Part II: World War II and the Atomic Bomb

Breakthroughs in aeronautics during the two decades between World War I and World War II raised new possibilities for air warfare. Scientists and engineers dramatically increased the speed, size, and range of aircraft. The fragile biplanes of World War I gave way to sturdy, reliable flying machines. By the late 1930s, most of the world's strongest countries were building up their air forces and working air power into their overall military strategies.

The European War

Air power was an integral element of Nazi Germany's military strategy in World War II. German generals trained their armies to quickly overcome their opponents through a *blitzkrieg*, or "lightning war." On the ground, German offensives were spearheaded by fast-moving tanks. In the air, the Nazi Luftwaffe (air force) struck military positions to break down enemy defenses.

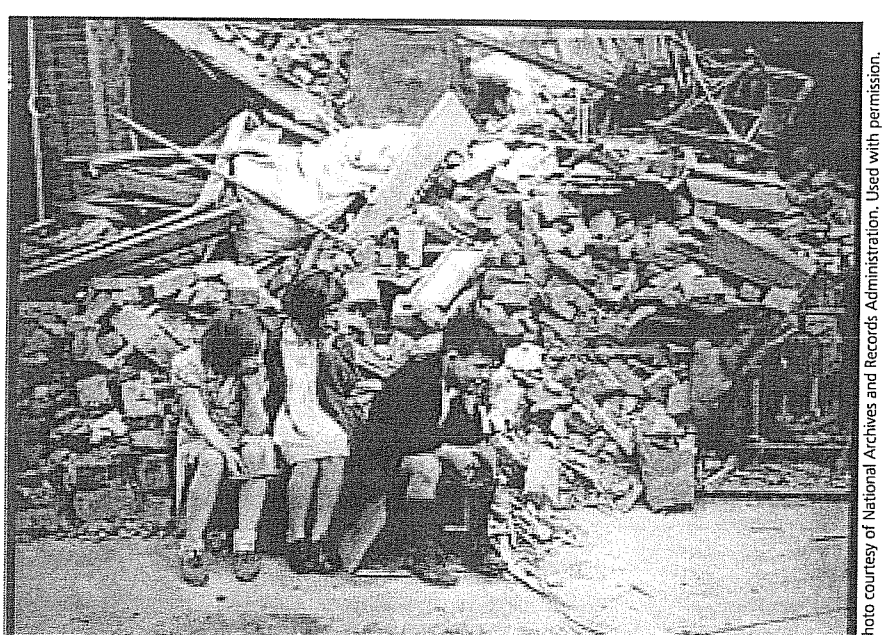
How did the Nazis use air power in World War II?

In September 1939, Poland became the first victim of the German *blitzkrieg*. Within a few weeks, Nazi armies overran much of Poland and destroyed many of the country's largest cities. The Luftwaffe intentionally bombed urban centers to terrorize Poland's civilian population. The leaders of the United States, Britain, France, and other Western democracies were stunned by the speed and ruthlessness of the German assault. They were forced to recognize that the rulers of the Axis alliance—Germany, Italy, and Japan—cared little for established rules of war or individual rights. German leader Adolf Hitler began carrying out plans to enslave millions of Slavs and exterminate Jews as his troops were invading Poland.

In the spring of 1940, Hitler turned his war machine on Western Europe. The Nazis used many of the same tactics that had smashed Polish resistance. The first city to be intentionally bombed in the West was Rotterdam in the Netherlands. In May 1940, fifty German bombers dropped ninety-four tons of explosives on Rotterdam's center, killing one thousand civilians. The British retaliated by bombing Germany's highly industrialized Ruhr Valley.

After the fall of France in June 1940, Hitler focused his attention on Britain. The Nazis planned to invade Britain in "Operation Sea Lion," but first they hoped to soften up British defenses with an intensive bombing campaign. In August 1940, the Luftwaffe began bombing British airfields and aircraft factories. The bombing raids, conducted during daylight hours to enable German pilots to find their targets, took a heavy toll on the Luftwaffe.

In the fall of 1940, Nazi strategists switched to less accurate nighttime bombing and increasingly took aim at Britain's cities,



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Children sit outside what used to be their home in London, September 1940.

especially London and the surrounding areas. Their aim was to destroy the British will to resist rather than Britain's military might. For nine months, Londoners were forced to spend many of their nights huddled in air raid shelters. By May 1941, nearly forty-four thousand civilians had been killed in Britain. After a particularly devastating attack of the "London blitz" in 1940, British Prime Minister Winston Churchill ordered the British air force to retaliate by launching raids on Berlin, Germany's capital.

