

# RESOURCE LETTER

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This is one of a series of Resource Letters on different topics intended to guide college physicists, astronomers, and other scientists to some of the literature and other teaching aids that may help improve course content in specified fields. [The letter E after an item indicates elementary level or material of general interest to persons becoming informed in the field. The letter I, for intermediate level, indicates material of somewhat more specialized nature; and the letter A indicates rather specialized or advanced material.] No Resource Letter is meant to be exhaustive and complete; in time there may be more than one letter on some of the main subjects of interest. Comments on these materials as well as suggestions for future topics will be welcomed. Please send such communications to Professor Roger H. Stuewer, Editor, AAPT Resource Letters, School of Physics and Astronomy, University of Minnesota, 116 Church Street SE, Minneapolis, MN 55455; e-mail: rstuewer@physics.umn.edu.

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## Resource Letter MP-1: The Manhattan Project and related nuclear research

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This Resource Letter provides a guide to literature on the Manhattan Project and related nuclear research. Books and journal articles are cited for the following topics: general works, technical works, biographical and autobiographical works, the German nuclear program, and technical papers of historical interest. A list of videos and websites dealing with the Manhattan Project, nuclear weapons, and nuclear issues is also given. © 2005 American Association of Physics Teachers.  
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### I. INTRODUCTION

The scientific, social, political, and military ramifications of the development of nuclear weapons under the auspices of the Manhattan Project (MP) are at least as significant today as they were in 1945. Apropos of this significance, the amount of published and electronic material offering analyses and interpretations of the MP is vast and constantly growing. As more and more previously classified material becomes publicly available, scientists and historians alike continue to revisit both the technical and human aspects of the project. The level of popular fascination with the science and personalities of twentieth-century nuclear physics can be gauged by the success of Michael Frayn's award-winning play *Copenhagen* (Ref. 108).

In early 2005, a *Google* search using the keywords "Manhattan Project" yielded millions of hits. While some of the sources that turned up are interesting and valuable, a cursory inspection reveals that many of them have nothing to do with physics or politico-military history or strategy. Faced with such a deluge of material, where should a physics teacher or student begin to look for credible, reasonably objective material on the history and science of the MP? This Resource Letter, which began as a bibliography of books, papers, and websites that I prepared for students, is an effort to address this need.

Because of the vast amount of material available on the

Manhattan Project, I have had to be extremely selective in this Resource Letter. Its purpose is thus to direct readers to good points of departure into the literature on the MP. I have deliberately restricted my attention to the most significant mainstream books, journals, and websites and largely to the World War II period. While I do not deal *pre se* with nuclear physics, postwar weapons development, or the political and social consequences of nuclear weapons, many sources devoted to these issues contain important information on the MP, so I include a number of them. I also take the term "Manhattan Project" to be sufficiently elastic to warrant including a few papers that treat significant discoveries in nuclear physics that laid the scientific basis of the project. I also include a list of sources on the German nuclear project, which motivated the Allied work.

### II. JOURNALS

There are no journals devoted specifically to the Manhattan Project, but the following ones often include pertinent historical, biographical, and technical articles.

*American Journal of Physics*

*American Scientist*

*Annual Review of Nuclear and Particle Science*

*British Journal for the History of Science*

*Bulletin of the Atomic Scientists*

*Historical Studies in the Physical and Biological Sciences*

*Isis*

*Journal of Chemical Education*

*Physics in Perspective*

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### III. BOOKS AND JOURNAL ARTICLES

The sources cited below are divided into five categories: (A) general works, (B) technical works, (C) biographical and autobiographical works, (D) the German nuclear program, and (E) technical papers of historical interest. I list books first, followed by journal articles, most of which should be accessible in any reasonably well-stocked (or networked) college or university library. Many sources might arguably be assigned to a different category. Section III A is divided into two parts: Section III A 1 lists synoptic overviews (including some official government reports) while Sec. III A 2 deals with sources addressing specific topics within or components of the MP. Sources in both Secs. III A 1 and III A 2 are listed in chronological order of publication from earliest to most recent; in Sec. III A 2 sources on a given topic are grouped together with books and journal articles interleaved to maintain chronological ordering within a given topic. Sources appearing in Secs. III B–III E are in no particular order except that some effort has been made to group sources on a given topic. The sources listed in Sec. III E pertain to the original discoveries underlying the physics of the MP.

#### A. General works

##### 1. Synoptic overviews

1. **Dawn Over Zero: The Story of the Atomic Bomb**, W. L. Laurence (Knopf, New York, 1946). Laurence was a *New York Times* science reporter who was allowed to visit Los Alamos during the MP, witnessed the Trinity test, and rode aboard *Bockscar* on the Nagasaki bombing mission. This work was the one of the first serious popular accounts of the MP. (E)
2. **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**, H. D. Smyth (Princeton U.P., Princeton, 1948). This work was the first official report on the Manhattan Project. The edition cited here includes various appendices and British and Canadian statements not included in the original 1945 edition. The 1945 edition is reproduced in Refs. 5 and 135. (I)
3. **A History of the United States Atomic Energy Commission. Vol. 1: The New World, 1939/1946**, R. G. Hewlett and O. E. Anderson (Pennsylvania State U.P., University Park, PA, 1962). Detailed history of the Manhattan Project prepared under the auspices of the Historical Advisory Committee of the U. S. Atomic Energy Commission; Hewlett was the AEC's Chief Historian. (I)
4. **Manhattan Project: The Untold Story of the Making of the Atomic Bomb**, S. Groueff (Little, Brown, Boston, 1967). This work was one of the first extensive popular histories of the Manhattan Project from fall 1942 to the Trinity test. (E)
5. **The Secret History of the Atomic Bomb**, A. C. Brown and C. B. MacDonald (Delta, New York, 1977). Drawn from Manhattan Engineer District files, this often-overlooked work gives a thorough semi-technical treatment of the Manhattan Project, and reproduces the original Smyth report (Ref. 2). (I)
6. **United States Army in World War II. Special Studies. Manhattan: The Army and the Atomic Bomb**, V. C. Jones (Center of Military History, United States Army, Washington, DC, 1985). Comprehensive history of Army involvement in the Manhattan Project. Unfortunately, this work no longer appears to be available through the Government Printing Office, but many libraries have it and used copies occasionally can be found. (I)
7. **The Making of the Atomic Bomb**, R. Rhodes (Simon and Schuster, New York, 1986). This Pulitzer Prize-winning work is probably the

best current overall survey of the context, personalities, and science and engineering of the Manhattan Project. Some chapters are not germane to the MP as such, but Rhodes does a superb job of explaining the relevant physics in layman's language. Also valuable for its extensive bibliography. (E)

