Technology in World War II

Total War

Total war was another new term that came out of the war. It means that all the nation's resources, civilian as well as military, must be brought to bear on the goal of achieving victory. A good case can be made for considering World War I, as well as World War II, a total war. In a total war automobile factories stop making cars and start making tanks. Aircraft factories are expanded and new ones built. Food and gasoline rationing is introduced. Women are recruited into auxiliary branches of the military to perform clerical and administrative tasks and free up more men for combat. Scientists are diverted from pure research to focus on devising new offensive or defensive weapons and improving existing ones. Censorship is imposed, and, in democratic societies, rights and freedoms are restricted.

Communications are a vital aspect of a total war effort. Aside from the obvious need to maintain secure communications for the military, there is also the need to use the tools of communication to wage propaganda warfare. Propaganda offensives have two goals: one goal is to target one's own military and civilian population, the other goal is to target the military and civilian population of the enemy. For one's own side, propaganda is used to keep up the morale, i.e., support for the war effort, on both the home front and among the military. Just the opposite is what is delivered to the enemy. You have seen that Hitler was a firm believer in the importance of propaganda from the early days of his political career. Once war broke out, the Allies turned out to be fast learners.

Propaganda

In wartime, the best propaganda is provided by military victories, be they in the air, on land, or at sea. They cheer the civilians at home and help justify home front sacrifices and the country's war aims as well. For enemy troops and civilians, they have the opposite effect. In World War II, both sides used the radio to deliver their messages. The Germans used, as their radio messenger to Britain, an Englishman with a posh upper class accent, promptly nicknamed Lord Haw-Haw by his English listeners. When he wasn't celebrating German military triumphs (when that was possible), he would deliver conventional anti-Semitic diatribes and attacks on Churchill and other Allied leaders.

For their part, the British Broadcasting Corporation (BBC) had an extensive foreign service, which delivered mostly propaganda-free news in just about all European languages. These nightly news broadcasts came on at a regular time and provided news of events that would not have passed the Nazi censors. In countries, such as France, with an active resistance movement, the broadcasts could include a message in code for the resistance fighters. These would be in the form of an innocuous sentence or two, perhaps combined with a piece of music, to signal a planned air drop or to coordinate on-the-ground sabotage with a planned bombing raid.

The American Office of War Information (OWI) also featured broadcasts delivered in German and other European languages.

The American poet, Ezra Pound, had settled in Italy in 1925 where he developed unorthodox economic ideas, which confirmed an already ingrained anti-Semitism. During the war he aired his views on regular broadcasts on Italian radio. He was arrested by American troops in 1945. He was declared unfit to stand trial for treason for reasons of insanity and confined to a mental hospital near Washington. He was eventually released and returned to Italy where he died in 1972.

In the Pacific theatre, Japan's version of Lord Haw-Haw, was Tokyo Rose, whose sultry voice impressed on her (largely) American listeners the futility of their efforts to defeat Japan and played current American song hits and big band jazz. While her message was no more effective than Lord Haw-Haw's, her show, thanks to the music and Rose's sexy voice, was likely a good deal more entertaining.

Movies were also used in the propaganda war as morale boosters. Noel Coward made a stirring film, *In Which We Serve*, about a British warship fought a heroic battle with the Germans. The British also made movies about the fighter pilot heroes of the Battle of Britain and the war in the North African desert. Hollywood was just as active. There were movies about the Marines at Guadalcanal and about the brave Soviet peasants standing up to the German invaders.

British and American governments also organized groups of entertainers made up of movie stars, comedians, dancers, and musicians who entertained the troops in base camps, and, in the Pacific, on aircraft carriers and battleships.

On the home front, savings bond drives, victory gardens, and scrap metal collection efforts by schoolchildren gave those at home a sense they were part of the war effort.

It is not clear that any of these efforts did much to shorten the war. But the movies and live entertainers from home provided some respite from the boredom and the danger of war. On the other side of the propaganda coin, the massive bombing raids on German cities, which were meant to weaken civilian morale and cripple production, apparently did neither. The civilian population continued to soldier on, and there is evidence that German airplane production actually increased. There is no question the Allies established superiority in the air, and the bombing attacks kept Germany back on its heels. But the war in Europe was finally won on the ground.

