14. Building the Atomic Bomb: The Manhattan Project

On July 16, 1945, in the darkness just before dawn, a flash lit up the New Mexico desert some 160 miles south of Santa Fe, and observers witnessed the world’s first nuclear mushroom cloud boil and climb more than seven miles into the sky. The U.S.-led program to develop a massive explosive device based on cutting-edge physics had taken five years, cost nearly $2 billion, and included research and production facilities in more than two dozen locations. Dubbed the Manhattan Project for its first headquarters in New York City, this program had yielded a weapon of astonishing potential. Exceeding most expectations, the bomb had exploded with a force of twenty thousand tons of TNT.

Franklin D. Roosevelt launched the atomic bomb project in 1939, after a letter signed by Albert Einstein explained the potential for such a weapon and suggested the Nazis might already be working to develop one. The president ordered immediate action on the information. The combatant that laid hold of such an annihilating weapon first would surely win the war.

Of course, FDR did not live long enough to witness the successful test detonation, nor to make the final order that sent B-29s over the Japanese homeland to drop nuclear bombs on Hiroshima and Nagasaki in August 1945. That would fall to his successor, Harry Truman, who until FDR’s death in April didn’t even know of the top-secret weapons program. But FDR’s secretary of war, Henry Stimson, who had supervised the bomb project and advised FDR on it, also headed a committee appointed by Truman to advise the new president on atomic policy. Even before the successful detonation, this committee recommended the bomb be used on Japan as soon as possible and without warning.

Though no one can say what FDR would have done in Truman’s place, according to Stimson, FDR and his war planners were concerned, first, with how the bomb could help them bring the war to a speedy end with a minimum of casualties, and, second, with controlling the use of nuclear weapons after the war; at no time, according to Stimson, did FDR suggest the bomb shouldn’t be used in war if it became available. “All of us of course understood the terrible responsibility involved in our attempt to unlock the doors to such a devastating new weapon,” he wrote. “President Roosevelt particularly spoke to me many times of his own awareness of the catastrophic potentialities of our work. But we were at war, and the work must be done.”

In the summer of 1945, the United States was at last in possession of deployable nuclear weaponry, and the war in the Pacific dragged on. A Japanese victory was out of the question, yet, thanks to a small cadre of fanatical militarists, a Japanese surrender seemed equally elusive. In approaching the Japanese mainland, Americans had sacrificed more than six thousand lives at Iwo Jima in February and twelve thousand in the spring at Okinawa. The Japanese had fought fiercely for both islands, losing some hundred thousand men at Okinawa, with many thousands of casualties among local civilians.

In June Truman authorized a tremendous amphibious assault on Kyushu, the third largest Japanese island, to take place that fall. Intelligence intercepts revealed the Japanese were massing their forces there. American casualty projections were astronomical. But the attack on Kyushu, code-named Operation Downfall, never took place. Instead the final assault on Japan would come from the air.
The Einstein Letter

On October 11, 1939, Franklin D. Roosevelt received one of the most important pieces of correspondence of his long presidency—a letter from Albert Einstein in which the world-famous scientist warned the president that new scientific discoveries involving a nuclear chain reaction might lead to the creation of extremely powerful bombs. The letter, drafted by Einstein’s colleague, the Hungarian-born physicist Léó Szilárd, also alluded to the fact that German scientists were working in this area. It noted that since Adolf Hitler’s seizure of Czechoslovakia in March, all sales of the key element uranium from Czechoslovak mines—an excellent source of the ore—had ceased. In light of this ominous development, Einstein urged the president to accelerate experimental work then being carried out in various university laboratories in the United States, and to take steps to secure an adequate supply of uranium ore.

FDR immediately established the Advisory Committee on Uranium, which held its first meeting ten days later, on October 21 For the next two years, the Uranium Committee wrestled with various scientific problems associated with the development of nuclear power, but progress was often slow. A majority of the committee members remained skeptical that an atomic weapon could be developed before the end of the war.

In the meantime, two German Jewish émigré scientists working in Great Britain, Otto Frisch and Rudolf Peierls, came to a strikingly different conclusion in the spring of 1940. Their work indicated that an atomic bomb might require no more than a few pounds of uranium, estimating quite accurately, as later tests would confirm) that a bomb made with just five kilograms (eleven pounds) of uranium would have the destructive power of several thousand tons of dynamite.

