the discussion of Z-Division’s postwar responsibilities (chapter 28).
United States, had the necessary scientific skills to assemble and deploy atomic weapons even after many had left Project Y to go back to their prewar lives. Louis Slotin, who was not allowed to join other Los Alamos staff on Tinian Island during the final months of the war because of his Canadian citizenship, had been assigned to the plutonium pit assembly team for the field preparation of the Fat Man weapons that were to be used in the two Crossroads tests, Able and Baker.702

In April 1946, to support Operation Crossroads and other early Cold War military goals involving atomic weapons, critical assembly work, despite its dangerous nature, was relocated to Pajarito Site.703 The Critical Assemblies Group moved its operations to Pajarito Canyon for public safety reasons. However, even after Daghlian’s fatal accident, no new safe-handling protocols for Dragon-type experiments were developed, and it was Slotin’s demonstration of a hands-on critical experiment on May 21, 1946, that led to his death.704

Postwar Pajarito Site

The decision to conduct critical assembly work at a remote location, away from the Los Alamos townsite, was directly related to Harry Daghlian’s death from radiation exposure in 1945. The choice of Pajarito Site was influenced by several factors, including its canyon location several miles east of the townsite and away from other laboratory technical areas. Edward Creutz’s Magnetic Method Group, which had developed firing site facilities at Pajarito Site to support the design of the Fat Man weapon, abandoned its

703 Hawkins, Project Y: The Los Alamos Story, 326.
implosion field testing by the end of 1945, and the laboratory and support buildings that remained at the site from Creutz’s research efforts would prove useful for Pajarito Site’s new focus on criticality research. Existing facilities also included high-explosives magazines, an explosives assembly building, a lumber storage building, and a carpentry shop located above on the mesa above and to the north of the main site area.\textsuperscript{705}

In April 1946, Pajarito Site was transferred to the Critical Assemblies Group and became Los Alamos’s primary facility for critical assembly work. Building 1, its main wing constructed in 1944, was built to support Ed Creutz’s implosion research. The central section of the building contained an electronics laboratory, shop, and photochemical laboratory, and was much larger than its high-bay annex, constructed in January 1946 (fig. 10.9).\textsuperscript{706} This smaller annex, still standing today, was built specifically for Slotin’s radiation-counting experiments and was the location of his 1946 accident.\textsuperscript{707} Like Daghlian, Slotin would receive a lethal radiation exposure.

After two fatal accidents, all critical assembly operations were halted until safer facilities could be constructed.\textsuperscript{708} More importantly, a new safety culture was developed as a result of the Slotin accident. No longer was the awareness of grave danger an acceptable safety philosophy when human error could result in death. In response to Slotin’s accident, new research buildings at Los Alamos and at other scientific research

\textsuperscript{705} Los Alamos Scientific Laboratory, "Technical Area Structure Location Plans," Los Alamos National Laboratory Records Center; Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See TA-18 site plans, records, and drawings.

\textsuperscript{706} McGehee, Of Critical Importance 2009, 9; Los Alamos National Laboratory, "Engineering Records," Los Alamos National Laboratory Records Center. See records and drawings for TA-18.

\textsuperscript{707} Position of Film Badges Placed at Pajarito Site, "1946," A-84-019, Box 2-6, Los Alamos National Laboratory Archives; Los Alamos National Laboratory, "Photographic Collections," Los Alamos National Laboratory Archives and Records Center. See TA-18 photographs.

\textsuperscript{708} Manhattan Engineer District, "Book VIII, Volume 2 - Technical Supplement," S8.
institutions were constructed with safety measures engineered into their very designs. According to the official *Manhattan District History*, “the second accident emphasized the fact that such accidents could occur with the most senior personnel in charge, and led to the establishment of a system of remote control for the necessary experimentation in this field.”

At Pajarito Site, remotely controlled experimental areas, called Kivas, were built for criticality experiments. The first Kiva building (now known as Casa 1) was built in 1948 at the former location of Creutz’s small firing site on the west side of the technical area. The quarter-mile separation between the new Kiva and the control room located in the main wing of Building 1 provided a safe working distance from which to operate critical assemblies.

