

## ATOMIC ECONOMICS

## Abstract

Few moments in human history can be compared to the culmination of events that brought the atomic bomb into creation. It is incredible to contemplate that while a nation was fighting a two front war that spanned from Europe into the Pacific, that the United States was able to utilize the time, energy, brains, materials, manpower, and capital to complete a project in four years. That under any other circumstances would have taken greater than half a century to complete.

First, this thesis will discuss breakthroughs in research that led scientists to believe that the atomic weapons could be built, the places where the breakthroughs took place, and who made them. Second, attention will be given to the circumstances surrounding the recommendations given to the United States government to start their own atomic program, and why Roosevelt agreed to fund the project. Third, a look at the economic impact and resources required to develop the atomic weapon, the people, materiel, resources, and capital that was needed to build the bomb. Fourth, a look at Harry Truman, the president who inherited the bomb from his predecessor, what he thought of the bomb, the moral implications of its use in warfare, and his reasoning on utilizing the weapon on Japanese civilian cities of Hiroshima and Nagasaki. Fifth, a look at the proposed alternatives to forcing the surrender of the Japanese in World War 2, and whether methods would have been effective. And finally, showing that the construction of the atomic weapon was economically and militarily the most effective option the American armed forces could utilize at the time.

## ATOMIC ECONOMICS

## The Economics of the Atomic Bomb: Cost and Utilization

“We knew the world would not be the same. Few people laughed, few people cried, most people were silent. I remembered the line from the Hindu scripture, the Bhagavad-Gita. Vishnu is trying to persuade the Prince that he should do his duty and to impress him takes on his multi armed form and says, “Now I am become Death, The Destroyer of worlds.” I suppose we all thought that, one way or another.”<sup>1</sup> Robert Oppenheimer spoke these words in reference to the first successful detonation of an atomic test in New Mexico.

The purpose of this honors thesis is to examine the development of the atomic bomb and the economics involved in the process of its creation and utilization. This will be done by evaluating the scientific progress at the possibility of utilizing atomic energy as a weapon, what discoveries encouraged scientists to believe that this endeavor was possible, and what convinced Roosevelt to dedicate a significant number of resources to the development.

To develop the atomic bomb, the research team needed vast resources to obtain and develop appropriate radioactive material. Physicists in both Europe and the United States had begun to conduct serious research in the potential of atomic energy, and its use as a weapon in combat. The key word in this discussion is potential: all current potential was speculation, for up to that time no successful test had been conducted, and no weapons development in previous history had necessitated such vast resources to perform the tests to see if the weapon would even be plausible. Most weapon research had been utilized to improve different weapons that had already existed but were made more efficient or more deadly. To build an atomic bomb would be something that was unprecedented, a new weapon that had yet to be

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<sup>1</sup> C. Landesman, “Rawls on Hiroshima: An Inquiry into the Morality of the use of Atomic Weapons in August 1945,” *Philosophical Forum* 34, no. 1 (Spring 2003): 21-38.

## ATOMIC ECONOMICS

seen, utilizing speculation science, and the consequences if such a weapon were built would be incalculable at the time.

Part of this thesis will be dedicated to demonstrating the knowledge of the mind before atomic potential and atomic bombs were fully realized. It is easy to justify the necessary cost both in manpower, money and material resources to construct this weapon because when we look back on history we know that it works, we knew that building the bomb is possible and that when it was utilized it was a primary factor in resolving the war in the Pacific and in international politics to this present day. The president, and his advisors as well as the scientists had far less evidence that this could be achieved, and if the potential boon was worth the vital war resources that would need to be allocated to the project. The ultimate question being: Why did they believe that the resources were better spent in pursuit of this project rather than overseas with the men on all the fighting fronts around the globe?

Significant attention for this thesis will be dedicated to economic potential and benefits of the atomic bomb concerning both presidents who were in power during its construction and utilization. First Franklin Roosevelt will be discussed and the information he received, and the considerations he made when he decided to fund the construction of an atomic weapon. At the time that atomic scientists desired to begin construction and research, they had to compete for resources with other projects within the American military such as training troops, building its fleet, and providing supplies for the Allies in the Lend-Lease Act. With the naval devastation in the Pacific and the declaration of war against Germany and Japan, it would be hard to justify the use of needed resources to construct this project.

## ATOMIC ECONOMICS

Skilled labor was needed everywhere in the United States to maintain the arsenal of democracy. Many young men were being mobilized for war and the United States needed any and all capable workers to maintain supplies and logistics. Aluminum, steel, iron, copper, were all needed to build planes, guns, ammunition, boats, electronic hardware, as well as various other wartime materiel. Coal and oil were other very valuable resources being used for the United States armies that were all in relatively short supply. To construct an atomic bomb, a number of factories would be required to produce any and all hardware required for the bomb, including its protective casing to the radioactive material that would ultimately be detonated over Hiroshima and Nagasaki. It is significant that all the materials listed above would be needed to make the atomic bomb project a success, and in very large quantities.

