



The Manhattan Project

an interactive history



U.S. Department of Energy - Office of History and Heritage Resources

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EXPLORING THE ATOM

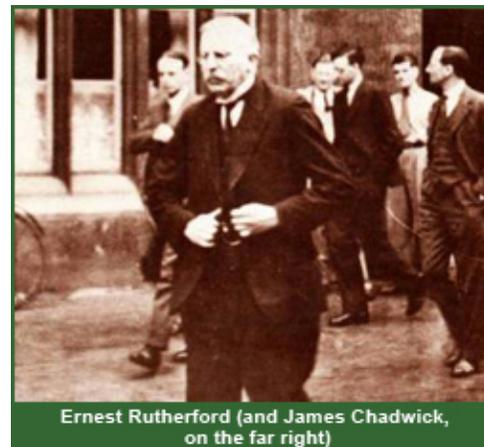
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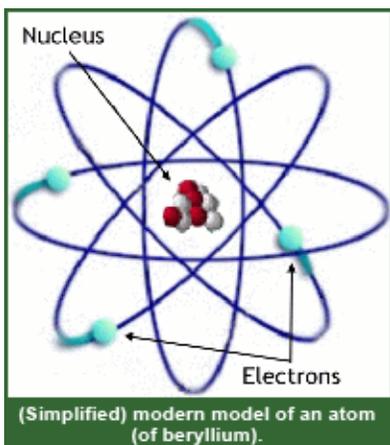
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The road to the atomic bomb began in earnest in 1919, when New Zealander Ernest Rutherford reported on a series of experiments he had been conducting, which involved the bombardment of light element nuclei with energetic α (alpha) particles.

Rutherford reported that nitrogen nuclei ejected what he suspected was "a hydrogen atom" (a proton). He concluded the nitrogen atom was "disintegrated" in the process, and he subsequently asked Patrick Blackett (a research fellow working under Rutherford) to study what precisely was happening. For the next four years Blackett used a cloud chamber to observe some 400,000 alpha particle tracks, which ultimately revealed that the nitrogen atom being bombarded had been transformed into an oxygen isotope in the process. Blackett discovered that the process was not one of disintegration but one of integration, and he published his discovery of the atomic transmutation of nitrogen into oxygen in 1925. The final addition to the atomic "miniature solar system" first proposed by Niels Bohr came in 1932 when **James Chadwick**, Rutherford's colleague at Cambridge, identified the third and final basic particle of the atom: the **neutron**.



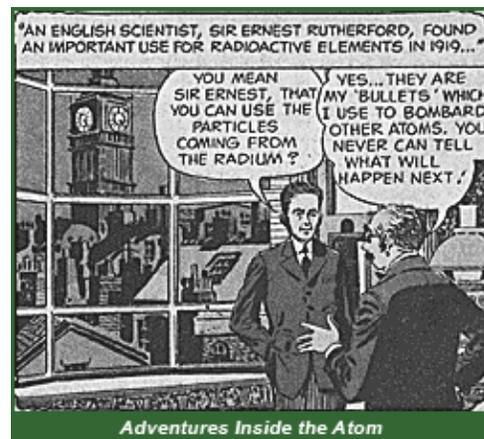
Ernest Rutherford (and James Chadwick, on the far right)



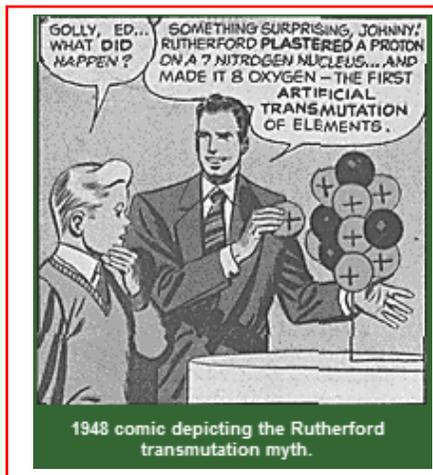
(Simplified) modern model of an atom (of beryllium).

By the early 1930s, the atom was thought to consist of a positively charged nucleus, containing both protons and neutrons, circled by negatively charged electrons equal in number to the protons in the nucleus. The number of protons determined the element's atomic number. Hydrogen, with one proton, came first and uranium, with ninety-two protons, last on the periodic table. This simple scheme became more complicated when chemists discovered that many elements existed at different weights even while displaying identical chemical

properties. It was Chadwick's discovery of the neutron in 1932 that explained this mystery. Scientists found that the weight discrepancy between atoms of the same element resulted because they contained different numbers of neutrons. These different classes of atoms of the same element but with varying numbers of neutrons were designated isotopes. The three isotopes of uranium found in nature, for instance, all have ninety-two protons in their nuclei and ninety-two electrons in orbit. But uranium-238, which accounts for over ninety-nine percent of natural uranium, has 146 neutrons in its nucleus, compared with 143 neutrons in the rare uranium-235 (.7 percent of natural uranium) and 142 neutrons in uranium-234, which is found only in traces in the heavy metal. The slight difference in atomic weight between the uranium-235



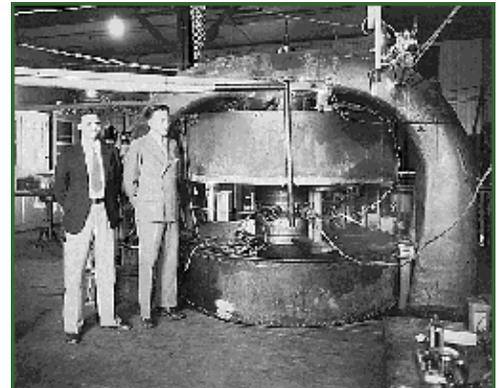
Adventures Inside the Atom



1948 comic depicting the Rutherford transmutation myth.

and uranium-238 isotopes figured greatly in nuclear physics during the 1930s and 1940s.

The year 1932 produced other notable events in atomic physics. The Englishman J. D. Cockroft and the Irishman E. T. S. Walton, working jointly at the Cavendish Laboratory, were the first to split the atom when they



M. Stanley Livingston and Ernest O. Lawrence in front of a 27-inch cyclotron, Rad Lab, University of California, Berkeley, 1934.

bombarded lithium with protons generated by a type of **particle accelerator** (dubbed a "**Cockroft-Walton machine**") and changed the resulting lithium nucleus into two helium nuclei. Also in that year, **Ernest O. Lawrence** and his colleagues M. Stanley Livingston and Milton White successfully operated the first **cyclotron** at the **University of California, Berkeley** (right).

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Sources and notes for this page.

The text for this page was adapted from, and portions were taken directly from, the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 1. For additional information on the work of Rutherford and Blackett, see: American Institute of Physics, Center for History of Physics, "Rutherford's New World," accessed October 12, 2017, <https://history.aip.org/exhibits/rutherford/sections/atop-physics-wave.html>; Peter Galison, *Image and Logic: A Material Culture of Microphysics*, Chicago, IL, and London, UK: University of Chicago Press, 1997; and Steven B. Krivit, *Lost History: Explorations in Nuclear Research*, vol. 3, San Rafael, CA: Pacific Oaks Press, 2016. The photograph of Ernest Rutherford (and **James Chadwick** in the background) is courtesy the [Lawrence Berkeley National Laboratory](#). The atom graphic is a combination of graphics that were originally produced by the [Washington State Department of Health](#) (the nucleus) and the [Environmental Protection Agency](#) (everything else); the combination of the two graphics, the labels, and other customizations, are original to the Department of Energy's Office of History and Heritage Resources. The photograph of the cyclotron at the "Rad Lab," and its caption, are courtesy the [National Archives](#). Click [here for more information on the comic book images](#).

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SOURCES AND NOTES

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Below are the collected specific notes for the text and images used on the pages of this web site. For a discussion of the most important works on the Manhattan Project, see the "[Suggested Readings](#)." For a general discussion of the use of sources in this web site, see "[A Note on Sources](#)."

To scan the sources and notes for various categories, choose from the list below. To view the sources and notes for a specific web page, see the footnote at the bottom of each page (exceptions include this page and the [home page](#); the sources and notes for the home page are the first ones listed below).

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HOME

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: *The Signature Facilities of the Manhattan Project* (Washington: History Division, Department of Energy, 2001), 1. The national news survey referred to was conducted by the "Newseum," originally located in Arlington, Virginia, but

scheduled to reopen in Washington, DC. The survey can be viewed at <http://www.newseum.org/century/finalresults.htm>. The photograph of **General Leslie Groves** with **Robert Oppenheimer** is courtesy the [Department of Energy](#). Return to the [home page](#).

