ATOMIC HERITAGE FOUNDATION
910 17TH ST. NW, SUITE 408, WASHINGTON DC 20006
(202) 293 0045 WWW.ATOMICHERITAGE.ORG

Transforming the Relationship between Science and Society: The Manhattan Project and Its Legacy

Report on the workshop funded by the National Science Foundation held on February 14 and 15, 2013 in Washington, DC

Table of Contents

Executive Summary iii

Introduction 1

The Workshop 2

Two Motifs 4

Core Session Discussions 6

- Scientific Responsibility 6
- The Culture of Secrecy and the National Security State 9
- The Decision to Drop the Bomb 13
- Aftermath 15
- Next Steps 18

Conclusion 21

Appendix: Participant List and Biographies 22

Report prepared by Carla Borden. Design and layout by Alexandra Levy.

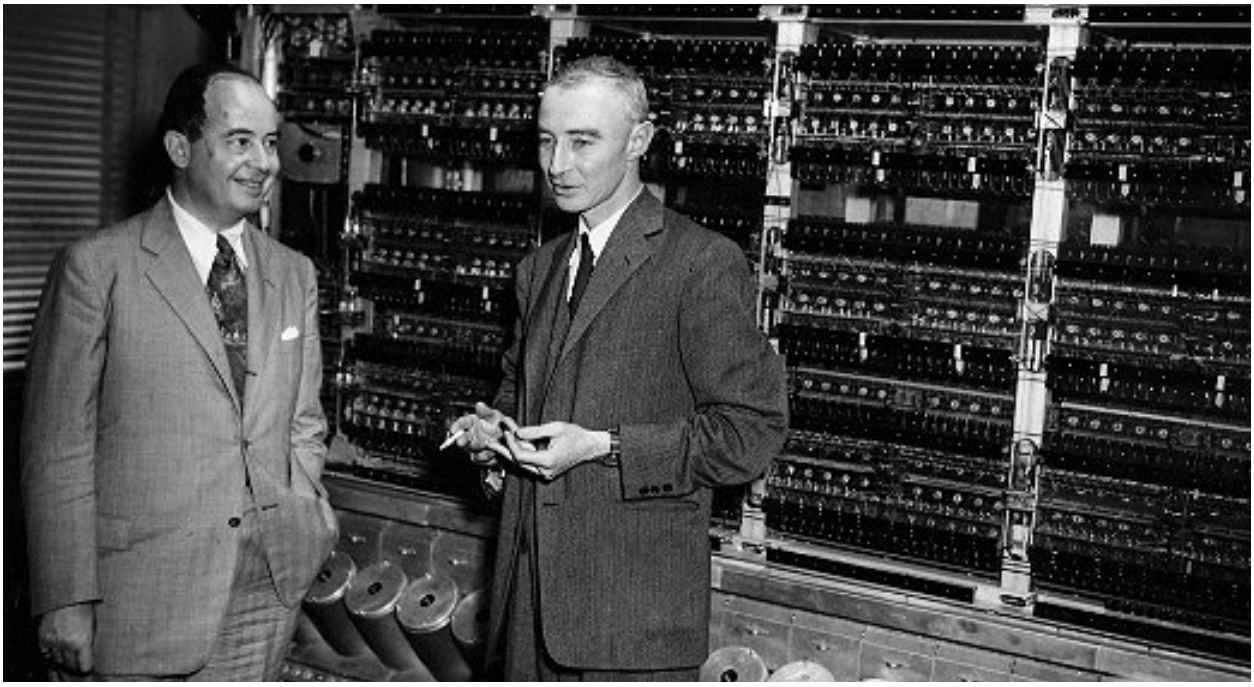
Executive Summary

The story of the Manhattan Project—the effort to develop and build the first atomic bomb—is epic, and it continues to unfold. The decision by the United States to use the bomb against Japan in August 1945 to end World War II is still being mythologized, argued, dissected, and researched. The moral responsibility of scientists, then and now, also has remained a live issue. Secrecy and security practices deemed necessary for the Manhattan Project have spread through the government, sometimes conflicting with notions of democracy. From the Manhattan Project, the scientific enterprise has grown enormously, to include research into the human genome, for example, and what became the Internet. Nuclear power plants provide needed electricity yet are controversial for many people. Deterrence and proliferation of nuclear weapons present a constant global challenge. In sum, the Manhattan Project can claim a legacy of transforming the relationship between science and society in ways that are far-reaching and irrefutably relevant today.

Today's younger generations have little connection to World War II or memory of the Cold War

To engage the public in understanding the relationship between science and society through the prism of the Manhattan Project, the Atomic Heritage Foundation (AHF) proposes to organize a major traveling exhibition. With support from the National Science Foundation to advance interdisciplinary scholarship and informal science education, the AHF convened a two-day expert planning workshop. Historians, physicists, engineers, sociologists, policy makers, and leaders in the field of informal learning followed a thorough, focused agenda covering exhibition content and strategies for presentation. The sessions were productive beyond the participants' own expectations; the group exchanged stimulating ideas with unflagging energy, building solidly on the base AHF had laid.

Workshop participants noted that, as World War II and even the Cold War recede farther from the direct experience of prospective exhibition visitors, the effective creation of context and of opportunities for empathy will be crucial. The exhibition will have to temper the complexity of the subject matter too, as well as its controversial aspects. In response, the group suggested a range of risk management tools and programming techniques. With the advantage of such insights and experience, the proposed exhibition should serve as a valuable vehicle for learning about the evolving roles of science, technology, and innovation in our lives.



John von Neumann and J. Robert Oppenheimer in front of the MANIAC computer in 1952 in Los Alamos
Photo by Alan Richards, courtesy of the Shelby White and Leon Levy Archives Center, Institute for Advanced Study

Some key recommendations:

- Ensure that future planning includes representatives of diverse science and humanities disciplines, communities, and perspectives.
- In the exhibition explain the importance to the Manhattan Project not only of physics and engineering but of chemistry and metallurgy. Emphasize the role of British scientists.
- In the exhibition and related programs use a mix of interpretive, participatory modes; also offer books, audio-visuals, and more takeaways at the gift shop, which becomes the next stage of the exhibition and continues the learning process.
- Consider designing the exhibition in interlocking modules. Such a design will reinforce the connectedness of the topics being explored and allow for square footage to be adjusted according to the size of the host facility.
- Present the doubled-edged nature of scientific discoveries as intended/unintended or positive/negative—not good/bad.
- Recognize the existence of conflicting opinions on the Manhattan Project, but do not remain neutral or passive in the face of myths and misconceptions; base the interpretation of the story on the latest scholarship and seek to increase knowledge.

Introduction

"Surely, we are being presented with one of the greatest triumphs of science and engineering, destined deeply to influence the future of the world."

~Niels Bohr

The research and engineering project to harness the energy of the atom, named for its first sites in New York City, had profound and far-reaching consequences. It accelerated changes in science and set off a continuum of reactions outside the laboratory that have been felt in international power politics, agriculture, protest movements, medicine, the presidency, photography, ecology, warfare, economics, popular culture, research ethics, attitudes toward science, government, and the future—aspects of our world and lives both foreseeable and unanticipated. The Manhattan Project not only influenced the relationship between science, technology, and society, it also serves as a case study of the relationship.