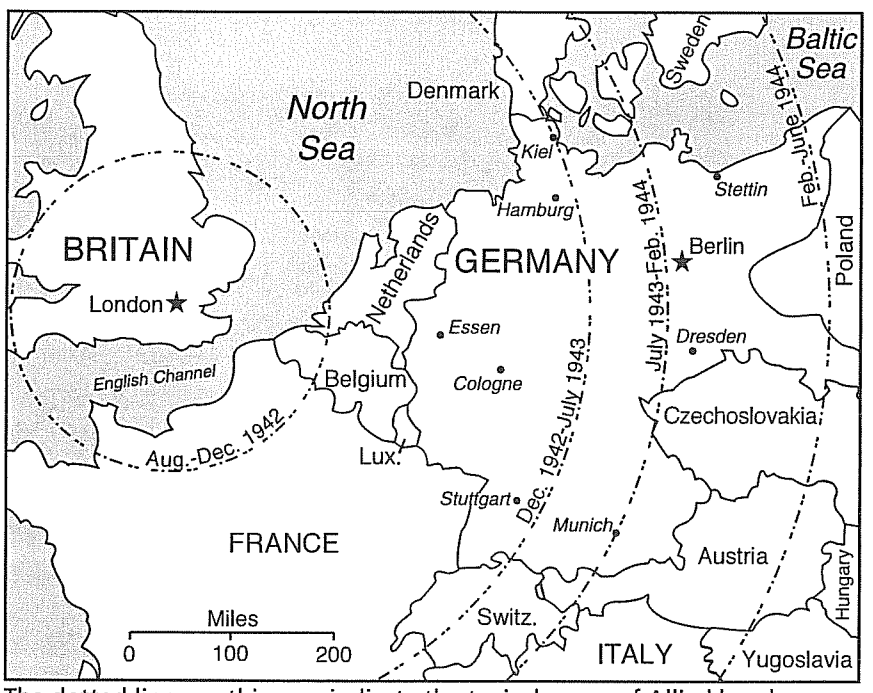
How did Roosevelt respond to the military tactics of the Nazis?

U.S. President Franklin D. Roosevelt was shocked by the military tactics of the Nazis. Soon after Germany's invasion of Poland, he strongly condemned Nazi bombing raids on civilians.

> ***"The ruthless bombing from the air of civilians in unfortified centers of population...has sickened the hearts of every civilized man and woman, and has profoundly shocked the conscience of humanity....I am therefore addressing this urgent appeal to every Government which may be engaged in hostilities publicly to affirm its determination that its armed forces shall in no event, and under no circumstances, undertake the bombardment from the air of civilian populations."***
>
> —President Franklin D. Roosevelt

By the time the United States entered the war in December 1941, Roosevelt's plea had been rejected by the Axis and the Allies alike. Hitler's invasion of the Soviet Union in June 1941 had introduced a new level of barbarity to the conflict. In the first six months of the German assault, one million Soviet troops were killed or wounded. Another 3.5 million Soviets were taken prisoner; more than 90 percent of them were to die in captivity.

The scope of the war against the Allies in Europe was characterized not just by German bombing raids but by submarine attacks throughout the Atlantic as well as land warfare from North Africa to the suburbs of Moscow. This terrified Allied citizens and gave their leaders great pause. Many worried that the Axis powers might prevail. It was under these conditions that American and British military strategists developed more accurate and more deadly bombing, seeking to cripple war industries and to force the Nazis to concentrate on defending their homeland.



The dotted lines on this map indicate the typical range of Allied bombers during the War.

The tremendous battles on the Eastern Front relieved pressure against the British. At the same time, the enormous industrial potential of the United States soon tipped the balance of power in favor of the Allies. In 1942, the Allies were already

gaining air superiority on the Western Front. During the course of the entire year, only twenty-seven Londoners lost their lives in German bombing raids. Meanwhile, British and American pilots were increasingly striking the German homeland.

What choices did Allied bombers have when considering when to bomb and whom to target?