EVENTS

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1890s-1939: Atomic Discoveries

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). The meaning of the word "atoma" is from the entry on "Democritus" in *The Concise Oxford Companion to Classical Literature*, edited by M. C. Howatson and Ian Chilvers (New York: Oxford University Press, 1993), 167-168. Click [here for more information on the comic book image](#). The atom graphic is a combination of graphics that were originally produced by the [Washington State Department of Health](#) (the nucleus) and the [Environmental Protection Agency](#) (everything else); the combination of the two graphics, the labels, and other customizations, are original to the Department of Energy's Office of History and Heritage Resources. The **fission** graphic is adapted from a graphic originally produced by the Washington State Department of Health; the modifications are original to the Department of Energy's Office of History and Heritage Resources. Return to [this event](#).

A Miniature Solar System, 1890s-1919

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). The information in this page is derived from the essays on the history of "Chemistry" and "Physics" in Roy Porter and Marilyn Ogilvie, eds., *The Biographical Dictionary of Scientists* (New York: Oxford University Press, 2000), 26-27, 59-60. The photographs of J. J. Thomson and Niels Bohr are courtesy the [Fermi National Accelerator Laboratory](#). Click [here for more information on the comic book image](#). The illustration of Ernest Rutherford's concept of an **atom** is modified from a graphic produced by the [Lawrence Berkeley National Laboratory](#). The portrait of **Albert Einstein** is courtesy the [Library of Congress](#); it was taken in 1947 by Oren Jack Turner; its copyright was not renewed. Return to [this event](#).

Exploring the Atom, 1919-1932

The text for this page was adapted from, and portions were taken directly from, the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 1. For additional information on the work of Rutherford and Blackett, see: American Institute of Physics, Center for History of Physics, "Rutherford's New World," accessed October 12, 2017, <https://history.aip.org/exhibits/rutherford/sections/atop-physics-wave.html>; Peter Galison, *Image and Logic: A Material Culture of Microphysics*, Chicago, IL, and London, UK: University of Chicago Press, 1997; and Steven B. Krivit, *Lost History: Explorations in Nuclear Research*, vol. 3, San Rafael, CA: Pacific Oaks Press, 2016. The photograph of Ernest Rutherford (and **James Chadwick** in the background) is courtesy the [Lawrence Berkeley National Laboratory](#). The atom graphic is a combination of graphics that were originally produced by the [Washington State Department of Health](#) (the nucleus) and the [Environmental Protection Agency](#) (everything else); the combination of the two graphics, the labels, and other customizations, are original to the Department of Energy's Office of History and Heritage Resources. The photograph of the cyclotron at the "Rad Lab," and its caption, are courtesy the [National Archives](#). Click [here for more information on the comic book images](#). Return to [this event](#).

Atomic Bombardment, 1932-1938

The text for this page was adapted from, and portions were taken directly from the History Division, now [Office of History and Heritage Resources](#), publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 1-2. The "moonshine" comment is from Lawrence Badash, "Introduction," in *Reminiscences of Los Alamos, 1943-1945*, edited by Lawrence Badash, Joseph O. Hirschfelder, and Herbert P. Broida (Dordrecht, Holland: D. Reidel Publishing Company, 1980), xi. For Niels Bohr's views, see "Neutron Capture and Nuclear Constitution," *Nature* 137 (1936), 344. For more on **Enrico Fermi's** experiments, see William R. Shea, "Introduction: From Rutherford to Hahn," in *Otto Hahn and the Rise of Nuclear*

Physics, edited by William R. Shea (Dordrecht, Holland: D. Reidel Publishing Company, 1983), 15. "Atomic" and "nuclear" are basically synonymous; much as the term "pile" gradually gave way to "reactor," "atomic" was gradually replaced by "nuclear" during the later years of the Manhattan Project and afterwards. The photograph of the 27-inch **cyclotron** is courtesy the [Department of Energy](#) (via the [National Archives](#)). Click [here for more information on the Solvay conference](#). The portrait of Einstein is courtesy the [Library of Congress](#); it was taken in 1947 by Oren Jack Turner; its copyright was not renewed. The photographs of **Enrico Fermi** are courtesy the [Argonne National Laboratory](#). Return to [this event](#).

The Discovery of Fission, 1938-1939

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 2. The meaning of the word "atomon" is from the entry on "Democritus" in *The Concise Oxford Companion to Classical Literature*, edited by M. C. Howatson and Ian Chilvers (New York: Oxford University Press, 1993), 167-168. The choice of the word "fission" is discussed in William R. Shea, "Introduction: From Rutherford to Hahn," in *Otto Hahn and the Rise of Nuclear Physics*, edited by William R. Shea (Dordrecht, Holland: D. Reidel Publishing Company, 1983), 15. The **fission chain reaction** graphic is adapted from a graphic originally produced by the [Washington State Department of Health](#); the modifications are original to the Department of Energy's Office of History and Heritage Resources. The photograph of **Lise Meitner** and Otto Hahn is courtesy the [Department of Energy](#) (via the [National Archives](#)); the National Archives identifies the man as Ernest Rutherford, but other sources agree in labeling this a picture of Meitner and Hahn in their Kaiser Wilhelm Institute Laboratory in Berlin). Click [here for more information on the comic book images](#). Return to [this event](#).

Fission Comes to America, 1939

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 3-4. For more on the self-censorship implemented by the scientific community within the United States, see Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 11-12. The **fission chain reaction** graphic is adapted from a graphic originally produced by the [Washington State Department of Health](#); the modifications are original to the Department of Energy's Office of History and Heritage Resources. The photograph of the 60-inch **cyclotron** is courtesy the [Department of Energy](#) (via the [National Archives](#)). Click [here for more information on the comic book image](#). The graphic illustrating the two main isotopes of **uranium** is adapted from images that originally appeared in *The Harnessed Atom: Nuclear Energy and Electricity* (DOE/NE-0072; Washington: Office of Program Support, Department of Energy, 1986), 18. Click [here for more information on the group photograph of Enrico Fermi, Leo Szilard, and the rest](#). Return to [this event](#).

1939-1942: Early Government Support

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). The photograph of **Albert Einstein** with **Leo Szilard** is courtesy the [Federation of American Scientists](#). Click [here for information on the photograph of the 1940 meeting at Berkeley](#). The photograph of **President Franklin Roosevelt** signing the declaration of war on Japan, December 8, 1941, is courtesy the [National Archives](#). Return to [this event](#).

Einstein's Letter, 1939

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Early Uranium Research, 1939-1941

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Volume I, *A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 29-32. Click [here for information on the photograph of Ernest Lawrence, Arthur Compton, Vannevar Bush, and James Conant](#). The photograph of **Columbia University** ca. 1903 is courtesy the [Library of Congress](#); it originated from the Detroit Publishing Company and was a 1949 gift to the Library of Congress from the State Historical Society of Colorado. The photograph of **Vannevar Bush** and **Arthur Compton** is courtesy the [Lawrence Berkeley National Laboratory](#). Return to [this event](#).

Piles and Plutonium, 1939-1941

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Reorganization and Acceleration, 1940-1941

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The MAUD Report, 1941

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 9. On the credibility the MAUD Committee members had in Washington, see McGeorge Bundy, *Danger and Survival: Choices About the Bomb in the First Fifty Years* (New York: Random House, 1988), 48-49. For the origin of the word "MAUD," see the footnote in [Dennis C. Fakley, "The British Mission," *Los Alamos Science* \(Winter/Spring 1983\), 186](#). In addition to the internet version, which is accessible [here](#), the MAUD Report is available on the National Archives microfilm collection M1392, *Bush-Conant File Relating to the Development of the Atomic Bomb, 1940-1945* (Washington: National Archives and Records Administration, 1990), reel #1/14. The photograph of Niels Bohr is courtesy the [Fermi National Accelerator Laboratory](#). Click [here for information on the photograph of Vannevar Bush and James Conant](#). Return to [this event](#).

A Tentative Decision to Build the Bomb, 1941-1942

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[Laboratory](#). The note from Roosevelt to Bush is available on the National Archives microfilm collection M1392, *Bush-Conant File Relating to the Development of the Atomic Bomb, 1940-1945* (Washington: National Archives and Records Administration, 1990), reel #1/14. Click [here for more information on the photograph of the S-1 Uranium Committee](#). The photograph of Werner Heisenberg is courtesy the [National Archives](#); it is reprinted in Jeremy Bernstein, ed., *Hitler's Uranium Club: The Secret Recordings at Farm Hall* (Woodbury, NY: American Institute of Physics, 1996). Return to [this event](#).

