

Special Feature

Learning the Wrong Lessons from Hiroshima: US Nuclear Testing in 1946

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When the United States conducted two nuclear attacks against civilian targets and primarily civilian populations in Hiroshima and Nagasaki in August 1945 the world was collectively shocked. While the scale of the destruction was not new, tens and even a hundred thousand civilians had been killed in single air raids early in World War Two, the new weapon used to conduct the attacks was still shocking. Single bombs that could kill tens of thousands of people indiscriminately in a second and set cities instantly ablaze was horrifying. As the world learned about the nature of the weapons, and the use of radiation as a military tool for killing, horror at the attacks grew. This revulsion was supposedly true even for the US President Harry Truman, who had ordered the nuclear attacks. According to the diary of Henry Wallace, Truman's Commerce Secretary, Truman told a cabinet meeting on 10 August 1945 that he had halted a third nuclear attack on Japan because "the thought of wiping out another 100,000 people was too horrible. He didn't like the idea of killing 'all those kids.'"¹

I have described how there was a primary narrative about nuclear weapons that emerged in the West during the first weeks and months of the Atomic Age: nuclear weapons were so destructive that humankind was now faced with a choice between eliminating major wars, or destroying civilization with nuclear weapons. This fundamental "fork in the road" narrative was advanced in 1945 by American religious, military, political and social leaders. "Mankind stands at a crossroads of destiny," wrote former Major George Fielding Eliot in the *New York Herald Tribune* just a few weeks after the attacks, "The decisions which now confront the mind of man are the most important in his history. Upon these decisions hangs his continued existence on this planet."² Human beings in many countries were anxious about what nuclear weapons might portend for the future of human civilization. People at that time had seen two world wars and a global depression in their own lifetimes. It was natural to image yet another world war—World War Three, that would be fought with nuclear weapons—looming just ahead.

Into this anxious world came news that the United States would be detonating more nuclear weapons in the summer of 1946. Three nuclear tests were to be conducted at the US Trust Territory of the Marshall Islands. These tests, the first of over 2,000 nuclear tests that would follow the two nuclear attacks of 1945, would set a course for nuclear weaponry, and for preparations for nuclear war that would define the coming Cold War era. Rather than learn the lessons that filled people worldwide with anxiety about nuclear explosions, the United States would now embrace them as fundamental to American security, domination and identity. Standing after Hiroshima at that fork in the road, the United States charted a dedicated path towards further destruction.

The two nuclear tests at Bikini Atoll in the Marshall Islands in 1946 were named Operation Crossroads and were carried out by a cross-service military command named Joint Task Force One. These tests have been analyzed primarily for their role establishing protocols for postwar nuclear weapon testing in terms of colonial or postcolonial test siting, the relationship between the nuclear weapon laboratories and the military, and their legacy in Marshallese society.³ This article will examine the degree to which we can understand Operation Crossroads as an extension of the military actions in Hiroshima and Nagasaki rather than in their role as foundational events in the history of Cold War nuclear weapon testing.

The Manhattan Project

In 1938, the process of nuclear fission was discovered accidentally in the laboratory of Otto Hahn and Fritz Strassmann at the Kaiser Wilhelm Institute for Chemistry in Berlin, Germany.⁴ At first, they were uncertain why the chemical experiments they were running were producing excess energy for which they could not account. Over the subsequent weeks, physicists Lise Meitner and Otto Frisch deduced that the basis of this excess energy was that some of the uranium that they were working with had experienced nuclear fission.⁵ Nuclear fission had been theorized, but never observed before in the real world.

Nuclear fission is the process by which a neutron splits the nucleus of an atom of uranium-235 (after its invention in 1940, plutonium was also found to be able to fission). The nucleus of atoms is held together by one of the four fundamental forces of the universe, known as the “strong force.”⁶ When the nucleus is split, the energy of the strong force holding it together is released. This is nuclear energy. It can be used in a sustained chain reaction to produce energy, or in a rapid chain reaction that releases energy in an explosion. The

amount of energy in the strong force that holds together the nucleus of one atom is not very substantial, but physicists were aware from time news of this discovery spread throughout the global scientific community in 1938 that it might well be possible to assemble sufficient amounts of a fissile material and release the strong force holding together the nuclei of trillions and trillions of atoms in a single second. This was the idea of a nuclear weapon.⁷

News of the fissioning of uranium spread around the scientific world within weeks of the experiment in Berlin. In the summer of 1939, expat Hungarian physicists Leo Szilard and Eugene Wigner drafted a letter advising the United States government about the possibility of using uranium in an atomic bomb and had the letter signed by their friend Albert Einstein and then delivered to the White House.⁸ Over the next two years the United States government provided the seed money and infrastructure that would formally grow by 1941 into the Manhattan Engineering District, or Manhattan Project as it is popularly known.