Technology and War

Scientists joined forces with military strategists to create a range of new weapons for use in the Second World War. On both sides of the battle front, thousands of researchers applied scientific techniques to the special problems of war. In the United States alone, 30 000 scientists and engineers were employed in the development of new weapons and machines, as well as new medical techniques.

Breaking the Codes

Science played a key role in breaking German and Japanese secret communications codes. The British were able to crack the German code in April 1940. They used this knowledge to help the RAF during the Battle of Britain and throughout the war. The Americans were successful in breaking the Japanese secret codes, which helped them locate and track the Japanese fleet. As a result, the Americans were able to win critical naval battles and begin the destruction of the Japanese navy.

In 1938, a Polish mechanic working in a factory in eastern Germany discovered that the plant was secretly manufacturing signalling machines for the German army. The man carefully observed the parts being made and turned over the information to a British agent in Warsaw. With help from the Polish secret service, he was smuggled out of Poland to Britain. There he created a model of the machine, called Enigma, from memory. British scientists realized that Enigma was the key to breaking the German communications code. The Polish secret service stole a complete working machine from the factory, then British scientists began the complicated task of solving the puzzle of Enigma. By April 1940, the code was broken. For the rest of the war the Allies were able to read secret German messages.

Medical Technology

New or improved drugs and medical techniques made an important contribution to the war and saved the lives of one out of every two wounded soldiers. In the war in the Pacific, malaria was a constant threat to the troops. The principal source of the traditional cure—quinine—was the island of Java. When Java was captured by the Japanese in 1942, the Allies successfully developed a synthetic form of quinine. This new drug was critical to the success of Allied troops in both the Middle East and Asia.

Radar

Radar is used to detect the nature, position, and movement of an object. Electromagnetic waves are beamed out, reflected from the target, and picked up by the radar unit, which then converts the signals into images on a screen. This technology was being developed by Britain, Germany, and the United States prior to the war, but it was the British who made the most rapid progress. Radar provided them with an early warning system for the German air raids and played an important role in winning the Battle of Britain.

Jet Planes

Germany produced the first jet airplane in 1939. By 1941, the Germans had developed a jet fighter plane. These jet planes could fly at speeds much greater than propeller-driven aircraft and would have given Germany air superiority. But when Hitler was presented with the new plane in November 1943, he demanded that it be adapted for bombing. This delayed production of the aircraft until the fall of 1944; as a result, the plane was ready too late to play an important role in the German war effort. The Allies were also developing their own jet planes and had their fighters ready for use in Belgium by 1945.

Rockets

As the Allies invaded France and Russian forces moved against Germany from the east, Hitler announced that the German people would be saved by new "miracle inventions." The first of these, the V-1 (Vengeance), was a pilotless monoplane that carried an explosive warhead. Almost 10 000 of these **buzz-bombs** (so called because of the noise they produced) were fired at British cities beginning in 1944. But while the V-1 inflicted serious damage, the more advanced V-2 rockets that followed gave Britain cause for far greater concern. The V-2 flew at supersonic speed, giving no warning and offering no opportunity for defence. Fortunately, British intelligence discovered where these bombs were being developed. An Allied bombing raid on the production plant in August 1943 delayed its manufacture until the following year. In September 1944, however, V-2s were fired on Britain. Still, the delay was an important one for Britain. Had the V-2 been available to the Germans earlier, it might have changed the course of the war.

The Atomic Bomb

In 1939, Albert Einstein, a physicist who had emigrated from Germany to the United States in 1933, wrote a letter to President Roosevelt advising him that German scientists were working on an atomic bomb that would be capable of mass destruction. In response to this German threat, Roosevelt established the **Manhattan Project** to develop an atomic bomb for American use. Robert Oppenheimer led a group of American and Allied scientists in developing the bomb. Following its successful testing in New Mexico in July 1945, the United States was ready to use the ultimate weapon of destruction.