Allied policymakers were soon confronted with a moral dilemma. Staging raids in daylight hours allowed British and American pilots to distinguish military targets from residential areas, but left them more vulnerable to German air defenses. Bombing at night was safer for the Allied pilots, but accuracy was lost. A British study of nighttime bombing conducted early in the war concluded "that although Bomber Command believed they had found the target, two-thirds of the crews actually failed to strike within five miles of it."

Ultimately, the British decided in favor of nighttime attacks. As early as February 1942, Arthur Harris, the chief of British Bomber Command, gained approval from Churchill to target Germany's industrial cities and their civilian populations. The policy of dropping bombs on large areas rather than narrowly defined targets became known as "strategic bombing." British Bomber Command developed a precise formula for carrying out raids on German cities, calculating that one ton of high explosives was needed for every eight hundred inhabitants.

> ***"It has been decided that the primary objective of your [Allied] operations should now be focused on the morale of the enemy civil population and in particular, of the industrial worker."***
> —Arthur Harris, British Bomber Command

The suffering caused by British bombing quickly surpassed that of the London blitz. A British attack on the German port city of Lubeck in March 1942 marked the first raid in which the number of dead and wounded exceeded ten thousand people. In May 1942, the British began launching a thousand bombs or more against a single target. Their first target was the German city of Cologne.

How did technological experimentation enable the British to succeed in efforts to destroy German industrial centers?

British military officials also led the way in maximizing the destructiveness of their bombing operations. In 1942, they tested various combinations of high-explosive bombs (which destroy buildings) and incendiary bombs (which start fires). They also experimented with bombing patterns. The British learned that dropping high-explosive bombs splintered wood frame structures and shattered windows, thus providing the fuel and increased air flow necessary to spread fires ignited by incendiary bombs. The British objective was to create a "firestorm" that would engulf virtually an entire city in a blazing inferno.

The first large-scale effort to engineer a firestorm was directed against Hamburg, Germany's second-largest city, in July 1943. The five-day operation began with wave after wave of Allied warplanes dropping their bombs on target areas marked by flares. The technique, later known as "carpet bombing," leveled Hamburg sector by sector. The carpet bombing quickly overwhelmed the capacity of the city's fire-fighting and communications system.

On the third night of the attack, a combination of high temperatures, low humidity, and the increased use of incendiary bombs set the stage for a firestorm. Hurricane-like winds fanned the flames and spread the firestorm over eight square miles of the city. Temperatures within the firestorm rose to more than 1,400 degrees Fahrenheit. Asphalt pavement melted, trapping civilians seeking to escape. Bodies were charred and shrunken into tiny blackened bundles. More than forty-five thousand Germans, mostly civilians, perished that night.

> ***"The total destruction of this city [Hamburg] would achieve immeasurable results in reducing the industrial capacity of the enemy's war machine. This, together with the effect on German morale, which would be felt throughout the country, would play a very important part in shortening and in winning the war."***
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> —Order Authorizing "Operation Gomorrah"

Why was Dresden bombed?

The Allied bombing of German urban industrial centers continued to escalate after the Hamburg firestorm. In the United States and Britain there was little public protest against the strategic bombing campaign. Germans had earned a reputation for cruelty among Americans in the early stages of the war, especially during the London blitz. Furthermore, American newspapers generally did not report on civilian casualties in the Axis countries.

While Churchill publicly referred to the policy of "dehousing" German workers, neither he nor Roosevelt told their peoples about the extent or the intent of the Allied bombing of German population centers. The war objective remained, as President Roosevelt stated after the Casablanca Conference in January 1943, "a policy of fighting hard on all fronts and ending the war as quickly as we can on the uncompromising terms of unconditional surrender."

By early 1945, Adolf Hitler's ambitions had been all but smashed. Allied forces were marching into Germany from the west while the Soviet army was pushing back the retreating Nazis in the east. In February 1945, the Allies dealt a further blow to Germany by bombing the eastern German city of Dresden. Known best for its beautiful medieval architecture, Dresden was of little military significance and had been spared from earlier attack. Nonetheless, to ensure Germany's unconditional surrender and to assist the Soviet advance in the east, the Allies staged one of the largest raids of the war against the city, involving nearly twenty-eight hundred aircraft. The firestorm that resulted was visible for two hundred miles. Approximately one hundred thousand Germans, mostly civilians, were killed—the largest loss of life in a single day up to that point of the twentieth century. Three months later, on May 7, 1945, Germany surrendered unconditionally after U.S. and Soviet forces met in central Germany.