The Manhattan Project was largely successful because of its virtual limitless access to US federal funding and resources during wartime. Under the umbrella of the project entire cities were purpose built—Oak Ridge, Tennessee to manufacture highly-enriched uranium; Hanford, Washington to manufacture plutonium; Los Alamos, New Mexico as a laboratory and bomb assembly facility—and a vast network of support facilities that were erected from coast to coast.⁹ The elite physical and chemical scientists of the United States, the United Kingdom, and many refugee scientist who had fled Nazi controlled areas, assembled in Los Alamos to design the weapon, while the production facilities at Oak Ridge alone used twice the electrical consumption of New York City.¹⁰ Hundreds of thousands of workers were employed at various Manhattan Project sites. This heavy investment in science, engineering and manufacturing, and the commitment of such a large labor force, were essential to the project's successful production of both nuclear power plants and nuclear weapons in less than five years.

The nuclear attacks on Hiroshima and Nagasaki

Early in 1945 the United States was successfully manufacturing small amounts of highly-enriched uranium at Oak Ridge, and plutonium in the reactors at Hanford. These materials were transferred to Los Alamos where they were used in experiments, and ultimately in the construction of nuclear weapons. Two different designs were used in building the weapons, each with a different process to solve the problem of assembling a critical mass of the fissile materials at the moment of detonation, but keeping them dispersed beforehand. The gun

design was built with the uranium from Oak Ridge, and the implosion design was built utilizing the plutonium from Hanford.¹¹ After the war only the US would not manufacture gun design nuclear weapons again, but only implosion weapons, in part because it was cheaper to manufacture plutonium than to enrich uranium.

Manhattan Project scientists were confident in the gun design and felt no need to test it, however there was sufficient uncertainty about the implosion design that it was tested before the nuclear attacks on Japan. The Trinity test, the first detonation of a nuclear weapon on Earth, was conducted several hundred kilometers south of Los Alamos in south-central New Mexico on 16 July 1945.¹² After this successful test, unassembled weapons were transported by the US Army to a forward base on Tinian, an island in the Northern Marianas in the Pacific Ocean that the US had liberated from Japan in 1944. On Tinian the US Army had built the largest airbase of the war which was used continually in the aerial attacks against the Japanese military and Japan itself. Members of the 509th Composite Group of the US Army Air Forces, who had been training to conduct nuclear attacks for several years, were forward positioned to Tinian.¹³

On 6 August members of the 509 Composite Group departed Tinian in the *Enola Gay* B-29 Superfortress with the gun design weapon, nicknamed “Little Boy,” and flew to Hiroshima. At 8:15 in the morning they conducted a nuclear attack on the city of Hiroshima resulting in the deaths of around 100,000 human beings, and the injury of tens of thousands. Three days later, on 9 August, members flew the B-29 named *Bockscar* carrying the implosion weapon, nicknamed “Fat Man,” and at 11:02 conducted a nuclear attack on the city of Nagasaki, killing a little less than 100,000 people and wounding tens of thousands more.¹⁴

The devastation in Hiroshima and Nagasaki cannot be overstated. Large sections of both towns were disintegrated in less than a second, and fires burned out areas that were not flattened by the blast wave. Tens of thousands were killed instantly and tens of thousands more wounded so severely by the blast and heat that they died over the next few hours or days of their injuries and burns. The burst of prompt gamma radiation penetrated through buildings and human bodies at deadly or harmful levels out to 3km, weakening as it traveled beyond that distance. Radiation levels were lethal to those exposed without shielding to over 1km and remained harmful even to those indoors extending further out. Many who received high doses of external radiation died on the day of the attacks, while many more became sick and died over the coming months from illness and organ failure.

Prior to the two nuclear attacks, the number of people who were understood to have been exposed to significant levels of radiation numbered in the hundreds (many more were exposed at uranium mines, but their exposures were yet to be studied, treated, or even acknowledged).¹⁵ This resulted in a lack of clarity about how the exposures in Hiroshima and Nagasaki would affect those who did not succumb quickly. Many would develop cancers and other illnesses resulting in early morbidity over the coming years and decades, typified by the death of 12-year-old Sadako Sasaki (often the single human being in either Hiroshima or Nagasaki who can be named by Americans) from leukemia ten years after having been exposed to radiation at the age of two.

More people were exposed to radiation from radioactive fallout, which remained at the site and spread downwind from the attack locations. People who entered the cities to find loved ones or to help the community after the attacks also began to become sick from radiation exposures, as did those who lived where the fallout clouds deposited particles. In Hiroshima the fallout came down with rain that also carried soot from the fires, leading to it being called “black rain.” Recent court rulings have expanded the number of people exposed to black rain who are legally entitled to official status and compensation as *hibakusha*.¹⁶

The bomb was always intended as a shock weapon: its use in Japan was intended to compel surrender through fear, not through the loss of essential personnel or facilities. In his seminal article justifying the nuclear attacks on Japan, Henry Stimson, the wartime US Secretary of War explained that, “I felt that to extract a genuine surrender from the Emperor and his military advisers, they must be administered with a tremendous shock.”¹⁷ The destruction wrought in Hiroshima and Nagasaki were not greater than that being inflicted on dozens of Japanese towns by fire bombings weekly since March 1945. The impossibility of guarding against a single plane getting through and releasing a single bomb achieving the scale of loss that took hundreds of B-29s hours when using napalm weapons was intended to confront Japanese military leaders, and the Emperor, with an inability to conceive of a way forward besides surrender. The nuclear attacks were not conducted for their military utility but for their capacity at psychological destabilization.