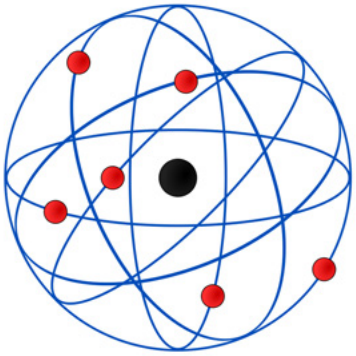
For the 75th anniversary of the Manhattan Project, to be commemorated in 2017–2021, the Atomic Heritage Foundation (AHF) is moving forward with planning for a national traveling exhibition. Public interest in both the history and science of what some have called one of the most momentous developments of the 20th century remains high, yet appreciation of the facts and their complexity is seriously lacking. Scholars are uncovering new evidence about the historical personalities and events as documents from wartime allies and adversaries—especially Japan—are declassified. There is more than ample historical justification for looking into this complexity. And the relevance of nuclear programs to the 21st century is surely self-evident.

No exhibition to date has treated the Manhattan Project comprehensively. The exhibition medium itself offers unique opportunities for outreach to different age groups simultaneously; it can encompass a variety of levels of learning as well as formats of learning through a mix of interpretive modes. By moderating diverse viewpoints for the public, it can invite visitors into the scholarly process, arouse their curiosity, and let them think about issues for themselves in a more informed way. A traveling exhibition has the additional advantage of allowing organizers to reevaluate, update, and add content. The hub venues for the exhibition would be centers of informal science learning: science centers and museums.

Strands of Informal Science Learning

- Strand 1 – Sparking Interest and Excitement
- Strand 2 – Understanding Scientific Content and Knowledge
- Strand 3 – Engaging in Scientific Reasoning
- Strand 4 – Reflecting on Science
- Strand 5 – Using the Tools and Language of Science
- Strand 6 – Identifying with the Scientific Enterprise

From the presentation by Anthony "Bud" Rock, CEO, Association of Science-Technology Centers, Inc. on the first day.



The Workshop

As part of the exhibition planning process, the AHF convened a workshop on February 14–15, 2013, in Washington, D.C., "Transforming the Relationship between Science and Society: The Manhattan Project and its Legacy." Funding was provided by the National Science Foundation's Informal Science Education program in the Directorate for Education and Human Resources (EHR), and the Science, Technology and Society Program in the Directorate for Social, Behavioral and Economic Sciences (SBE). Generous in-kind support for the workshop came from the offices of Latham & Watkins LLP.

AMSE Deputy Director Ken Mayes, author Andrew Brown, AHF President Cindy Kelly, and historian J. Samuel Walker at the workshop

Introductory presentations by Richard Rhodes, Pulitzer Prize–winning author of *The Making of the Atomic Bomb* and AHF board member; Anthony "Bud" Rock, CEO of the Association of Science-Technology Centers, Inc.; and Alan Friedman, consultant in museum development and science communication, set the stage.

The general goals of the workshop were to advance interdisciplinary scholarship and informal education in the science museum field. A more specific goal was to develop ideas for interpreting the Manhattan Project with the practical goal of an exhibition.

The development of atomic weapons through the Manhattan Project and their use in 1945 have polarized scientists, scholars, and the public ever since. The drama of the Manhattan Project abounds in ambiguity, multiple intersecting themes and characters. Its legacy reaches around the world to the present day. Participants were invited to consider how to exhibit the relationship between science, technology, and society through the Manhattan Project in imaginative, inspiring, and responsible ways. No small challenge, and one taken up with gusto.

Workshop participants (see the Appendix for participant profiles) shared a keen interest in the proposed exhibition, for its historic importance as well as its broader educational value. Many of

them were scholars of history, science, technology, and society. They brought to the table not only an exceptional depth of knowledge of complementary aspects of the science and history of the Manhattan Project but also great intellectual curiosity.

Just as expert and multifaceted were museum professionals from Manhattan Project historic sites, the Smithsonian Institution, and science museums; interpretation specialists from the National Park Service; and leaders in science and technology center organizations. The groups reflected the two programs of the National Science Foundation that had joined to support the workshop, and each core workshop session paired a speaker on substantial issues with one on interpretive exhibition strategies. The contingents overlapped without being redundant; at the same time individuals' opinions diverged on a number of issues. Overall, participants contributed valuable insights, new information, and solid recommendations on presentation.

A group shot of some of the participants at the workshop

Participants covered much ground over the two days of the workshop yet recognized that time constraints precluded fuller discussion of many topics the exhibition would have to address. Among the most important was the central role that sciences in addition to physics, and countries in addition to the United States, played in Manhattan Project work—particularly chemistry and metallurgy in the first case, and Britain in the second. In deciding how to represent the sciences, scientists, and international aspects of the story, organizers would want to further diversify future planning discussions. Many more of the ideas participants wished to examine are included in the Core Sessions section below.

The main body of this report provides condensed versions of the core session presentations and discussions, which assume a certain familiarity on the part of readers with the relevant history. Core session topics were: Moral Responsibilities of Scientists, Decision to Drop the Bomb, Culture of Secrecy, National Security State, and Cold War: Avoiding Armageddon. Some of the topics have been recombined and relabeled here. A final session was devoted to general recommendations for next steps and conclusions. First, however, the report departs briefly from the workshop agenda in order to underscore two motifs in participants' conversations.

For those wishing to experience the proceedings more fully, edited videos of the presentations and the discussions can be found on AHF's YouTube page (youtube.com/user/AtomicHeritage).

Two Motifs

The Specter of Enola Gay: How can an exhibition on the Manhattan Project and its legacy, which are so contentious, negotiate the sensitivities of the subject?

The Enola Gay on display today at the National Air and Space Museum Udvar-Hazy Center in Chantilly, VA. The B-29 is accompanied by a brief description of the plane and the bombing

A watch on display at the Hiroshima Peace Memorial Museum, stopped at the moment the atomic bomb was dropped

Again and again discussion turned to the historic controversy over the National Air and Space Museum's plans to display the Enola Gay in an exhibition commemorating the 50th anniversary of the end of World War II. Veterans had vehemently opposed recognizing Japanese casualties, and the original exhibit was canceled. Enola Gay faced some specific risks—an unsympathetic cultural and political climate, the celebratory mandate of the museum as well as its "official, national" status and vulnerability to pressure from Congress—that a Manhattan Project exhibition sponsored by a private organization such as AHF would be spared. Another significant factor in favor of the current proposal: more time has passed since the end of the war. ("It takes a hundred years to talk about a war," said Richard Rhodes, quoting Civil War historian Shelby Foote.)

Can exhibitions successfully address controversial issues? Yes! *Race: Are We So Different?* and *Sex: A Tell-All Exhibition,* among others, were cited as confirmation and analyzed for lessons. Also remarked was the fact that American University mounted an exhibition with some of the artifacts that would have been displayed at the Air and Space Museum, with Japanese participation—and without incident.

The Anachronism Problem: If the Enola Gay debacle was precipitated by carryover from the past to the present, can Manhattan Project exhibition organizers and visitors avoid imposing the present on the past?