1942: Difficult Choices

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). The photograph of **Leslie Groves** at his desk is reprinted in the inside front cover of Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988). Click [here for more information on the photograph of the S-1 \(Uranium\) Committee](#). Return to [this event](#).

More Uranium Research, 1942

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 10-11, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 168-69. **President Franklin Roosevelt's** reply to **Vannevar Bush** is cited in Hewlett and Anderson, Jr., *The New World, 1939-1946*, 406. The photograph of the blocks of **uranium** is courtesy [Los Alamos National Laboratory](#); it is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 99. The map of Manhattan Project facilities in North America is reproduced from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 463. The photograph of **Ernest Lawrence** (and others) in front of a **cyclotron** is courtesy the [Lawrence Berkeley National Laboratory](#). The photograph of **Columbia University** is courtesy the [Library of Congress](#); it originated from the Detroit Publishing Company, and it was a 1949 gift to the Library of Congress from the State Historical Society of Colorado. Return to [this event](#).

More Piles and Plutonium, 1942

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Enter the Army, 1942

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Groves and the MED, 1942

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Picking Horses, November 1942

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Final Approval to Build the Bomb, December 1942

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 16-17. For more on the Lewis Committee Report, see the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 113. The photograph of **Franklin Roosevelt** is courtesy the [National Archives](#). Click [here for more information on the photograph of the S-1 \(Uranium\) Committee](#). The photograph of **Vannevar Bush** and **Arthur Compton** is courtesy the [Lawrence Berkeley National Laboratory](#). The note from Roosevelt to Bush is available on the National Archives microfilm collection M1392, *Bush-Conant File Relating to the Development of the Atomic Bomb, 1940-1945* (Washington: National Archives and Records Administration, 1990), reel #1/14. Return to [this event](#).

1942-1944: The Uranium Path to the Bomb

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). Portions were adapted or taken directly from the History Office publications: Terrence R. Fehner and F. G. Gosling, *Origins of the Nevada Test Site* (DOE/MA-0518; Washington: History Division, Department of Energy, December 2000), 26, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 167. Click [here for more information on the picture of the Alpha racetrack at Y-12](#). The photograph of **K-25** is courtesy the [Federation of American Scientists](#). Return to [this event](#).

Y-12: Design, 1942-1943

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 20-22. See also the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 141-52. The photograph of **Ernest Lawrence** slumping in his chair from fatigue is courtesy the [Lawrence Berkeley National Laboratory](#). The diagram illustrating the **electromagnetic method** is

reproduced from the [Department of Energy](#) report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 138. The photograph of **Leslie Groves** at his desk is reprinted in the inside front cover of Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988). The photograph of the **Y-12** calutron is courtesy [Oak Ridge National Laboratory](#) (via the [Lawrence Berkeley National Laboratory](#)). The photograph of the Y-12 racetrack construction appears courtesy the Department of Energy. Return to [this event](#).

Y-12: Construction, 1943

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 22-23. See also the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 155. Kenneth D. Nichols, Groves's chief aide and deputy, recounts his adventure in borrowing the silver in *The Road to Trinity* (New York: William Morrow and Company, Inc., 1987), 42. The photograph of the groundbreaking at **Y-12** is courtesy the [Oak Ridge National Laboratory](#). The aerial view of the construction at Y-12 and the photograph of the Beta Racetrack are both reproduced from Gosling, *The Manhattan Project*, 22-23. The photograph of **Ernest Lawrence** is courtesy the [Lawrence Berkeley National Laboratory](#). The photograph of the construction of the Alpha Racetrack and its building at Y-12 are both courtesy the [National Archives](#); they were taken by **Ed Westcott** and are reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 87-88. The map of **Oak Ridge** is reproduced from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 131. The photograph of **Robert Oppenheimer** in front of a blackboard is reproduced by permission of the J. Robert Oppenheimer Memorial Committee. Return to [this event](#).

Y-12: Operation, 1943-1944

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 23-24. See also the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 165-167, 294-296. Click [here for more information on the picture of the Alpha racetrack at Y-12](#). The two photographs of the calutron operators at their control panels are both courtesy the [Lawrence Berkeley National Laboratory](#). The photograph of the shift change at **Y-12** is reproduced from the photo insert in F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0002; Washington: History Division, [Department of Energy](#), October 2001). Return to [this event](#).

Working K-25 into the Mix, 1943-1944

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 24-26. The photograph of **K-25** is courtesy the [Federation of American Scientists](#). The photograph of **Y-12's** Beta Racetrack is reproduced from Gosling, *The Manhattan Project*, 23. The diagram showing multiple stages of the **gaseous diffusion** process is reproduced from the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 98. Return to [this event](#).

The Navy and Thermal Diffusion, 1944

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 26. The photograph of the **diffusion** columns at **S-50** is courtesy the [National Archives](#); it was taken by **Ed Westcott** and is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York:

Harry N. Abrams, Inc., Publishers, 1995), 92. The photograph of Philip Abelson is courtesy the Lawrence Berkeley National Laboratory. The diagram illustrating the liquid thermal diffusion method is reproduced from the Department of Energy report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 138. The map of **Oak Ridge** is reproduced from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 131. The aerial photograph showing S-50, the power plant for **K-25**, and the Clinch River, is reproduced in the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), between pages 296 and 297. Return to [this event](#).

1942-1944: The Plutonium Path to the Bomb

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). The terms "atomic pile" and "nuclear reactor" refer to the same thing. The term "pile" was more common during early atomic research, and it was gradually replaced by "reactor" in the later years of the Manhattan Project and afterwards. In this web site, the phrase "**pile (reactor)**" is used to refer to early, experimental piles, and "reactor (pile)" is used to refer to later production reactors, which had more elaborate controls and in general more-closely resembled post-war reactors. Much as the term "pile" gradually gave way to "reactor," "atomic" was gradually replaced by "nuclear." The painting of **CP-1 going critical** is courtesy the [National Archives](#). Click [here for more information on the aerial photograph of Hanford](#). Return to [this event](#).

Production Reactor (Pile) Design, 1942

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 26-27, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 108-9, 174-82. Also used were Jack M. Holl, *Argonne National Laboratory, 1946-96* (Urbana, IL: University of Illinois Press), 13-16, and Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 190-91. The terms "atomic pile" and "nuclear reactor" refer to the same thing. The term "pile" was more common during early atomic research, and it was gradually replaced by "reactor" in the later years of the Manhattan Project and afterwards. In this web site, the phrase "**pile (reactor)**" is used to refer to early, experimental piles, and "reactor (pile)" is used to refer to later production reactors, which had more elaborate controls and in general more closely resembled post-war reactors. Much as the term "pile" gradually gave way to "reactor," "atomic" was gradually replaced by "nuclear." The schematic drawing of **X-10** is reproduced from Hewlett and Anderson, *The New World*, 195. The drawing of **CP-1** is courtesy the [National Archives](#). The **Hanford reactor** schematic is reproduced from the [Department of Energy](#) report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 164. The photograph of **Vannevar Bush** and **Arthur Compton** is courtesy the [Lawrence Berkeley National Laboratory](#). The portrait of **Leslie Groves** is courtesy the [Los Alamos National Laboratory](#). Return to [this event](#).

DuPont and Hanford, 1942

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 28-29, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 188-90. Also used was Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 108-9. Also used was Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 108-9. The photograph of Walter Carpenter and the generals is courtesy the DuPont Corporation; it is reprinted in Stephane Groueff, *Manhattan Project: The Untold Story of the Making of the Atomic Bomb* (Boston: Little, Brown, and Company, 1967). The aerial photograph of the **X-10** complex is courtesy

the [Oak Ridge National Laboratory](#). The photograph of **Vannevar Bush, James Conant, Leslie Groves**, and Franklin Matthias is courtesy the DuPont Corporation; it is reprinted in Stephane Groueff, *Manhattan Project: The Untold Story of the Making of the Atomic Bomb* (Boston: Little, Brown, and Company, 1967). The **Hanford** location map is courtesy the [Hanford Site](#). Return to [this event](#).