An overview history of Pajarito Site written at the end of its lifetime as a Los Alamos research facility notes this paradigm shift in safety culture, which was implemented so that human decision making and the possibility of human error were removed from experimental protocols:

> In general, content changes in the procedures were consistent with the development of a safety culture in the laboratory, and the most important function of the procedures was to protect the people who handled the fissile material. Safety was considered to be one of the goals of design and operation, not something superposed.

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709 Ibid., I-9.

710 Ibid., V-6.

This new approach of engineered safety controls was in direct contrast to the concept credited to Enrico Fermi that a clear understanding of the immediate danger by researchers would drive safe behavior. In Fermi’s defense, however, Slotin certainly knew of the danger involved in hands-on work with critical assemblies, and, for some reason known only to him, continued to take risks with his experimental work, risks that would cost him his life and seriously injure his coworkers. The seemingly cavalier nature of wartime criticality research is highlighted by Hoddeson in *Critical Assembly*. She describes a dangerous experiment conducted by members of the hydride critical assemblies group who were bringing an assembly to criticality by “the added tamping of someone sitting on top,” adding that “they would hop off just as the assembly went critical.”\(^\text{712}\) She also notes that hands-on experiments, such as those conducted by both Daghlian and Slotin, were carried out “in defiance of the rules G-Division had established regarding critical assemblies.”\(^\text{713}\)

**The Accident**

The specific details of Louis Slotin’s accident and of the events that occurred immediately afterwards have long been overshadowed by inaccurate public narratives that have effectively spun a web of rumor and legend. To counter this modern mythology, archival documents from the national laboratory’s archives, including post-accident statements by the survivors, have been extensively examined to produce a history of Slotin’s accident at Pajarito Site.

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\(^{712}\) Hoddeson, *Critical Assembly*, 341.

\(^{713}\) Ibid.
On the afternoon of May 21, 1946, Los Alamos scientist Louis Slotin was conducting an experiment at Pajarito Site’s Building 1 to bring plutonium to a critical state. He was demonstrating an experiment known as “tickling the dragon’s tail,” which was essentially a hands-on Dragon-type experiment where a subcritical assembly is brought close to critical for the purposes of understanding critical mass and other properties of fissile material. Besides Al Graves, for whom Slotin was performing the demonstration, there were five other scientists in the room along with a security guard. The main wing of Building 1, oriented east to west, was located to the north of the smaller high-bay room where the accident occurred; the two rooms were connected by a north-south running corridor. In addition to a set of double doors leading to the main wing via the corridor, the high-bay room had two entrance doors centered along its west and east walls and a loading dock door on its south wall. Two researchers, who were not in the building to observe the experiment, were working along the east wall of the high-bay room performing a separate experiment (fig. 10.10).714

Slotin’s table-top set up was similar to Daghlian’s experiment in that the plutonium pit being studied by Slotin, today known as the “Demon core,” was the same pit used in the Omega Site experiment that led to Daghlian’s death.715 Unlike Daghlian’s assembly, however, the plutonium core was reflected by two beryllium hemispheres, with


the subcritical pit seated in the center of the bottom hemisphere (fig. 10.11). Slotin was attempting to lower the upper beryllium hemisphere over the subcritical core to reflect neutrons generated by the plutonium back on itself, which would cause the assembly to become more critical. The upper hemisphere had a hole in the top and Slotin was using this to control the movement of the reflector with his left hand; his right hand was holding a screwdriver.

The upper beryllium hemisphere made contact with the bottom hemisphere when the screwdriver Slotin was using slipped. Once the gap between the two reflectors closed, the plutonium core reached a supercritical state and started a chain reaction in a matter of a microsecond. Those in the room noticed a blue flash at the moment of contact and, Slotin, for one, later commented on a sensation of heat and a strange taste in his mouth, a “sour taste, like lemon.” Slotin had little time to react and jerked the upper hemisphere away with his left hand, which was resting on the upper shell at the time of the accident. Contrary to popular myth, Slotin did not throw himself between the assembly and the other men in the room to protect them from the radiation, which, after the initial burst, had dissipated. Similar to the previous criticality accidents at Omega Site, the