The War in the Pacific

In East Asia, the world war had begun with the Japanese invasion of China in August 1937. Although Japan had signed international agreements to prevent war, the Japanese government in the 1930s was increasingly controlled by forces determined to carve out a regional sphere of influence through military might. In 1931, they had seized control of the rich coal and iron ore reserves in the northeastern Chinese province of Manchuria to support their country's industrialized economy.

When the Japanese plunged deeper into China in 1937, President Roosevelt vigorously denounced their attack. The growing American economic stake in China, as well as the activities of American missionaries, caused

Reg Manning in *The Arizona Republic*.

Japan drives through Manchuria to reach the center of China.

the United States to take China's side in the international arena.

The Japanese image in the United States was tarnished early in the Sino-Japanese war. In the fall of 1937, Japan staged bombing raids against the Chinese commercial center of Shanghai. American newspapers reported widely on Japanese efforts to terrorize the city's residents and printed moving photos of orphaned children and maimed civilians. A few weeks later, the Japanese captured Nanjing, the Chinese capital. As hundreds of foreign residents watched, Japanese troops took part in a rampage of murder, rape, and looting against the civilian population. More than two hundred thousand Chinese were killed and the city was burned to the ground. The American press labeled the atrocity the "Rape of Nanking."

Why did the United States enter the War?

The Japanese brought war to the United States on December 7, 1941, with their surprise attack on the U.S. naval base at Pearl Harbor, Hawaii.

> ***"Yesterday, December 7, 1941—a day which will live in infamy—the United States of America was suddenly and deliberately attacked by naval and air forces of the Empire of Japan....It [is] obvious that the attack was deliberately planned many days or even weeks ago. During the intervening time the Japanese government has deliberately sought to deceive the United States by false statements and expressions of hope for continued peace.... Always we will remember the character of the onslaught against us. No matter how long it may take us to overcome this premeditated invasion, the American people, in their righteous might, will win through to absolute victory....We will not only defend ourselves to the uttermost but will make very certain that this form of treachery shall never again endanger us."***
>
> —President Franklin D. Roosevelt

Although U.S. military intelligence had predicted a Japanese offensive in the Pacific, the Japanese did not officially declare war on the United States until after their warplanes had struck Pearl Harbor. Americans were outraged at the breach of fair play. Both U.S.

policymakers and the general public had assumed that America's neutrality would not be violated, even by the Axis. Once and for all, the Japanese had defined themselves in American eyes as an evil, treacherous enemy willing to defy accepted international standards.

What contributed to U.S. attitudes about Japan?

Events during the first few months of the war hardened American attitudes toward Japan. In the Philippines, American soldiers who surrendered were treated mercilessly by their Japanese captors. More than seven thousand Allied prisoners of war died during what came to be known as the "Bataan Death March." As was the case with the war in Europe, many felt that fierce Japanese tactics might overwhelm American efforts.

Never before in U.S. history had an enemy triggered such hatred as the Japanese. In the press, radio, and film, the Japanese were typically depicted as vicious and heartless. Newspaper political cartoons portrayed them as apes, monkeys, and vermin. Japanese-Americans were rounded up and placed in internment camps.

American hatred toward the Japanese shaped U.S. policy as well. Prominent voices within the Roosevelt administration pressed for the complete annihilation of Japan. Admiral William Leahy, Roosevelt's chief of staff, and the editors of the influential *Collier's* magazine compared Japan to Carthage, the mortal enemy of ancient Rome.

Why did the United States bomb Tokyo?

By 1944, the United States was moving rapidly to dismantle Japan's island empire in the Pacific. After the capture of Guam, Saipan, and Tinian, the United States built bases for long-range bombers and began an intense air campaign against Japanese cities. As was the case in the air war against Germany, military planners experimented with different bombing tactics in order to maximize the damage inflicted on Japan. Unlike German urban centers, where most civilians lived in brick and stone buildings, Japanese cities contained sprawling areas of wooden houses. General Curtis LeMay and his staff realized that American bombers delivering largely incendiary loads could reproduce the firestorm phenomenon of Hamburg and Dresden.