Based on demographic realities, an increasing number of visitors to the exhibition will have little if any personal connection to World War II, or even the Cold War, and thus may be less likely to bring a sense of historical empathy to the subject. They will come with contemporary perspectives, however.

Workshop participants uniformly affirmed the importance of creating a dialogue between the present and the past, and of providing context on the prevalent attitudes and emotions at the time the bombs were used. Films about the war, the bomb (*Dr. Strangelove*), the McCarthy era, post-apocalyptic television series, and September 11 documentation offer points of reference for post-millennial generations, as do other platforms such as live dramatizations. Organizers also need to bear in mind that the exhibition is not planned to open until at least 2017 and could reach a host site ten years down the road. "Today," "present," "now" are moving targets.

The Science Museum of Minnesota's exhibition on race received national acclaim for its innovative approach to a difficult and emotional topic

Although the possibility of controversy exists for any exhibition or artifact, any subject or its interpretation, advisers to the Manhattan Project exhibition are seeking healthy discussion about science, history, and society as an integral part of the program. Take on controversy directly, they insisted.

Risk management tactics include "preemptive preparatory education" of frontline museum staff. Pre-, mid-, and post-exhibition assessments will be useful to anticipate controversy and how successfully the message of the exhibition is being communicated. Workshop participants recommended forming a risk mitigation committee.

Core Session Discussions

Scientific Responsibility

"[M]orality is a lot like gravity. It's a pervasive force which is essential for human activity, but like gravity is a weak force, and it's easily overcome."
~Andrew Brown, MD; author, *Keeper of the Nuclear Conscience: The Life and Work of Joseph Rotblat*

The life experiences of Manhattan Project scientists had an important bearing on how they understood their responsibility. Many were drawn to the project by their opposition to fascism. Some were refugees from the Nazis who had family members still in Europe, others were Britons whose laboratories had suffered bombing raids—and then there were Americans who had friends and relatives fighting overseas. Overall they were deeply invested in winning the war.

The momentum of the project rather quickly subsumed the role of scientists in the industrial-scale production of fissile material for the military. At the same time, individual scientists had moral as well as pragmatic reservations about the development and use of an atomic bomb by the United States. Niels Bohr, James Franck, Glenn Seaborg, and others tried to impress the highest authorities with their concerns.

Four great physicists: Niels Bohr, James Franck, Albert Einstein, and Isidor I. Rabi

After Hitler was defeated and Germany surrendered in May 1945, over one hundred Manhattan Project scientists signed a petition seeking a demonstration of the weapon before using it on a Japanese city. But the decision to use the bombs was not governed by the scientists' views, or moral arguments, but by military and political considerations.

After the war, and in some cases for the rest of their lives, Manhattan Project scientists were heavily represented in peacekeeping and international disarmament efforts, through institutions such as the Pugwash Conferences on Science and World Affairs, the Bulletin of Atomic Scientists, the Federation of Atomic Scientists (now the Federation of American Scientists), and the British Atomic Scientists Association. Other scientists continued to work for the government, on nuclear weapons or on arms control.

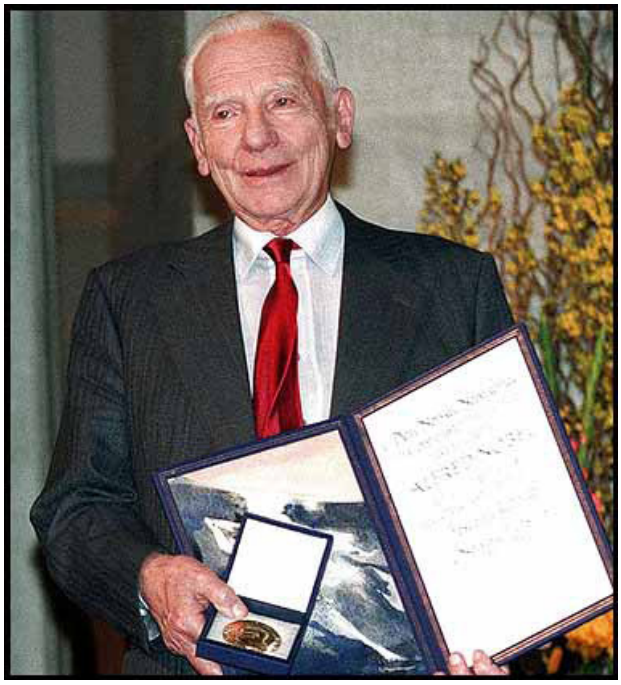
General Leslie Groves, J. Robert Oppenheimer, and other scientists examining the site of the Trinity test

"The concept of social responsibility, even to be responsible, requires that people have some knowledge of the consequences of their action."

~Kelly Moore, PhD; author, *Disrupting Science: Social Movements, American Scientists, and the Politics of the Military, 1945–1975*

What does it mean to be a socially responsible scientist? After the use of the bomb and the end of the war, scientists expressed divergent views on the morality of the government's decision and whether they had had a collective or even individual "responsibility" to participate in the Manhattan Project. The Society for Social Responsibility in Science was a group that represented such critical thinking.

Scientists—who by the mid-1950s had become more differentiated in their specializations and thus occupational subcultures—also did not hold uniform understandings about whom they were responsible to, the government or the emerging "public." The former was the prevalent choice both during and after the war: scientists would present neutral facts to assist the government in making good decisions. Organizations such as the Greater St. Louis Citizens' Committee for Nuclear Information, though, embodied social responsibility toward the public. Didn't scientists, for example, have an obligation to warn the public of possible harm from radiation?



Joseph Rotblat after receiving the Nobel Peace Prize for founding the Pugwash Conferences

In addition to knowledge, social responsibility requires options for action. Because of the strict secrecy regime, Manhattan Project scientists had fewer options than scientists in the late 1960s, who could publicly disseminate scientific ideas and advocate for or against them. Organizations that did this included the Union of Concerned Scientists and the Natural Resources Defense Council.

Presentation Strategies, Issues, and Recommendations: Scientific Responsibility

- Put science itself in context. Science was not regarded as altogether beneficent at the start of World War II—look back at the poison gas used by both sides in World War I, for example. Was it "perverted" in World War II?
- Don't overestimate the role of the scientists. During the war they were "hired hands."
- Focus on biographies of people—and not only the charismatic scientists—who did specific things; include diverse views. The scientists were not one-dimensional, and there was no one right course of action.
- Include cases of scientific research and applications from today with moral ambiguity (genetics, nanotechnology, using polio vaccination programs to gather intelligence). In that context, note that scientists operate in an environment of uncertainty—that's how they discover new things. And some of the questions scientists are asked to decide are policy questions, not fundamentally science questions.
- Scientists did not fall into the categories of "hawks and doves" as these are now used.
- Convey that engagement of scientists in public and political debate is important.
- Look at Japanese peace museums.
- Bring to the exhibition planning table people with negative experiences of the Manhattan Project enterprise: for example, Native American miners exposed to radiation. Also include scientists.

The Culture of Secrecy
and the National Security State

"When we talk about secrecy in the Manhattan Project, it is a cluster of practices."
~Alex Wellerstein, PhD; author and host,
"Restricted Data: The Nuclear Secrecy Blog"

In the 1970s physicist Philip Morrison declared there was really only one secret in the Manhattan Project: that you could build a bomb and it would work. Secrecy, though, was another matter, contagious, pervasive, and systematized, a context for work on the bomb as well as a historical subject in its own right. And it did not end after the secret was out.