8. **The Manhattan Project: A Documentary Introduction to the Atomic Age**, M. B. Stoff, J. F. Fanton, and R. H. Williams, eds. (McGraw-Hill, New York, 1991). This work reproduces a number of official documents and memoranda concerning the MP, including Einstein's letter to President Roosevelt, minutes of the Interim and Target Committees, the Franck Report, and diary entries of political and military figures. It is now somewhat dated because so much material is available online, but it is still worth perusing. (E)
9. **Picturing the Bomb: Photographs from the Secret World of the Manhattan Project**, R. Fermi and E. Samra (Harry N. Abrams, New York, 1995). Beautifully reproduced and instructively captioned photographs of sites and artifacts associated with the MP. The first author is Enrico Fermi's granddaughter. (E)
10. **Dark Sun: The Making of the Hydrogen Bomb**, R. Rhodes (Simon and Schuster, New York, 1995). This companion volume to Ref. 7 details the development of the hydrogen bomb. Particularly interesting is Rhodes's description of Soviet espionage in the United States during the MP and afterward. (E)
11. **The Manhattan Project: Making the Atomic Bomb**, F. G. Gosling (U.S. Department of Energy, Washington, DC, 2001). A brief but very readable and well-illustrated summary; DOE publication number DOE/MA-0002. Available free as a pdf document from the U.S. Department of Energy at <http://ma.mbe.doe.gov/me70/history/index.htm>. (I)

##### 2. Specific topics within the Manhattan Project

The following sources are largely non-technical works addressing specific topics: Los Alamos, the British contribution to the MP, the first self-sustaining chain reaction and the role of heavy water in World War II, the Trinity test, Oak Ridge, espionage activities, family life and personal reminiscences, the bombings of Hiroshima and Nagasaki (including the political decision-making process that led up to the use of the bombs), the results of and aftermaths of the bombings, and a few sources dealing with political, ethical, social, and sociology-of-science issues. Sources are listed chronologically within each topic.

12. **Los Alamos: Beginning of an Era, 1943-1945**, Los Alamos Scientific Laboratory Public Relations Staff (Los Alamos Historical Society, Los Alamos, 1986). This brief (60-page), well-illustrated booklet relates the history of Los Alamos and the design and testing of the bombs. It is available from the Bradbury Museum at Los Alamos and also through online booksellers. (E)
13. "Statements Relating to the Atomic Bomb," *British Information Services*, *Rev. Mod. Phys.* **17** (4), 472–490 (1945). This paper gives statements issued in August 1945 by Winston Churchill and the British "Directorate of Tube Alloys." While the emphasis is on British efforts within the MP, this paper also presents an excellent survey of nuclear research along with a description of the Frisch-Peierls memoranda and the work of Sir George Thomson's MAUD committee. (E)
14. **Britain and Atomic Energy 1939-1945**, M. M. Gowing (St. Martin's Press, London, 1964). Study of the British contributions to the Manhattan Project. Includes the Frisch-Peierls memoranda of 1940 (see also Ref. 48) and the MAUD reports of 1941. (E)
15. **British Scientists and the Manhattan Project: The Los Alamos Years**, F. M. Szasz (St. Martin's Press, New York, 1992). Examines the stories of two dozen British scientists who contributed to the development of the atomic bombs. (E)
16. **The First Reactor**, United States Department of Energy. This publication (DOE/NE-0046, December 1982) presents a brief, well-illustrated account of the first atomic pile (CP-1) to achieve a self-

sustaining chain reaction (Ref. 131). Available online as a pdf document from the DOE's Public Information Center at <http://www.ne.doe.gov/home/docs.html>. (I)