CP-1 Goes Critical, December 2, 1942

The text for this entry is based upon, and portions were taken directly from, a press release, written by the Press Relations Section of the Manhattan Project, November 26, 1946 (to be released December 1, 1946) entitled "Background Material for Use in Connection with Observance of the Fourth Anniversary, December Second, of the Scientific Event of Outstanding Significance in the United States Program of Development of Atomic Energy"; this release is available on the University Publications of America microfilm collection *President Harry S. Truman's Office Files, 1945-1953* (Frederick, MD: 1989), Part 3, reel #41/42; the press release itself is a government document. See also John F. Hogerton, ed., "Chicago Pile No. 1 (CP-1)," *The Atomic Energy Deskbook* (New York: Reinhold Publishing Corporation, 1963, prepared under the auspices of the Division of Technical Information, U.S. **Atomic Energy Commission**), 97-98. For "gamble" quote, see the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 109. The terms "atomic pile" and "nuclear reactor" refer to the same thing. The term "pile" was more common during early atomic research, and it was gradually replaced by "reactor" in the later years of the Manhattan Project and afterwards. In this web site, the phrase "**pile (reactor)**" is used to refer to early, experimental piles, and "reactor (pile)" is used to refer to later production reactors, which had more elaborate controls and in general more closely resembled post-war reactors. Much as the term "pile" gradually gave way to "reactor," "atomic" was gradually replaced by "nuclear." The painting of **CP-1** going critical and the drawing of the pile by itself are both courtesy the [National Archives](#). The photograph of the construction of CP-1 is courtesy [Argonne National Laboratory \(ANL\)](#); it is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 103. Click [here for more information on the photograph of "Met Lab" alumni](#). The photograph of **Enrico Fermi** is courtesy the [Department of Energy](#) (via the [National Archives](#)). The data printout is reproduced from Hewlett and Anderson, *The New World*, between pages 112 and 113. The photograph of the Chianti is courtesy ANL. Return to [this event](#).

Seaborg and Plutonium Chemistry, 1942-1944

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 27-28, 30-31. The photograph of **Glenn Seaborg** looking at the first sample of pure plutonium at the **Met Lab** in 1942 is courtesy the [Lawrence Berkeley National Laboratory](#). The photograph of the interior of cell in a **Queen Mary** was taken by Robley Johnson and is courtesy the [Department of Energy \(DOE\)](#); it is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 76-77. The flow chart is reproduced from the DOE report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 172. Return to [this event](#).

Final Reactor Design and X-10, 1942-1943

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#), publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 30, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 193-201. The terms "atomic pile" and "nuclear reactor" refer to the same thing. The term "pile" was more common during early atomic research, and it was gradually replaced by "reactor" in the later years of the Manhattan Project and afterwards. In this web site, the phrase "**pile (reactor)**" is used to refer to early, experimental piles, and "reactor (pile)" is used to refer to later production reactors, which had more elaborate controls and in general more closely resembled post-war reactors. Much as the term "pile" gradually gave way to "reactor," "atomic" was gradually replaced by "nuclear." The schematic drawing of **X-10** is reproduced from Hewlett and Anderson, *The New World*,

195. The photograph of X-10 is courtesy the [Oak Ridge National Laboratory](#). The **Hanford reactor** schematic is reproduced from the [Department of Energy](#) report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 164. The photograph of **CP-2** is courtesy the [Argonne National Laboratory](#). Return to [this event](#).

Hanford Becomes Operational, 1943-1944

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 32-35, 41-42, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 212-22, 304-10. See also Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 218. Click [here for more information on the aerial photograph of Hanford](#). The photograph of the mess hall is reproduced from the [Department of Energy](#) report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 25. The photograph of the face of B Reactor is reproduced from the History Office publication: *The Signature Facilities of the Manhattan Project* (Washington: History Division, Department of Energy, 2001), 7. The photograph of B Reactor under construction is courtesy the [Hanford Site](#). The photograph of the front face of F Reactor was taken by Robley Johnson; it is courtesy the [Department of Energy \(DOE\)](#), and it is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 71. The photograph of several Queen Marys is courtesy Richland Operations, DOE—Robley Johnson or his assistant, photographer; it is reprinted in Peter Bacon Hales, *Atomic Spaces: Living on the Manhattan Project* (Urbana and Chicago: University of Illinois Press, 1997), 133. Return to [this event](#).

1942-1945: Bringing It All Together

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). The photograph of the "**Tech Area**" at **Los Alamos** is courtesy the [Los Alamos National Laboratory](#). The photograph of Eric Jette, Charles Critchfield, and **Robert Oppenheimer** is reprinted in [Los Alamos Scientific Laboratory](#), *Los Alamos: Beginning of an Era, 1943-1945* (Los Alamos: Public Relations Office, Los Alamos Scientific Laboratory, ca. 1967-1971), 20. The photograph of **Leslie Groves** and Oppenheimer is courtesy the [Department of Energy](#). Return to [this event](#).

Establishing Los Alamos, 1942-1943

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 35, 37-38. See also *In the Matter of J. Robert Oppenheimer: Transcript of Hearing Before Personnel Security Board, Washington, D.C., April 12, 1954, Through May 6, 1954* (Washington, D.C.: Government Printing Office, 1954), 12-13. The list of staff at **Los Alamos** is adapted in part from "Dateline: Los Alamos," a special issue of the monthly publication of [Los Alamos National Laboratory \(LANL\)](#) (1995), 8. The photograph of the "**Tech Area**" at **Los Alamos** is courtesy LANL. The map of Los Alamos is reprinted from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 330. The photograph of the students playing hockey on Ashley Pond is reprinted from "Dateline: Los Alamos," a special issue of the monthly publication of LANL (1995), 7. The photograph of **Ernest Lawrence, Enrico Fermi**, and Isidore Rabi is courtesy LANL. The photograph of the MP checking the resident's ID is reprinted in the photo insert of F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (Washington: History Division, DOE, October 2001). Return to [this event](#).

Early Bomb Design, 1943-1944

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 38-39. The photograph of "Little Boy" is courtesy the U.S. Army Corps of Engineers (via the [National Archives](#)). The **fission chain reaction** graphic is adapted from graphics

originally produced by the [Washington State Department of Health](#); the modifications are original to the Department of Energy's Office of History and Heritage Resources. The sketches of the **gun-type** and **implosion** approaches to bomb design are reproduced from Robert Serber's [April 1943 "Los Alamos Primer,"](#) 21-22. The photograph of the "Ivy Mike" **hydrogen bomb** test is courtesy the Department of Energy's [Nevada Site Office](#). Return to [this event](#).

Basic Research at Los Alamos, 1943-1944

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 39-40. Click [here for more information on the group photograph of scientists at Los Alamos](#). The photograph of **Enrico Fermi** is courtesy the Argonne National Laboratory. The photograph of **Hans Bethe** is courtesy the [Los Alamos National Laboratory \(LANL\)](#). The photograph of **Robert Oppenheimer** in front of a blackboard is reproduced by permission of the J. Robert Oppenheimer Memorial Committee. The photograph of Emilio Segrè is courtesy the [Lawrence Berkeley National Laboratory](#). The photographs of the **neutron cross section** experiment and of the blocks of **uranium** are courtesy LANL; they are reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 99 and 109. The photograph of Deke Parsons is reproduced from [Los Alamos Scientific Laboratory, Los Alamos: Beginning of an Era, 1943-1945](#) (Los Alamos: Public Relations Office, Los Alamos Scientific Laboratory, ca. 1967-1971), 59. Return to [this event](#).

Implosion Becomes a Necessity, 1944

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 40, 42. The diagram illustrating **implosion** is reproduced from the [Department of Energy](#) report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 13. The photograph of the implosion experiment is courtesy the [Los Alamos National Laboratory](#); it is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 111, 116. The photograph of Fat Man is courtesy the U.S. Army Corps of Engineers (via the [National Archives](#)). The photograph of **Leslie Groves** with **Robert Oppenheimer** is courtesy the Department of Energy. Click [here for more information on the Hanford B Reactor photograph](#). Return to [this event](#).

Oak Ridge and Hanford Come Through, 1944-1945

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 40-42. See also the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 294-310, 374. Four devices were completed by the end of August 1945: 1) the **implosion-type plutonium device** tested on July 16, 1945, at the Trinity Site; 2) the **gun-type uranium bomb** ("Little Boy") **detonated over Hiroshima** on August 6, 1945; 3) the implosion-type plutonium bomb ("Fat Man") **dropped on Nagasaki** on August 9, 1945; and 4) a fourth bomb, also an implosion-type plutonium device, which **Leslie Groves** reported to the War Department would be available for use in the war by about August 24. For more on the number and design of nuclear weapons available following the end of the war, see "[The Manhattan Engineer District, 1945-1946](#)." The photograph of the **Y-12** complex at **Oak Ridge** is courtesy the [Lawrence Berkeley National Laboratory](#). The three diagrams illustrating methods of **uranium enrichment** are reproduced from the [Department of Energy](#) report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 138. The photograph of B Reactor under construction is courtesy the [Hanford Site](#). Return to [this event](#).