New factories would have to be built, because no factory within the United States or the world had the capability of producing uranium and plutonium in large enough quantities that would be needed for the bomb. Each factory would require a large amount of the resources, many metals, energy, and thousands of skilled laborers to run the machines. The scientific contribution would also be immense, to develop any new technology normally lots of minds are needed to bring it into being and the atomic technology would require many scientists to develop, not only American scientists, but a large number of Jewish immigrants and scientists from the United Kingdom. A whole village at Los Alamos would be built to accommodate them to produce the weapon. But with economics and limited resources it is important to realize that when you allocate a resource it means that it is not being used for another task and every ton of metal, every skilled worker, and every scientist that was being directed to the Manhattan project was not being used to build new weaponry, to man machines that created engines of war, and to develop alternate technology to the war front.

## ATOMIC ECONOMICS

All these will be examined to determine why Roosevelt believed that this diverting of resources was worthy to help the war effort.

Upon Roosevelt's death, the role of commander in chief fell to Vice President Harry Truman, who previously had very little idea of the purpose or the existence of the Manhattan project, or that it was very near to completion. Before he became Vice president, Truman headed a committee that oversaw war expenditures, and attempted to eliminate wasteful spending. Another aspect of this paper will study Truman's thoughts and reactions of learning the capabilities of the bomb, his belief on whether the cost of the project was worth the product it produced, and why he decided to use it in battle.

Finally, research will be conducted on the final decision to drop the bomb. Many questions will be asked pertaining to this subject. There were many significant cities contained in mainland Japan, why were Hiroshima, and Nagasaki designated as the bombs targets. Also, had the bomb been perfected earlier, would it have been used on European soil, or were the bombs specifically destined for Japanese reception because of their attack at Pearl Harbor? Additionally, what knowledge did the American scientist possess about the atomic bomb, did they know about the serious side effects of radiation, or how long it would be present in the soil, or was it an unsuspected consequence that had not been foreseen? Did the upper echelon of military planners, strategists, and officers including the president see the weapon as a unique game changer that should only be used in the most dire of circumstances, even to the point of never being used at all? Or did they see the atomic weapon, as just another bomb of the millions that had been dropped throughout the war by both sides on hundreds of cities just with a bigger bang, that it was a significant improvement on previous technology but it was just the same practice utilized by both sides just on a larger scale?

## ATOMIC ECONOMICS

An unfortunate side effect of the world wars was a significant increase of civilian casualties. Both sides willingly bombed cities with military significance and with high civilian population densities such as London, Berlin and Tokyo. Was Truman concerned about using these bombs on cities with high civilian concentration? Was the 100,000 deaths caused by this bomb something horrendous and out of the ordinary or to Truman was it another example of the carnage that every participant in this war had committed, and a means to end the war without further loss of his own citizens.

On its conclusion this paper will discuss the economics of the bomb, what leading opinions are in its utilization and what humanity has wrote about its use in warfare. Was it economically sound, the cost to produce it, the materials used to build it, the men it took to create its necessary properties? Was it worth the price to produce a bomb that could level a whole city? Was the cost worth the men that it would save from having to invade mainland Japan? Was there any viable alternatives that would have forced Japanese surrender without the use of these weapons? Can you truly fault a president that would rather kill soldiers and civilians of its enemy, whom it was in a contest of war in large numbers by ways unavailable to other nations, if it meant saving hundreds of thousands of his own peoples lives? Would the United States public ultimately support its government's decision to produce and utilize atomic weaponry in active warfare?

### **Development of Atomic Theory**

In 1911, Earnest Rutherford had theorized that each atom had a core aspect known as the nucleus, and that this nucleus was a storehouse of enormous energy potential. James Chadwick in 1938 discovered the neutron a subatomic particle without a charge and therefore

## ATOMIC ECONOMICS

in theory would be capable of penetrating the Nucleus.<sup>2</sup> It was two Germans, Otto Hahn, and Fritz Strassman, that split the atom, demonstrating that nuclear fission was possible. Had it been any other country this news would be welcoming, but the scientists responsible worked directly for the Nazis. Fortunately, at that time they were not aware of the concept they had verified, and its implications.<sup>3</sup>

Nuclear fission is the division of nuclei in isotopes in certain heavy elements, such as plutonium and uranium; this causes the release of energy, additional neutrons, and an enormous quantity of heat.<sup>4</sup> The confirmation of the possibility of nuclear fission was verified in experiments both in the United States and in Europe by January of 1939. The possibility of utilizing this release of atomic energy as a means of an energy source or as a weapon, became a topic of immediate speculation across the scientific community.<sup>5</sup>

Leo Szilard, a Jew born in Hungary, and trained in Germany was forced to flee after the Nazi purges, wrote this about the verification of nuclear fission, “This in itself might make it possible to produce power by means of nuclear energy, but I do not think that this possibility is very exciting, for the cost of investment would probably be too high. I do however see possibilities in another direction. These might lead to large scale production of energy and radioactive elements, unfortunately also perhaps to atomic bombs.”<sup>6</sup>

Naturally, on the completion of such a discovery, those that conducted the research would desire to publish their findings to receive credit, earn accolades, and gain respect among their peers. American born physicists were largely unaccustomed to using their

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<sup>2</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb* (New York: Columbia University Press, 2007), 15.