719 As early as June 1946, accounts of the accident included a description of Slotin throwing himself between the assembly and the other men in the room to save their lives. See "Hero of Los Alamos," 93. This myth has prevailed and is a popular theme today that supports the notion of Slotin as hero and “sacrifator.”
chain reaction was short lived due to thermal conditions that accompanied the critical reaction.\textsuperscript{720}

Everyone immediately left the room, by the corridor to the main wing, and by the east door (fig. 10.12).\textsuperscript{721} The super-critical reaction had emitted a blast of neutrons and gamma rays, and all the men in the room received significant exposures. Those closest to Slotin and the experimental assembly received the highest doses. Louis Slotin died nine days later.\textsuperscript{722}

**National Memory and Meaning through Time**

**Responses**

Harry Daghlian and Louis Slotin’s unfortunate deaths had wide-reaching ramifications, not only affecting how the postwar laboratory conducted its criticality testing but impacting American popular culture as well. While today both the Slotin and Daghlian accidents are well known, it is Slotin’s accident that has been more often appropriated by the arts and media. The details of Daghlian’s accident were deliberately downplayed in Los Alamos’s initial news release; the first national account of his death was published months later.\textsuperscript{723}

Louis Slotin’s accident, on the other hand, was publicized immediately. National response was swift. His accident and death have now taken on mythic proportions, and he

\textsuperscript{720} Hoddeson, *Critical Assembly*, 342.

\textsuperscript{721} The movie *Fat Man and Little Boy* incorrectly showed the accident victims marking their locations with chalk on the floor before leaving the room, and had Slotin calculating everyone’s dose on the spot. See Joffé, "Fat Man and Little Boy."


\textsuperscript{723} Engle, "Unsung Sacrifice of a Young Atom Scientist."
is often depicted as a hero who made the ultimate sacrifice to protect those around him. The details of both accidents have been used as narrative devices time and again, in movies, television, novels, poetry, operas, plays, and perhaps most fascinatingly, in religious tracts.\textsuperscript{724} Harry Daghlian’s accident was fictionalized in author Joseph Kanon’s 1997 novel, \textit{Los Alamos}.\textsuperscript{725} Louis Slotin’s accident also appeared as a plot device in \textit{Fat Man and Little Boy}, the 1989 film directed by Roland Joffé that dramatized the construction of the first nuclear weapons during World War II. Although taken out of its postwar context for the purpose of the film’s storyline, the accident portrayed in \textit{Fat Man and Little Boy} involved a plutonium core and served as a key dramatic moment in the film.\textsuperscript{726} In playwright Paul Mullin’s \textit{Louis Slotin Sonata}, Mullin depicts Slotin as an egotistical man who spends his last days coming to terms with his mortality while dealing with his constant need to be impressive to others.\textsuperscript{727} Appropriated by novelists, screenwriters, poets, composers, and playwrights, the two accident accounts make for compelling drama, especially the invisible danger of radiation and the nature of both experiments, simple hands-on research but with immediate deadly consequences. A slip of the hand, a slip of the screwdriver—both accidents resonate because these are universal human actions.


\textsuperscript{726} Joffé, "Fat Man and Little Boy."

\textsuperscript{727} Julio Martinez, "Louis Slotin Sonata, (Dark comedy -- Hollywood Court Theatre; 99 seats; $15 top)," \textit{Variety} November 23, 1999.
National Mythology

Louis Slotin’s 1946 accident and death and, to some extent, Harry Daghlian’s fatal accident continue to resonate today. The details of Slotin’s accident, often incorrectly recounted out of ignorance of the facts or deliberately misstated as part of creative license, have been appropriated for many reasons: for entertainment, for artistic expression, for school assignments, and even for religious lessons. Why did this national mythology emerge so quickly from a single death that happened in the wake of a world war with so many deaths, and why has the accident made Slotin into a tragic public figure? Not only have public responses to the story of the accident changed through time, but the various meanings ascribed to Slotin’s death have also changed.