In March 1945, an air raid on Tokyo, Japan's capital, demonstrated the awesome power of the U.S. bombing campaign. The targets were the industrial districts of Tokyo, where factories were often flanked by working-class neighborhoods. Since the labor and morale of Tokyo's workers were viewed as central to Japanese resistance, U.S. officials believed that the "necessity of war" concept justified their decision to strike against Japanese civilians.

More than three hundred B-29 superfortress bombers, each carrying two tons of incendiaries packed in 100-pound and 6-pound gelled gasoline (napalm) bombs, descended on Tokyo. At least fifteen square miles of the city were consumed in the resulting firestorm. A column of superheated air rose into the sky, generating turbulence that flipped over U.S. bombers flying more than one mile above Tokyo. In the first six hours of the firestorm, more than one hundred thousand people died.

LeMay was encouraged by the attack on Tokyo. Before the month was over, he ordered the firebombing of three more Japanese cities. By the end of the war, LeMay had ordered the firebombing of sixty-four Japanese cities. The assault came to a temporary halt only when the supply of bombs was exhausted.

What was fighting like in the Pacific islands?

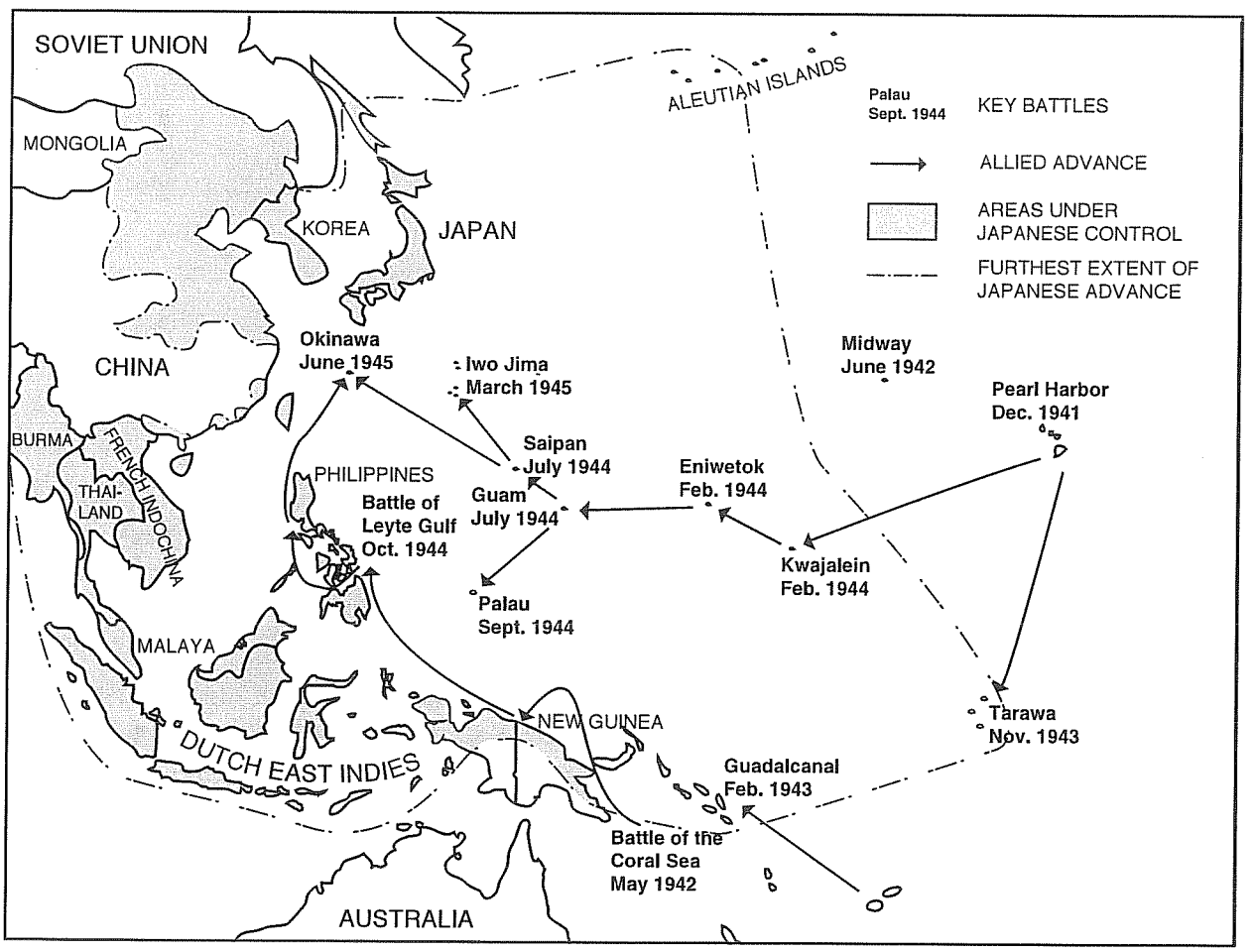
Despite the ghastly loss of life suffered by Japanese civilians from the air war in the spring of 1945, most U.S. strategists assumed that the United States would have to invade Japan's home islands to force the unconditional surrender of their enemy. Japanese resistance was expected to be ferocious. Island battles in the Pacific in 1944 and 1945 had already given American military officials an idea of what awaited their troops.