17. **Heavy Water and the Wartime Race for Nuclear Energy**, P. Dahl (IOP, Bristol, UK, 1999). Detailed history of the role of heavy water during World War II. (E)
18. **Day of Trinity**, L. Lamont (Atheneum, New York, 1965) This work concentrates mostly on the development of Los Alamos and the Trinity test; among many others, the author interviewed Kenneth Bainbridge, Hans Bethe, General Groves, Philip Morrison, Oppenheimer, and some of the GI's who provided security at Los Alamos. (E)
19. **Trinity**, K. T. Bainbridge (Los Alamos Scientific Laboratory, Los Alamos, NM, 1976). Bainbridge was the Trinity test director; this declassified version of his report on the test was published by Los Alamos as Report No. LA-6300-H. Copies of this report are available as a pdf document from the Los Alamos history and NSF Digital Library websites (Refs. 134, 135). (A)
20. **The Day the Sun Rose Twice**, F. M. Szasz (University of New Mexico Press, Albuquerque, 1984). The story of the Trinity test site; particularly interesting for its discussions of the role of weather forecasting, fallout analysis, and the history of "Jumbo," a 200-ton steel container that was intended to contain the plutonium from the test in the event of a fizzle but was never used. (E)
21. **The Trinity Experiments**, Thomas Merlan (Prepared by Human Systems Research, Inc., for White Sands Missile Range, 1997. White Sands Missile Range Archaeological Report No. 97-15). Semitechnical report on results of experiments associated with the Trinity test. (I)
22. **City Behind A Fence: Oak Ridge, Tennessee 1942-46**, C. W. Johnson and C. O. Jackson. (University of Tennessee Press, Knoxville, 1981). An examination of life at Oak Ridge. (E)
23. **Oak Ridge National Laboratory: The First Fifty Years**, L. Johnson and D. Schaffer (University of Tennessee, Knoxville, 1994). A history of the first half-century of ORNL. (E)
24. **The Implosion Conspiracy**, L. Nizer (Fawcett, Greenwich, CT, 1974). The story of the Rosenberg trial through the eyes of an attorney. (E)
25. **Klaus Fuchs, Atom Spy**, R. Williams (Harvard U.P., Cambridge, 1987). As a member of the British Mission to the MP, Fuchs passed considerable information to the Soviets, apparently including a virtual blueprint of the Trinity device. Arrested in England, Fuchs spent nine years in prison. This book explores his life, espionage activities, hearing and trial, and includes copies of his and Harry Gold's confessional statements to British counterintelligence and the FBI. Gold was Fuchs's American contact. (E)
26. "The grandfather of the hydrogen bomb?: Anglo-American Intelligence and Klaus Fuchs," M. Goodman, *Historical Studies Phys. Biol. Sci.* **34** (1), 1-22 (2003). This article explores the possibility that information passed by Fuchs may have played a much larger role in the development of the Soviet hydrogen bomb than previously thought. (E)
27. **Standing By and Making Do: Women of Wartime Los Alamos**, J. Wilson and C. Serber, eds. (The Los Alamos Historical Society, Los Alamos, 1988). Accounts (originally written in 1946) of life at Los Alamos, mostly by wives of scientists working there. (E)
28. **Their Day in the Sun: Women of the Manhattan Project**, R. C. Howes and C. C. Herzeneberg (Temple U.P., Philadelphia, 1999). Based on extensive interviews, the authors examine the lives and work of female physicists, chemists, biologists, technicians, and others on the MP. Includes an appendix listing female scientific and technical workers on the project. (E)
29. **The Decision to Drop the Bomb**, L. Giovannitti and F. Freed (Methuen, London, 1967). Based on an earlier television documentary, this book examines the decision to use atomic bombs and the Japanese surrender and aftermath. (E)
30. **Hiroshima and Nagasaki**, J. Claypool Miner (Watts, New York, 1984). Examines the planning for and aftermath of the bombings of Hiroshima and Nagasaki. (E)
31. **Hiroshima**, J. Hersey (Knopf, New York, 1985). Originally published in 1946, this compelling work of first-hand accounts of Hiroshima survivors is a "must read" for students of the MP. The edition cited here includes an additional chapter written 40 years later which brings the survivors' stories up to date. (E)
32. **Hiroshima Diary: The Journal of a Japanese Physician, August 6 - September 30, 1945: Fifty Years Later**, M. Hachiya, translated and edited by W. Wells (University of North Carolina Press, Chapel Hill, 1995). Originally published in 1955, this moving book is the diary of Dr. Michihiko Hachiya, who in 1945 was the Director of Hiroshima Communications Hospital. Dr. Hachiya was injured in the Hiroshima bombing and treated numerous victims. The translator, Dr. Warner Wells, was a surgical consultant to the Atomic Bomb Casualty Commission. (E)
33. **Enola Gay: Mission to Hiroshima**, G. Thomas and M. Morgan-Witts (White Owl, Belton, Loughborough, UK, 1995). Extensively illustrated history of the activation, deployment, and missions of the 509th Composite Group of the U.S. Army Air Force that delivered *Little Boy* and *Fat Man*. (E)
34. **The Decision to Use the Atomic Bomb and the Architecture of an American Myth**, G. Alperowitz (Knopf, New York, 1995). Based on examination of diary entries and government documents, the author concludes that the argument that the atomic bombing of Japan was the only way to save hundreds of thousands or millions of lives is not true and that other options (notably modified surrender terms and a Russian invasion) were available to President Truman and his advisors. (E)
35. **Harry S. Truman and the Bomb: A Documentary History**, R. H. Ferrell (High Plains, Worland, WY, 1996). Reproductions of documents, memoranda, diary entries, and press releases relevant to President Truman's decision to use atomic bombs. (E)
36. **A Peril and a Hope: The Scientists' Movement in America 1945-47**, A. K. Smith (University of Chicago Press, Chicago, 1965). The development of nuclear weapons thrust scientists into public-affairs roles unlike any they had previously experienced. This book is the definitive account of "atomic politics" and scientists' involvement therewith in the two years following the end of the war. The Franck Report is reproduced in Appendix B. (E)
37. **The Atomic Bomb: The Great Decision**, P. Baker, ed. (Holt, Rinehart and Winston, New York, 1968). A collection of articles and essays on the use of the bombs and post-war policies and ethical issues. Includes Secretary of War Henry Stimson's "The Decision to Use the Bomb." (E)
38. "Scientists With a Secret," S. R. Weart, *Phys. Today* **29** (2), 23-30 (1976). Examines the self-censorship of research on nuclear fission following its discovery. (E)
39. "Nuclear fission: Reaction to the Discovery in 1939," L. Badash, E. Hodes, and A. Tiddens, *Proc. Am. Philos. Assoc.* **130** (2), 196-231 (1986). The authors summarize nearly four decades worth of speculation on the possibilities for atomic energy from the time of Rutherford's early researches on radioactivity through the discovery of the neutron and artificially induced radioactivity, and then analyze scientific and popular-media reactions to the discovery of fission during the year 1939. (E)
40. "Books on the Bomb," R. Seidel, *Isis* **81** (3), 519-537 (1990). This essay reviews books (to the late 1980s) dealing with the development of nuclear weapons and the consequent political and human legacies. (E)
41. "The Origin of the Liquid-Drop Model and the Interpretation of Nuclear Fission," R. H. Stuewer, *Perspect. Sci.* **2**, 39-92 (1994). Detailed, insightful account of the development of the liquid-drop model of the nucleus and its role in the interpretation of fission. (I)
42. "Roots of Dissent: The Chicago Met Lab and the Origins of the Franck Report," M. Price, *Isis* **86** (2), 222-244 (1995). In June 1945 a small group of scientists at the University of Chicago's Metallurgical Laboratory prepared a petition arguing against the use of atomic bombs on Japanese cities. This petition subsequently became known as the Franck Report; this article explores its origins and development. The Franck Report itself is reproduced in Refs. 8 and 36. (E)
43. **Scientists and the Development of Nuclear Weapons: From Fission to the Limited Test Ban Treaty, 1939-1963**, L. Badash (Humanities, Atlantic Highlands, NJ, 1995). This short book gives an excellent qualitative survey of nuclear science and politics from the discovery of radioactivity through the 1990s, including discussions of early specu-

lation on atomic energy, the discovery of fission, the MP, reactions to the bombings of Hiroshima and Nagasaki, domestic and international political developments, the formation and activities of the AEC, scientist's problems with security hearings, and arms control efforts. (E)

44. **Hiroshima's Shadow: Writings on the Denial of History and the Smithsonian Controversy**, K. Bird and L. Lifschultz, eds. (The Pamphleteer's Press, Stony Creek, CT, 1998). This collection of nearly 50 essays examines issues such as whether it was necessary to drop the bombs, whether they can be considered to have ended the war, and the controversy surrounding the Smithsonian Institution's 1995 *Enola Gay* exhibit. (E)
45. **From Nuclear Transmutation to Nuclear Fission, 1932-1939**, P. Dahl (IOP, Philadelphia, 2002). A thorough account of the invention and development of accelerators and nuclear research in Europe and America through the discovery of fission; gives a flavor of the excitement of 1930's nuclear research. (E)
46. "Deconstructing the Bomb: Recent Perspectives in Nuclear History," J. Hughes, *Bri. J. History Sci.* **37** (4), 455-464 (2004). In this essay, the author reviews and gives a number of references to recent works analyzing the cultural historiography of nuclear weapons and technology. (E)

## B. Technical and historical works

The sources listed here are of a more technical nature than those in Sec. III A, but many of them should be accessible to undergraduate seniors in physics. The journal articles discuss how critical masses and the effects of nuclear explosions can be estimated.