Media response to Slotin’s accident began shortly after the postwar laboratory issued its initial press release.728 The accident originally resonated with the American people because it provided a more immediate connection to the dangers of radiation. This was not a distant act of war in some foreign land. Slotin, after all, was working here in the United States. After the war, people were just beginning to understand the effects of atomic weapons through news reports about the Japanese exposure victims.729 Even though Harry Daghlian was the first Los Alamos fatality, for most, Slotin’s case would be the first widely publicized death by radiation, cementing its place in American public memory.


729 Hersey, Hiroshima.
Why then has the accident story continued to be appropriated? Mirroring changing perceptions about atomic weapons and atomic energy, the response to the accident has changed through time. The accident speaks to several basic emotions including fear and anxiety: fear of radiation; fear of nuclear war; fear of technology; anxiety about the Cold War; and anxiety about the dangers of scientific discovery in general. To some, the experimental assembly is an analogy for the bomb itself and the story of Slotin’s death is a parable, representing the use of nuclear weapons on the people of Japan and their deaths from radiation exposure.

Over the years, Slotin has alternately been portrayed as a hero and as a villain. His motivation for continuing to perform dangerous hands-on criticality experiments has been ascribed to complacency, carelessness, scientific hubris, and recklessness. As a heroic figure, his purported actions to save others in the room have been used to illustrate Christian lessons of self-sacrifice. Underlying some of the emotional response to Slotin’s accident is the fear that a simple human error, such as a slip of a screwdriver, could result in the release of such tremendous and lethal power. In the public’s mind, the

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Slotin accident has reinforced one of the greatest apprehensions about nuclear weapons: that mankind has created the very means to destroy itself.\footnote{See Richard Rhodes, "Nuclear Options [review]," \textit{New York Times} May 15, 2005, no page number.}

**Tragic Hero**

In death, Slotin is now a mythic figure and the accident has taken on mythological proportions. The almost seventy years of continued interest in the accident suggests that Slotin is indeed a tragic hero in the true classical sense. Like the Greek myth of Prometheus, Manhattan Project scientists refashioned the gift of fire and gave knowledge of atomic energy to the world. To continue the analogy, Slotin’s death, like an evil released from Pandora’s box, represents a loss of innocence and a new atomic reality. As the tragic hero of Richard Rhodes “great tragic epic of the 20th century,” Louis Slotin embodies the traits described in classical mythology: he was young and armed with the special skill of knowledge, his heroic behavior led to self-sacrifice, and his confidence could be considered his fatal flaw.\footnote{Ibid.} At the time of the accident, Slotin was the leading expert in the world when it came to criticality research and experimentation. He was head of the Critical Assemblies Group. He had been responsible for the handling of the Trinity plutonium core and had participated in earlier experiments at Omega Site that helped determine the critical mass of uranium and plutonium, essential scientific findings leading to the development of the Little Boy and Fat Man weapons (fig. 10.13).

Louis Slotin knew of the risks inherent in his work. He was present during the last experiment of the Dragon machine, where incorrectly calibrated equipment led to unplanned energy releases and the accidental destruction of the experiment. He worked...
side by side with other Los Alamos scientists who had received exposures from the June 1945 criticality accident involving a uranium assembly that was being moderated with water. As Harry Daghlian’s supervisor, he was responsible for writing the final report about the August 1945 fatal accident, including a summary of the effects of radiation exposure on Daghlian’s body. According to Otto Frisch, Enrico Fermi had specifically warned Slotin about the risks inherent in his research:

Later I left Los Alamos and Louis Slotin took over the group working on critical assemblies. He told me that Fermi warned him, “You know that in this sort of work you have perhaps an even chance to survive your work here.” Slotin was rather shaken about it. Even so, he did use something makeshift—some people say it was a pencil, some people say it was a screwdriver—to separate two lumps of the active material which he knew would give a fast reaction if that separating material was removed. The screwdriver slipped out, and he was killed.\(^{735}\)

Some researchers have recently asserted that the tragic event was truly an accident and not an act of recklessness. Contributing to this theory is the observation that Slotin’s thumb placement in the top opening of the uppermost beryllium hemisphere might have changed the criticality profile of the experiment, which had been conducted many times before without incident.\(^{736}\)

\(^{735}\) Frisch, "The Dragon Experiment: Keynote Address; Presented at the FAST BURST REACTORS Conference, University of New Mexico, January 28-30, 1969, Albuquerque, New Mexico," 15.