(/)

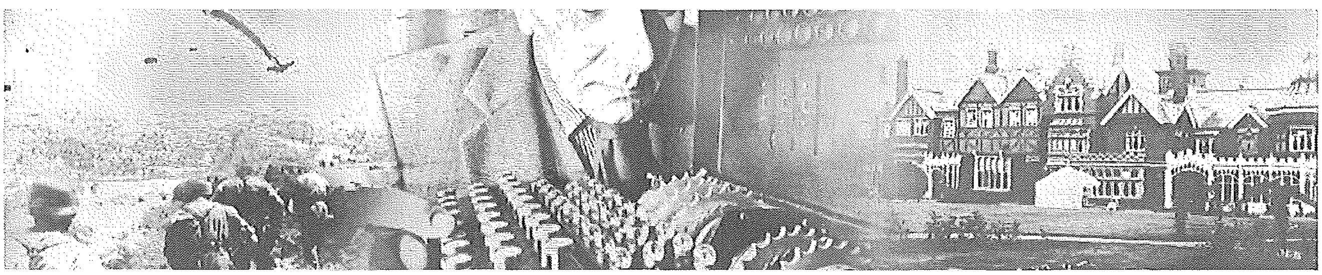
Home (/) H2 (/h2) What's On (/tv-schedule) Shows (/shows) Features (/features)

Videos (/videos) Book Club (/book-club)

History of WW2

Code Breaking

09/1939 to 09/1945



“It was thanks to ULTRA that we won the war.”

- Churchill to King George VI

During World War II (/study-topics/history-of-ww2), Germany believed that its secret codes for radio messages were indecipherable to the Allies. However, the meticulous work of code breakers based at Britain's Bletchley Park cracked the secrets of German wartime communication, and played a crucial role in the final defeat of Germany (/study-topics/history-of-ww2/disintegration).

The Enigma story began in the 1920s, when the German military - using an ‘Enigma’ machine developed for the business market – began to communicate in unintelligible coded messages. The Enigma machine enabled its operator to type a message, then ‘scramble’ it using a letter substitution system, generated by variable rotors and an electric circuit. To decode the message, the recipient needed to know the exact settings of the wheels. German code experts added new plugs, circuits and features to the machine during the pre-war years, but its basic principle remained the same.

The first people who came close to cracking the Enigma code were the Polish. Close links between the German and Polish engineering industries allowed the Polish Cipher Bureau to reconstruct an Enigma machine and read the Wehrmacht's messages between 1933 and 1938. In 1939, with German invasion looming, the Poles shared their information with the British, who in turn established the Government Code and Cipher School at Bletchley Park in Buckinghamshire. Mathematicians and intelligence experts, with the help of primitive early computers, began the complex and urgent task of cracking the Enigma code.

The Germans, convinced their Enigma messages were unbreakable, used the machine for battlefield, naval, and diplomatic communications. Although the experts at Bletchley first succeeded in reading German code during the 1940 Norwegian campaign, their work only began to pay off meaningfully in 1941, when they were able to gather evidence of the planned invasion of Greece, and learn Italian (/study-topics/history-of-ww2/italy) naval plans for the Battle of Cape Matapan. In the autumn, the Allies gained advantage in North Africa (/study-topics/history-of-ww2/north-africa) from deciphering coded messages used by Rommel's (/biographies/erwin-rommel) Panzer Army. Information obtained from such high-level German sources was codenamed ULTRA.

The Germans also enjoyed some noteworthy code breaking successes. The B-Dienst (surveillance service) broke British Naval code as early as 1935, which allowed them to pinpoint Allied convoys during the early stages of the Battle of the Atlantic (/study-topics/history-of-ww2/battle-of-the-atlantic). Although the US altered its naval code in April 1942, the change came too late to prevent the havoc wreaked by Operation Paukenschlag, the German U-boat campaign off America's east coast early that year. The Germans also managed to crack Soviet and Danish code systems. But their efforts – fragmented and divided between rival cryptology departments - lacked the consistent success achieved at Bletchley Park.

From 1941 onwards, Bletchley's experts focused upon breaking the codes used by German U-boats (/study-topics/history-of-ww2/battle-of-the-atlantic) in the Atlantic. In March 1941, when the German armed trawler 'Krebs' was captured off Norway complete with Enigma machines and codebooks, the German naval Enigma code could finally be read. The Allies could now discover where U-boats were hunting and direct their own ships away from danger.

The German Navy, rightly suspicious that their code had been cracked, introduced a fourth wheel into the device, multiplying the possible settings by twenty six. The British finally broke this code that they called 'Shark' in December 1942. Using ULTRA always presented problems to the Allies, because any too blatant response to it would cause the Germans to suspect their messages were being read. But neverthless Bletchley Park and its staff made a crucial and groundbreaking contribution to the defeat of the Axis.