47. **Project Y, The Los Alamos Story**, D. Hawkins (Tomash, Los Angeles, 1983). Originally published as Los Alamos Report No. LAMS-2532, *Manhattan District History, Project Y, The Los Alamos Project*, this book, now unfortunately out of print, gives a detailed technical and administrative history of Los Alamos from its inception through December 1946. (I)
48. **The Los Alamos Primer: The First Lectures on How To Build An Atomic Bomb**, R. Serber (University of California Press, Berkeley, 1992). The original lectures given by Serber to Los Alamos scientists in April 1943 are reproduced and supplemented by extensive annotations. Includes the March 1940 Frisch-Peierls reports (*Memorandum on the Properties of a Radioactive "Super-bomb"* and *On the Construction of a "Super-bomb" Based on a Nuclear Chain Reaction in Uranium*) that can be said to have started the MP. (A)
49. **Critical Assembly: A Technical History of Los Alamos during the Oppenheimer Years, 1943-1945**, L. Hoddeson, P. W. Henriksen, R. A. Meade, and C. Westfall (Cambridge U.P., Cambridge, 1993). An authoritative technical history of Los Alamos during the war years. (A)
50. **Megawatts and Megatons: A Turning Point in the Nuclear Age?**, R. L. Garwin and G. Chappak (Knopf, New York, 2001). Excellent synoptic treatment of nuclear power, nuclear weapons, radiation effects, waste disposal, and associated environmental and political concerns. (I)
51. **The Effects of Atomic Weapons**, S. Glasstone, executive ed. (US-GPO, Washington, DC, 1950). Prepared for the Department of Defense and the Atomic Energy Commission under the direction of the Los Alamos National laboratory, this sobering volume summarizes technical analyses of the shock, blast, thermal, and radiation effects of nuclear explosions on structures and people. (A)
52. **Sourcebook On Atomic Energy, 3rd ed.**, S. Glasstone (Krieger, New York, 1979). Published under the auspices of the Division of Technical Information of the United States Atomic Energy Commission, this volume surveys the history of atomic theory, radioactivity, nuclear forces, fission, reactors, synthetic elements, and biological effects of radiation. (A)
53. "Review of Nuclear Weapons Effects," H. L. Brode, *Annu. Rev. Nucl. Sci.* **18**, 153-202 (1968). This article gives an advanced technical account of the fireball, shock, thermal, radiation, electromagnetic pulse, and fallout effects of nuclear explosions. (A)
54. "Nuclear Explosions," A. A. Broyles, *Am. J. Phys.* **50** (7), 586-594

(1982). An undergraduate-level account of the physics and effects of nuclear explosions. (A)

55. "Estimate of the critical mass of a fissionable isotope," E. Derrington, *Am. J. Phys.* **58** (4), 363-364 (1990). A straightforward one-dimensional, time-independent model for estimating the critical mass of a spherical sample of a fissionable isotope. (I)
56. "Estimating the Critical Mass of a Fissionable Isotope," B. C. Reed, *J. Chem. Educ.* **73** (2), 162-164 (1996). The approach of Ref. 55 is extended to three dimensions and to approximately incorporate the effects of scattering. (I)
57. "The Critical Mass," J. Logan, *Am. Sci.* **84** (3), 263-277 (1996). Solid account of the concept of critical mass and Werner Heisenberg's erroneous analysis thereof; includes a detailed chronology of significant events between January 1939 and March 1942. (I)
58. "Nuclear Weapons," D. E. Neuenschwander. A four-part series of papers published in *The Society of Physics Students (SPS) Observer*, Fall 2001 (pp. 10-14), Winter 2001/Spring 2002 (pp. 10-14), Fall 2002 (pp. 9-13), and Spring 2003 (pp. 11-15). Good undergraduate-level treatment of the physics of fission and nuclear weapons. (A)
59. "Heisenberg and the critical mass," J. Bernstein, *Am. J. Phys.* **70** (9), 911-916 (2002). This treatment of how critical masses are computed makes for a sort of users guide to *The Los Alamos Primer* (Ref. 48) and concurs with Hans Bethe's assessment in Ref. 111 as to Heisenberg's misunderstanding of the issue. (A)

## C. Biographical and autobiographical works

The first 14 sources below primarily concern Oppenheimer, Lawrence, Groves, Fermi, and Compton; the remaining deal with other individuals involved with either the project or the physical discoveries relevant to it. Books beyond the first 14 are ordered alphabetically according to the individual concerned.

60. **Robert Oppenheimer: Letters and Recollections**, A. K. Smith and C. Weiner, eds. (Harvard U.P., Cambridge, 1980). Collection of Oppenheimer's correspondence, 1922-1945. Includes a brief chronology of Oppenheimer's life and a list of his scientific publications. (E)
61. **Robert Oppenheimer: Shatterer of Worlds**, P. Goodchild (BBC, London, 1980). A well-illustrated treatment of the Manhattan Project and Oppenheimer's life. (E)
62. **Oppenheimer: Portrait of an Enigma**, J. Bernstein (Doubt, Chicago, 2004). Engaging brief biography of Oppenheimer by one who knew him personally. (E)
63. **J. Robert Oppenheimer and the American Century**, D. Cassidy (Pi, New York, 2005). This and Ref. 64 are full scholarly biographies of Oppenheimer. Cassidy devotes fairly little space to the well-trodden ground of Oppenheimer's Los Alamos years but gives a much more complete picture of his life and scientific work than many sources. Includes lists of Oppenheimer's publications and students. (E)
64. **American Prometheus. The Triumph and Tragedy of J. Robert Oppenheimer**, K. Bird and M. J. Sherwin (Knopf, New York, 2005). At nearly 600 pages this book is likely to become one of the definitive biographies of Oppenheimer. The authors particularly examine his upbringing, ethical outlook, and postwar political activities. Descriptions of physics can be somewhat muddled in places. (E)
65. **109 East Palace: Robert Oppenheimer and the Secret City of Los Alamos**, J. Conant (Simon and Schuster, New York, 2005). New arrivals at Los Alamos were greeted by Dorothy McKibben at a small office at 109 East Palace Avenue in Santa Fe. This engaging book tells the story of Oppenheimer and Los Alamos primarily through McKibben's recollections. (E)
66. **The Oppenheimer Case: Security on Trial**, P. M. Stern with the collaboration of H. P. Green (Harper & Row, New York, 1969). Analysis of the AEC's Oppenheimer hearings. (E)
67. **Brotherhood of the Bomb: The Tangled Lives and Loyalties of Robert Oppenheimer, Ernest Lawrence, and Edward Teller**, G. Herken (Holt, New York, 2002) Herken analyzes the personalities of three of the leading figures of the nuclear age; controversial for its