<sup>3</sup> *Ibid.*, 15.

<sup>4</sup> David Dietz, *Atomic science, bombs, and power*. 25.

<sup>5</sup> *Ibid.*, 124.

<sup>6</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 15.

## ATOMIC ECONOMICS

science for military purposes. Luckily the foreign born physicists, whom most had arrived in America due to Nazi purges, recognized the potential for a weapon, and the dangers of any of the information they had published falling into the wrong hands. Leo Szilard and Enrico Fermi sought to censor further findings from being circulated into the public forum, where anyone could read their reports. In the spring of 1939, with the cooperation of Niels Bohr, the group of scientists pressing for confidentiality and censorship of the discoveries, were able to curb publication on the research completed by fellow Americans on nuclear fission by voluntary agreement.<sup>7</sup>

Leading American and British physicists agreed to secrecy due to the political tension in Europe. Unfortunately, Frederic Joliot of France, refused to censor his work, and as a result a little over 100 papers were published on nuclear fission before the end of 1939. Many of which confirmed, and bolstered the research the Nazi's had already completed.<sup>8</sup> By the next year American scientists established a voluntary censorship across the country. It is of note, that the scientists were the first to recognize the need for secrecy of this material, and took steps themselves to establish it. Szilard stated that it was necessary that the U.S. government be made aware of the threat that the Nazi study of nuclear fission possessed, but more importantly he had to convince them to develop and build an atomic bomb of their own, before the Germans did.

The first contact with the American government, about the potential use of nuclear fission as a weapon of war, was in March of 1939. This was established by Dean G.P. Pegram of Columbia University to the Navy department, whom he arranged a conference with

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<sup>7</sup> David Dietz, *Atomic science, bombs, and power*, 124.

<sup>8</sup> *Ibid.*, 124.



## ATOMIC ECONOMICS

physicist Enrico Fermi.<sup>9</sup> Fermi pointed out to Navy officials the possibility of obtaining atomic power from fission with slow neutrons, or the ability to create an atomic bomb with the fission of fast neutrons.<sup>10</sup> On the initial presentation of this information, the Navy was unimpressed, but told the scientists with polite interest to keep them informed of future developments.<sup>11</sup>

With the combined effort of American physicists, as well as foreign physicists Leo Szilard, Eugene Wigner, Edward Teller, V.F. Weisskopf, and Enrico Fermi, it was demonstrated that fast neutrons were released in uranium fission. This would be an important breakthrough, which would make them confident enough to approach the government again in the probability that an atomic weapon could be produced.<sup>12</sup> On verification and conclusion of this experiment, Szilard, Wigner, and Einstein informed Alexander Sachs, a New York economist who served as an advisor to President Roosevelt, about their findings. Einstein was chosen to write the letter because of his prominence and fame earned from his theory of relativity. The first letter written by Einstein on August 2, 1939 warned that the advances in physics had made an atomic bomb possible and that Germany was likely to try to build such a bomb.<sup>13</sup> Little was done by the government to promote research of nuclear fission after the conclusion of this meeting. Word soon reached the United States that research on nuclear fission was being done by Germany, in the Kaiser Wilhelm Institute in Berlin.<sup>14</sup>

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<sup>9</sup> David Dietz, *Atomic science, bombs, and power*, 125.

<sup>10</sup> *Ibid.*, 126.

<sup>11</sup> *Ibid.*, 125.

<sup>12</sup> *Ibid.*, 125.

<sup>13</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 16.

<sup>14</sup> Peter N. Kirstein, "Hiroshima and Spinning the Atom: America, Britain, and Canada Proclaim the Nuclear Age, 6 August 1945," *Historian* 71, no. 4 (Winter 2009): 820.

### Government Interest

Einstein wrote in detail a letter about the research that was being done at the Kaiser Wilhelm Institute, and why the United States should follow suit if they did not wish to be left behind in this endeavor, or be at the mercy of such a weapon with nothing to defend them from it. He delivered this letter to Sachs to be hand delivered to Roosevelt on October 11, 1939.<sup>15</sup> Upon receiving this letter, Roosevelt commanded Brigadier General Edwin M. Watson to form a committee to look into the matter. This committee was dubbed the advisory committee on uranium and was led by Lyman J. Briggs, the director of the National Bureau of Standards. It held its first meeting on October 21, 1939.<sup>16</sup> Upon further investigation the Briggs, committee report was delivered on November 1, 1939. It recommended two possibilities; one was that a controlled reaction could be reproduced and used as a power source for submarines, the other was whether it could be explosive and power a super bomb. They authorized the expenditure of funds an amount of six thousand dollars which was to be used to purchase a small quantity of uranium and graphite, on February 20, 1940. The project would eventually cost slightly more than 2 billion dollars; accounting for inflation the project would have cost 25 billion by today's standards.<sup>17</sup>

By June of 1940, it was common knowledge to that nuclear fission sometimes occurred in three natural occurring elements when bombarded with neutrons. These three elements were uranium, thorium, and protactinium, which would release large amounts of energy during fission.<sup>18</sup> The fission of thorium and protactinium could only be achieved with

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<sup>15</sup> Edwin Fogleman, *Hiroshima: The Decision to Use the A-Bomb* (New York, NY: Scribner Research Anthologies, 1964), 24.