< US Entry and Alliance (/study-topics/history-of-ww2/us-entry-and-alliance)

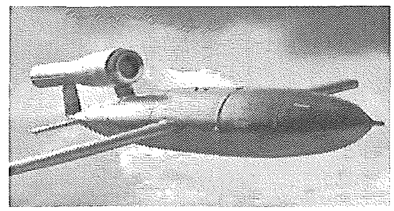
The science and technology of World War II

BY DR. DAVID MINDELL

Provided by The National Museum of World War II.

For all the role of science, mathematics, and new inventions in earlier wars, no war had as profound an effect on the technologies of our current lives than World War II (1939-45). And no war was as profoundly affected by science, math, and technology than WWII.

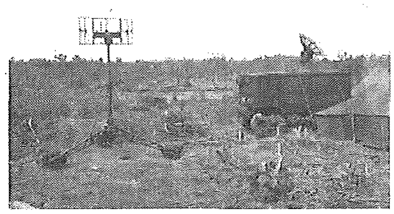
We can point to numerous new inventions and scientific principles that emerged during the war. These include advances in rocketry, pioneered by Nazi Germany. The V-1 or "buzz bomb" was an automatic aircraft (today known as a "cruise missile") and the V-2 was a "ballistic missile" that flew into space before falling down on its target (both were rained on London during 1944-45, killing thousands of civilians). The "rocket team" that developed these weapons for Germany were brought to the United States after World War II, settled in Huntsville, Alabama, under their leader Wernher von Braun, and then helped to build the rockets that sent American astronauts into space and to the moon. Electronic computers were developed by the British for breaking the Nazi "Enigma" codes, and by the Americans for calculating ballistics and other battlefield equations. Numerous small "computers"—from hand-held calculating tables made out of cardboard, to mechanical trajectory calculators, to some of the earliest electronic digital computers, could be found in everything from soldiers' pockets to large command and control centers. Early control centers aboard ships and aircraft pioneered the networked, interactive computing that is so central to our lives today.



The V-1 or "buzz bomb" was one of the early bombers used during World War II.

Seeing through the clouds and beyond

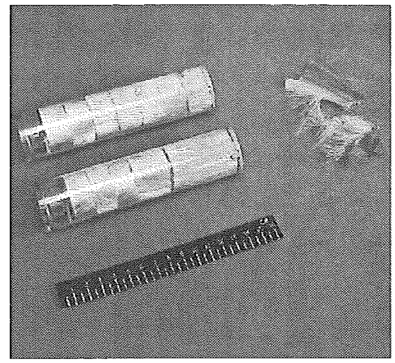
The entire technology of radar, which is the ability to use radio waves to detect objects at a distance, was barely invented at the start of the war but became highly developed in just a few years at sites like the "Radiation Laboratory" at MIT. By allowing people to "see" remotely, at very long distances, radar made the idea of "surprise attack" virtually obsolete and vastly enlarged the arena of modern warfare (today's radars can see potential attackers from thousands of miles away). Radar allowed nations to track incoming air attacks, guided bombers to their targets, and directed anti-aircraft guns toward airplanes flying high above. Researchers not only constructed the radars, but also devised countermeasures: during their bombing raids, Allied bombers dropped thousands of tiny strips of tinfoil, code-named "window" and "chaff" to jam enemy radar.



Radar system in operation in Palau during World War II.

By constructing complex pieces of electronic equipment that had to be small, rugged, and reliable, radar engineering also set the foundations for modern electronics, especially television. Radar signals could also be used for navigation, as a ship or airplane could measure its distance from several radar beacons to "triangulate" its position. A system for radar navigation, called LORAN (long-range navigation) was the precursor to today's satellite-based GPS technology.

The military found other uses for radar. Meteorologists, for example, could track storms with this new technology—a crucial skill to have when planning major military operations like D-Day. When weapons designers discovered a way to place tiny radar sets onto artillery shells, the proximity fuse was invented. These new fuses would explode when they neared their targets. By the end of the war, proximity fuses had became a critical component in many anti-aircraft shells.



Two different types of chaff and their canisters, with a ruler for scale. Chaff was dropped from planes during World War II to jam enemy radar.

A real shot in the arm

World War II also saw advances in medical technology. Penicillin was not invented during the war, but it was first mass produced during the war, the key to making it available to millions of people (during World War II it was mostly used to treat the venereal diseases gonorrhea and syphilis, which had been the scourge of armies for thousands of years).