Nuclear imaginaries of 1945/46

The United States entered the postwar world in a power position. The only combatant whose cities and industrial capacity were undamaged, it was also the only nation in pos-

session of nuclear weapons. A third weapon being prepared for use in Japan was held back and became the first in America's postwar nuclear stockpile. Not only was the US the sole nuclear weapon state in the late 1940s, it was also the only nation in a position to study both nuclear weaponry and the health effects of radiation exposures.

Early work by numerous US agencies to quantify and study both mortality from the attacks, and also the ongoing health effects of radiation exposures led to the formation of the Atomic Bomb Casualty Commission (ABCC) in both Hiroshima and Nagasaki in 1946.¹⁸ This agency would study the health impacts of radiation on the hibakusha, and would ultimately build a database to correlate radiation exposures to subsequent health effects. The US imagined that such data would be useful in protecting American troops on atomic battlefields in the future, at protecting Americans during nuclear attacks on the homeland, and also in calculating how best to harm enemy soldiers and civilians.¹⁹

The ABCC would only quantify and study the short-lived external radiation experienced in the burst of the weapon and not consider the health impacts of those exposed to internalized radioactive particles from the fallout. It was imagined that in the future there was likely to be subsequent usage of nuclear weapons in war, and therefore radiation exposures would be more likely to resemble the exposures of those living near to the detonation in Hiroshima than those living where the black rain fell. However, while there never was a nuclear war with the direct use of weapons against an enemy during the Cold War, over 2,000 nuclear weapons would be detonated in "tests," exposing millions of people to radioactive fallout worldwide.²⁰

As the sole nuclear weapon state in the immediate postwar world, the United States understood itself as holding unrivaled military power and being in a position to exert its political will globally. While the Soviet Union had played a greater role in the defeat of Nazi Germany, and had a larger standing army, the new weapons placed the United States in a superior military position. Although the United States understood that Japan had been a defeated nation before the attacks on Hiroshima and Nagasaki, it also believed that its use of the nuclear weapons compelled Japanese surrender. For American military strategists and political leaders, nuclear weapons appeared to be militarily useful weapons, and they imagined that their sole possession of them would translate into political dominance in the postwar world.²¹

Towards that imaginary, the United States military worked to more fully understand the

capacities of nuclear weapons, to enhance their power, and to make them more affordable to manufacture. Work began immediately after the surrender of Japan to further develop and improve nuclear weapons, and also to generate data about their effects on military and civilian targets.²² This was to be accomplished through a program of nuclear weapon testing, and thus began a weapon testing program that would endure beyond the end of the nascent Cold War, and eventually see the US itself detonate more than 1,000 nuclear weapons in total.

Planning Operation Crossroads

The US began the postwar testing of nuclear weapons less than a year after the attack on Hiroshima during Operation Crossroads at Bikini Atoll in the Marshall Islands in the summer of 1946. These first tests of the postwar era began, in part, as a reflection of the war that had just ended. On 14 September 1945, Lieutenant General B. M. Giles in the Tokyo headquarters of the US Army suggested that an atomic bomb be used to destroy and sink what remained of the Japanese naval fleet, to render the ships useless. Commenting on behalf of the US Navy one month later, Admiral Ernest King replied that the Navy advocated expanding the operation so that it could also focus on determining the effects of nuclear explosions on naval vessels. Having experienced a massive loss in the surprise attack on Pearl Harbor in 1942, Navy leaders were keen to understand how to protect ships from atomic attack, and how far apart ships should be when deployed to limit the destruction of a fleet at sea.²³ They also hoped to demonstrate that nuclear weapons did not make traditional naval vessels obsolete.

A Joint Task Force combining units from both the US Army and Navy was formed to plan and conduct three nuclear tests to study the effects of the nuclear weapons on ships and other materials. The ships would include a variety of warships and merchant vessels to determine the impacts on different vessels at various distances. Joint Task Force One was formally authorized in January 1946 and planning began in earnest for the three tests.

The location chosen for the tests was Bikini Atoll in the Marshall Islands in the mid-Pacific. The US had occupied the Marshalls since defeating the Japanese there in early 1944; the Japanese had taken over occupation of the islands from the Germans at the beginning of World War One, and the Germans had taken colonial possession of them centuries earlier from the Spanish.²⁴ While the US had conducted its first nuclear test in New Mexico in July 1945, fallout from the test had crossed the nation to the Eastern seaboard and had deposited

in various locations including on the Illinois/Indiana border thousands of miles from the detonation.²⁵ Awareness of the threat of radioactive fallout to the well-being of American citizens, the US chose to test the three weapons outside of the continental United States. In January of 1946, the U.S. Navy announced that Bikini Atoll was chosen, a site that “may accurately be described as one of the most remote places of the earth.”²⁶