<sup>16</sup> David Dietz, *Atomic science, bombs, and power*, 125.

<sup>17</sup> Paul Calore, "What the First Atomic Bomb Cost to Develop," What It Costs, <http://historical.whatitcosts.com/facts-atomic-bomb.htm> (accessed February 1, 2011).

<sup>18</sup> David Dietz, *Atomic science, bombs, and power*, 125.

## ATOMIC ECONOMICS

the bombardment of fast neutrons, but the fission of uranium could be caused by fast or slow neutrons, and this made uranium preferable out of the natural occurring elements. The element plutonium, synthesized for the first time in 1940 by Glenn Seaborg appeared to have the same properties as uranium; plutonium was created by sending neutrons into uranium 238.<sup>19</sup> The addition of neutrons to uranium was the key to creating the new element plutonium, which would be desired by scientists to create atomic weapons.

There were some ideas on how to effectively enrich uranium to a fissionable isotope of uranium, or to transform it into plutonium. The European scientists, specifically the Germans concentrated on the use of heavy water to regulate and cause a reaction.<sup>20</sup> Heavy water is simply oxygen that has been bonded to two heavy hydrogen or deuterium instead of regular hydrogen. In molecular geometry, it is nearly identical to water, and its properties are very similar to water. Regular hydrogen, on its nucleus, only contains one proton, whereas deuterium is a stable isotope of hydrogen that at its nucleus contains one proton and one neutron, thus earning it its heavy name. The theory was that if the uranium is bathed in heavy water, the extra neutrons will transfer to the uranium from the heavy hydrogen, causing it to react. The downfall for Germany was that they relied on this to enrich and regulate their uranium reactions. Heavy water is a relatively scarce material, and because of the rarity of it, and the difficulty in which it is produced. The Germans were not able to produce a bomb, or a nuclear reactor throughout the Second World War. The only factory they had access to that produced heavy water was located in Norway, which was destroyed by saboteurs in 1943.<sup>21</sup>

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<sup>19</sup> David Dietz, *Atomic science, bombs, and power*, 126.

<sup>20</sup> *Ibid.*, 126.

<sup>21</sup> *Ibid.*, 123.

## ATOMIC ECONOMICS

Heavy water would be a key component in enriching uranium, and other radioactive isotopes in the desire to create a nuclear reactor, or bomb after World War II.<sup>22</sup>

The Americans, however, decided to follow Fermi's and Szilard's suggestion of utilizing carbon in the form of graphite, and embedding lumps of uranium in the graphite like raisins on a cake.<sup>23</sup> The graphite would reduce neutron activity in its vicinity, and provide ready access to its own neutrons to continue a self sustaining reaction. The first research contract from the government in the research of atomic weapon possibilities was rewarded to Columbia University, in July of 1941. The first lattice structure of uranium and graphite was designed. This was the forerunner of what would become known as a nuclear reactor or a uranium pile and would cost 150,000 dollars to create.<sup>24</sup>

Arthur Compton, a Nobel laureate in physics, and head of the Office of Science Research and Development, began the construction of a graphite and uranium lattice, underneath the football stadium stands at the University of Chicago. A nuclear reactor was constructed later known as the Chicago pile, this controlled chain reaction would produce plutonium. On December 2, 1942, nearly a year after the American entrance into the war, Fermi ignited the pile for five minutes, stating that it had gone critical. After that time he deactivated it, the result, it barely produced enough energy to power a light bulb. That day, America and the rest of the world crawled into the nuclear age.<sup>25</sup> Fermi had conducted a successful nuclear test, which had gone critical in one of the most populous cities in North America. Fortunately, the Italian had kept the reaction under control, keeping everyone

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<sup>22</sup> David Dietz, *Atomic science, bombs, and power*, 123.

<sup>23</sup> *Ibid.*, 126.

<sup>24</sup> Peter N. Kirstein, "Hiroshima and Spinning the Atom: America, Britain, and Canada Proclaim the Nuclear Age, 6 August 1945," *Historian* 71, no. 4 (Winter 2009): 805-27.

<sup>25</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 23.