While penicillin itself is still used today, it was also the precursor to the antibiotics that we take today to keep simple infections from becoming life-threatening illnesses. Medicines against tropical diseases like malaria also became critical for the United States to fight in tropical climates like the South Pacific. Pesticides like DDT played a critical role in killing mosquitoes (although the environmental impacts of DDT would last a long time; a famous book about DDT, Rachel Carson's Silent Spring (1962), would help found the modern environmental movement). The science and technology of blood transfusions were also perfected during World War II, as was aviation medicine, which allowed people (including us) to fly safely at high altitudes for long periods. Studies of night vision, supplemental oxygen, even crash helmets and safety belts emerged from aviation medicine.

Penicillin is prepared in the lab. U.S. Army Medical Department, Office of Medical History.

One word, "plastics"

Chemical labs cooked up a host of new technologies, from new types of explosives to incendiary bombs (including napalm, a form of jellied gasoline heavily used in Vietnam, but first used on the Pacific island of Tinian against the Japanese), flame throwers, and smoke screens. New materials and new uses for old materials appeared as well. Companies manufacturing consumer goods (such as silverware) converted to manufacture military goods (such as surgical instruments). Automobile factories re-tooled to make tanks and airplanes. These industrial modifications required rapid and creative engineering, transportation, and communications solutions. Because of the need to put most resources into the war effort, consumers at home experienced shortages and rationing of many basic items such as rubber, gasoline, paper, and coffee (the country imposed a national "Victory" speed limit of 35 miles per hour to save wear on tires—natural rubber being in short supply since the Japanese had occupied much of Southeast Asia). Consumers had to conserve, or just do with out. Women's skirts were made shorter to save material and bathing suits were made out of two pieces (these later became known as "bikinis," named after an island in the Pacific where the army tested atomic weapons). The 3M company felt compelled to run advertisements apologizing to homemakers for the scarcity of Scotch tape in stores across the country; available supplies of the product had been diverted to the front for the war effort. 3M promised "when victory comes "Scotch" cellulose tape will be back again in your home and office."

New materials emerged to fill these voids; many had been invented just before the war but found wide use during World War II: plastic wrap (trademarked as Saran wrap) became a substitute for aluminum foil for covering food (and was used for covering guns during shipping); cardboard milk and juice containers replaced glass bottles;

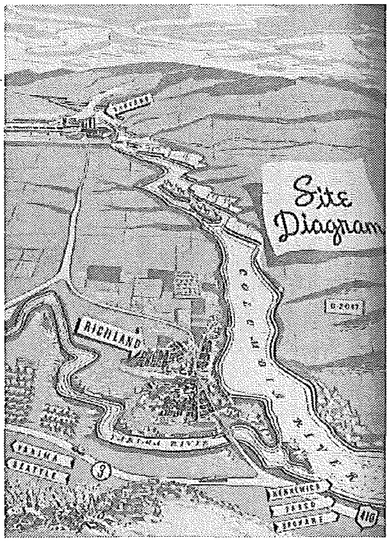
acrylic sheets were molded into bomber noses and fighter-plane canopies; plywood emerged as a substitute for scarce metals, for everything from the hulls of PT boats to aircraft wings. The look and feel of 1950s America – a "modern" world of molded plywood furniture, fiberglass, plastics, and polyester – had its roots in the materials innovations of World War II.

You are what you eat

A variety of military C-rations on display. Image source (http://en.wikipedia.org/wiki/File:Crations-museumdisplay.jpg).

The science of nutrition expanded greatly during WWII. In the United States, scientists worked to identify which vitamins and minerals were most essential to a healthy body and in what amounts. Studies were conducted to determine how many calories were burned doing various activities. Proper food preparation, storage and handling, and preservation became a top priority for the military. Soldiers' rations were carefully formulated to supply the maximum amount of nutrition and energy, while providing for variety and taste. Meeting these challenges meant working first in the laboratory before working in the kitchen. The development of the D-ration provides a great example. The "D" ration was a high-calorie emergency ration that came in the form of a fortified chocolate bar. A three-portion package of these bars would provide a soldier with 1,800 calories of energy. Once the military settled on a chocolate bar for their emergency ration, scientists set about creating it, with the following requirements: it had to weigh 4 ounces, it had to be high in calories, it had to be able to withstand high temperatures, and it had to taste "a little better than a boiled potato." This last requirement was imposed to keep soldiers from snacking on their emergency rations in non-emergency situations. By the end of the war, millions of these rations had been produced in the United States and delivered around the world, along with billions of other rations for the military.