Bikini Atoll was actually home to 186 people, whose families had lived on the atoll for centuries. To use the atoll for nuclear testing, the entire population had to be evacuated and resettled on another atoll or island. In March 1946, the 167 Bikinians currently living there were displaced from their homes so that the atoll could transition into a nuclear test site.²⁷ Over the next decades the Bikinians would be moved multiple times before settling themselves primarily over 800km away in the southern Marshall Islands.²⁸

The Joint Task Force began to make preparations for the nuclear tests scheduled to begin in the summer of 1946. 96 naval ships from multiple countries were either navigated or towed to Bikini Atoll to be placed in the lagoon as target vessels for the tests. These were primarily US ships but also included some Japanese and German vessels. The target fleet included aircraft carriers, destroyers, battleships, submarines, and smaller vessels. The support fleet used by Task Force personnel to stage, maintain, examine and later efforts to salvage and decontaminate the target fleet included 146 naval ships and 156 military aircraft. Other equipment brought to the site included, 4 television transmitters and 750 cameras.²⁹ Since the whole world was interested in and worried about nuclear weapons, the Crossroads tests were intended to be intensely documented. With only low-quality images available of the mushroom clouds rising out of Hiroshima and Nagasaki, the mushroom clouds of Bikini would be photographed and filmed from multiple angles, and reproduced in newspapers globally.

To staff the support vessels, stage experiments and manage the weapons and measurements of their effects, 42,000 US military personnel would participate in Operation Crossroads by the mid-summer. This was in addition to the scientific staff from Los Alamos, eight congressmen, and media professionals there to cover and promote the events. The tests were to be broadcast live on radio stations heard in many countries around the world. To stand in for human beings and experience the explosions directly would be “204 goats, 200 pigs, 5000 rats” all placed in cages or pens on the target fleet for the first test, more would be placed on the target fleet for the second test. There was a scientific and medical basis for choosing these stand-ins for humans: “Pigs were particularly valuable since their skin and

short hair are comparable to man's. Goats were useful because their weight is comparable to man's and the quantity of their body fluid is sufficient for extensive laboratory analysis. Rats, time-honored experimental animals of radiology, were a logical choice since so much is known about their response to radiation and the correlation of their responses with man's."³⁰

The first test, Able, was to replicate the two attacks on Japan, with a weapon dropped by an airplane over the lagoon of Bikini and detonated at a similar altitude. The second test, Baker, would see a weapon detonated underwater amidst the target fleet in the lagoon. The third test, scheduled for 1947 and named Charlie, planned on a weapon being detonated deep underwater outside of the lagoon and some distance away from Bikini.

The Operation Crossroads tests

Test Able took place on the morning of 1 July 1946 (local time), with an airdropped implosion weapon detonated slightly lower than the Hiroshima explosion and yielding approximately 23kt. Five vessels sunk as a result of the effects of the detonation, but many more were badly damaged and experienced fires.³¹ Support vessels began to enter the lagoon two hours after the test, led by radiation monitor crews, but ultimately bringing thousands of service personnel in salvage crews. They spread out throughout the lagoon to determine the conditions and radioactivity of the ships, whether they were operable, and whether they could be decontaminated. They also checked on the condition of the thousands of animals that had endured the weapon's effects directly on their bodies. Test personnel determined that 35% of the animals that experienced the Able explosion were dead by the end of September 1946.³²

Test Baker took place on the morning of 25 July 1946, about 27 meters beneath the surface of the water, and also was an implosion type weapon that yielded about 23kt. Because the detonation occurred underwater the force lifted millions of tons of water out of the lagoon into a wide, low-hanging mushroom cloud that only rose several hundred meters in the air before it was pulled back down by gravity into the lagoon. The vivid, heavy and low mushroom cloud is often reproduced in images of mushroom clouds; it is only one of 8 underwater detonations of a nuclear weapon.³³

The specific dynamics of the water laden mushroom cloud of the Baker test were to have dramatic impacts of the whole of Bikini Atoll and all of the materials and living things

there. Whereas an atmospheric detonation creates a fireball in the air that rises from the point of the epicenter high into the air, sucking up materials from the ground below (which fill the cloud and “mushroom” it outward), and then drifts on the wind depositing the ionized radioactive particles back down to the ground as fallout, the Baker mushroom cloud quickly dropped all of this material back down into the water. There was no downwind dispersal of the fallout which meant it all concentrated in the lagoon.

The Baker explosion sunk nine ships and damaged many more, however, it was the radiation that would prove to have the most impact. As the blast wave rippled through the lagoon, and then the tons of water in the mushroom cloud fell back, a base surge of water and mist spread across the lagoon and engulfed the target fleet. “The base surge...left a kiss of death on the majority of the target vessels. The white billows carried radioactive fission products equivalent to many tons of radium.”³⁴ Nearly all of the ships became highly radioactive with over 90% later being judged militarily useless. Most of the onboard animals had survived the blast only to perish from radiation sickness in the first and second week after the explosion. Just five days after the test a top-secret telegram from the Joint Task Force leadership was transmitted to the Joint Chiefs of Staff of the US military in Washington, D.C. which described how, “contaminated ships became radioactive stoves, and would have burned all living things aboard with invisible and painless but deadly radiation.”³⁵ As they sat in the lagoon over the coming days and weeks the hulls and then the interiors of the ships became increasingly radioactive, compounding the risks for personnel carrying out damage assessments and decontaminating the ships and equipment. As support ships entered and left the lagoon, they too became increasingly radioactive. All of the 42,000 service personnel assigned to the mission were being exposed, and their exposures were increasing daily.