EXTRA **The Villager** EXTRA

VOLUME 1 — Richland, Washington, Monday, August 6, 1945 — NUMBER 22—A

IT'S ATOMIC BOMBS

News Spreads Slowly, Surprises Everyone Here

Jubilation And Satisfaction Follows Revelation Of Product Manufactured Here

Richland was about the last place in the country to hear the news of the atomic bomb. As in other parts of the country it was the housewives who first heard the news over their radios, and broke it to their husbands in a flurry of telephone calls which kept the switchboards humming.

In town, the stores were all closed until noon and few people were on the street. It was THE VILLAGER reporter who spread the word to most of those encountered. Disbelief was soon followed by enthusiasm. Everyone felt the same reaction—"It's nice to know what this project is all about" and "May be the war will end promptly."

Development Of Bomb Traced

President Truman Releases Secret of Hanford Product

Many Hanford workers discovered what they were working on from the newspaper headlines after the bombs were dropped

A chronology of secrecy relevant to the Manhattan Project begins in the late 1930s with self-censorship by physicists. In 1939 President Roosevelt approved work on uranium and wanted to keep it secret from Germany and Japan—even more so than radar—but probably also from Congress, out of concern that that body would squelch the project as a boondoggle. Secrecy escalated with the transfer of the project to the military, and General Groves instituted an information control policy with serious penalties for offenders. Workers knew only what they needed to do their jobs; they were forbidden from sharing information even among themselves.

After the war top project scientists developed declassification guidelines for the scientific and technical information related to the bomb; some of it was never to be released. Espionage, real and imagined, became part of the story. The regime of secrecy has continued and spread to nearly all aspects of the federal government.

Among the Manhattan Project's practices of secrecy were regulations and laws, personnel investigations and security clearances, isolation and fencing of project sites, oaths and indoctrination in "security consciousness," document control, code names, compartmentalization of knowledge, censorship and disinformation, and black budgets.

Did secrecy work? The Soviets knew about the bomb before President Truman. Some scientists and others saw secrecy as destructive, dangerous, absurd, and/or counterproductive. Yet its success and failure are difficult to define, and it has left a powerful if ambiguous legacy in attitudes about science and government.

"It was [required of the workers] that they not talk to anybody about what they were doing, including the people they were working with, including the person at the workstation next to them, including their families."
~Robert Mac West, PhD; Informal Learning Experiences, Inc.

General Groves wanted the secret Manhattan Project research and production facilities to be in remote, low-population areas, away from the coasts, and scattered across the country. In Oak Ridge, Tennessee, the three plants were situated in separate mountain valleys so that an explosion in one plant would not damage the others. Facilities were built with amazing speed. In addition to Oak Ridge, the other main sites were at Los Alamos, New Mexico, and Hanford, Washington.

A crowded mess hall at Hanford. Eight were eventually built to accommodate tens of thousands of workers

At the sites, provision had to be made for all the needs and activities of workers and their families: housing, schools, libraries, transportation, worship, and leisure. "Planned towns" grew up, Oak Ridge's designed by the noted architecture firm Skidmore, Owings and Merrill. A total of approximately 130,000 people lived in the secret scientific cities. Security was tight, and numerous billboards reminded workers not only of their valuable contribution to the war effort but of their duty to maintain secrecy. Not until President Truman announced on August 6, 1945, the dropping of the bomb on Hiroshima, and newspapers carried banner headlines, did many of the workers grasp the big picture.

"The Manhattan Project epitomized the…tension between the openness of science and the necessity for secrecy of military projects of national security."
~Robert Norris, PhD; author, *Racing for the Bomb: General Leslie R. Groves, the Manhattan Project's Indispensable Man*

That atomic research was going on surprised no one who was paying attention. However, some of the physicists working on nuclear fission recognized its potential for weapons of mass destruction and were the first to urge secrecy upon their American and European colleagues. Groves' priority was also to keep physics breakthroughs and technical developments secret from the Germans primarily but additionally from the Japanese, Russians, and all other nations so that the U.S. position after the war would be as strong as possible. Groves also wanted to ensure that domestic powers (e.g., Congress) not interfere.

A billboard extolling secrecy to workers in Oak Ridge

Compartmentalization of knowledge was the keystone to secrecy. The typical models of collaboration and competition to advance scientific knowledge assumed a unique structure during the Manhattan Project. Groves and Oppenheimer wrestled with the clash of scientific and military cultures.

With his powers as director of the Manhattan Project, Groves became an architect of the national security state, whose features include paramount concern for security and secrecy and the creation of intelligence and counterintelligence organizations to oversee operations and respond to espionage threats.

After the war science was harnessed to advance national security in a number of projects. On the other side of the coin, national security restrictions together with changes in the public perception of atomic energy inhibited the development of nuclear power.

Presentation Strategies, Issues, and Recommendations: Culture of Secrecy

- To physically represent the control of knowledge in the culture of secrecy, focus on the practices. There are lots of artifacts: documents, posters, rubber stamps, polygraphs, code machines, etc. But the story is more about motivations, ambiguities, and consequences than objects.
- Everybody loves to learn a secret; anything on the exhibition with the word "secret" will appeal. Feature novels in the gift shop with "secret" in the title. But how "secret" leads to the national security state is more complex.
- Draw on the excellent existing resources for helping visitors understand the secret cities, especially the lives of the people who worked there and their families, the challenges they faced, and the creative ways they addressed those challenges. Resources include Ed Westcott's photos, the Atomic Heritage Foundation oral histories, and artifacts such as drivers' licenses with no pictures or names and license plates with no state or county.
- Tell the stories of the people and communities evicted from their land in order to create these sites.
- Look at the social structure of the secret scientific cities, which did not necessarily conform to gender and racial stereotypes. Women held menial jobs but were represented in scientific, technical, and engineering positions as well. African-Americans also worked at all levels; however, most were laborers and were relegated to the least desirable housing. Housing, recreational facilities and schools were segregated.
- Confront the competing secrecy narratives (secrecy was/was not successful, it was necessary/excessive/destructive, it was absurd/counterproductive/ineffective/necessary). Don't romanticize the absurdist elements.
- What areas of information about the bomb remain secret?
- Unlocking the secrets of nature (the atom) can be brought up to the present, with the human genome project.
- Don't lead visitors to conclude that science is dangerous, or all about secrets and espionage; a "public good" thread has to emerge.
- Elaborate on control vs. openness in science.
- Use existing museums at the Manhattan Project sites as resources and potential test sites for programming.
- Check Newseum displays on withholding, planting, and shaping information.
- Develop activities for school groups to illustrate how compartmentalization of knowledge interferes with solving problems. The Bradbury Science Museum in Los Alamos has a program that can serve as a model.
- Contrast the communications systems then and now, and challenge kids' to imagine how to maintain secrecy today.
- What were the effects of secrecy on democracy and trust of science and government?
- How were leaks or scientists suspected of espionage dealt with during the Manhattan Project? What about today?
- Have visitors take oaths of secrecy. Would they have done it?
- Discuss leaks and the growth of the American secrecy and security apparatus since 9/11.
- How would foreign visitors respond to the secrecy/national security state topic?