## ATOMIC ECONOMICS

involved safe and happy. This experiment would go a long way into showing Franklin Roosevelt that the investment in nuclear weaponry would be worthwhile.<sup>26</sup>

The decision to create the atomic bomb can be traced to Franklin Roosevelt. The decision to embark on a creation of a theoretical item took great courage, and a trust in a personal vision and that of his scientists.<sup>27</sup> The sacrifices required that he assign many brilliant scientists to this endeavor, when their talents were needed on additional ventures, such as radar development, took great faith. Roosevelt showed great trust in his scientists, when gave resources to build the plants that would be needed to produce the elements and material necessary to make a potential atomic bomb, during a two front war. These plants would need war materials such as steel, copper, aluminum, iron, coal, and oil, which at the present time there was a shortage, with most going to prepare for the war effort or to be directly used in it. To build and man these plants required the labor of tens of thousands of skilled workers, and skilled laborers were needed everywhere, due to most able young men fighting in the military.<sup>28</sup>

The gamble that Roosevelt took by allocating war resources to the construction of a theoretical weapon, that had as of yet been demonstrated in nature was great. Had this venture failed, it would have shown dire consequences for President Roosevelt, and the harshest and severest criticism would have hailed down on the president and his advisors. When the expenditures on the development of the atomic bomb had reached into the millions of dollars, Admiral William D. Leahy, Roosevelt's chief of staff confronted him with his fears of the congressional investigations that would happen soon or someday, potentially led by the future president Harry Truman. Roosevelt replied, "Don't worry. If the bomb works, there

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<sup>26</sup> Ibid., 25.

<sup>27</sup> David Dietz, *Atomic science, bombs, and power*, 123.

<sup>28</sup> Ibid., 123.

## ATOMIC ECONOMICS

will be no investigations, and if it doesn't, there will never be time to investigate anything else.”<sup>29</sup>

Roosevelt consulted his top policy group whether the atomic bomb would be a worthwhile investment for the government to undertake. The group included Vice President Henry Wallace, Secretary of War Henry Stimson, army chief of Staff George C. Marshall, Vannevar Bush, and James Bryant Conant. Bush's task was to recruit Arthur H. Compton, the physicist who oversaw the Chicago Pile at the University of Chicago. Compton was asked to conduct a review on the feasibility of building the atomic weapon. Compton recruited some of the greatest scientists available in American nuclear research including Fermi, Wigner, Ernest Lawrence, Harold Urey, Glenn Seaborg, and Robert Oppenheimer.<sup>30</sup>

Previous research dictated that the more plentiful uranium 238 did not fission, and could not be used for an atomic weapon. Uranium 235, however, could fission, and would be needed to build a bomb. The dilemma was that only 1 out of 140 Uranium atoms were the 235 isotope, found in nature.<sup>31</sup> To separate the two isotopes would be a laborious task and if it required hundreds of pounds of uranium to create a bomb, which prior estimates predicted, the need for thousands of pounds of material to produce a suitable explosion would be inefficient, and this amount would be impossible to complete.<sup>32</sup>

Hope was found by Otto Frisch, a German born scientist, he calculated that it would only require two pounds of uranium 235 to produce an atomic bomb, much less than had previously been predicted. Other reports published soon after, predicted that only 25 pounds of uranium would be needed to build a bomb. Though the task would be laborious, a factory

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<sup>29</sup> Ibid., 124.

<sup>30</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 18.

<sup>31</sup> Ibid., 17.

<sup>32</sup> David Dietz, *Atomic science, bombs, and power*, 126.

## ATOMIC ECONOMICS

could be built to produce it, but at a great expense, and by their calculation by 1943 they could produce enough material to produce a bomb, if they began construction immediately.<sup>33</sup>

The six page report officially created by the National Academy of Sciences was delivered by Bush to the president in November of 1941. It was positive that the mass of U235 needed to build a bomb, was no less than 1 kg and no more than 100kg.<sup>34</sup> Shortly after, the United States was bombed at Pearl Harbor on December 7, 1941. Four days later Germany declared war on the United States on December 11, 1941.

The United States was not only at war with Germany, who it had planned on being in conflict sooner or later, but also with Japan, a nation it believed it could easily defeat. The scientific prowess demonstrated by the Germans, and their potential to create a bomb, was fully understood by the United States top officials. In January of 1942, Roosevelt issued authorization to Bush, to accelerate research on the atomic bomb. In effect, he demanded that the bomb be accelerated from the research phase, to the development stage of the project. The project to give the United States nuclear superiority was officially off the ground.<sup>35</sup>

Glenn Seaborg, part of the expert panel on the National Academy of the Sciences, had to determine if the atomic project was worth the expenditures needed to create plutonium in his lab in Berkeley California. He created Plutonium, by bombarding uranium 238 with neutrons until it became PU239 a fissionable element.<sup>36</sup>

S-1 was the codename that the top officials gave the program designated to build the atomic bomb, and they would refer to it as such until successful testing was completed three years later. In June of 1942, Bush told Roosevelt it was time for the army to undertake the

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<sup>33</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 18.

<sup>34</sup> *Ibid.*, 18.