\(^{736}\) Richard E. Malenfant, "An Historic Perspective: The Real Basis of Nuclear Criticality Safety," in Nuclear Criticality Safety Division (NCSD), 2013 Conference (Wilmington, North Carolina: 2013), no page number. Dick Malenfant has also posited that Slotin’s left thumb introduced an additional and, more to the point, unplanned reflection into the critical assembly set up (Dick Malenfant, LANL Pajarito Site worker, retired, personal communication with author, June 2015). Otto Frisch also described a near miss when he leaned over a subcritical assembly and his body reflected neutrons back into the set up. See Frisch, "Somebody Turned the Sun on with a Switch!," 17.
Louis Slotin, today as well as in the early years after his death, is characterized as an atomic martyr—a pawn and innocent victim in the United States’ militarization of atomic science. In accounts of his accident, Slotin is often portrayed as a hero who sacrificed himself to save others. But this has not been the only response to his death. In fact, laboratory director Norris Bradbury, while not mentioning Slotin by name, reflected in July of 1946 that safety rules for critical-assembly work would not “prevent accidents of this type, and where human judgement [sic] is directly involved undue prior familiarity in some cases or carelessness in others will ultimately lead to a disaster.” Furthermore, the official Manhattan District History states that Slotin was performing his hands-on criticality experiment in violation of existing safety rules, noting that “failure to obey the established regulations resulted in [the] accident.” In any case, in none of the accounts written by accident survivors is there mention of Slotin throwing himself between the critical assembly and nearby observers in a deliberate act of heroism. This frequently repeated narrative element is simply a vital part of the Slotin myth. Without it, Slotin could not be portrayed as a tragic hero in the twentieth-century epic of the Manhattan Project.

Documenting the place and historical context of the Slotin Building at Pajarito Site has uncovered some of the conflicting meanings and pervasive myths that surround Louis Slotin’s fatal radiation accident. A review of the postwar accident and earlier

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criticality accidents at Omega Site demonstrates that Louis Slotin is undeniably a tragic hero in the classical sense: he was the world’s expert in his field but his overconfidence may have been his fatal flaw. The accident building at Pajarito Site will soon become part of our national heritage with its inclusion in the new historical park, but how will the National Park Service interpret both the myth and reality of the Slotin story? The challenges faced by park planners will not only include developing historical landscapes at Los Alamos for public access, but will also include the creation of interpretive materials that will populate the places of atomic history with current understandings of historical significance and social meaning.

Formal interpretive control over the details and legacy of the Slotin accident, however, may have already been lost. Like the irresolvable controversy surrounding the use of atomic weapons during World War II, the Slotin accident has already moved into a public space of memory and meaning that allows its story to be borrowed for any use yet owned by no one.

The place of Slotin’s accident is unquestionably one of Pierre Nora’s lieux de mémoire, but it may already be a profoundly sacred space due to its association with Slotin’s death and the dangers of radiation. In the same vein, the building itself may become a shrine to the changing meaning of what the Slotin accident represents to the world, regardless of what the national laboratory or the National Park Service intend.

Future place-making and park planning activities at Pajarito Site will need to consider not only the sense of place that the Slotin building brings to the Manhattan Project narrative but also the raw power of place already inherent in the building as a war memorial for those who have lost their lives to atomic warfare.
Fig. 10.1. Louis A. Slotin was a Canadian scientist who worked at Los Alamos during the Manhattan Project. His area of expertise was criticality research, and he was Group Leader of the Critical Assemblies Group, based at Pajarito Site, at the time of his fatal accident on May 21, 1946.