Final Bomb Design, 1944-1945

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publications: F. G. Gosling, *The Manhattan Project: Making the*

Atomic Bomb (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 42-43, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 253, 321. The photograph of "D-Day" is courtesy the [National Archives](#). The photograph of **Robert Oppenheimer** in front of a blackboard is reproduced by permission of the J. Robert Oppenheimer Memorial Committee. The photograph of **SED** Herb Lehr holding the Gadget's core is courtesy the [Los Alamos National Laboratory \(LANL\)](#); it is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 138. The photograph of Kenneth Bainbridge is courtesy LANL. The photograph of the buttons of **plutonium** metal at **Los Alamos** in 1945 is courtesy LANL (via the [Federation of American Scientists](#)). The photograph of Little Boy is courtesy the U.S. Army Corps of Engineers (via the National Archives). Return to [this event](#).

Atomic Rivals and the ALSOS Mission, 1938-1945

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). "Atomic" and "nuclear" are basically synonymous; much as the term "pile" gradually gave way to "reactor," "atomic" was gradually replaced by "nuclear" during the later years of the Manhattan Project and afterwards. For the German atomic program, see David Irving, *The German Atomic Bomb* (New York: Simon and Schuster, 1968). On the ALSOS mission, see Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 280-291. For the Japanese program, see Pacific War Research Society, *The Day Man Lost* (Kodansha International, 1972), and Deborah Shapley, "Nuclear Weapons History: Japan's Wartime Bomb Projects Revealed," *Science* 199 (1978), 152. It should be noted also that two authors have in recent years argued Japan and Germany were much closer than has been generally realized to developing nuclear weapons. In *Japan's Secret War: Japan's Race Against Time to Build Its Own Atomic Bomb* (New York: Marlowe & Company, 1995), Robert K. Wilcox argues that Japan came *extremely* close to completing a bomb. In *The Nuclear Axis: Germany, Japan and the Atom Bomb Race, 1939-1945* (Phoenix Mill, UK: Sutton Publishing Limited, 2000), Philip Henshall implies that both Germany and Japan made much more progress than is generally known and that this may have been covered up by the Allies for some reason that relates somehow to the **Cold War**. Neither author provides footnotes, however, and it is therefore often impossible to determine what their source is for any particular statement. Further, their most important (and controversial) arguments often rely more on supposition and the raising of "unanswered questions" than on detailed, verifiable evidence. Their arguments have not been generally accepted within the historical profession. Still, there is interesting information in both regarding their subjects, and -- used with caution -- they can be useful sources of information. The photograph of the V-2 rocket being tested in Florida after the war is courtesy the [National Oceanic and Atmospheric Administration's photo library](#). The photograph of Werner Heisenberg with Niels Bohr is courtesy the [Fermi National Accelerator Laboratory](#). The diagram illustrating the **liquid thermal diffusion method** is reproduced from the Department of Energy report *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to their Environmental Consequences* (Washington: Center for Environmental Management Information, Department of Energy, January 1997), 138. The photograph of "D-Day" is courtesy the [National Archives \(NARA\)](#). All other photographs are courtesy NARA and are reprinted in Jeremy Bernstein, ed., *Hitler's Uranium Club: The Secret Recordings at Farm Hall* (Woodbury, NY: American Institute of Physics, 1996). Return to [this event](#).

Espionage and the Manhattan Project, 1940-1945

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). The main sources for this entry were:

- Christopher Andrew and Vasili Mitrokhin, *The Sword and the Shield: The Mitrokhin Archive and the Secret History of the KGB* (New York: Basic Books, 1999);
- John Earl Haynes and Harvey Klehr, *Venona: Decoding Soviet Espionage in America* (New Haven and London: Yale University Press, 1999);
- David Holloway, *Stalin and the Bomb: The Soviet Union and Atomic Energy, 1939-1956* (New Haven, CT: Yale University Press, 1994);
- Jeffrey T. Richelson, *A Century of Spies: Intelligence in the Twentieth Century* (New York: Oxford University Press, 1995); and
- Allen Weinstein and Alexander Vassiliev, *The Haunted Wood: Soviet Espionage in America -- the Stalin Era* (New York: Random House, 1999).

For a summary of the failure of German espionage in the United States (and in Britain), see Richelson, *Century of Spies*, 139-144.

On the scope of Soviet espionage in the United States in general, see Andrew and Mitrokhin, *Sword and Shield*; Haynes and Klehr, *Venona*; and Weinstein and Vassiliev, *Haunted Wood*.

On Cairncross as the source of the first word on atomic energy to reach Moscow, see Holloway, *Stalin and the Bomb*, 82-83; Andrew and Mitrokhin, *Sword and Shield*, 114; and Weinstein and Vassiliev, *Haunted Wood*, 172. Cairncross may have passed word as early as October 1940; see Richelson, *Century of Spies*, 136. In 1993, Cairncross denied to the Schecters ever having passed this information (Jerrold and Leona Schecter, *Sacred Secrets: How Soviet Intelligence Operations Changed American History* (Washington: Brassey's, 2002), 348 (note 5)). On Maclean passing word of the atomic bomb program in the fall of 1941, see Richelson, *Century of Spies*, 137. On Maclean in general, including his work with the AEC, see Haynes and Klehr, *Venona*, 52-55. On the Flerov letter, see Holloway, *Stalin and the Bomb*, 76-79.

On the name "ENORMOZ," see Andrew and Mitrokhin, *Sword and Shield*, 118. For those Soviet intelligence operations that were detected and stopped, see Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 263-266, and Haynes and Klehr, *Venona*, 325-326.

For the sources consulted regarding **Klaus Fuchs** and **Theodore Hall**, see the notes for their separate entries (**Fuchs' notes**; **Hall's notes**).

The information on the Rosenbergs and David Greenglass is from Andrew and Mitrokhin, *Sword and Shield*, 128; Haynes and Klehr, *Venona*, 295-303, 307-311; and Weinstein and Vassiliev, *Haunted Wood*, 198-202, 205-216, 221-222, 327-334.

The information on May is from Holloway, *Stalin and the Bomb*, 105. On Pontecorvo, see Christopher Andrew and Oleg Gordievsky, *KGB: The Inside Story of Its Foreign Operations from Lenin to Gorbachev* (New York: HarperCollins, 1990), 317-318, 379.

On FOGEL/PERSEUS, see Weinstein and Vassiliev, *Haunted Wood*, 190-195, and Haynes and Klehr, *Venona*, 16, 313-314. Before Theodore Hall was identified, FOGEL/PERSEUS was sometimes mistakenly thought to be the source that turned out to be Hall. On MAR, see Andrew and Mitrokhin, *Sword and Shield*, 117. On the strange "walk-in" in New York, see Weinstein and Vassiliev, *Haunted Wood*, 193. On ERIC, see *ibid.*, 181-182, and on QUANTUM, see Haynes and Klehr, *Venona*, 311-313.

For estimates of how many years Soviet espionage sped up their atomic weapons program, see Andrew and Mitrokhin, *Sword and Shield*, 132, and Holloway, *Stalin and the Bomb*, 222.

The **Los Alamos** ID Badge photograph of Fuchs was taken in 1944; it is courtesy the [Los Alamos National Laboratory \(LANL\)](#) and is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 106. The photograph of Werner Heisenberg is courtesy the [National Archives \(NARA\)](#); it is reprinted in Jeremy Bernstein, ed., *Hitler's Uranium Club: The Secret Recordings at Farm Hall* (Woodbury, NY: American Institute of Physics, 1996). The photograph of Hall and the photograph of Donald Maclean are courtesy the [National Security Agency](#). The photographs of David and Ruth Greenglass, Julius Rosenberg, and Ethel Rosenberg, are all courtesy the U.S. Attorney for the Southern District of New York (via NARA). Click [here for more information on the photograph of Kasparov, Kamen, and Kheifits](#). The "Silence Means Security" propaganda poster is courtesy the Office of Government Reports, United States Information Service, Division of Public Inquiry, Bureau of Special Services, Office of War Information (via NARA). The photograph of the first Soviet atomic test is courtesy the [Federation of American Scientists](#).