Test planners had understood that after the water detonation, fission products (like strontium-90 and cesium-137) that usually distribute downwind from the mushroom cloud would likely be retained and concentrated in Bikini lagoon, but they had not anticipated the incredibly high levels of radiation that actually did eventuate. Radiation risk in Operation Crossroads was assessed by the Radiological Safety Section under the command of Colonel Stafford Warren. Warren was a physicist and radiologist who had worked in the Manhattan Project, and was one of the first American scientists to conduct radiological surveys in both Hiroshima and Nagasaki in September and October 1945. As monitors working in the Radiological Safety Section observed levels rising on the target fleet, and then the support fleet vessels, Warren and his staff became concerned that there was no safe way for the sup-

port personnel to continue working and living on the boats. On August 3, nine days after the Baker test, Warren came to the conclusion that any attempts to mediate exposures or reduce contaminations were futile, and the only course forward was to immediately evacuate all military personnel.³⁶

Warren had been expressing his analysis and worries to Joint Task Force Commander Vice Admiral William Blandy. Blandy had little understanding of radiobiological issues, and on August 10 Warren showed him a radiograph of a surgeonfish caught in Bikini lagoon. The radiograph showed a “photographic” image of the body of the fish produced solely using the radiation coming from its body onto the photographic plate. The fish showed the presence of radiation throughout its entire body, on each scale. It also showed a glowing area in its digestive tract and stomach, revealing that the fish was not merely radioactive because it was immersed in radiologically contaminated water, but that consuming contaminated food had internalized particles inside of its body which it was metabolizing. Blandy conceded that such systemic contamination being present just weeks after the Baker test put the personnel at too high risk to continue to work in the lagoon for several more weeks, as had been planned. The 42,000 military personnel working as part of the Joint Task Force were slowly transported from Bikini Atoll to Kwajalein Atoll, and from there many returned to the US: Bikini Atoll was completely evacuated by September 26. The Charlie test, tentatively scheduled for the following year, was cancelled because of the loss of Bikini Atoll as a staging area, and the fact that the entire target fleet was now too radioactive to be used.³⁷

Following the radiological disaster of Operation Crossroads, the US military placed Bikini Atoll on “interim status” and moved its nuclear testing program in the Marshall Islands to Enewetak Atoll until 1954.³⁸ During this “interim,” extensive studies were carried out on the movement of radioactive particles through the ecosystem of the atoll, conducted primarily by the Applied Fisheries Laboratory of the University of Washington under the aegis of the US Atomic Energy Commission.³⁹

Operation Crossroads as a model for Cold War weapon developments

Operation Crossroads had been heavily attended, documented and promoted by media around the world. Fascinated and terrified by the nuclear attacks on Hiroshima and Nagasaki, many people feared what nuclear weaponry portended for the future, and paid attention to the news coverage of the tests so that they might better understand the new weapons. The focus of news coverage was the detonations themselves, the immaculately

documented explosions and mushroom clouds, and the impacts on the target fleet. Because of this focus and the copious amounts of reporting and images from Able Day and Baker Day, the US military was able to hide the actual radiological disaster that unfolded in the weeks after the second test. This success in hiding the disaster would hold until the publication of the 1948 book, *No Place to Hide*, written by David Bradley, a medical doctor who had been part of the radiation monitoring team in Operation Crossroads.⁴⁰ As I have written elsewhere, the book describes the tests as the radiological disaster that they were, helping readers to grasp the nature and danger of radioactive fallout.⁴¹ Little more than a year after Bradley's book came out, the Soviet Union tested its first nuclear weapon and the Cold War began to become increasingly unnerving. Rather than being concerned about fallout, most Americans became terrified of a direct attack by Soviet weapons (although it would have been nearly impossible for a Soviet bomber to enter American airspace in the early 1950s).

For the US military, Operation Crossroads provided vast amounts of information about the effects of nuclear weapons. The attacks on Hiroshima and Nagasaki had been conducted on enemy territory, and US assessment teams could not enter the cities for over a month to begin gathering data on the impacts of the attacks on materials and human beings. At Bikini, the tests had been conducted in a controlled setting with massive amounts of instrumentation gathering data, and were entered hours later by teams of thousands of personnel working on assessment of the detonations on ships, fuel, machinery, and living creatures. Assessment continued even after the evacuation of the task force a few weeks after the Baker debacle by the marine biologists from the University of Washington.

There were two clear purposes to gathering this data. First, the behavior and impacts of nuclear detonations were to help guide the defense of military bases and assets, as well as civil defense preparations in the United States, efforts which took on increased vigor and funding after Soviet development of similar weapons in 1949. But much more importantly for the US, the data was to guide early strategies about how to use nuclear weapons against an enemy in wartime to maximize damage, mortality and terror. Nuclear weapons were a revolutionary new weapon, and they did not easily fit into existing military strategies. While their utility as "larger aerial bombs" was understood and utilized against Japan in 1945, Crossroads and subsequent tests were designed to enhance their military effects.