On the island of Saipan and its smaller neighbor, Tinian, thirty thousand Japanese soldiers died trying to prevent U.S. marines from gaining a base to launch air raids against Japan. When American victory was certain, twenty-two thousand Japanese civilians on the islands, many of them women and children, committed suicide by jumping off high cliffs. Japanese officials had sought to convince the civilians that they would be tortured or raped if they fell into American hands.

The island of Iwo Jima was still closer to Japan and was in fact a Tokyo prefecture (a district or neighborhood), making it an essential part of Japan in Japanese eyes. Japanese fighter pilots flew from Iwo Jima's two airfields to intercept American B-29 bombers headed toward Japanese cities. The order from Tokyo was that the island had to be held at all costs. When U.S. marines landed on Iwo Jima in February 1945, they encountered the bloodiest fighting in Marine Corps history. Nearly five thousand of the attacking Americans were killed and more than twenty thousand were wounded in the five-week struggle. Among the Japanese defenders, more than eighteen thousand died, often by suicide. Only one thousand Japanese were taken prisoner.

According to the traditional Japanese warrior code of *bushido*, to surrender was to break the bonds of duty and obligation that linked the soldier to his divine emperor and to his family. Death was preferred over dishonor. In addition, many Japanese troops believed that Allied forces would kill them if they surrendered. In the case of certain American and Australian units, Japanese fears were in fact justified.

After the fall of Iwo Jima, the island of Okinawa became the next inferno in the Pacific. Again, suicide claimed the lives of tens of thousands of Japanese soldiers during the



battle in the spring of 1945. In all, 185,000 Japanese troops died defending Okinawa, located less than five hundred miles from Japan's main islands. The United States lost 12,500 soldiers on Okinawa, the highest number of deaths in the island campaign.

In addition to the ground fighting, U.S. ships involved in the island landings had to fend off a desperate wave of suicide air attacks. Known as *kamikaze*, meaning "divine wind," Japanese aviators loaded their airplanes with explosives and tried to crash them into enemy ships or aircraft. Beginning in the fall of 1944, hundreds of kamikaze pilots sacrificed themselves in suicide missions against Allied forces.

> ***"I know the Japanese intimately. The Japanese will not crack. They will not crack morally or psychologically or economically, even when eventual defeat stares them in the face. They will pull in their belts another notch and fight to the bitter end. Only by utter physical destruction or utter exhaustion can they be defeated. That is the difference between the Germans and the Japanese. That is what we are up against in fighting Japan."***
>
> —Joseph Grew,
> former U.S. Ambassador to Japan

With each step toward the Japanese homeland, the American casualty rate climbed. In the first thirty-one months after Pearl Harbor, 106,000 Americans either died or were severely wounded in the Pacific war. From July 1944 to July 1945, U.S. casualties topped 185,000.

What were the concerns about an invasion of Japan?

Estimates about the cost of an invasion of Japan's main islands varied widely. General Douglas MacArthur, who had been named to command the invasion force, predicted in June 1945 that his troops would suffer about ninety-five thousand casualties, one-third of them deaths, in the first ninety days of the operation. In contrast, leaders of the navy and air force put forth much higher estimates, warning that as many as five hundred thousand Americans would be killed or wounded in an invasion of Japan.