The Decision to Drop the Bomb

"Most of the questions that arouse so much debate and so much controversy, and indeed so much ill will amongst scholars, as well as apparently the general public, [are] based on counterfactuals."
~J. Samuel Walker, PhD; author, *Prompt and Utter Destruction: Truman and the Use of Atomic Bombs Against Japan*

"We are confronted with the problem of trying to close the gap between scholarly research on the one hand and popular misconceptions and oversimplifications on the other."
~Richard Rhodes, author, *The Making of the Atomic Bomb*

"I think the tactic here, with controversy, is to try to avoid the museum voice."
~J. Shipley Newlin, Science Museum of Minnesota

Was the use of the bomb necessary to end the war? How long would the war have gone on? Were the Japanese about to surrender? If we had not used the bomb, would we have had to invade Japan? Were the bomb and invasion the only alternatives? How many casualties would an invasion have exacted? How many lives were saved—American and Japanese—by the bomb? What should President Truman have done?

All of these questions are extremely important, contentious, and emotionally charged; the exhibition will need to recognize and respect that. Some of the answers are basically unknowable; one hopes the exhibition will help visitors to recognize and respect that as well.

The Japanese official surrender aboard the USS *Missouri*

Myths need to be addressed, flaws pointed out in the traditional and revisionist views on the end of the war in the Pacific, and new questions investigated. Scholars over the last 10–15 years, with the benefit of evidence not available previously, have offered varying interpretations of circumstances that impinged on U.S. and Japanese decisions. A consensus seems to be emerging that the bomb together with the Soviet invasion of Japanese-controlled territory was decisive in Japan's surrender. But the debate continues—including at the workshop, where it was lengthy, often heated, and called on a wide range of facts and arguments.

Presentation Strategies, Issues, and Recommendations: Dropping the Bomb

- Avoiding the "official" museum voice does not mean the exhibition organizers should be neutral. Letting each side present its view in its own words may defuse a significant part of the controversy. But the presenting organization has to let its own expertise be heard. An approach could be: the overwhelming consensus of the scholars who studied this is X. This we know is accurate; these are the facts we build on, and the facts may change. The following conjectures are not accurate. And here are the areas where there is still legitimate uncertainty and ambiguity which future scholars should help resolve.
- Reflect not only current scholarship but the feelings of people at the time, especially American soldiers heading to the Pacific, perhaps also Japanese who were afraid they would die if the war continued.
- Try to bring Japanese voices and materials into the exhibit.
- Put visitors in the role of historians confronting raw materials, so they will see how difficult it is to make sense of them.
- Was Truman's action really a decision, or was he carried forward by momentum? What Japanese decisions moved the United States toward using the bomb?
- Celebration vs. horror at the bombing.
- Include the issue of strategic bombing that precedes the decision to use the atomic bomb. The most destructive attack on Japan was not Hiroshima or Nagasaki, it was the first big firebombing of Tokyo.
- In addition to the creation of the device discuss its "weaponization" and the delivery.
- Why did we never use the bomb again? Why did no one else?
- Is it possible to reduce or eliminate nuclear weapons? Is it possible to control knowledge and technology once they are widely available?
- Were civilians a just target? Is the "just war" theory supportable, not only for nuclear but conventional weapons?
- Was the atomic bomb, especially at that time after the fire bombings of Dresden and Tokyo, really qualitatively different?
- What was known about radiation? Those who knew were not in the decision-making flow. The public's impressions of the number of radiation deaths over the long-term and the facts are very divergent.
- Was the purpose of the bomb to kill as many people as possible? To be a deterrent against a German bomb? With just a visually dramatic display, would have it been an effective means to send a message to Japan (and the Soviets)? Simply to end the war?
- How did the bomb change the relationship of science and society? How did it change our relation with the natural world?

Aftermath

"[During the Cold War] we understood what science meant in the relationship between our countries, so it became a cornerstone of foreign policy."
~Anthony "Bud" Rock, CEO, Association of Science-Technology Centers, Inc.

In 1944 scientists working on the Manhattan Project had expressed concern about proliferation and control after the bomb was used. Public opinion, immediately and overwhelmingly in favor of the bombing of the Japanese, dramatically shifted following the publication of John Hersey's novel *Hiroshima* (1946) and media coverage of survivors' suffering. Despite the United States' initial nuclear monopoly, and General Groves' efforts to maintain it, polls showed Americans did not feel safer about the future. The new technology that was seen as having ended a war now made war seem both unthinkable and an all-too-real existential threat.

Manhattan Project scientists also had warned of the Soviet Union's desire to develop nuclear capabilities, and the American monopoly was in fact short-lived. After the Soviets detonated their first atomic bomb in 1949, the British developed weapons technology so they would have a "restraining influence" on the United States.

Efforts to control the arms race were national (U.S. Atomic Energy Commission), international (United Nations), and non-governmental (Federation of American Scientists, Pugwash). Although U.S. and Soviet scientific communities were competitive and less than trusting of one another during the Cold War, they nevertheless strove to keep channels of communication open. President Eisenhower's Atoms for Peace program spread nuclear technologies, with both beneficial and adverse results. Nuclear physics was often associated with military uses; biology, agriculture, and medicine represented the "peaceful" face of atomic energy.

The United States' Ivy Mike thermonuclear test, the first test of a hydrogen bomb

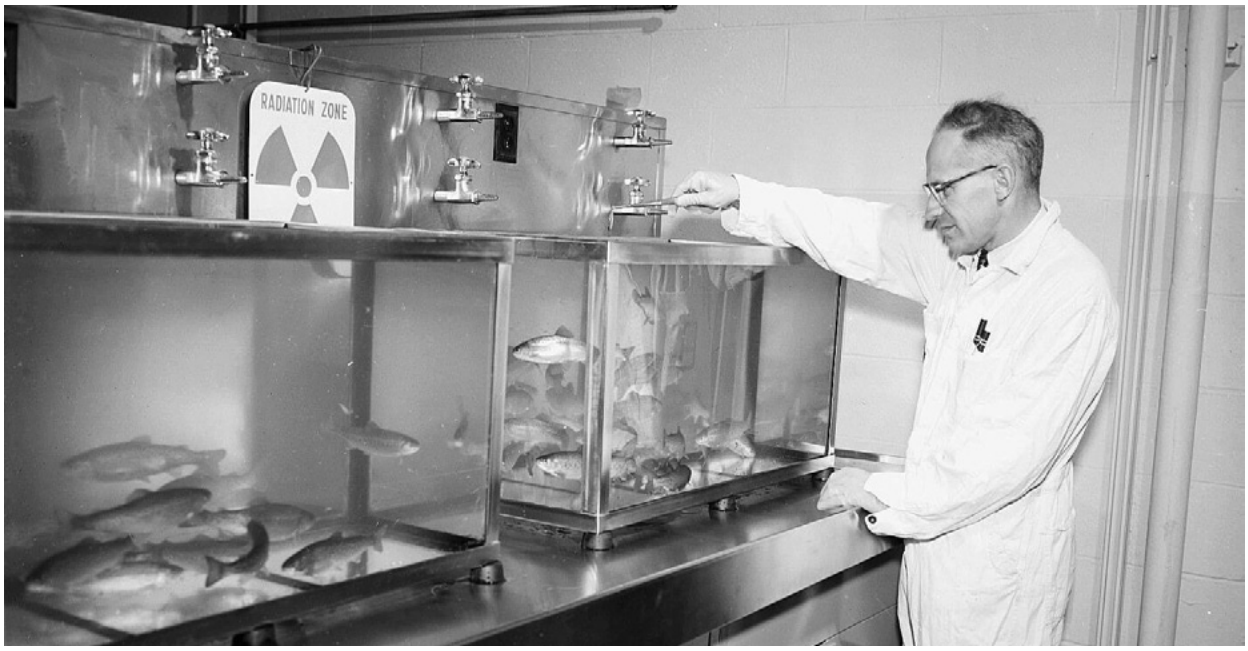
Presentation Strategies, Issues, and Recommendations: The Cold War