Many of the lessons of Operation Crossroads and how the tests were integrated into military planning were laid bare in the various sub-reports assembled into the *Final Report of the Joint Chiefs of Staff Evaluation Board for Operation Crossroads*, which was published

internally in 1947. Tests Able and Baker were specifically designed to measure the impact of a nuclear attack on naval ships and, theoretically, a navy base. Parts of the Final Report detailed the impact of the pressure from the blast wave and the heat on various types of naval ships, and also on the component parts of ships. It discussed how the hulls of ships were affected, whether the engines were damaged; what kind of protection was afforded by various methods of fuel storage; how far away from the epicenter a ship would need to be to have its weapon systems and ordnance survive and continue to be usable.⁴²

After the Able test, many ships were effectively restored, could be navigated and, in theory, return to battle. Assessments were made as to what kinds of repairs might be needed, and what kinds of design alterations would be most productive to facilitate the survival of a fleet that endured an aerial attack. The fate of test animals was used to determine the survivability at various distances of crews and their ability to engage in normal activities. A wide range of systems were evaluated for their functionality after attack, from electrical and plumbing, to communications and navigation. Such assessments were also used to strategize increased damage to enemy targets and the lethality of effects on enemy troops and populations. This was the primary focus of the Final Report.

A foundational document of understanding the military use of nuclear weapon effects can be found in, "The Evaluation of the Atomic Bomb as a Military Weapon," which was included as Enclosure "A" of the Final Report, and dated 30 June 1947. The evaluation concluded that the two nuclear tests of Operation Crossroads, "provided data essential to future military planning, giving bases for the calculation of the conditions under which the maximum destructive effects of an atomic explosion will be obtained against various types of land and water targets and against living organisms."⁴³ Enclosure "A" imagined both the use of nuclear weapon effects against an enemy population, and the structural nature of atomic warfare in the future.

The two nuclear attacks against Japan were aerial attacks, as was the first Crossroads test; the second Crossroads test was of a shallow underwater weapon. These embodied the limits to weapon delivery in 1946: weapons could be brought to an enemy by both plane or ship. However, the analysts of the Bikini tests were well aware that this limitation was only a temporary boundary, and that nuclear delivery systems would come to play an essential role in nuclear war planning: "No weapon can be more effective than the means to bring it into action against the enemy; hence the necessity for coordinated development of atomic weapons and weapon-carriers and their integration into a series of devices, each with a

tactical or strategic purpose.” Military analysts were already *imagineering* the future of nuclear warfare, “In the category of weapon-carrier may be included any means of ultimate delivery such as aircraft, guided missiles, rockets, torpedoes and mines of all types.” These future missiles need not be based solely on land, “Inseparable from the development of bombs and bomb-carriers should be the planning of naval surface and submarine vessels from which atomic bomb carriers may be launched or discharged.”⁴⁴ Already in 1947, after one postwar test series, the whole of what would come to be called the “nuclear triad” was being envisioned.

Similarly, analysts were hammering out the rationale of nuclear first use, and the delegation of war making powers from the legislature to the executive. “In such warfare, the element of surprise will be an essential, the possession of which will be the only assurance of success and whose lack may be catastrophic,” reasoned the authors, “Offense, recognized in the past as the best means of defense, in atomic warfare will be the only means of defense.” Therefore, Americans may have to alter their understanding of declarations of warfare, “Traditionally, the policy of the United States is one of non-aggression and, as a result, in the past we have awaited attack before employing military force...Presently the duty of the Commander-in-Chief (before a declaration of war by Congress) is confined to action only after the loss of American lives or treasure,” however, “In the future it must be made his duty to defend the country against incipient attack by atomic weapons whenever another nation is readying an atomic attack upon us.”⁴⁵ Less than two years after the termination of World War Two, the outlines and logics of nuclear warfare were taking shape in the wake of the Bikini tests.

It was specifically the presence of persistent radiation from the fallout which put tens of thousands of US military personnel at risk and eventuated in the cancellation of the third test and the evacuation of the troops. “When a bomb is exploded underwater, lethal residual radioactivity assumes an importance greater than the physical damage caused by the explosion,” concluded analysts. Not only was the impact of radiation more militarily useful than the blast and heat effects of the detonation, it was specifically the fallout, and not the burst of prompt radiation which is understood as valuable. The burst of external gamma radiation that harmed so many in Hiroshima and Nagasaki “may be great for a brief period, is secondary in importance to radioactivity from other sources.”⁴⁶ Those other sources being the various paths of exposure to fallout.

In the seven months of assessment from the evacuation of Operation Crossroads personnel

to the issuance of the evaluation of nuclear weapons as tools for warfare, it was the military utility of residual radiation—fallout—that deeply impressed the military strategists. Even when imagining nuclear weapons as essentially larger bombs, the behavior of residual radiation enhanced the destructive capacity of traditional, World War Two levels of destruction. When discussing cities as targets, the report details that while “conventional means of fire control, emergency policing, care of the wounded and restoration of essential services” would mitigate the blast and fire impacts of atomic bombs, “the personnel for these services would have to be recruited from outside the area and where radioactive contamination existed could enter it only with extreme difficulty and after some lapse of time.”⁴⁷ Here we see the understanding that destruction is not the only military utility of the bomb, but the disruption of recovery by radiological contamination would deal a further blow to those who suffered the initial attack, and demoralize the general population.