The destoyer of worlds



This diagram of Hanford, Washington, was created to show its strategic location for creating plutonium. About the photograph (http://www.learnnc.org/lp/multimedia/14174)

And of course we're all familiar with the Atomic Bomb, two of which were dropped on Japan to end the Pacific war in 1945. In a pioneering effort, the United States mobilized a massive cadre of scientists, engineers, and industrial plants. Two cities were selected to house processes integral to the bomb's development. Oak Ridge, Tennessee, was surrounded by 59,000 acres of farmland and wilderness. The workers here separated out uranium for the bomb. In Hanford, Washington, the city was chosen for its 500,000 acres of isolated land bordering the Columbia River. Here workers created the new element plutonium. Atomic weapons are so complicated, in terms of the physics, and so difficult to build, in terms of the technology, that two different types of weapons were built, to increase the chances of getting at least one of them right. The bomb dropped on Hiroshima was a uranium-type bomb, and the one dropped on Nagasaki used plutonium.

Scientists in Nazi Germany were working on an atomic bomb as well. But without the huge commitment of resources that the American government offered its scientists, they barely got out of the starting gate. The Atomic Bomb was like radar in that a small number of devices could make a major impact on military operations, so the new invention could have an effect before going into full scale mass production. By contrast, most conventional weapons took so long to mass produce that if they were not at least on the drawing board when the war started they often arrived too late to impact the war. It is notable, however, that the speed with which new weapons systems came on-line, from the drawing board to the factory floor to the battlefield had never before been seen.

New ideas for a new age of warfare

Again, as in earlier eras, perhaps the most profound impacts of World War II were as much great ideas as they were pieces of hardware. Before the war, scientists were professors who ran small laboratories with students, with small amounts of money. Before the war scientists were looking into fundamental principles of the natural world, without much regard for practical applications, and they rarely attracted the attention of national governments. During World War II, science became mobilized on a grand scale; many of these professors and their students dropped everything to work on war-related challenges and initiative. The massive "research and development" (R&D) laboratory emerged in its modern form. The paradigm of these efforts was the "Manhattan Project" which put thousands of physicists together with Army-scaled logistics and designed, built, and manufactured the first atomic bombs. Other laboratories included the so-called "Radiation Laboratory" at MIT which developed radar. Numerous other laboratories focused on everything from electronics to medical research to psychological testing. By the end of the war, the atomic bomb made it clear that science had, in the words of one scientist, "lost its innocence" – that is it was now a critical tool of military power, and was given government money for research at many thousands of times the pre-war levels. Scientists became advisors to presidents on the most pressing issues of national and foreign policy. Ever since World War II, the American government has mobilized science, mathematics, and engineering on a vast scale, whether in large government laboratories, by funding research in universities, or by purchasing high-tech products from companies in industry.

That's great, but how do I use it?

A woman works on the nose of a bomber at the Douglas Aircraft Company plant in Long Beach, California in 1942. About the photograph (http://www.learnnc.org/lp/multimedia/14178)

Any discussion of the scientific and technological advancements during WWII must acknowledge the important developments in the field of training. It was one thing to design and build thousands of new, high-tech weapons and produce wondrous new medicines, but without people trained to use them, they would be worthless. New technologies – from moving pictures to new kinds of projectors and even simulators – allowed the military to train thousands of men and women quickly and efficiently (and formed the predecessors to modern technologies like PowerPoint presentations). At the end of the war, one frustrated Nazi general remarked that he and his fellow officers were not surprised that American industry could mobilize for war as quickly as it did. What was surprising and ultimately a major element of Germany's undoing was how quickly American industry and the American war machine could train its people.

Another critical idea that emerged during the war was "operations research," or OR. Early in the war, some British scientists recognized that a great deal of effort was being put into making new weapons (what they called "developmental research"), but not very much scientific thinking was going into how to use them in complex, real-world military operations (hence "operations research"). A classic problem was hunting Nazi submarines in the Atlantic Ocean that were sinking Allied ships. You only have so many airplanes, and they can only fly for so many miles before they need to refuel. What is the best way to organize the search patterns for these airplanes to have the most likelihood of finding these submarines? Mathematicians got hold of this problem and formulated in mathematical terms, using statistics and probability, which were then solvable for optimal solutions. The new "science" of operations research—applying mathematical principles to flows of materials—was then used on a whole variety of wartime problems, from dropping bombs on enemy cities to calculating the flow of goods through a factory production line. Similar techniques are used today in everything from scheduling airliners to running the "supply chain" at Wal-Mart.