- The Cold War should be an epilogue or afterword to the exhibition, or a separate exhibition. It is too complex, more so than the Manhattan Project. If one views the exhibition as a history exhibition, it has to stop somewhere.
- Following the underlying science, the secrecy and compartmentalization of knowledge, would allow organizers to make connections through the Cold War and into the present.
- To certain generations, the Cold War and the arms race signals fear. Fear can be a motivation to get visitors engaged, but which elements of the fearful universe should the exhibition communicate? Fear is not what visitors should leave the exhibition with.

"'If we are going to spend a few hundred million dollars in the atomic energy field to perfect an instrumentality of death, then let us take a little of that money to develop an instrumentality to preserve life' (Illinois legislator Everett Dirksen, 1947). And radioisotopes in particular seemed to provide a way to redeem the destructive uses of the atom."
~Angela Creager, PhD; author, *Life Atomic: Radioisotopes in Science and Medicine*

The power of atomic energy demonstrated by the Hiroshima and Nagasaki bombs seemed to raise Americans' hopes that it could revolutionize medicine, and particularly cure cancer. Physicians had been putting radioactive materials such as radioisotopes to therapeutic use for four decades, but after the war the materials were far more widely available. Manhattan Project leaders and later the new Atomic Energy Commission, which succeeded the Manhattan Project, decided to make Oak Ridge a radioisotope production site to supply civilian institutions.

Like the 17th-century microscope, radioisotopes gave researchers a new mode of perception, a way of understanding life in molecular terms. The isotopes could tag and follow atoms through chemical reactions or biological systems: photosynthesis, for example, and hormones in the blood-



A worker at Hanford's fish hatchery, where scientists observed the effect of radiation on fish

stream. Scientists were quick to use this tool, which transformed biochemistry and biomedicine and made major contributions to ecology.

Non-military exposure to radioactive materials went largely unregulated in the first decade after the war. However, during the war, at Hanford, scientists had become concerned about potential danger from the plant's radioactive waste on the Columbia River ecosystem. Dying fish would have affected the economically important local fishing industry—and aroused people's curiosity about the secret work. Manhattan Project ecologists tracking radioactive waste made the crucial discovery that radioactivity concentrates as it moves up the food chain, to potentially lethal levels. The information was classified until 1955, at which point in time debates about radioactive fallout were beginning. Negative images of radioisotopes and atomic energy more generally since then have mainly obscured the earlier, hopeful expectations the public had for them.

Presentation Strategies, Issues, and Recommendations: Radioisotopes

- Explore the overlap and contrast between military and civilian activities.
- Big Science emerges from the Manhattan Project with the national laboratory system and with major federal investment in scientific research.
- The Manhattan Project changes citizens' relations to science and scientists. Science becomes a much greater part of people's lives than it had been.
- The greater regulation of radioisotope research by the late 1950s arguably led to more oversight of researchers in general.
- All sorts of new fields emerged or were developed by the Manhattan Project such as high-speed photography, imaging technology, high explosives in general, and high-speed computing.

The Mars Rover is powered by plutonium, another legacy of the Manhattan Project

Next Steps

"Great idea, how do we sell it?"
~Alan Friedman, PhD; consultant in museum development and science communication

"[E]xhibits are their own thing. [T]hey mean both more and less than you ever intend."
~Art Molella, PhD; director, Lemelson Center,
Smithsonian National Museum of American History

Concept and design
Workshop participants discussed several exhibition models, but everyone agreed that a mix of interpretive modes will be required to present such a complex and controversial subject, and bring it alive for visitors. Books, films, DVDs, and a Web presence also will be necessary to supplement the exhibition.

Effective tactics exist to deal with complexity and controversy in exhibitions
For example, present historical reenactments with actors reading Manhattan Project scientists' actual words in a debate; re-create features of the physical sites where the story took place; use the testimony of eyewitnesses, either through documents or video; let visitors interact with each other and become involved through role-playing and character storytelling. These tactics can help visitors get beyond strong emotions about the issues and consider other perspectives.

An interactive exhibit at the Science Museum of Minnesota's *Race* exhibition

Exhibit Organization
A number of ideas emerged about how the exhibition should be organized. A chronological approach raised certain problems, such as selecting a cutoff date. Some participants recommended ending the historical story in the late 1940s or early 1950s, and then having an "epilogue" about impacts on and contrasts with today.

A separate suggestion was to offer visitors a "who what where when" before going into "why," to "detoxify" the subject. Another idea was to use these categories as a framework: the science (represent the preceding science and the inevitability of the discovery of fission), the bombs (in the context of strategic bombing history), biographies, energy (nuclear power, Atoms for Peace), and arms control.

The group also discussed, and seemed enthused by, the use of modules—physical units corresponding to a mental Venn diagram. The center module would be