There were new diplomatic calculations to be made too. With Germany defeated, the Soviet Union was now prepared to enter the war in Asia. At the Yalta Conference in February 1945, Soviet leader Josef Stalin promised President Roosevelt that his country would join the fight against Japan within three months of Germany's surrender. At the time, U.S. officials welcomed Soviet participation. By the summer of 1945, however, relations between the two wartime allies were growing increasingly strained, and the United States feared the Soviets' hold on Eastern Europe as well as its threat to China.

The Development of the Atomic Bomb

The bitter struggle of the Second World War fueled the quest to build an atomic bomb. Scientists in Europe and the United States had begun work on the question of nuclear energy in the first decades of the twentieth century as an extension of their studies on atomic structure and radioactivity. In the 1930s Hungarian physicist Leo Szilard suggested the possibility of using the neutron, a part of the atom, to split the nucleus, or center, of another atom into two smaller parts. This process, called fission, would release energy. The splitting of the nucleus, according to Szilard, would release additional neutrons, which in turn could split other nuclei. The result would be a self-sustaining nuclear chain reaction. By the end of the decade, scientists had made important strides toward triggering a nuclear chain reaction. Experiments with uranium demonstrated that fission was possible using an isotope (an element of similar structure but with different mass) of uranium called U-235, and the energy released from that reaction would be tremendous.

In April of 1939, the German government undertook limited research into the military

uses of atomic energy. Both policymakers and scientists in the United States and Britain watched Germany's advances in nuclear research with growing anxiety, concerned that Germany might develop a bomb before the Allies could. In July of that year, Leo Szilard, along with his friend and colleague Albert Einstein, helped to write a letter alerting President Franklin Roosevelt that recent experiments with uranium might lead to "extremely powerful bombs of a new type." Just before signing, Einstein commented, "For the first time in history men will use energy that does not come from the sun."

What early progress was made in the development of an atomic bomb?

As a result of the fear of growing Nazi power, the U.S. government began several research projects to investigate the power and potential of nuclear fission. In December 1942 a team led by Italian immigrant Enrico Fermi created a self-sustaining nuclear chain reaction in a squash court under the University of Chicago's field house using a form of uranium that had very little U-235 in it. Although this experiment only produced one-half a watt of energy (less than the power in one candle), it was the first time the energy of the atom had been harnessed by humans.

Scientists would need several pounds of pure U-235 to achieve the critical mass necessary for an effective fission bomb. Natural uranium ore contains only 0.7% U-235, so the extraction process would be difficult and expensive. The British developed a method to collect U-235, but they were concerned that the Nazis might bomb a uranium factory located in England. The United States therefore built a factory on a sixty thousand acre site in Oak Ridge, Tennessee.

Meanwhile, Glen Seaborg, a physicist at the University of California, identified in 1941 another element which could be used for fission—plutonium 239. Pu-239 was cheaper to make than U-235, but it was very radioactive and poisonous to humans. Afraid of a radioactive leak, in January 1943 scientists chose a remote section of southeastern Washington state as a site for the giant plutonium-generating reactor.

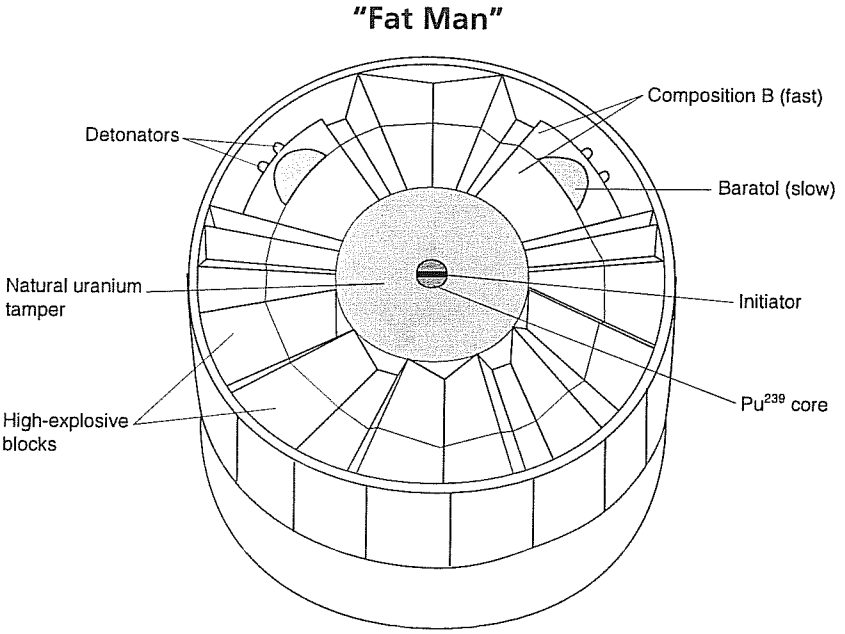
Why did the government combine scientists working on the bomb into a single program?