The authors were very precise that while radioactive fallout was effective as a means of causing sickness and death, it had a special value as a psychological terror weapon. They cite the uncertainty of contamination among survivors as creating a long-lived disruption of the functioning of enemy societies after a nuclear attack. The report imagined that people would flee an attacked city and carry radiological particles with them that could contaminate and harm others, and that among those who fled some would develop sickness and some would die which would make all fleeing anxious about their own welfare. This capacity for the psychological terrorizing of the whole of an enemy society, including those who did not endure any actual physical attack, was understood as militarily transformative: a section of the report is dedicated to the concept of “Psychological Atomic Warfare.”⁴⁸ Whereas World War Two was understood as the era of total war, in which cities had become “legitimate” targets, nuclear weapons prompted American military strategists to begin to see whole countries, and entire populations as targets.

Legacies of Operation Crossroads

We can look at Operation Crossroads and see the emergence of an American relationship with nuclear weapons that would endure throughout the Cold War. The utility of nuclear weapons as political tools; the performative power of their testing, manufacture and stockpiling; and the lack of concern for the human and ecological legacies of their production and detonation. The presence of media from dozens of countries, the live radio broadcast of the tests, the endless repetition of film of the tests, especially the Baker test, images of which are among the most iconic in Cold War media, helped to focus the world media

on the spectacle of testing, and the centrality of the new weapons as super weapons that denoted the US as a “superpower.” The radiological disregard of human beings would be repeated, especially in the wake of the brutal Bravo test of 1954.⁴⁹

Understandings of the long-term impacts of exposures to radioactivity for the hibakusha in Japan were only beginning to come into focus at the time of Operation Crossroads, so US military analysts were astonished at the breadth and persistence of the effects of residual radiation on the target vessels, the support vessels, the operational personnel, and the flora and fauna of Bikini Atoll itself. These effects would be intensely studied, and over time become central to strategic military understandings of how to wage nuclear war. Nuclear targeting during the Cold War would focus on the use of the blast and heat of the weapons to neutralize an enemy’s nuclear weapons and capacity to retaliate, but radioactive fallout was understood as the weapon effect that could, according to a 1954 Strategic Air Command briefing, leave the Soviet Union “a smoking, radioactive ruin at the end of two hours.”⁵⁰ Fallout clouds, especially from thermonuclear weapons, were strategized to blanket the whole of enemy territory, devastating the population and making its cities unlivable. Operation Crossroads analysts saw clearly that, “The correlation of the explosion of atomic bombs over Japanese cities and against naval vessels, at Bikini, gives ample evidence that the bomb is pre-eminently a weapon for use against human-life and activities in large urban and industrial areas, as well as seaports.”⁵¹

When Bikini Atoll was taken off of “interim status” for the Bravo test of an H-bomb in 1954, another radiological disaster occurred directly as a result of the immense fallout cloud that drifted eastward after the detonation. Hundreds of Marshallese suffered exposure to dangerous levels of radiation. Later calculations estimated the average exposure of those from Rongelap (approximately 152km away from Bikini) was equal to that of people who were 2.4km from ground zero during the nuclear attack on Hiroshima.⁵² The entire crew of the Daigo Fukuryū Maru tuna fishing boat was exposed to radiation and subsequently suffered from radiation sickness, with one crewmember dying six months after the test.⁵³

While the United States tried to hide the radiological impact of the Bravo test, it also quickly integrated the lethality of such a fallout cloud hundreds of miles from the epicenter of an H-bomb attack, leading Admiral Harry Felt of the US Navy’s Pacific Command to comment in 1961 that if the US SIOP nuclear attack plan was carried out against the Soviet Union, he would be more concerned about fallout from the attack drifting towards bases under his command than he would about a direct attack by the Soviets.⁵⁴ As the Soviet

Union also developed intercontinental ballistic missiles to carry thermonuclear weapons to the continental United States, President John Kennedy warned American Civil Defense managers in 1961 that “Radioactive fallout, extending down-wind for as much as several hundred miles, could account for the major part of the casualties which might result from a thermonuclear attack on an unprotected population.”⁵⁵

This concern over the effects of nuclear detonations, and specifically thermonuclear explosions did not stop the US or other nuclear weapon states from detonating them frequently as “tests.” Just as the fallout from Operation Crossroads made return to their homes and property impossible for the evacuated Bikinians, someone’s home and family was downwind of these (and all) massive H-bomb tests. Little care was given to the fact that human beings were directly experiencing effects of the weapons that were designed as military effects which could be inflicted on an enemy. When the detonations were classified as tests, the fact that people suffered from the effects of the weapons was not deemed warfare. This callous disregard for downwind populations, and also for test site personnel and military troops, was normalized at Operation Crossroads and continued throughout the Cold War.