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1945: Dawn of the Atomic Era

Portions of the text for this page were adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 45, and Terrence R. Fehner and F. G. Gosling, *Origins of the Nevada Test Site* (DOE/MA-0518; Washington: History Division, Department of Energy, December

2000), 31-32. "Atomic" and "nuclear" are basically synonymous; much as the term "pile" gradually gave way to "reactor," "atomic" was gradually replaced by "nuclear" during the later years of the Manhattan Project and afterwards. Click [here for more information about the photograph of the Trinity test](#). The photograph of the lone soldier walking through an **almost-completely leveled** portion of **Hiroshima** is courtesy the Department of the Navy (via the [National Archives](#)). Return to [this event](#).

The War Enters Its Final Phase, 1945

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 42, 45-46. The photographs of "D-Day," the B-29s, and the Yalta Conference are courtesy the [National Archives](#). The photograph of **Harry Truman** taking the oath of office is courtesy the [Truman Presidential Museum and Library](#). The photograph of Paul Tibbets with his ground crew in front of the Enola Gay is reproduced from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 535. Return to [this event](#).

Debate Over How to Use the Bomb, Late Spring 1945

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 45-47. See also Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 530. The photograph of **Robert Oppenheimer**, **Enrico Fermi**, and **Ernest Lawrence** is courtesy the [Lawrence Berkeley National Laboratory](#). Click [here for information on the photograph of Ernest Lawrence, Arthur Compton, Vannevar Bush, James Conant, Karl Compton, and Alfred Loomis](#). The portrait of **President Harry S. Truman** is courtesy the [Truman Presidential Library](#). The photographs of "Joe 1" (the first Soviet atomic test) and of **Leo Szilard** with **Albert Einstein** are courtesy the [Federation of American Scientists](#). The photograph of **Leslie Groves** and Thomas Farrell is reprinted from Jones, *Manhattan*, 512. Return to [this event](#).

The Trinity Test, July 16, 1945

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 48-49. On the availability of additional plutonium bombs (but not uranium), see "[The Manhattan Engineer District, 1945-1946](#)." The "long-hairs" remark is quoted in Los Alamos Scientific Laboratory, *Los Alamos: Beginning of an Era, 1943-1945* (Los Alamos: Public Relations Office, Los Alamos Scientific Laboratory, ca. 1967-1971), 53; the anecdotes re the final seconds of the countdown are from *Los Alamos: Beginning of an Era*, 50-51. Click [here for information on the color photograph of Trinity](#). The photograph of SED Herb Lehr holding the Gadget's core is courtesy the [Los Alamos National Laboratory \(LANL\)](#) and is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 138. The following pictures are also courtesy LANL: the bunker at S-10,000, the plutonium core being unloaded from the car, the gadget being hoisted up the tower, the unidentified man sitting next to the gadget, and the photograph of Kenneth Bainbridge. The map of the **Trinity Test Site** is reproduced from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 479. The photograph of **Robert Oppenheimer** with **Leslie Groves** at the Trinity Site appears on the cover of the History Office publication: *The Signature Facilities of the Manhattan Project* (Washington: History Division, Department of Energy, 2001). The photograph of Fat Man is courtesy the U.S. Army Corps of Engineers (via the [National Archives](#)). Return to [this event](#).

Safety and the Trinity Test, July 1945

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: Terrence R. Fehner and F. G. Gosling, *Origins of the Nevada Test Site* (DOE/MA-0518; Washington: History Division, Department of Energy, December 2000), 30-33. See also Barton C. Hacker, *The Dragon's Tail: Radiation Safety in the Manhattan Project, 1942-1946* (Berkeley, CA: University of California Press, 1987), 75-78, 84-86, 89-93, 98-108. The photographs of the radiation safety team, the bunker at S-10,000,

and the tank **Enrico Fermi** used to roll up on ground zero soon after the test are all courtesy the [Los Alamos National Laboratory](#). The map of the **Trinity Test Site** is reproduced from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 479. Click [here for more information on the photograph of the Trinity mushroom cloud](#). The photograph of Stafford Warren is reprinted in Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 414. Return to [this event](#).

Evaluations of Trinity, July 1945

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: [F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* \(DOE/MA-0001; Washington: History Division, Department of Energy, January 1999\), 49-50](#). The two cables are quoted in the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 383, 386. **Leslie Groves's** comment that he no longer considered the Pentagon safe from attack is from Leslie R. Groves, *Now It Can Be Told* (New York: Harper & Row, 1962), 434. Stimson's observations on **President Harry Truman's** reactions to the news are from Herbert Feis, *The Atomic Bomb and the End of World War II* (Princeton, NJ: Princeton University Press, 1966), 85. The photograph of Groves with **Robert Oppenheimer** is courtesy the [Department of Energy](#). The photograph of Truman, James Byrnes, and William Leahy and the photograph of George Harrison, Groves, **James Conant**, and **Vannevar Bush** are reproduced from Hewlett and Anderson, *The New World*, opposite 393 and 417, respectively. Click [here for more information on the photograph of Trinity](#). The portrait of Emperor Hirohito is courtesy the United States Army Signal Corps (via the [Library of Congress](#)). The photograph of George Marshall and Henry Stimson is courtesy the [Center of Military History, United States Army](#). The photograph of Joseph Stalin, Truman, and Winston Churchill at the Potsdam Conference is courtesy the [Truman Presidential Library](#). Return to [this event](#).

Potsdam and the Final Decision to Bomb, July 1945

The text for this page was adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: [F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* \(DOE/MA-0001; Washington: History Division, Department of Energy, January 1999\), 50-51](#). For **President Harry Truman's** account of his informing Stalin about the bomb, see Harry S. Truman, *Memoirs: Volume 1, Year of Decisions* (New York: Doubleday & Company, 1955), 416. On the Potsdam Declaration, see the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 395. The casualty figures for the *Indianapolis* and Okinawa are taken from Samuel Eliot Morison, *The Two-Ocean War: A Short History of the United States in the Second World War* (New York: Little, Brown and Company, 1963), 556, 566, and Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History of the United States of America* (New York: The Free Press, A Division of Macmillan, Inc., 1984), 463-464. The photographs of the Potsdam conference and of President Harry Truman are courtesy the [Truman Presidential Library](#). Click [here for more information on the picture of Potsdam and the note Truman wrote on the back of it](#). Click [here for more information on the image of the order to drop the atomic bomb](#). The photograph of Paul Tibbets with his ground crew in front of the Enola Gay is reproduced from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 535. The photograph of "Little Boy" is courtesy the U.S. Army Corps of Engineers (via the [National Archives \(NARA\)](#)). The photograph of the Marine at Okinawa is courtesy the [United States Marine Corps](#) (via NARA). Return to [this event](#).

The Atomic Bombing of Hiroshima, August 6, 1945

Portions of the text for this page were adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: [F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* \(DOE/MA-0001; Washington: History Division, Department of Energy, January 1999\), 51-53](#). Also used was the report on "The Atomic Bombings of Hiroshima and **Nagasaki**" in the official *Manhattan District History*, produced by the War Department in 1947 at the direction of **Leslie Groves**, especially pages 1-19; the "Atomic Bombings" document is available in the University Publications of America microfilm collection, *Manhattan Project: Official History and Documents* (Washington: 1977), reel #1/12; the report

itself is a government document. Tibbets's description is from Paul W. Tibbets, "How to Drop an Atom Bomb," *Saturday Evening Post* 218 (June 8, 1946), 136. The estimate of Little Boy's yield is from *United States Nuclear Tests, July 1945 through September 1992* (DOE/NV-209-REV 15; Las Vegas, NV: Nevada Operations Office, Department of Energy, December 2000), vii. Summaries of Hiroshima and Nagasaki casualty rates and damage estimates appear in Leslie R. Groves, *Now It Can Be Told* (New York: Harper & Row, 1962), 319, 329-330, 346, and Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 545-548. A translation of the leaflets dropped on Japan in between Hiroshima and Nagasaki can be found in Dennis Merrill, ed., *Documentary History of the Truman*, Volume 1, *The Decision to Drop the Atomic Bomb on Japan* (Bethesda, MD: University Publications of America, 1995), 194-195. The photograph of the mushroom cloud is courtesy the [United States Air Force \(USAF\)](#) (via the [National Archives \(NARA\)](#)). The photographs of Little Boy and Fat Man are courtesy the U.S. Army Corps of Engineers (via NARA). The photograph of the Enola Gay landing at Tinian Island is courtesy the USAF. The photograph of the woman with burns on her back is courtesy the U.S. Army Corps of Engineers (via NARA). Click [here for more information on the animated aerial photographs of Hiroshima](#). The photographs of the mushroom cloud taken from the ground and of the debris (including the Hiroshima Peace Memorial (Genbaku "A-bomb" Dome) are courtesy the [Federation of American Scientists](#). The photographs of the hospital and of the lone soldier walking through an almost-completely leveled portion of the city are courtesy the Department of the Navy (via NARA); the former was taken by Wayne Miller. The November 1945 portrait of **President Harry Truman** is courtesy the [Truman Presidential Library](#). Return to [this event](#).