Although scientists made remarkable strides toward creating an atomic bomb in the early stages of World War II, U.S. policymakers felt that improved organization and coordination would speed up the pace of the effort. The most important step toward consolidation came in August 1942 when the U.S. Army established the Manhattan Project to direct the activities of the several sites involved in nuclear research.

Scientist J. Robert Oppenheimer was hired to direct the actual design and construction of an atomic bomb. He personally recruited many of the scientists who would work together in nearly total isolation in Los Alamos, New Mexico. Few refused. For nearly three years, the desert community hosted the largest team of scientists the world has ever seen. Officially, Los Alamos did not exist. Mail was sent to a post office box in Santa Fe and letters and phone calls were censored to insure secrecy. The scientists and engineers at Los Alamos developed a strong bond among themselves. They were united by the conviction that their work might help win the war and lead to a boundless supply of nuclear energy.

What problems did the Manhattan Project scientists uncover?

The scientists faced several problems, including designing a bomb that would use the smallest amount of fissionable material needed for a self-sustaining nuclear chain reaction. They also needed to create separate compartments in the bomb to hold small quantities of fissionable material until the bomb detonated. Otherwise, the heat generated by the early stages of the chain reaction would melt the bomb and lead to incomplete fission and the release of less destructive energy. Two types of bombs were developed. "Little Boy" used U-235. The other type, known as the "Fat Man," used plutonium.



What was the result of the testing of the bomb?

As the war in Europe was ending, it became clear through intelligence that the Nazis did not have the material necessary to develop atomic bombs, and in fact had been focusing their research efforts on rockets. Germany's collapse had no impact on the momentum of the Manhattan Project, however. By July 1945, two months after the Nazi surrender, components for three atomic bombs had been manufactured and B-29 planes had been refitted to carry the weapons. The pilots of these planes had trained for ten months in Utah, and while they were aware of the importance of their potential mission, they did not know what kinds of bombs they might be asked to drop.

The existence of the bomb remained a closely guarded secret. Even Harry Truman, vice-president during most of the war, did not know about the bomb until he assumed the presidency after Roosevelt's death on April 12, 1945. At the same time, the Los Alamos team was uncertain if the weapon they had created would actually work. A test was scheduled for mid-July 1945 to detonate one of the two implosion bombs designed at Los Alamos.

The test bomb, a twin of "Fat Man" code-named "Trinity," was mounted on a hundred-foot tower at the Alamogordo Bombing Test Range in New Mexico. After a brief thunderstorm had safely passed, the device was triggered at 5:29 a.m., July 16.

The Los Alamos scientists watched the detonation from a safe distance and had different reactions. They had formed a betting pool on the results of the test. Some expected the implosion technique to fail. Others estimated yields from three hundred tons of TNT (Oppenheimer's bet) to forty-five thousand tons of TNT (scientist Edward Teller's guess). A Columbia University physicist, Isidor Rabi, put his money on a yield of eighteen thousand tons of TNT. He won.

Otto Frisch said the explosion rose like "a red-hot elephant standing balanced on its trunk." Then the bang came, "quite loud though I had plugged my ears." Phil Morrison, another scientist who was ten miles from the test site, said the bomb looked like "a desert sun in the midst of night." Isidor Rabi, at the base camp, said later, "I haven't got over it yet. It was awful, ominous, personally threatening. I couldn't tell why." As the group's leader, J. Robert Oppenheimer, watched the explosion, he was reminded of a verse from a Hindu holy book: "I am become death, the shatterer of worlds."

After twelve years of research and more than $2 billion in expenditures, an idea that a generation of physicists had only imagined as a theoretical possibility was suddenly a reality. President Truman, who at the time of the test was meeting with British Prime Minister Winston Churchill, Soviet leader Josef Stalin, and Chinese President Chiang Kai-shek in Potsdam, Germany, now had the responsibility of deciding if and how the atomic bomb would be used.