Fig. 10.2. Omega Site, shown here in mid-1946, was the first location for criticality research. In 1945, Louis Slotin and his co-worker Harry Daghlian shared space at Omega Site with members of the wartime reactor group who were conducting critical-mass experiments using the Water Boiler reactor, also known as LOPO (for “Low Power”).
Fig. 10.3. The LOPO Water Boiler reactor contained a solution of uranium and water. Los Alamos scientists used this type of reactor to determine the critical mass of uranium. LOPO was the world’s third nuclear reactor, after the Chicago Pile and the Clinton Pile (known today as the X-10 Graphite Reactor).

Fig. 10.4. Many of the experiments conducted at Omega Site involved various configurations of uranium. In the Dragon experiment, a subcritical uranium-235 hydride slug was dropped from the top of an experimental tower, shown above, using guides that would allow the slug to pass very rapidly through another subcritical but stationary arrangement of uranium. This test, known as the “Drop,” was also given another nickname, the “Dragon,” because dropping the slug and allowing the system to achieve criticality for a brief moment was like “tickling the tail of a sleeping dragon.”
Fig. 10.5. The Dragon experiment appeared simple and straightforward, but concerns were raised about its safety (shown here from above). In fact, the last Dragon experiment resulted in an accidental overheating of its uranium components. In June of 1945, another experiment using cubes of uranium in a spherical arrangement resulted in the accidental but non-fatal exposure of three Omega Site workers.

Fig. 10.6. Harry K. Daghlian, like Louis Slotin, was a Los Alamos scientist with significant experience working with critical assemblies. His accident occurred on the night of August 21, 1945, several weeks after the Fat Man and Little Boy weapons were dropped on Japan.
Fig. 10.7. Daghlian, at center right, was a member of Project Trinity’s plutonium pit assembly team and helped transport the gadget’s plutonium core from the McDonald Ranch House to the Trinity test tower.

Fig. 10.8. Harry Daghlian’s experimental set up included a plutonium pit surrounded by tungsten-carbide bricks to serve as neutron reflectors. By Daghlian’s own account, he was assembling the experiment when he noticed it was about to go critical. His hand slipped and he dropped a brick on the assembly, causing it to go supercritical, which released dangerous amounts of radiation. Harry Daghlian died twenty-five days later, on September 15, 1945.
Fig. 10.9. The Critical Assemblies Group moved to Pajarito Site in remote Pajarito Canyon after Harry Daghlion’s accident and death. Hazardous critical-assembly experiments were still conducted by hand in a small, high-bay annex adjoining the main part of Building 1 (both shown at center). The two rooms were connected by an earth-covered corridor.

Fig. 10.10. Louis Slotin’s accident occurred in the afternoon of May 21, 1945. He was demonstrating a dragon-type experiment to Al Graves. Slotin and Graves were closest to the experiment and would receive the highest exposures. The six others in the room were either observing the accident, employed as site security, or were working on other research projects. This drawing shows the locations and names of those involved in the accident and the location of radiation monitors and known radioactive sources that were in the room at the time of the accident.
Fig. 10.11. Louis Slotin’s experiment involved a subcritical mass of plutonium seated within a beryllium hemisphere, which was being used as a neutron reflector. A second beryllium hemisphere was placed over the lower one (as demonstrated above), and the two halves were kept slightly apart using a screwdriver. When the tool slipped, the shells came together, and the assembly went supercritical releasing a burst of radiation.

Fig. 10.12. A series of photographs were taken after the accident. These views will be used to interpret the events of the accident once the Slotin Building becomes a public site of memory as part of the place-making process involved in developing the Manhattan Project National Historical Park.
Fig. 10.13. Louis Slotin, shown at left with the Trinity gadget, may very well be remembered as the true tragic hero of the Manhattan Project. Over the years, Slotin has been mythologized as both a hero for purportedly saving the others from certain death and as a martyr to the dangers of atomic science. Some have seen his expertise and confidence as a fatal flaw and have questioned his status as a hero, feeling that he took unnecessary risks while conducting such a dangerous type of hands-on experiment.
PART V.
CONCLUSION
EPILOGUE:
THE MANHATTAN PROJECT NATIONAL HISTORICAL PARK—
EMBRACING THE CONTROVERSY

“Lifting the Veil”

On December 19, 2014, President Barack Obama signed legislation authorizing the Manhattan Project National Historical Park. A handful of technical facilities built during the Manhattan Project still exist at Los Alamos, but just as in World War II, the workshops, bunkers, and firing sites are located behind government security fences in restricted areas away from town. With the passage of the park legislation, however, these few remaining Manhattan Project properties will now be preserved as public sites of memory, and sometime in the unknown future, when security fences come down and access rules change, the historic built environment that represents the very science of the bomb will be accessible to visitors as part of the new national park experience.