The Frisch–Peierls memorandum spurred the British government into action.

By July 1941, a new committee established to look into the efficacy of uranium weapons—the Military Application of Uranium Detonation, or MAUD, Committee—concluded that a uranium bomb was not only within reach but was likely to lead to decisive results in the war. The committee recommended that the United Kingdom begin work on such a weapon without delay.

British prime minister Winston Churchill fully supported this conclusion and in October 1941, the British government launched the TUBE ALLOYS project to build an atomic weapon. But Churchill also recognized that such a project would require enormous scientific and financial resources, and he welcomed American participation in the effort. Hence, he kept FDR apprised of the work in Britain, ordering that the July 1941 MAUD report be sent directly to FDR’s scientific advisors.

FDR was alarmed at the new findings. When he received word that the U.S. Office of Scientific Research (which had replaced the Uranium Committee) not only agreed with the MAUD report but also believed the Germans had gained a two-year head start on the Allies in developing nuclear weapons, he immediately approved a crash program to urgently pursue the construction of an atomic bomb.
The Manhattan Project

Franklin D. Roosevelt’s decision to throw the full weight of the United States government behind the effort to develop a nuclear weapon radically augmented the scope and scale of atomic weapons work being carried out on both sides of the Atlantic. By the fall of 1942, the British and American efforts were merged and placed under the control of the U.S. War Department in what was now called the Manhattan Project.

Centered in the United States, under the overall direction of Brigadier General Leslie R. Groves of the U.S. Army Corps of Engineers, the Manhattan Project would quickly evolve into one of the most sophisticated large-scale scientific efforts in human history. It involved scientists working at labs in a number of leading universities in the United States, Britain, and Canada, as well as the creation of significant new federal facilities—including Clinton Laboratories (renamed Oak Ridge National Laboratory in 1948) in the newly created town of Oak Ridge, Tennessee, which, between 1943 and 1945, grew from sparsely populated farmland (original residents were evicted) to a city and scientific facility of more than seventy-five thousand people; the Hanford Engineering Works located in south-central Washington State, which employed over fifty thousand workers in the construction of the world’s first full-scale nuclear reactor; and the Los Alamos National Laboratory, in Los Alamos, New Mexico, which employed more than five thousand scientists and engineers.

In one of the war’s great ironies, Germany’s persecution of European Jews had in fact impoverished its own scientific program, while sending a number of brilliant Jewish émigrés to form the backbone of United States–led atomic weapons research. A nuclear bomb, they thought, would be the Allies’ only defense should the Nazis lay hold of this powerful weapon.

Carried out in utmost secrecy, the Manhattan Project received top priority from 1942 until the end of the war. After years of work, roughly three months after FDR died of a brain hemorrhage at Warm Springs, Georgia, scientists tested the first atomic bomb at a remote desert bombing range about two hundred miles south of Los Alamos. Code-named Operation Trinity, the explosion took place at 5:29 a.m. on July 17, 1945, while General Groves, Manhattan Project scientific director Robert Oppenheimer, and others involved in the project looked on in amazement. The blast created a fireball that was visible for more than sixty miles.

In the summer of 1945, the Nazis already defeated, some scientists working on the U.S. atomic program expressed misgivings about using the bomb in war, hoping the mere threat of its use could press the Japanese to surrender. An informal poll of Manhattan Project scientists working in Chicago, taken a few days before the successful test detonation in the New Mexico desert, found that a majority favored some kind of public display of the bomb’s power before dropping it on populations.
Hiroshima and Nagasaki

President Harry Truman learned of the successful bomb test while attending the Potsdam Conference outside of Berlin. After mentioning somewhat casually to Joseph Stalin that the United States had a new weapon, Truman ordered preparation for its use against Japan. On July 26, 1945, the president, joined by the newly elected British prime minister, Clement Attlee, issued the Potsdam Declaration, calling on Japan to surrender unconditionally or face "prompt and utter destruction." The Japanese government declined to consider the American terms, because they did not guarantee that Japan could retain its emperor, the very symbol of the nation. So Truman issued the order to proceed with the use of the bombs.