<sup>35</sup> J. Samuel Walker, *Prompt and Utter Destruction: Truman and the Use of Atomic Bombs Against Japan*, Revised ed. (Chapel Hill: The University of North Carolina Press, 2005), 24.

<sup>36</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 19.

## ATOMIC ECONOMICS

enormous responsibility of constructing the factories that would separate the uranium isotopes, and the sites that would create the plutonium element.<sup>37</sup>

### **Economic Understanding and Construction**

The army was the best for constructing factories, because it had the largest budget, and had a number of years of experience building large scale construction projects in a short amount of time. Also, the large cost of building top secret projects was easily hidden within the Army's prodigious budget. Colonel Leslie Groves was chosen to take over the project. Groves, had recently overseen the construction of the Pentagon, and was a man with a reputation of getting the job done, regardless of the obstacles.<sup>38</sup> There was a problem in acquiring material because the project did not have the highest priority rating from the government, which was necessary to get all the resources it needed. Leslie Groves was put in charge of the project to get supplies. Groves stated in reflection of the Manhattan Project, "My mission as given to me by Secretary Stimson was to produce this at the earliest possible date so as to bring the war to a conclusion."<sup>39</sup>

Groves was promoted to Brigadier General upon receiving his new job, and soon differences in how the project was progressing were noted. He got the job done, and immediately began to solve previous problems. Within the first days, he had purchased 1,250 tons of high quality Uranium ore, which had been sitting in storage in New York. He quickly got the AAA rating for acquiring resources.<sup>40</sup> Upon purchasing raw materials necessary for jumpstarting the project, he purchased 52,000 acres of land in eastern Tennessee, to construct facilities to separate Isotopes of U235 from U238, and a small pilot nuclear reactor to produce

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<sup>37</sup> Ibid., 19.

<sup>38</sup> Barton J. Bernstein, "Reconsidering the 'Atomic General': Leslie R. Groves," *Journal of Military History* 67, no. 3 (July 2003): 883-920.

<sup>39</sup> Ibid., 883-920.

<sup>40</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 19.



## ATOMIC ECONOMICS

plutonium. Many thousands of people would be needed to build and run the factories, and the town of Oak Ridge came into being with the help of the Tennessee Valley Authority, to accommodate these men and women.<sup>41</sup>

To produce Plutonium, it required far more land, water, space, and electricity than was available at Oak Ridge. Due to the shortage, the Government bought 500,000 acres of virgin land, the equivalent of 780 square miles by the Columbia River near Hanford Washington. They began to construct the reactors and separation plants needed to produce Plutonium.<sup>42</sup> On December 8, 1942, without the approval of Congress, bolstered by the success of the Chicago Pile, Roosevelt approved the huge construction budgets necessary to build the atomic bomb, which were already spiraling upward at an uncontrollable rate. Most of the buildings utilized for the construction of the bomb, were some of the largest and most expensive in the world. Many of them did not reach their full production capacity until after 1945. One of the Oak Ridge structures, the k-25 gaseous construction plant used for producing U235, was the largest building in the world, measuring 4 stories high and measuring over half a mile long, it covered two million square feet and was the first fully automated plant in history. However, it still required three thousand workers at a time, or nine thousand workers for three shifts.<sup>43</sup>

By April of 1943, Groves controlled nearly every aspect of the atomic project, and habitually gave assignments and deadlines that appeared impossible to complete, but he also incentivized everyone involved to complete their duties by the given dates.<sup>44</sup> When Groves received command of the Manhattan project, and made all these purchases, there was no

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<sup>41</sup> Barton J. Bernstein, "Reconsidering the 'Atomic General': Leslie R. Groves," *Journal of Military History* 67, no. 3 (July 2003): 883-920.

<sup>42</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 20.

<sup>43</sup> *Ibid.*, 22.

<sup>44</sup> Barton J. Bernstein, "Reconsidering the 'Atomic General': Leslie R. Groves," *Journal of Military History* 67, no. 3 (July 2003): 883-920.

## ATOMIC ECONOMICS

guarantee that the bomb could even be made. Advances made by Oppenheimer in late 1942, showed a preliminary design for what the bomb would look like.<sup>45</sup>

One of Groves's main concerns for his project was keeping his secrets from his enemy, the Germans, and from his allies, the Soviet Union. Groves organized the project so that the 125,000 people that would come to work for him only knew about their specific assignments, and not about anything that was going on around them, a system known as compartmentalization.<sup>46</sup> Oppenheimer, the Scientific Director of the Manhattan Project, and previously the professor of theoretical physics at California Berkley, disagreed with this necessity, maintaining that the exchange of ideas made progress faster. In response Groves would create a central lab to meet both their requirements for secrecy, and a place for scientists to discuss their breakthroughs, supervised.<sup>47</sup> A ranch was bought 35 miles south of Santa Fe, and the central laboratory at Los Alamos would be built there. A community would be built around that site and would soon house 6000 people. This population included the scientists and their families, and formed a community with the highest average IQ on the planet.<sup>48</sup> They would be confined to the same P.O. box able to exchange their ideas, but isolated from outside contact.