DOE properties located at LANL and listed in the park legislation are associated with key events on the roughly three-year timeline of science and engineering that led to the development of the world’s first atomic weapons. Each property has its own origin story and wartime history and holds differing meanings for the public of today. Some places, like the scientific birthplaces of the Trinity gadget and the Little Boy and Fat Man bombs, contribute to international narratives about the end of World War II and the use of atomic weapons on the people of Japan. Others speak to our own national history and the Cold War legacy of nuclear weapons, like the wartime technical areas of S-Site, K-Site, Q-Site, and Pajarito Site that have served as the foundation stock upon which the modern-day weapons laboratory at Los Alamos was grafted.
Although these places of the bomb, when taken together, are the embodiment of Project Y’s scientific and technological history, many of the details regarding the specific roles they played during World War II are not part of the standard telling of the Manhattan Project story. The social histories of the many who labored on the project have been overlooked in favor of the biographies of a chosen few. The wartime experiences of nonscientists and enlisted personnel have been overshadowed by the memoirs of famous scientists and military leaders. Generally, the wartime contributions of men have been highlighted, neglecting the essential roles of women in the Manhattan Project narrative.

The technical story of the bomb is difficult to understand, and the language of science that infuses the historical documentation of Project Y has effectively obscured the meaning of certain key events, including the important work of implosion diagnostics that led to the development of Fat Man. The narratives of Los Alamos places and events have also been lost in government archives with restricted access. Manhattan Project stories have been shrouded in government secrecy and security practices related to the development of atomic weapons that were established during the war and that continue today.

Most significantly, the remaining places of the bomb at Los Alamos will be forever associated with the harsh reality of the events that ended World War II and the fear and anxiety of the Cold War that followed. An overpowering master narrative centering on the first use of atomic weapons has led to the interpretive neglect of Project Y’s support organizations and planning efforts, and an under appreciation of how
scientific and engineering solutions to wartime challenges were vital to the creation of the new and world-changing technology of atomic science.

The purpose of this study has been to identify wartime narratives that are currently obscured by the bomb’s veil of controversy. This dissertation has used an examination of place as a means to free hidden history, including the themes of wartime security, secrecy, expediency, innovation, ingenuity, and risk. A focus on the places of the bomb has freed stories of displaced communities, unknown people, and underrepresented institutions. An exploration of historical landscape has freed narratives of wartime high-explosives use. The study of architectural drawings, photographs, and archival documents has freed technical accounts of the bomb.

Place-making in the form of formal park-making will actively engage the public with the remaining buildings and structures currently located behind the fence at the national laboratory. Today, these are raw, under-interpreted places; in the future, however, preserving and developing them as part of a new national historical park will transform them into sites of memory that will inform the public about the history of the Manhattan Project.

The narratives and themes revealed in this study contribute to a greater appreciation of the widespread national effort that came together during World War II to support the Manhattan Project. This research has unmuted the voices of women and SEDs, has recovered lost technologies and lost places, and has restored connections between Los Alamos and other Manhattan Project installations that supported the development and deployment of the first atomic bombs. From Trinity to Tinian,
Wendover to Washington, D.C., Dahlgren, Virginia, to the desert of Inyokern, California, this dissertation has profiled places that deserve a page in atomic history.

**Key Findings**

This study has argued that the decision to use atomic weapons on Japan to end the war is truly the polarizing master narrative of Manhattan Project history. An examination of national, regional, and local case studies has established that Los Alamos will continue to be a contested place.