On August 6, at 8:15 a.m. local time, the B-29 Enola Gay dropped the first of America's two remaining atomic weapons on the Japanese city of Hiroshima. Within a matter of minutes, a twenty-thousand-foot mushroom cloud rose over the city. The initial explosion and radiation killed an estimated sixty thousand people, while another sixty thousand are estimated to have died from radiation poisoning and other injuries in the weeks and months that followed. Three days later, another B-29 appeared, this time above the Japanese city of Nagasaki, where at 10:58 a.m. local time, the second atomic bomb was dropped, killing an estimated thirty-five thousand people outright, with another forty thousand dying in the aftermath from severe injuries or the effects of radiation.

Having suffered these two devastating air attacks, as well the invasion of Manchuria by Russian forces, the Japanese signaled their willingness to surrender within twenty-four hours of the bombing of Nagasaki, so long as doing so would not compromise the status of the emperor. Shortly thereafter, the Truman administration quietly indicated its willingness to allow the emperor to remain on the throne, and on Aug. 14, 1945, Japan surrendered. The Second World War was over.
The Legacy of the Manhattan Project

America’s successful development of atomic weapons and decision to use them in the war against Japan will forever remain controversial. Some contend that using the bombs against a greatly weakened Japan was needlessly destructive of human life and an unacceptable attack on civilians. Others argue that it saved lives by finally ending World War II and perhaps by displaying the bomb’s terrible power—and thus preventing its use in later conflicts.

The United States, of course, did not remain the sole nuclear power for long. The Soviets exploded their own bomb in 1949, setting off the nuclear arms race and widespread fear of a truly world-ending conflict that characterized the decades-long Cold War. Prominent Manhattan Project alumni were among those who pleaded for disarmament and control of nuclear weapons during these years.

But the legacy of the Manhattan Project—which employed more than 130,000 people at a cost of two billion 1940s dollars—goes far beyond the creation of new weapons. It led, for example, to the development of nuclear power as a way of generating electricity. The first nuclear reactor for power generation began operating in 1951 in Idaho, and by 2008 nuclear power accounted for nearly 20 percent of America’s electricity production.

The wartime Manhattan Project also set the precedent for large-scale federal investment in scientific research and for the government-industry collaborations that can bring discoveries into practical use. The federal project’s large-scale production of the special materials, such as plutonium and uranium, required to build nuclear bombs represented an industrial feat as much as it did a scientific breakthrough; DuPont, the chemical company, played a significant role.

Moreover, government research begun in places like Oak Ridge, Tennessee, and Los Alamos, New Mexico, contributed very significantly to postwar advances in biological research and medicine. In 1946 the newly created Atomic Energy Commission took over Manhattan Project facilities to manage the peacetime development of atomic science. One important initiative was to begin supplying reactor-produced “radioisotopes” (radioactive isotopes) to universities and hospitals for research, making them far more available than they had been before the war.

These radioactive variants of chemical elements can be used to “tag” chemical compounds so they can be traced, using a radiation detector, as they undergo chemical reactions. Researchers have used the technique to better understand processes from plant photosynthesis to human absorption of minerals such as iron and calcium.

Perhaps most notably, radioactive labels have become a vital tool in clinical medicine, with more than twenty million procedures taking place in the United States each year. Most are diagnostic imaging procedures in which the radioisotope, injected into the body, helps doctors study the patient’s heart, brain, or other organs, or track cancer progression. The technology can also be used to treat certain cancers, for example in a procedure called brachytherapy in which tiny radioactive pellets or “seeds” are implanted in or near a tumor, delivering high-dose radiation that damages cancer cells.

Indeed, radioisotopes also have a number of industrial applications, from studying the movement of sewage or surface water to monitoring soil erosion and corrosion of metals.

The Manhattan Project launched by Franklin D. Roosevelt in a race against the Nazis to produce a weapon of unprecedented force—a weapon, according to FDR’s secretary of war Henry Stimson, “as legitimate as any other of the deadly explosive weapons of modern war”—did not reach fruition in time to affect the Allies’ war against Germany. But the project’s effects around the world have been profound, enduring, and nearly as varied as the consequences of knowledge itself.