The projects were not completed as they had been done in the past with foresight, problem solving, and development. They were asked to prepare for everything, and develop all aspects at the same time. This is best demonstrated by the simultaneous development of

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<sup>45</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 21.

<sup>46</sup> Barton J. Bernstein, "Reconsidering the 'Atomic General': Leslie R. Groves," *Journal of Military History* 67, no. 3 (July 2003): 883-920.

<sup>47</sup> *Ibid.*

<sup>48</sup> Johnny D. Boggs, "The Town That Gave Birth to the Bomb," *World War 2*, 22, no. 8 (December 2007): 30-32.

## ATOMIC ECONOMICS

both the uranium and plutonium bombs. Many of the scientists worked in labs that were not yet completely constructed.<sup>49</sup>

Industrial plants were required to produce machines that they had never had to produce before, and required to replicate and produce entirely new technologies and materials, which had yet to be developed.<sup>50</sup> Among the new technologies, a material was created that could move the highly corrosive uranium hexafluoride gas through Oak Ridge's gas diffusion plant, to prevent seals from failing, and toxic gas escaping into the open air. The recently developed slippery compound that was rushed into service would be later known as Teflon.<sup>51</sup>

Additional problems faced by the scientists were that plutonium and uranium 235 were unable to be triggered into a chain reaction in the same manner. Plutonium required a device that would cause it to implode, something very difficult to achieve at that time. The continuous problems experienced by the diffusion factories, meant that U235 was not being produced in great enough quantities.<sup>52</sup> Uranium could be detonated by slamming the fissionable material into a non critical element, much simpler than was required by plutonium.

The uranium factories were unable to produce a pure form of U235, instead the item that was eventually produced was enriched Uranium, about 50 percent U235. The Uranium bomb 'Little Boy' would require 50 kg of 50 percent 235 and 14 kg of 89 percent U235. The development of radioactive material was so slow that there was not enough fissionable material to produce a bomb until July of 1945. It would take months before a second Uranium bomb could be produced. It had taken nearly two years for a multi-million square foot

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<sup>49</sup> Ibid.,

<sup>50</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 23.

<sup>51</sup> Ibid., 23.

<sup>52</sup> Ibid., 23.

## ATOMIC ECONOMICS

factory, manned by 9000 workers, to produce 141 pounds of fissionable uranium.<sup>53</sup> If the US wanted an arsenal of atomic bombs they would need to be made out of plutonium.

Plutonium presented complex problems of its own. Even though it could be created faster than uranium 235, the mechanism in which to produce detonation was much more technical, and harder to develop. This problem gave Oppenheimer extreme anxiety, and a bad case of insomnia. He nearly quit because of the difficulties in producing a detonation device.<sup>54</sup> The system utilized to implode plutonium was developed by foreign physicist Dr. Kistiowsky. It was a lens trigger that focused the energy evenly over the plutonium. It would be complex and troublesome to develop, as well as debatable if it would work. The difference between the atomic elements being used as weapons was that the uranium bomb could utilize a simple gun trigger to cause a chain reaction, a much easier method than needed for plutonium, but uranium 235 was much more difficult to produce.<sup>55</sup>

By early 1945, the uranium plants were beginning to develop uranium in sufficient quantities, to begin building a bomb by late July. A test was set up on July 15, 1945, to see if a plutonium bomb would work; the device was nicknamed the gadget. A number of differing opinions circulated throughout the community on what the test would produce. Some believed a small explosion would be produced, a couple believed nothing would happen, and a minority opinion believed that the explosion could ignite the atmosphere in an apocalyptic nightmare.<sup>56</sup> A high mushroom cloud marred the horizon early in the morning, the test was an

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<sup>53</sup> David Dietz, *Atomic science, bombs, and power*, 38.

<sup>54</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 23.

<sup>55</sup> Cameron Reed, "From Treasury Vault to the Manhattan Project," *American Scientist* 99, no. 1 (Jan/Feb 2011): 40-47.

<sup>56</sup> Carl Crouthamel, "Qualms About Bombs," *Science and Spirit* 15, no. 1 (Jan/Feb2004): 24-25.

## ATOMIC ECONOMICS

overwhelming success, and the tonnage measured 18,000 tons of TNT.<sup>57</sup> The United States now had an alternative to invasion to end the war in the Pacific.