analysis of Oppenheimer's possible membership in the communist party. (E)

68. **In the Shadow of the Bomb: Oppenheimer, Bethe, and the Moral Responsibility of the Scientist**, S. Schweber (Princeton U.P., Princeton, 2000). Examines the lives of Oppenheimer and Bethe, with particular emphasis on their respective involvements in postwar political and moral issues raised by the development of nuclear weapons. (E)
69. **Now It Can Be Told: The Story of the Manhattan Project**, L. R. Groves (Harper & Row, New York, 1962). Now somewhat dated, but still valuable; the view from one who was there. (E)
70. **Racing for the Bomb: General Leslie R. Groves, The Manhattan Project's Indispensable Man**, R. S. Norris (Steerforth, South Royalton, VT, 2002). The author makes a compelling case for his subtitle in this fascinating account of the life and work of General Groves. (E)
71. **Atoms in the Family: My Life with Enrico Fermi**, L. Fermi (University of Chicago Press, Chicago, 1954). Enrico Fermi's life and work as related by his wife, Laura. Chapters 18–23 deal with the first chain-reacting pile and the Fermis time at Los Alamos. (E)
72. **Enrico Fermi: Physicist**, E. Segrè (University of Chicago Press, Chicago, 1970). Very readable biography of the father of controlled nuclear power written by one of his closest collaborators. (E)
73. **Atomic Quest**, A. Compton (Oxford U.P., New York, 1956). These memoirs of the wartime Dean of Physical Sciences at the University of Chicago relate his work with "Metallurgical Laboratory" under whose auspices Fermi achieved the first self-sustaining chain reaction and which played a central role in the design of the plutonium-producing piles. (E)
74. **Alvarez: Adventures of a Physicist**, L. Alvarez (Basic, New York, 1987). Alvarez became involved with the MP through working on cyclotrons at Berkeley, and rode aboard an observation plane during the Hiroshima bombing mission. This eclectic Nobel Prize-winning scientist later became a leading proponent of the asteroid-impact theory to explain a mass extinction some 65 million years ago. (E)
75. **The Neutron and the Bomb: A Biography of Sir James Chadwick**, A. Brown (Oxford U.P., Oxford, 1997). Warmly-written biography of the discoverer of the neutron. Particularly interesting for its description of Chadwick's deep involvement with the British mission to the Manhattan Project. (E)
76. **James B. Conant: Harvard to Hiroshima and the Making of the Nuclear Age**, J. G. Hershberg (Knopf, New York, 1993). Conant was President of Harvard University when Vannevar Bush recruited him to the National Defense Research Council in June 1940. Conant became one of the chief administrators of the Manhattan Project and a scientific advisor to General Groves. This work gives a comprehensive account of Conant's life and work, and includes a copy of his eyewitness report on the Trinity test. (E)
77. **What Little I Remember**, O. Frisch (Cambridge U.P. Cambridge, 1979). Frisch helped to interpret fission, is generally credited with being the first experimenter to deliberately produce fission, and joined Rudolf Peierls in estimating that the critical mass of U-235 might be on the order of kilograms. (E)
78. **Uncertainty: The Life and Science of Werner Heisenberg**, D. C. Cassidy (Freeman, New York, 1993). Published prior to release of the Farm Hall transcripts (see Sec. D), this work continues to be the major scholarly biography of Heisenberg. (E)
79. **Lise Meitner: A Life in Physics**, R. L. Sime (University of California Press, Berkeley, 1996). By far the best account of the life and work of Lise Meitner. Contains useful appendices explaining radioactive decay sequences. See Ref. 91. (I)
80. **The Road to Trinity**, K. D. Nichols (Morrow, New York, 1987). Memoirs of General Groves's second-in-command. (I)
81. **Bird of Passage: Recollections of A Physicist**, R. Peierls (Princeton U.P., Princeton, 1985). Memoirs of the other half of the Frisch–Peierls team; written with humor and warmth. (E)
82. **Peace and War: Reminiscences of a Life on the Frontiers of Science**, R. Serber with R. P. Crease (Columbia U.P., New York, 1998). Serber's association with the MP began at Berkeley when he was a postdoctoral collaborator of Oppenheimer; he delivered *The Los Alamos Primer* lectures in April 1943 (Ref. 48). This work covers his time at Los Alamos, on Tinian Island where the combat bombs were prepared, and his reflections on being one of the first Americans to visit Hiroshima and Nagasaki after the war. (E)
83. **Genius in the Shadows: A Biography of Leo Szilard, The Man Behind the Bomb**, W. Lanouette with B. Szilard (University of Chicago Press, Chicago, 1992). Five years before the discovery of fission, Leo Szilard conceived the idea of a neutron-induced chain reaction and attempted to patent the idea. This biography reviews his life and work. (E)
84. **Memoirs: A Twentieth-Century Journey in Science and Politics**, E. Teller with J. Shoolery (Perseus, Cambridge, MA, 2001). Controversial memoirs of a unique twentieth-century physicist. Includes a transcript of Teller's testimony at Oppenheimer's AEC hearing. (E)
85. **Edward Teller: The Real Dr. Strangelove**, P. Goodchild (Harvard U.P., Cambridge, MA, 2004). Despite the title, Goodchild presents a humane, balanced review of Teller's life and work based on archival work and interviews with Teller himself and many of his colleagues and friends. (E)
86. **Adventures of a Mathematician**, S. M. Ulam (Scribners, New York, 1976). Ulam shares credit with Edward Teller for critical contributions to the design of fusion weapons. Chapter 8 of this memoir deals with his life and work at Los Alamos between 1943 and 1945. (E)
87. **All in Our Time: The Reminiscences of Twelve Nuclear Pioneers**, J. Wilson, ed. (Bulletin of the Atomic Scientists, Chicago, 1975). Brief essays by a dozen individuals involved in the discovery of fission, the first chain-reacting pile, and Los Alamos. (E)
88. **Reminiscences of Los Alamos 1943-1945**, L. Badash, J. O. Hirschfelder, and H. P. Broida, eds. (Reidel, Dordrecht, 1980). Reminiscences of a number of eminent Los Alamos scientists, based on a series of lectures held in 1975. Includes Richard Feynman's humorous "Los Alamos From Below." (E)
89. **Brighter than a Thousand Suns. A Personal History of the Atomic Scientists**, R. Jungk, translated by J. Cleugh (Harcourt Brace Jovanovich, New York, 1958). The first half of this book deals with nuclear research and the MP from about 1918 through 1945. Current historians disagree strongly with Jungk's sympathetic portrayal of the German nuclear project. (E)
90. "SEDs at Los Alamos: A Personal Memoir," B. Bederson, *Phys. Perspect.* **3**, 52–75 (2001). "Special Engineer Detachment" personnel were GI's with scientific training. In this memoir written some 55 years after the events described, Bederson recalls his tenure as an SED at Oak Ridge, Los Alamos, and on Tinian Island. (E)
91. "The Discovery of Fission," O. Hahn, *Sci. Am.* **198** (2), 76–84 (1958). Hahn's career in radioactivity research started in 1905 when he went to Montreal to study with Ernest Rutherford. This paper relates his version of the work that culminated with the discovery of fission in December 1938 (Ref. 120). Hahn's version is seriously contested in Ref. 79. (E)
92. "The Discovery of Fission," O. R. Frisch and J. A. Wheeler, *Phys. Today* **20** (11), 43–52 (1967). Summary of the events surrounding the discovery and interpretation of fission by two who played significant roles in that work. (I)
93. "Bringing the news of fission to America," R. H. Stuewer, *Phys. Today* **38** (10), 49–56 (1985). This paper appears in an edition of *Physics Today* devoted to commemorating the centennial of Niels Bohr's birth. Drawing on private correspondence and unpublished sources, Stuewer relates the dramatic stories of how Bohr brought news of the discovery of fission to America and of his efforts to protect the priority of Meitner and Frisch's interpretation of that phenomenon (Ref. 121). (E)
94. "Groves and the Scientists: Compartmentalization and The Building of the Bomb," S. Goldberg, *Phys. Today* **48** (8), 38–43 (1995). Examines General Groves's approach to security during the Manhattan Project. Goldberg had been working on a biography of Groves but died before completing it; the project was completed by Robert Norris as Ref. 70. (E)
95. "Graveyard shift, Hanford, 28 September 1944—Henry W. Newson," A. H. Snell, *Am J. Phys.* **50** (4), 343–348 (1982). An account of the discovery of Xenon poisoning in the initial operation of the first Hanford plutonium-producing reactor. (I)
96. "Eugene Wigner, Nuclear Engineer," A. M. Weinberg, *Phys. Today* **55** (10), 42–46 (2002). Engaging account of one of the principal designers