The Atomic Bombing of Nagasaki, August 9, 1945

Portions of the text for this page were adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 53-54. Also used was the report on "The Atomic Bombings of **Hiroshima** and Nagasaki" in the official *Manhattan District History*, produced by the War Department in 1947 at the direction of **Leslie Groves**, especially pages 1-19; the "Atomic Bombings" document is available in the University Publications of America (UPA) microfilm collection, *Manhattan Project: Official History and Documents* (Washington: 1977), reel #1/12; the report itself is a government document. For an account of the mission, see the "Eye Witness Account: Atomic Bomb Mission Over Nagasaki" press release, written by William L. Laurence of the *New York Times* and released on September 9, 1945; this is also available on reel #1/12 of the UPA *Manhattan Project* microfilm collection. Summaries of Hiroshima and Nagasaki casualty rates and damage estimates appear in Leslie R. Groves, *Now It Can Be Told* (New York: Harper & Row, 1962), 319, 329-330, 346, and Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 545-548. For a description of Kokura Arsenal and interesting reflections on its postwar fate, see "Chapter 4: Kokura" of Paul Saffo's essay "The Road from Trinity: Reflections on the Atom Bomb"; this is available on Paul Saffo's web site at <http://www.saffo.com/essays/the-road-from-trinity-reflections-on-the-atom-bomb/>. The map showing the flight paths for the Hiroshima and Nagasaki missions is reproduced from Gosling, *Making the Atomic Bomb*, 52. The photographs of Fat Man and of the general devastation at Nagasaki are courtesy the U.S. Army Corps of Engineers (via the [National Archives \(NARA\)](#)). The photograph of the destruction at the Mitsubishi facility north of ground zero is courtesy the [Los Alamos National Laboratory](#); the photograph was taken by Robert Serber and is reprinted in Rachel Fermi and Esther Samra, *Picturing the Bomb: Photographs from the Secret World of the Manhattan Project* (New York: Harry N. Abrams, Inc., Publishers, 1995), 190. The photograph of the mother and child is courtesy the [Department of Energy](#) (via NARA). The photograph of the bodies in the trench is reprinted from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 548. The portrait of Emperor Hirohito is courtesy the United States Army Signal Corps (via the [Library of Congress](#)). Return to [this event](#).

Japan Surrenders, August 10-15, 1945

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). The surrender negotiations are detailed in Gerhard L. Weinberg, *A World at Arms: A Global History of World War II* (New York: Cambridge University Press, 1994), 886-893. On the availability of the next plutonium bomb by August 17 or 18, see the memorandum, **Leslie Groves** to George Marshall, August 10, 1945, which is in Groves's file of "Top Secret" MED Correspondence, 1942-1946 (available from the [National Archives \(NARA\)](#) on microfilm

M1109). For Groves's request for additional targets and Kenneth Nichols's suggestion that Tokyo be added to the target list, see Groves to General Henry "Hap" Arnold, August 10, 1945, which is also in Groves's "Top Secret" MED correspondence. The photographs of the U.S.S. *Missouri* during the surrender ceremony and of the B-29s are courtesy NARA. The photograph of the **Potsdam conference** is courtesy the [Truman Presidential Library](#). The photograph of the mushroom cloud over **Hiroshima** is courtesy the [United States Air Force \(USAF\)](#) (via NARA). The portrait of Emperor Hirohito is courtesy the United States Army Signal Corps (via the [Library of Congress \(LOC\)](#)). The photograph of Fat Man is courtesy the U.S. Army Corps of Engineers (via NARA). The photograph of the Japanese soldiers on Guam is courtesy the LOC. Return to [this event](#).

The Manhattan Project and the Second World War, 1939-1945

Portions of the text for this page were adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publications: [F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* \(DOE/MA-0001; Washington: History Division, Department of Energy, January 1999\), 54](#), and [The Signature Facilities of the Manhattan Project](#) (Washington: History Division, Department of Energy, 2001), 1. The estimates of deaths from the war are from Gerhard L. Weinberg, *A World at Arms: A Global History of World War II* (New York: Cambridge University Press, 1994), 322 and 894-895, and Chapter 1, "Rubble: The World in 1945," in Thomas G. Paterson, *On Every Front: The Making and Unmaking of the Cold War*, Revised Edition (New York: W. W. Norton and Company, 1992), 3-20. The photograph of the post-war celebration is courtesy the [Oak Ridge National Laboratory](#). The photograph of the Frenchman watching German troops enter Paris, and of the baby in Shanghai, 1937, are both courtesy the [National Archives](#). The map of all the **MED** facilities in North America is reproduced from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 63. Click [here for more information on the comic book image](#). Return to [this event](#).

1945-present: Postscript -- The Nuclear Age

Portions of the text for this page were adapted from, and portions were taken directly from the History Division, now [Office of History and Heritage Resources](#), publication: [Terrence R. Fehner and F. G. Gosling, *Origins of the Nevada Test Site* \(DOE/MA-0518; Washington: History Division, Department of Energy, December 2000\), 34](#). "Atomic" and "nuclear" are basically synonymous. Much as the term "pile" gradually gave way to "reactor," "atomic" was gradually replaced by "nuclear" during the later years of the Manhattan Project and afterwards. The drawing of a suggested fallout shelter design is courtesy the Federal Emergency Management Administration (via the [National Archives](#)). The photographs of the "Joe 1" Soviet test and the "Ivy Mike" American thermonuclear (**hydrogen bomb**) test are courtesy the [Federation of American Scientists](#). Return to [this event](#).

Informing the Public/Public Reaction, August 1945

Portions of the text for this page were adapted from, and portions were taken directly from the [Office of History and Heritage Resources](#) publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 368, 406-407, and from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 553-562. Also used was Paul Boyer, *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age* (Chapel Hill: The University of North Carolina Press, 1985, 1994). President **Harry S. Truman's** "Statement by the President Announcing the Use of the A-Bomb at Hiroshima," August 6, 1945, is in *Public Papers of the Presidents of the United States, Harry S. Truman, 1945* (Washington: Government Printing Office, 1961), 197-200. The "Smyth Report" is Henry DeWolf Smyth, *Atomic Energy for Military Purposes: The Official Report on the Development of the Atomic Bomb under the Auspices of the United States Government, 1940-1945* (Princeton, NJ: Princeton University Press, 1945); the Smyth Report was commissioned by **Leslie Groves** and originally issued by the **Manhattan Engineer District**; Princeton University Press reprinted it in book form as a "public service" with "reproduction in whole or in part authorized and permitted." On the continued postwar emphasis on security, see the numerous press releases issued by the War Department throughout the rest of 1945 and 1946 emphasizing the continued need for security; these releases can also be found on the University Publications of America (UPA) microfilm collection, *Manhattan Project: Official History and Documents* (Washington: 1977), reel #1/12; and the UPA microfilm collection *President Harry S. Truman's Office Files, 1945-1953* (Frederick, MD: 1989), Part 3, reel #41/42. See also the August 11, 1945, advisory for the press (which is also available on reel

#1 of the UPA *Manhattan Project* microfilm collection). Paul Fussell quote from "From the Rubble of Okinawa: A Different View of Hiroshima," *Kansas City Star*, August 30, 1981. The photograph of James F. Byrnes and Truman on the U.S.S. *Augusta* is courtesy the [Truman Presidential Library](#). Click [here for information on the photograph of Vannevar Bush and James Conant](#). The photograph of Henry Smyth and **Ernest Lawrence** discussing the Smyth Report is reprinted in Hewlett and Anderson, *The New World*, facing page 376. Click [here for more information on the comic book images](#). The photograph of the lone soldier walking through an almost-completely leveled portion of **Hiroshima** is courtesy the Department of the Navy (via the [National Archives](#)); it was taken by Wayne Miller. Return to [this event](#).