The use of western history as an analytical framework has uncovered regional and national narratives that were played out on the stage of New Mexico’s Pajarito Plateau. This approach has led to the discovery of stories about local populations displaced by the creation of a wartime laboratory, including the pre-Manhattan Project history of Hispanic and Anglo homesteaders and ranch owners. Exploring the significance and meaning of the Pond Cabin has revealed a historical place that has both intersected with and influenced broad patterns of western history during the twentieth century.

Researching the history, specialized architecture, and landscape of Gun Site has disclosed contributions by the Navy, military contractors, and educational institutions that were key to the development of the Little Boy weapon. This study has contended that many of these contributions have been overlooked because government secrecy practices have limited access to historical information about the Manhattan Project and have resulted in a form of historical forgetting.

A focus on the high-explosives landscape of S-Site has demonstrated that themes of wartime urgency, safety, and risk can be understood through the study of architecture and worker memories. This dissertation’s examination of Los Alamos’s laboratory
buildings and firing sites has exposed themes of ingenuity and problem-solving and contributes to an appreciation of Project Y’s feats of applied physics, experimentation, and hands-on engineering. This study has also shown that the technical places of the bomb serve as a backdrop for worker experiences and that the remembered narratives of Army recruits, WACS, SEDs, and civilians provide the generations of today with an understanding—in human terms—of what it took to design and build the bombs that ended World War II.

Describing the uneven application of historic preservation efforts has illuminated how some Los Alamos places have been restored and how others have been ignored or even forgotten. Noting that the historical connections between Trinity Site and Los Alamos have faded over the years, this dissertation argues that the interpretation of V-Site, the concrete bowl, and Pajarito Site’s Creutz test as part of formal park-making efforts will effectively restore this severed connection.

An investigation of the underrepresented history of Project Alberta’s final delivery and assembly efforts has unearthed the hidden histories of unsung places (Mare Island, Port Chicago, Inyokern, Muroc, and Salton Sea), unsung people (Norman Ramsey and E. J. Workman), and unsung institutions (the Navy, Caltech, and UNM). The very place of Los Alamos’s Quonset Hut, where Fat Man’s high-explosives sphere was assembled, is revealed as a direct link between the Pajarito Plateau and the Pacific.

The concluding chapter of this study, through its documentation of the place of Louis Slotin’s criticality accident and its examination of other wartime and postwar radiation accidents, uncovers a Los Alamos narrative long usurped by writers and society at large. A historical analysis of the May 1946 criticality accident underscores the stark
reality of this terrifying event, which has been overshadowed by the meaning, memory, and mythology of Slotin, the foremost hero of Richard Rhodes’ great tragic epic of the twentieth century.

While the creation of formal sites of public memory is influenced by the present-day cultural sensibilities of the group, the meaning of commemorated places is viewed through the present and past experiences of the individual. National places of memory are intended to speak to everyone, but each person will hear the story differently. The preservation of the very places of the bomb will allow for a more personal engagement with the events of Project Y. The physical experience of visiting the nation’s remaining atomic spaces will inform the park visitor about past settings, associations, and feelings that only an authentic experience of place provides. Direct encounters with these places will generate a body memory of sights, sounds, color, and smell, and this personal and emotional experience is how individual memories of the Manhattan Project will be formed. The meaning of these sites, however, will be influenced by the content of institutional interpretation and the use of formal place-making techniques that will bridge the gap between the pure experience of place and an understanding of its historical significance.

The overpowering controversy surrounding the history of the atomic bomb will likely remain as a key element of the Manhattan Project National Historical Park’s public interpretation, serving as a constant reminder of Los Alamos’s wartime legacy that continues to resonate today. Nonetheless, to fully appreciate this contested history and its rich and complex narrative, one must embrace the controversy, absorb its meaning, and
then move beyond it. At Los Alamos, the overshadowed places, spaces, and historical landscapes of the bomb are sites of memory, true lieux de mémoire, whose very setting and feeling will spark new memories of place for future generations of park visitors, and whose unearthed narratives and historical associations will provide the intellectual stage for continued dialogues about the memory and meaning of the development and use of nuclear weapons.
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SPEECHES, LECTURES, AND CONFERENCE PRESENTATIONS


DISSERTATIONS AND THESES


FILMS AND PLAYS