See G.I. Joe add, subtract, calculate logarithmic equations

It was not just scientists, mathematicians, and engineers that utilized math and science during WWII. Average soldiers, sailors, airmen, and Marines were regularly called upon to use math and science skills, often newly learned, to accomplish their missions. Taking measurements for firing artillery weapons, reading maps and compasses, determining air speeds and altitudes, setting timers on fuses, these tasks and countless others required a fundamental understanding of many math and science rules. More complicated operations, like navigating an airplane, ship, or submarine, interpreting radar signals, or even fixing a broken tank could require intense and sophisticated training.

Even Army cooks used math. Cooking meals for thousands of men meant using math to formulate amounts of ingredients, determine cooking time, and appropriately plan an effective schedule for getting meals out on time. The average soldier may not have understood how an atom bomb worked—they didn't need to know that—but for day-to-day operations, using math and science skills wisely could make a big difference on the battlefield.

The darker side

World War II also saw plenty of disturbing uses of math and science. The Nazi Holocaust, in which 6 million Jews and millions of other people "undesirable" to the German state were murdered, ranks as one of the foulest crimes in human history. Yet the perpetrators saw themselves as anything but primitive barbarians. Nazi race "science" purported to show "scientifically" the superiority of the white "Aryan" race over all other peoples, complete with measurements, classifications, men in white coats, and fancy-sounding scientific theories (later shown to be completely false). When the Nazis formally decided to systematically murder the entire Jewish population of Europe (at the Wannsee conference in 1942), they carried out their malevolent ideas by applying industrial methods borrowed from factories—everything from assembly-line-type organization of killing factories to IBM-punch-card machines keeping track of every last detail. "Mass destruction" instead of "mass production." Even the medical profession, usually the best example of science and compassion in any culture, got into the act by carrying out horrific "experiments" on prisoners of war and civilians. Similarly, Nazi "high tech" weapons of new rockets and buzz bombs were used to attack civilians in a futile attempt to awe them into submission. Had these technologies and techniques and the vast resources put into the Nazi death camps been used to actually fight the war, rather than simply for malicious acts of terror, the Nazis might have stood up more strongly to the U.S. and its allies. The Nazis proved that a "scientific" mindset could well be applied to methods that were themselves mad, but their "rational" approach was undone by their irrational rage.

Good guys, bad guys, right and wrong — it's all here

In conclusion, World War II was the first "high tech war," if we define that modern phrase to mean a war fought with new technologies that were specifically invented for that particular war. The atomic bombs were but the most visible of thousands of small inventions, from materials in the home to training films to new ways of seeing the enemy that contributed to the war effort. The organization of this great war of invention had lasting effects, setting the stage for our "national innovation system" to this day – where the country employs the talents of scientists and engineers to help solve national problems. Moreover, the inventions of World War II can be found in so much of our daily lives, from Saran wrap to computers and large-scale production and shipping of industrial products. Even our education system, the very way we train people to use new technologies, finds some of its origins in World War II. Sometimes it might seem lamentable that so much of our noblest energy – scientific and engineering creativity – goes into humanity's most destructive activities. But like it or not, technology and war continue to be intertwined.

The fields of science and math and the technology that their study produces is not restricted to any one country or side in a war. Scientific and technological progress served both sides in WWII. Both sides poured national resources into developing new and better weapons, materials, techniques for training and fighting, improvements in transportation, medicine, nutrition, and communications. Science and math also know no morality. Alone, they can exist in pure form, devoid of practical use for good or bad. It is only when people apply their actions, desires, intentions to that science and math that they have an opportunity to use them for positive or negative purposes. Each generation of humans can then examine those uses and decide for themselves as a society and as individuals if that science and math was used wisely or not.

Learn more

RELATED TOPICS

- Search LEARN NC for more resources on World War II, atomic bomb, food, mathematics, medicine, military, science, and technology.

Credits

By Dr. David Mindell (http://www.learnnc.org/lp/people/1345).

Provided by The National Museum of World War II (http://nationalww2museum.org/).

North Carolina Digital History: Credits and acknowledgments (http://www.learnnc.org/lp/editions/nchist-worldwar/4993)