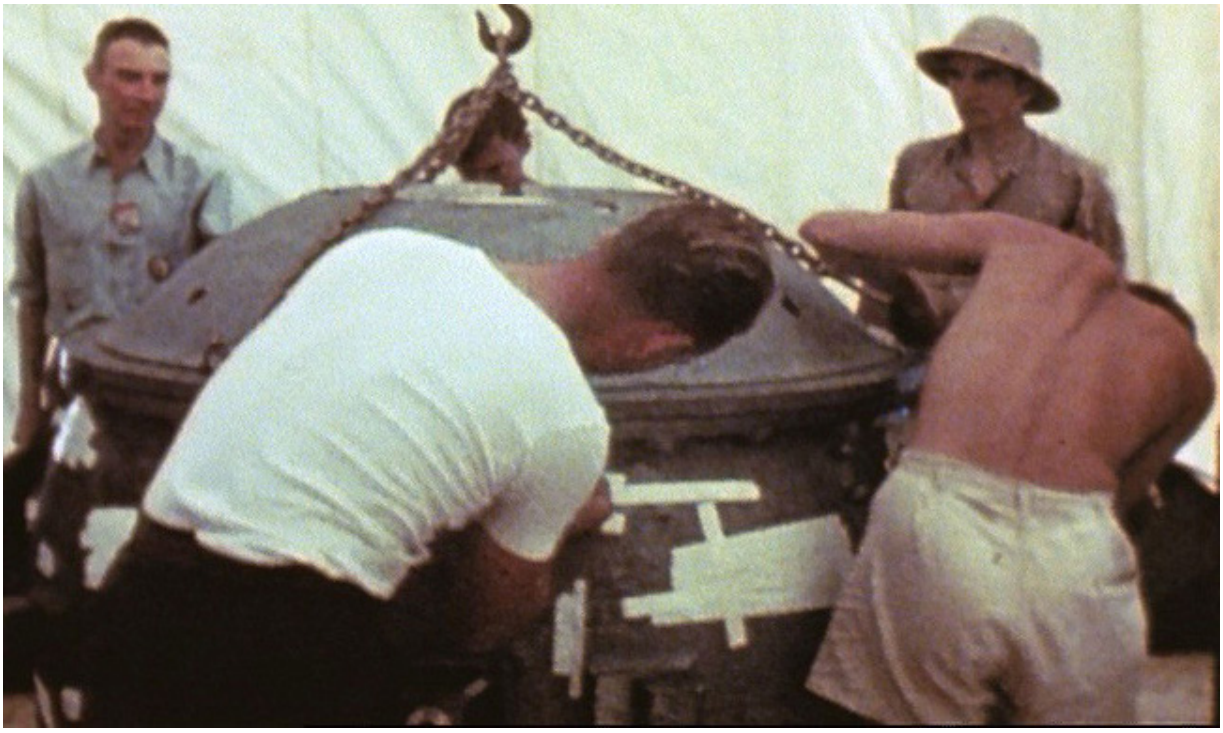
the bomb; four to eight others, on the sorts of themes the workshop examined, would extend off of it. Each module would contain artifacts, testimonies, documents, etc., to form a coherent presentation that also would be intimately connected to the center. Not only would such a spatial plan communicate the relationships among the themes, but it would offer stand-alone, informative stories for visitors who might visit only one module. The storyline could be non-linear—a considerable advantage for those planning thematic content and for visitors who do not go through exhibitions in a designated sequence. In addition, the exhibition could fit into host sites of varying sizes by changing the number of modules on the floor.

Creating a heritage trail of Manhattan Project sites, in which different but complementary stories would be told at each site, was yet another exciting thought.

Active Engagement

- Exhibitions and events specifically designed to incorporate varying public perspectives into the presentations themselves
- Mechanisms to encourage direct interactions between individuals and groups (dialogues, forums, blogs, "meet the scientist/historian" discussions, citizen science projects, etc.)
- Role playing, theatrical performances, alternative narratives with differing outcomes, "table-top" gaming, and real-time group surveying
- Conferences and commemorations
- Virtual programming, extended on-line activities

From the presentation by Anthony "Bud" Rock, CEO, Association of Science-Technology Centers, Inc. on the second day.



Recommendations included focusing on the bomb and biographies of the scientists involved

Message

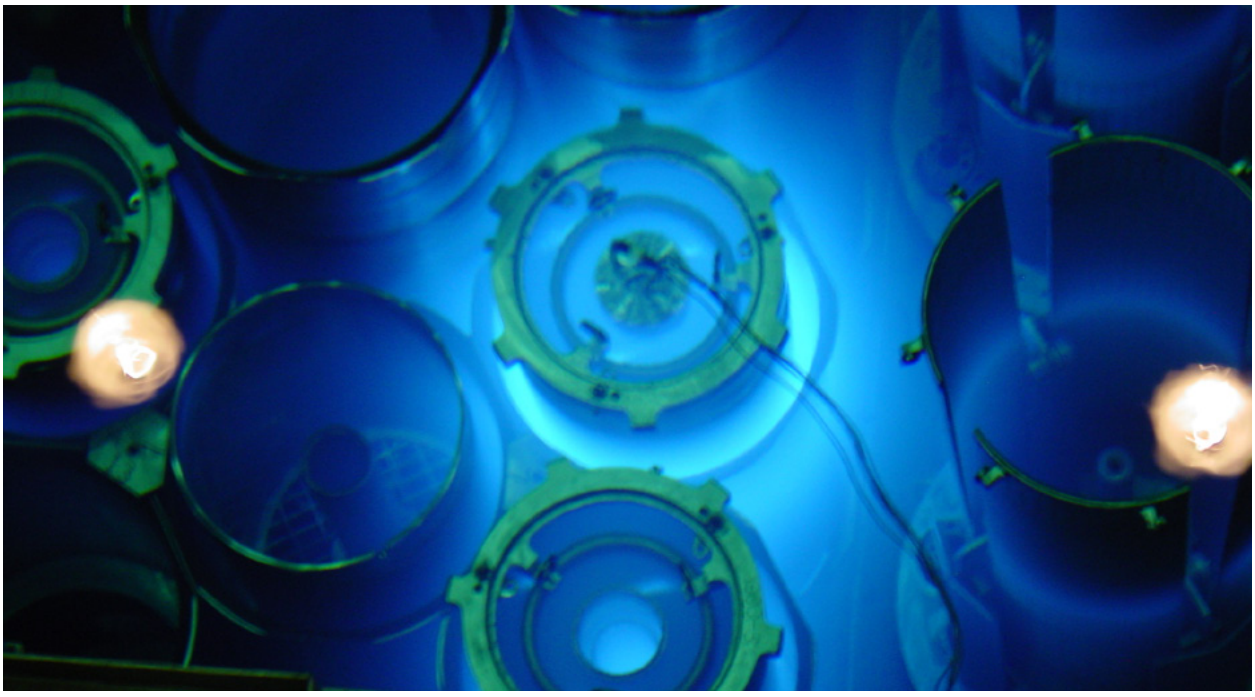
There was not much explicit discussion about the message, nor was there a clear consensus on what it should be. The closest participants came was that the exhibition should be objective about the introduction of a new technology that had intended and unintended consequences. The consequences were positive and negative, not good and bad. Another proposal using the positive/negative axis was: humankind discovers the wonders of the atom and invents the means of its own destruction. Scholarship and market research will bear on the final choice.

The tenor of the exhibition should be a mix of fun, play, sadness, and sorrow.

Market Research

Participants recommended conducting front-end research to determine what the public knows and wants, what the potential venues are interested in, and funders' expectations. Manhattan Project and atomic exhibitions have more stakeholders than expected, so they have to be identified in advance. Look at what is selling now, especially across disciplines. Conduct focus groups, and by age—if the exhibition will travel abroad, bring in international participants. Investigate the gaps in science centers' programs that this exhibition can fill. Some participants felt the sociological aspects of the Manhattan Project's legacy (e.g., the national security state) would be especially interesting and new for audiences. Anecdotally, a participant observed, no one is interested in nuclear reactors, they're interested in the bomb and whether we had to use it (although the age of the visitor will matter here). Research will test these impressions.

Participants weighed the kinds of museums that might take this exhibition: science or history? aviation? Should there be more than one version of the exhibition? Science centers can and do tackle socially relevant and controversial issues, and 61 percent of all adults visit a science center every year.



Cherenkov radiation inside a nuclear reactor today

Audience
Three main points here: age and generational considerations are very important; the exhibition ideally should travel to Europe and possibly Japan. Participants were most definite that the exhibition should be one we would be proud to show in Japan.

Traveling
An exhibition will perform differently in different venues. For example, how many visitors attend, how long they stay, or how they use the exhibition depends in part on where the venue is, whether it is a community gathering place or a must-see location, what else is in the neighborhood.