of the Hanford reactors written by a former student and collaborator. (I)

97. "Some Reminiscences of Mass Spectroscopy and the Manhattan Project," A. O. Nier, *J. Chem. Educ.* **66** (5), 385–388 (1989). Alfred Nier's separation of the uranium isotopes in early 1940 led directly to experimental confirmation that it is the lighter isotope that fissions under slow-neutron bombardment. In this paper he relates his involvement with the MP. See also Ref. 126. (I)
98. "Trinity—a reminiscence," G. B. Kistiakowsky, *Bull. Atom. Sci.* **36** (6), 19–22 (1980). Kistiakowsky was intimately involved in the design and production of the Fat Man implosion-lens system. In this brief paper he relates some of the preparations leading up to the Trinity test, and in particular discusses problems encountered with detonator electronics and casting explosive lenses. (E)

#### D. The German nuclear program

At the end of World War II, ten leading German physicists including Werner Heisenberg and Otto Hahn were interned at Farm Hall, an English country estate. Their conversations were recorded and have now been declassified (Ref. 103). The controversy over to what extent Heisenberg understood (or failed to understand) the basic physics of calculating critical mass has now largely been settled through analyses of these transcripts (Refs. 102, 104, 106, 110, 111). The question of what Heisenberg tried to relate to Bohr during their September 1941 meeting in Copenhagen remains open to interpretation (Refs. 113, 114, 116, 143); the text of Michael Frayn's play based on this event is listed as Ref. 108. For sake of completeness, one book on Soviet nuclear developments and policies is also included (Ref. 109).

99. *Alsos*, S. A. Goudsmit (Schuman, New York, 1947). First-hand account of the Allied mission charged with investigating German progress toward atomic weapons during World War II. See comments under Ref. 102. (E)
100. **The German Atomic Bomb: The History of Nuclear Research in Nazi Germany**, D. Irving (Simon and Schuster, New York, 1968). This book was one of the first serious analyses of the German nuclear program, with particular emphasis on pile experiments. Irving concludes that the German project failed because of both government attitudes toward science and the failure of scientists to win the confidence of the government. Includes photographs of various experimental piles. (E)
101. **Scientists under Hitler: Politics and the Physics Community in the Third Reich**, A. Beyerchen (Yale U.P., New Haven, 1977). This work examines the general political environment of physics research during the Third Reich, particularly the rise and fall of the "Aryan Physics" movement. (E)
102. **German National Socialism and the Quest for Nuclear Power 1939-1949**, M. Walker (Cambridge U.S., Cambridge, 1989). Walker gives a detailed history of efforts to develop nuclear power and isotope separation in Nazi Germany, concluding that the German project did not so much fail but took the course it did because of the cultural, economic, ideological, political, and scientific environments in which it took place. Chapter 6 includes some telling criticisms of Goudsmit's *Alsos* (Ref. 99). (E)
103. **Operation Epsilon: The Farm Hall Transcripts** (University of California Press, Berkeley, 1993). Transcripts of now-declassified conversations between German scientists interned in Britain. (E)
104. **Heisenberg's War: The Secret History of the German Bomb**, T. Powers (Knopf, New York, 1993). Powers's study of Heisenberg's work on the German nuclear project has been criticized for its interpretation of the Farm Hall transcripts favorable to Heisenberg. (E)
105. **Nazi Science: Myth, Truth, and the German Atomic Bomb**, M. Walker (Plenum, New York, 1995). Insightful account of the background and development of the German nuclear project. (I)
106. **Hitler's Uranium Club: The Secret Recordings at Farm Hall**, J. Bernstein (American Institute of Physics, New York, 1996). Bernstein,

a physicist and journalist, analyzes the Farm Hall transcripts. (E)