The destruction of ecosystems, and their persistent contamination with radionuclides was also first conducted during Operation Crossroads, and became standard operating procedure throughout the Cold War era of nuclear testing. Bikini Atoll became a “radiobiological laboratory” where the migration and transport of radioactive particles could be studied but remediation efforts always remained performative at best. By the mid-1950s the United States was secretly gathering the bones of the dead and teeth of children around the globe in Project Sunshine to continue to track the migration of radioactive particles, in what was, for all purposes, the Earth—radiobiological laboratory.⁵⁶

The US never conducted any remediation of Bikini Atoll, even though it has explicitly promised the Bikinians who had been displaced that they could return to their homes a few years after Operation Crossroads. Chemist Piero R. Danesi noted in 2009 that, “although remedial measures and resettlement of the local population have not yet taken place, several remedial options for Bikini were studied in detail.”⁵⁷ These studies have never eventuated in action, and now, 75 years later, multiple generations of Bikinians have not set foot on the island. This lack of a sense of responsibility towards those whose lives were disrupted by US nuclear testing betrays an entitlement that the US showed even to its own citizens, who lived downwind from the Nevada Test Site that would be established in 1951, and which would see over 900 detonations, the largest number of nuclear tests of any site on Earth.

The radiological legacy of US nuclear weapon production and testing is daunting. Tens of thousands of metric tons of spent nuclear fuel sit at the Hanford and Savannah River sites that were used to manufacture plutonium for US weapons, and countless other manufacturing sites have produced and dumped tons of radioactive waste.⁵⁸ The deep geological repository for non-fuel rod military high-level nuclear waste, the Waste Isolation Pilot Plant in New Mexico, has experienced several fires and radiological leaks in the first decades of its operations.⁵⁹ The two nuclear test sites in the Marshall Islands, Bikini and Enewetak Atolls, are heavily contaminated and laden with waste, while several additional atolls are too contaminated for habitation due to radioactive fallout. The Nevada Test Site is an active military site, the Nevada National Security Site, and has not been remediated. A small number of test site workers and downwinders are now eligible to receive limited compensation through the Radiation Exposure Compensation Act.⁶⁰

Conclusion: Nuclear weapons as American icons

In August 1945, the United States attacked two cities in Japan with nuclear weapons. This use of weapons of mass destruction was conducted against cities and their populations. While there were some military casualties and destruction of military assets, the majority killed were civilians, and large sections of residential cities were destroyed. Because the weapons used were nuclear weapons, hundreds of thousands of people were exposed to bursts of prompt radiation that penetrated their whole bodies, manifesting ongoing disease loads that unfolded over the rest of their lives, and also blanketed large areas with long-lived radioactive fallout, some of which will remain dangerous for millennia.

World War Two saw devastation on an unprecedented scale with all combatants conducting attacks against civilian populations and urban areas. Whole sections of cities were burned to the ground in fire bombings. The attacks in Hiroshima and Nagasaki were not unique in their toll, but in the means of their destruction and the ongoing legacies of radiation on those exposed during the attacks, and those who were and will be exposed to the fallout. The whole world was shocked at what was accomplished with one bomb carried on one plane in less than one second. Coming at the end of a war that saw tens of millions of civilians murdered, it foreshadowed an era in which whole societies might be annihilated. That was, in fact, the plan: “If used in numbers, atomic bombs not only can nullify any nation’s military effort, but can demolish its social and economic structures and prevent their reestablishment for long periods of time,” commented the analysts of Operation Crossroads, “With such weapons, especially if employed in conjunction with other weapons of mass

destruction as, for example, pathogenic bacteria, it is quite possible to depopulate vast areas of the earth's surface, leaving only vestigial remnants of man's material works."⁶¹

The United States worked for years to achieve the attacks on Hiroshima and Nagasaki, spent billions of dollars, and watched as the humanity recoiled. And its leaders said: yes, more of this. Rather than looking backwards at Hiroshima and Nagasaki with humanity and seeing an ominous warning about toying with technological apocalyptic weapons, the United States military looked at the destruction of those two cities, at the mass murder of the civilians, soldiers and children, at the radiological legacies of survivors and contaminated ecosystems, and saw the future. They prepared for a thousand Hiroshimas. They saw power, domination and imagined themselves wielding weapons of biblical proportions, and being the most powerful nation ever on the face of the Earth.

There were lessons to be learned from the nuclear attacks on Hiroshima. Lessons about the use of weapons of mass destruction against civilian populations. Lessons about the use of radiation as a weapon, inflicting damage on bodies with ongoing deleterious effects long after the attack. Lessons about the radiological contamination of ecosystems and the deposition of fallout particles that will outlive the attackers, and for some radionuclides like plutonium, will outlive the governments making and absorbing the attacks. Lessons about the ethics of wartime conduct and the legacies of war crimes. The United States did not learn these lessons after Hiroshima and Nagasaki. The lessons they learned were focused entirely on the power and destructive capacity of the weapons. They continue to embrace those toxic lessons today. After Hiroshima the United States stood at the fork of the road towards two futures and chose the wrong path.

Notes

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