The exhibition could snowball as it traveled, adding material in each place in collaboration with local partners; this material could accompany the exhibition to the next site and/or be left behind for the host institutions.

Conclusion

In a short two days, the AHF workshop produced impressively well-articulated options for a model, innovative exhibition. It would be based on the latest interdisciplinary scholarship and reflect diverse voices. At a deeper level, it will illuminate a turning point in war and peace, humanity and nature.

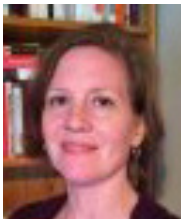
The Manhattan Project poses particular challenges of public perception. However, tools to meet the challenges are many, and opening minds to a development about which there is so little general knowledge and so much ambivalence— if not disapproval—would be a signature achievement.

Women workers at the Y-12 Plant in Oak Ridge. Their stories will be included in the exhibition, as will the perspectives of many other workers and people impacted by the project and the bombs

Appendix
Transforming the Relationship Between Science and Society Workshop Participants

Carla Borden, MA: Formerly Program/Publications Manager, Center for Folklife and Cultural Heritage, and Associate Director, Office of Interdisciplinary Studies, at the Smithsonian Institution. Borden wrote the final report on "Transforming the Relationship Between Science and Society."

Andrew Brown, MD: Radiation oncologist and author of *Keeper of the Nuclear Conscience: The Life and Work of Joseph Rotblat* (Oxford University Press, 2012) and *The Neutron and the Bomb: A Biography of Sir James Chadwick* (Oxford, 1997).



Kirsten Büchner, MA: Principal and owner of Insight Evaluation Services, Büchner has over twelve years of experience in field of visitor studies. She will conduct an evaluation of the "Transforming the Relationship between Science and Society" workshop.

Angela Creager, PhD: Professor and Director of Graduate Studies, Program in History of Science, Princeton University, author of *Life of a Virus*, coeditor of *Feminism in Twentieth-Century Science, Technology, and Medicine*, and author of the forthcoming book *Life Atomic: Radioisotopes in Science and Medicine* (UChicago Press, 2013).

Linda Deck, MS: Director of the Los Alamos National Laboratory's Bradbury Science Museum in Los Alamos, NM.

Al DeSena: Program Director, Division of Research on Learning Formal and Informal Settings, Education and Human Resources Directorate, National Science Foundation.

Charles D. Ferguson, PhD: President, Federation of American Scientists, and Adjunct Professor, Security Studies Program, Georgetown University, and Philip D. Reed Senior Fellow for Science and Technology at the Council on Foreign Relations.

Alan Friedman, PhD: Consultant in museum development and science communication. From 1984 to 2006, he served as Director of the New York Hall of Science creating new technologies to serve diverse audiences.

Cynthia C. Kelly, MAT: Founder and President of the Atomic Heritage Foundation, formerly a senior executive with the Federal government, and author or editor of seven books including *The Manhattan Project* (Black Dog & Leventhal, 2007) and a series of guidebooks to the Manhattan Project sites.

Fred Kronz: Program Director, Division of Social and Economic Sciences, Science, Technology, and Society Program, National Science Foundation.

Peter Kuznick, PhD: Associate Professor of History and Director, Nuclear Studies Institute, American University, author of *Beyond the Laboratory: Scientists as Political Activists in 1930s America,* and co-editor of *Rethinking Cold War Culture*. He recently collaborated with Oliver Stone on the book and documentary series *The Untold History of the United States*.

Alexandra Levy, MA: Program Manager at the Atomic Heritage Foundation since January 2012, Levy manages AHF's oral history project, social media, and publications.

J. Lawrence Lee: Engineer-Historian, Historic American Engineering Record, National Park Service.

Ken Mayes: Deputy Director of the American Museum of Science and Energy in Oak Ridge, TN.

Heather McClenahan, MA: Executive Director of the Los Alamos Historical Society in Los Alamos, NM.

Arthur Molella, PhD: Director, Lemelson Center for the Study of Invention & Innovation of the Smithsonian Institution. He was previously the curator of "Science in American Life" at the National Museum for American History.

Kelly Moore, PhD: Associate Professor, Department of Sociology, Loyola University Chicago. She is the author of *Disrupting Science: Social Movements, American Scientists, and the Politics of the Military, 1945-1975* (Princeton University Press, 2009) and in 2011-2012 served as Program Officer for the NSF's Science, Technology and Society Program.

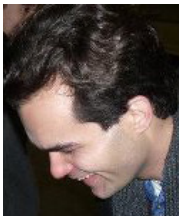
J. Shipley Newlin: Program Director, Physical Sciences and Technology, Science Museum of Minnesota, which produced the traveling exhibition, "Race: Are We So Different?" Newlin is program director for the museum's physics, engineering, and mathematics projects.

Robert (Stan) Norris, PhD: Senior Fellow, Federation of American Scientists and author of R*acing for the Bomb: General Leslie R. Groves*, *the Manhattan Project's Indispensable Man* (Steerforth Press, 2002).

Cameron Reed, PhD: Chair and Professor of Physics, Alma College. He is currently developing a synoptic history of the Manhattan Project for publication in 2014.

Richard Rhodes: Pulitzer Prize-winning author of *The Making of the Atomic Bomb* (Simon & Schuster, 1986), the first in a quartet on nuclear weapons history, as well as over twenty other books and a play, *Reykjavik* (2009).

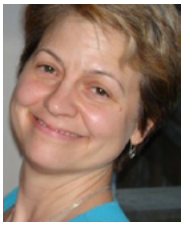
Anthony (Bud) Rock, PhD: Chief Executive Officer, Association of Science-Technology Centers, Inc., an organization of science centers and museums around the world, dedicated to furthering engagement with science.



James D. Skee: Edward Teller Fellow at the Department of Energy and doctoral candidate in history at the University of California-Berkeley.

Stephanie Toothman, PhD: Associate Director for Cultural Resources, the National Park Service. Toothman previously served as chief of cultural resource park and partnership programs for the NPS Pacific West Region, as regional historian, acting superintendent at Crater Lake National Park, and as acting director of the Interior Department's Office of Youth. She will address the workshop at the Feb. 14 dinner.

J. Samuel Walker, PhD: Former historian of the Nuclear Regulatory Commission and author of several books on nuclear history, including *Prompt and Utter Destruction: Truman and the Use of Atomic Bombs Against Japan* (University of North Carolina Press, 1997).



Julia Washburn, MA: Associate Director for Interpretation and Education, the National Park Service. Washburn previously served as senior vice president for grants and programs at the National Park Foundation and as key advisor to the National Parks Second Century Commission's Education Committee. She will address the workshop at the Feb. 14 dinner.

Sandy Weber: Cultural Resources Interpretive Specialist, Associate Directorate for Interpretation and Education, the National Park Service.

Alex Wellerstein, PhD: Associate Historian at the Center for the History of Physics at the American Institute of Physics. He runs the popular blog "Restricted Data: The Nuclear Secrecy Blog." A book version of his dissertation, *Knowledge and the Bomb: Nuclear Secrecy in the United States, 1939-2008*, will be published by UChicago Press.

Robert (Mac) West, PhD: Principal of Informal Learning Experiences, Inc., a Denver-based firm founded in 1992. He has extensive experience as a university professor, museum curator and museum director.