107. **Heisenberg and the Nazi Atomic Bomb Project: A Study in German Culture**, P. Rose (University of California Press, Berkeley, 1998). This book examines, through the context of German culture, Heisenberg's atomic-energy work and the evolution of the "Heisenberg Version" of the German nuclear project. While the author is clearly unsympathetic to both Heisenberg and German culture, his analysis of Heisenberg's wartime reports and the evolution of his post-Hiroshima thinking about how nuclear weapons function make for interesting reading. (E)
108. **Copenhagen**, M. Frayn (Anchor, New York, 2000). The text of Michael Frayn's acclaimed play which explores the 1941 Bohr–Heisenberg meeting. A DVD version of the play is also available. (E)
109. **Stalin and the Bomb: The Soviet Union and Atomic Energy 1939-1956**, D. Holloway (Yale U.P., New Haven, 1994). This well-documented work begins with an examination of Soviet science in the 1920s and presents a detailed examination of Soviet atomic energy policy and developments through to the testing of thermonuclear weapons in the 1950s. (E)
110. "Bomb Apologetics: Farm Hall, August 1945," J. Bernstein and D. Cassidy, *Phys. Today* **48** (8), 32–36 (1995). A physicist and a historian of science dissect how the Farm Hall detainees concocted a self-serving story to explain their failure to develop nuclear weapons for Hitler. (E)
111. "The German Uranium Project," H. A. Bethe, *Phys. Today* **53** (7), 34–36 (2000). Bethe, a Nobel Prize-winning nuclear physicist concludes that, at the time of his internment in England, Heisenberg did not properly understand how to calculate the critical mass. (E)
112. "A Lecture on Bomb Physics: February 1942," D. Cassidy, *Phys. Today* **48** (8), 27–30 (1995). Analysis of a talk given by Werner Heisenberg to German research officials in 1942. (I)
113. "A Historical Perspective on *Copenhagen*," D. Cassidy, *Phys. Today* **53** (7), 28–32 (2000). Cassidy examines what Heisenberg might have been trying to tell Niels Bohr during his visit to Copenhagen in September 1941. (E)
114. "New Light on *Copenhagen* and the German Nuclear Project," D. Cassidy, *Phys. Perspect.* **4**, 447–455 (2002). Cassidy reviews draft letters from Bohr to Heisenberg, refuting claims that the German nuclear program was a victim of deliberate failure. (E)
115. "The German Physical Society Under National Socialism," D. Hoffmann and M. Walker, *Phys. Today* **57**(12), 52–58 (2004). This work does not deal specifically with the German bomb project, but rather explores physicists' life and work and the political accommodations they had to make under the Third Reich. (E)
116. "The Drawing or Why History is Not Mathematics," J. Bernstein, *Phys. Perspect.* **5**, 243–261 (2003). During their September 1941 meeting in Copenhagen, Werner Heisenberg gave Niels Bohr a purported drawing of a reactor. The drawing eventually made its way through Bohr to Los Alamos, where it was examined by a panel of distinguished physicists. Bernstein examines this fascinating, little-known footnote to the MP. (E)

#### E. Technical papers of historical interest

The following references, roughly in chronological order, give key experimental and theoretical discoveries in fission, chain reactions, and synthesis of transuranic elements. This list is highly selective and represents only a tiny fraction of the papers published on these topics during the 1930s and early 1940s. Amaldi's 1984 paper (Ref. 132) is included for its comprehensive list of references.

117. "Possible Existence of a Neutron," J. Chadwick, *Nature (London)* **129**, 312 (1932). Chadwick's neutron-discovery paper; reproduced in Ref. 75. A more advanced analysis appears in "The Existence of a Neutron," *Proc. R. Soc. London, Ser. A* **136**, 692–708 (1932). (I)
118. "Possible Production of Elements of Atomic Number Higher Than 92," E. Fermi, *Nature (London)* **133**, 898–899 (1934). Fermi's paper announcing the production of transuranic elements by neutron bombardment of uranium. (I)