The Manhattan Engineer District, 1945-1946

The text for this page was adapted in part from, and portions were taken directly from the [Office of History and Heritage Resources](#) publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 55; and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 301-302, 624-637, 646, and Hewlett and Francis Duncan, *Atomic Shield, 1947-1952, Volume II, A History of the United States Atomic Energy Commission* (University Park, PA: Pennsylvania State University Press, 1969), p. xiii. Also used were Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 579-596; Rodney P. Carlisle with Joan M. Zenzen, *Supplying the Nuclear Arsenal: American Production Reactors, 1942-1992* (Baltimore: The Johns Hopkins University Press, 1996), 55-56, and AEC Staff Paper 1140, History of Expansion of AEC Production Facilities, August 16, 1963, box 1435, folder I&P 14, History, 1958-1966 Secretariat files, DOE Historical Research Center. The (unofficial) MED emblem is ca. 1946; it is reprinted in Jones, *Manhattan*, 89. The photograph of the Sandia security gate is courtesy the [Sandia National Laboratories](#). Click [here for information on the aerial photograph of Hanford](#). The photograph of Little Boy is courtesy the U.S. Army Corps of Engineers (via the [National Archives](#)). Return to [this event](#).

First Steps Toward International Control, 1941-July 1945

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). Portions were adapted from the History Office publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 55-57, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 325-331, 352, 357, 360-361, 367-369, 388, 390-391, 393-394. Also used were Martin J. Sherwin, *A World Destroyed: The Atomic Bomb and the Grand Alliance* (New York: Alfred A. Knopf, 1975), 38, 204-207, 215-216, 220-228, and McGeorge Bundy, *Danger and Survival: Choices About the Bomb in the First Fifty Years* (New York: Random House, 1988), 98-120, 125-126. On postwar atomic alternatives and the Interim Committee, see Sherwin, *A World Destroyed*, 121-128; 204-209, and Hewlett and Anderson, *New World*, 325-331, 354-360. On **General Leslie Groves's** view of the postwar bomb, see L.R. Groves memorandum, January 2, 1946, in *Foreign Relations of the United States, 1946, Volume I, General, The United Nations* (Department of State Publication 8573, 1972), 1197-1203. The photographs of the Yalta Conference and Henry L. Stimson are courtesy the [National Archives](#). The photograph of **President Franklin D. Roosevelt** and Winston Churchill at the Quebec Conference is reprinted in Hewlett and Anderson, *The New World*, opposite page 272; the man in between them is the Earl of Athlone, Governor-General of Canada, and the Canadian Prime Minister, Mackenzie King, is over Roosevelt's right shoulder. Click [here for information on the photograph of Vannevar Bush and James Conant](#). The photograph of the Potsdam conference is courtesy the [Truman Presidential Library](#). Return to [this event](#).

Search for a Policy on International Control, 1945

The text for this page is original to the Department of Energy's [Office of History and Heritage Resources](#). Portions were adapted from the History Office publications: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 55-57, and Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy*

Commission (Washington: U.S. Atomic Energy Commission, 1972), 417-421, 455-456, 459-466. Also used were Gregg Herken, *The Winning Weapon: The Atomic Bomb in the Cold War, 1945-1950* (New York: Alfred A. Knopf, 1980), 25-36, 41, 45-53; Walter Millis, *The Forrestal Diaries* (New York: The Viking Press, 1951), 95, and McGeorge Bundy, *Danger and Survival: Choices About the Bomb in the First Fifty Years* (New York: Random House, 1988), 146-148. **President Harry S. Truman's** Special Message to the Congress on Atomic Energy, October 3, 1945, and The President's News Conference at Tiptonville, Tennessee, October 8, 1945, are both in *Public Papers of the Presidents of the United States, Harry S. Truman, 1945* (Washington: U.S. Government Printing Office, 1961), 365-66, 381-83. The Joint Declaration by the Heads of Government of the United States, the United Kingdom, and Canada, November 15, 1945, is in *Documents on Disarmament, 1945-1959, Volume 1, 1945-1956* (Department of State Publication 7008, August 1960), 1-3. The photographs of Henry L. Stimson and James F. Byrnes, Truman's cabinet, Byrnes and Vyacheslav Molotov, Clement Attlee and Truman, and the Tomb of the Unknown Soldier are courtesy the [National Archives](#). Return to [this event](#).

Negotiating International Control, 1945-1946

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Civilian Control of Atomic Energy, 1945-1946

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Operation Crossroads, July 1946

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the Manhattan Project, 1942-1946 (Berkeley, CA: University of California Press, 1987), 116-153; and the History Office publications: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 580-581, and F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 55. The photograph of the evacuation of Bikini islanders is reproduced from Fehner and Gosling, *Origins of the Nevada Test Site*, 37. The two black and white photographs of the Baker test are courtesy the "Atomic Century" web site (now defunct). The photograph of Able, the color photograph of Baker, and the two video clips are courtesy the [Federation of American Scientists](#). The photograph of Stafford Warren is reprinted in Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb*, United States Army in World War II (Washington: Center of Military History, United States Army, 1988), 414. Return to [this event](#).

The VENONA Intercepts, 1946-1980

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The Cold War, 1945-1990

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Nuclear Proliferation, 1949-present

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PEOPLE

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PLACES

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PROCESSES

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SCIENCE

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Maps

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Manhattan Project: General

- **All Facilities**: Jones, *Manhattan*, 63;
- **"Places" Map**: the base map of the United States is taken from the History Office publication: *The Signature Facilities of the Manhattan Project* (Washington: History Division, Department of Energy, 2001); the labels are original to the Department of Energy's History Division, now [Office of History and Heritage Resources](#), 2003;
- **"Signature Facilities of the MED"**: reproduced from *Signature Facilities*, 2001);

Hanford

- **Hanford**: Jones, *Manhattan*, 213;
- **Hanford (black and white)**: reproduced from the History Office publication: Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World, 1939-1946: Volume I, A History of the United States Atomic Energy Commission* (Washington: U.S. Atomic Energy Commission, 1972), 225;
- **Hanford: Diagram**: reproduced from the "Smyth Report," which is Henry DeWolf Smyth, *Atomic Energy for Military Purposes: The Official Report on the Development of the Atomic Bomb under the Auspices of the United States Government, 1940-1945* (Princeton, NJ: Princeton University Press, 1945); the Smyth Report was commissioned by **Leslie Groves** and originally issued by the **Manhattan Engineer District**; Princeton

University Press reprinted it in book form as a "public service" with "reproduction in whole or in part authorized and permitted";

- **Hanford: Location:** courtesy the [Hanford Site](#);
- **Hanford: Native Peoples:** courtesy the [Hanford Site](#);
- **Hanford: Town:** courtesy the Hanford Science Center, [Department of Energy](#); the map is reprinted in Peter Bacon Hales, *Atomic Spaces: Living on the Manhattan Project* (Urbana and Chicago: University of Illinois Press, 1997), 102;

Los Alamos

- **Los Alamos:** Jones, *Manhattan*, 330;
- **Los Alamos: "Tech Area":** reproduced from Edith C. Truslow, with Kasha V. Thayer, ed., *Manhattan Engineer District: Nonscientific Aspects of Los Alamos Project Y, 1942 through 1946* (Los Alamos, NM: Manhattan Engineer District, ca. 1946; first printed by Los Alamos Scientific Laboratory as LA-5200, March 1973; reprinted in 1997 by the Los Alamos Historical Society), 18;

Oak Ridge

- **Oak Ridge:** Jones, *Manhattan*, 131;
- **Oak Ridge (black and white):** Hewlett and Anderson, *The New World*, 121;
- **Oak Ridge: Planned Facilities, 1942:** Jones, *Manhattan*, 48;

Other

- **Hiroshima and Nagasaki Missions:** reproduced from the History Office publication: F. G. Gosling, *The Manhattan Project: Making the Atomic Bomb* (DOE/MA-0001; Washington: History Division, Department of Energy, January 1999), 52;
- **Trinity Test Site:** Jones, *Manhattan*, 479;

Post-War

- **U.S. Nuclear Tests:** *United States Nuclear Tests, July 1945 through September 1992* (DOE/NV-209-REV 15; Las Vegas, NV: Nevada Operations Office, Department of Energy, December 2000), xiv.

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A Note on Sources

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Nuclear Energy and the Public's Right to Know

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