119. "Nuclear Physics A. Stationary States of Nuclei," H. A. Bethe and R. F. Bacher, *Rev. Mod. Phys.* **8** (2), 88–229 (1936), "Nuclear Physics B. Nuclear Dynamics, Theoretical," H. A. Bethe, *ibid.* **9** (2), 69–224 (1937), and "Nuclear Physics C. Nuclear Dynamics, Experimental," M. S. Livingston and H. A. Bethe, *ibid.* **9** (3), 245–390 (1937). This triad of papers, now known as "Bethe's Bible," gives a masterful summary of the state of nuclear physics to not long before the discovery of fission. (A)
120. "Discovery of Nuclear Fission," H. G. Graetzer, *Am. J. Phys.* **32** (1), 9–15 (1964). Gives a complete English translation of Hahn and Strassmann's fission-discovery paper of late 1938. See Ref. 91. (I)
121. "Disintegration of Uranium by Neutrons: A New Type of Nuclear Reaction," L. Meitner and O. R. Frisch, *Nature (London)* **143**, 239–240 (1939). The first interpretation of fission. (I)
122. "Number of Neutrons Liberated in the Nuclear Fission of Uranium," H. von Halban, F. Joliot, and L. Kowarski, *Nature (London)* **143**, 680 (1939). Published just four months after the discovery of fission, this paper was the first to give a quantitative measurement of the number of neutrons liberated per fission per each one consumed:  $3.5 \pm 0.7$ . (I)
123. "The Mechanism of Nuclear Fission," N. Bohr and J. A. Wheeler, *Phys. Rev.* **56**, 426–450 (1939). This classic paper published on the first day of World War II explored in detail the energetics of fission. (A)
124. "Calcul relative aux conditions essentielles de transmutation en chaîne de l'uranium," F. Perrin, *Comptes Rendus* **208**, 1394–1396 (1939). This paper by Francis Perrin gives the first published analysis of criticality conditions for uranium. For tampered  $U_3O_8$ , Perrin estimates a critical mass of 12 metric tons. (A)
125. "Critical Conditions in Neutron Multiplication," R. Peierls, *Proc. Cambridge Philos. Soc.* **35**, 610–615 (1939). The first paper published in English to explore conditions necessary for an explosive chain reaction. (A)
126. "Nuclear Fission of Separated Uranium Isotopes," A. O. Nier, E. T. Booth, J. R. Dunning, and A. V. Grosse, *Phys. Rev.* **57**, 546 (1940). This paper provided verification that slow-neutron fission in uranium is caused by U-235 and gives an estimated cross-section for that process. The authors emphasize the importance of large-scale isotope separation for investigation of chain-reaction possibilities. (A)
127. "Nuclear Fission," L. A. Turner, *Rev. Mod. Phys.* **12** (1), 1–29 (1940). This often-cited paper published in January 1940 comprehensively reviewed the experimental and theoretical understanding of fission up to one year after its discovery, and speculated on the possibilities for nuclear energy. (A)
128. "Atomic Energy from  $U^{238}$ ," L. A. Turner, *Phys. Rev.* **69**, 366 (1946). Written in May 1940 but withheld from publication until after the war, this paper points out that U-238 could be made to undergo fission "indirectly" by nuclei decaying from U-239 nuclei formed by neutron capture. (A)
129. "Radioactive Element 93," E. McMillan and P. H. Abelson, *Phys. Rev.* **57**, 1185–1186 (1940). Published in June 1940, this paper reports the discovery of neptunium as revealed by its growth from the 23-min beta-decay of U-239. Neptunium itself is shown to have a 2.3-day half-life. (A)
130. "Radioactive Element 94 from Deuterons on Uranium," G. T. Seaborg, E. M. McMillan, J. W. Kennedy, and A. C. Wahl, *Phys. Rev.* **69**, 366–367 (1946). Written in early 1941 but withheld from publication until 1946, this paper details the production of element 94 by deuteron bombardment of uranium by the reaction  $U^{238}(d,n)93^{239}$  and subsequent beta-decay of  $93^{239}$ . The authors remark that an alpha-emitting activity ( $Pu^{239}$ ) can be chemically separated from both uranium and element 93. (A)
131. "Experimental Production of a Divergent Chain Reaction," E. Fermi, *Am. J. Phys.* **20** (9), 536–558 (1952). Description of Fermi's first critical pile, published on the tenth anniversary of that achievement. (A)
132. "From the Discovery of the Neutron to the Discovery of Nuclear Fission," E. Amaldi, *Phys. Rep.* **111** (1-4), 1–331 (1984). Masterful account of the development of nuclear physics during the 1930s; contains over 900 references. Amaldi's career began as a student of Fermi. (A)

#### IV. VIDEO AND WEBSITES

The first source listed here is a video highly recommended for classroom use; the remaining are websites. Web addresses are given in **bold** type to distinguish them from surrounding punctuation. Readers are cautioned that websites and addresses can change.

133. "The Day After Trinity: J. Robert Oppenheimer & The Atomic Bomb," directed by John Else (Image Entertainment Studio, 1980). This excellent 90-min documentary tells the story of the Manhattan Project and Oppenheimer's postwar experiences. Includes interviews with Hans Bethe, Frank Oppenheimer, Stan Ulam, Robert Wilson, and others. Can be purchased in either DVD or VHS format from amazon.com.
134. The Los Alamos National Laboratory's history website can be found at [\*\*http://www.lanl.gov/history.shtml\*\*](http://www.lanl.gov/history.shtml).
135. The NSF Digital Library on the Atomic Bomb at [\*\*www.atomicarchive.com\*\*](http://www.atomicarchive.com) contains material on the history and science of the atomic bomb, and includes links to the full text of the Smyth report (Ref. 2) and the declassified version of Bainbridge's report on the Trinity test (Ref. 19).
136. The office for history of science and technology at UC-Berkeley has created a website exploring Robert Oppenheimer's life: [\*\*http://ohst.berkeley.edu/oppenheimer\*\*](http://ohst.berkeley.edu/oppenheimer).
137. The homepage of the Manhattan Project Heritage Preservation Association, Inc., can be found at [\*\*http://www.childrenofthemanhattanproject.org/\*\*](http://www.childrenofthemanhattanproject.org/). Thousands of pages (and constantly growing numbers of) of photographs, documents, personal memoirs, frequently-asked-questions and little-known facts are available here.
138. The NSF-funded *Alsos digital library for nuclear issues* at [\*\*http://alsos.wlu.edu\*\*](http://alsos.wlu.edu) provides links to a broad range of annotated references for the study of nuclear issues including books, articles, films, CD-ROMs, and websites.
139. Documents pertinent to the decision to use atomic bombs on the cities of Hiroshima and Nagasaki are reproduced on a site maintained by Gene Dannen at [\*\*http://www.dannen.com/decision/index.html\*\*](http://www.dannen.com/decision/index.html).
140. Carey Sublette maintains an extensive site on nuclear weapons at [\*\*http://nuclearweaponarchive.org/\*\*](http://nuclearweaponarchive.org/). This site features numerous frequently-asked-questions and links to other sites.
141. The homepage of the Bulletin of The Atomic Scientists is at [\*\*https://www.thebulletin.org/\*\*](https://www.thebulletin.org/). The print version of this bimonthly publication frequently carries statistics on nuclear tests and warhead deployments.
142. The "Bureau of Atomic Tourism" at [\*\*http://www.atomictourist.com/\*\*](http://www.atomictourist.com/) lists tourist locations around the world related to atomic explosions and devices.
143. Documents relating to the 1941 Bohr–Heisenberg meeting can be found at the Niels Bohr Archive, [\*\*http://www.nbi.dk/NBA/release.html\*\*](http://www.nbi.dk/NBA/release.html).
144. The homepage of the National Atomic Museum (Albuquerque, NM; soon to be renamed National Museum of Nuclear Science and History) can be found at [\*\*http://www.atomicmuseum.com/\*\*](http://www.atomicmuseum.com/).
145. [\*\*nuclearfiles.org\*\*](http://nuclearfiles.org), a project of the Nuclear Age Peace Foundation, contains links to numerous documents, maps, biographical information, data, and graphs.
146. I have prepared a spreadsheet-based timeline of the MP that can be downloaded from [\*\*http://othello.alma.edu/~reed/MPTimeline.xls\*\*](http://othello.alma.edu/~reed/MPTimeline.xls).

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