Truman would be responsible to decide to use the special bomb on the Japanese cities. Truman's memoirs reveal that his foremost concern in making this decision was saving American lives, and reducing the possibility of American casualties. It was Roosevelt that ordered the building of the bomb, and pushed the budget through without congressional authority. At the previous president's death, it landed fortuitously into Truman's lap. The decision to use the bomb is integral in the decision to build it in the first place, and that was to use it to destroy the United States enemies, and to win the war. The time that would dictate necessary utilization of the bomb was to win, and end the war.<sup>58</sup>

Some charge that the use of the bomb was racism, that only the Japanese would have been targeted, and that it would have never been used on white Europeans. But the bomb was built in fear that the Germans would develop a bomb of their own, and a majority of historians have reached a consensus that had the bomb been ready earlier it would most likely have been utilized against any and all enemy forces, including the Germans.<sup>59</sup> It is clear through examination of war records and strategic planning, that the United States did not hold back anything else in its arsenal when fighting the Germans. It utilized its heavy bombers and incendiary bombs on German cities to facilitate the end the war in Europe. It is ludicrous to believe that the United States would consider the atomic bomb to be inhumane to use against German cities, when US forces regularly bombed and incendiary bombed German civilians, there was no preferential treatment with the weapons. Saying racism was used against the

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<sup>57</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 25.

<sup>58</sup> Robert H. Ferrell, "President Harry S. Truman and the Bomb," *National Forum* 75, no. 4 (Fall 1995): 22-25.

<sup>59</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 46.

## ATOMIC ECONOMICS

Japanese when utilizing the atomic weapons is like stating it's more humane to burn alive enemy civilians than to vaporize them. Original training for atomic weapon runs included practice runs for potential German cities as well as Japanese cities.<sup>60</sup>

General Groves recalled that even as late as December of 1944, when it became clear that the bombs would not be ready for the end of the European theatre of war. Roosevelt told him in the presence of Henry Stimson that if the war was not over with Germany by the time the bomb was completed, that they should be prepared to use them on the Germans.<sup>61</sup>

By the end of 1944, through August 6 of 1945, the Allies saw nothing to cause the American leadership to believe that the Japanese would surrender with terms acceptable to the allies, which was unconditional surrender. British and American leadership, who both had to approve the use of the atomic bomb by agreement, saw no other way to end the war then by atomic force.<sup>62</sup> Instead of the Japanese becoming more willing to accept terms of surrender the greater the defeats they suffered, the opposite happened, the fighting seemed to intensify the closer the battlefield approached the home islands.<sup>63</sup>

The B-29 played an important role in strategic bombing for the Pacific theatre. This weapon had been originally intended for American use against the Germans, had they been able to overrun Europe, but was now being actively used against the Japanese. An attack on Tokyo, with incendiary bombs from these super fortresses, killed over 80,000 people. The slaughter can largely be attributed to Tokyo's buildings and infrastructure was constructed

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<sup>60</sup> Ibid., 56.

<sup>61</sup> Stimson, Henry L. "The Decision to Use the Atomic Bomb." *Decision to Use the Atomic Bomb: Academic Search Complete* (2009): 1-12.

<sup>62</sup> Alexander Burnham, "Okinawa, Harry Truman, and the Atomic Bomb," *Virginia Quarterly Review* 71, no. 3 (Summer 1995): 377-92.

<sup>63</sup> Robert H. Ferrell, "President Harry S. Truman and the Bomb," *National Forum* 75, no. 4 (Fall 1995): 22-25.

## ATOMIC ECONOMICS

mainly from wood. The B-29, the plane that the Japanese would come to fear, would become the delivery system for the atomic weapons.<sup>64</sup>

There were two conditions that led to the utilization of the atomic bomb against Japanese forces. First, was the requirement by the United States and its Allies for unconditional surrender. This was necessary, because they believed that Nazism and Japanese militarism had to be completely defeated to keep a peaceful postwar time, and so that the nations could occupy the defeated nations as to prevent another war, and implement a program of reform lead by the native people: “We are fighting this war because we did not receive unconditional surrender in the previous war.”<sup>65</sup>

There are arguments leveled that the Japanese would have surrendered if the emperor would be allowed to remain on his throne. These claims are not warranted, because these demands were not leveled until after the use of both atomic weapons on the Japanese cities. The demands made by the Japanese militants in charge of their armed forces before the bombs, did not meet the demands of the United States. Unconditional surrender was unacceptable to the Japanese in previous negotiations. Also, the second bomb was not viewed as a certainty to end the war, but as a way of putting pressure on the Japanese government, as well as its policy of bombing cities, blockading ports, and a planned invasion. The military planners believed that blockading and bombing would not end the war within a reasonable time period, and that only invasion could force the Japanese to surrender.<sup>66</sup>

Truman had to look at the dreadful casualty totals at Iwa Jima and Okinawa, when considering the option of invading Japan. The decreasing morale of his own soldiers, as they

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<sup>64</sup> Tom Masland and Hideko Takayama, “A Silent Bomb,” *Newsweek* 126, no. 4 (July 24, 1995): 31-33.

<sup>65</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 47.

<sup>66</sup> Donald Kagan, “Why America dropped the Bomb,” *Commentary* 100, no. 3 (September 1995): 17-23.

## ATOMIC ECONOMICS

contemplated what awaited them on the Japanese home islands, not to mention the pressure that the home front was putting on the government to end the war quickly, weighed down upon him. Truman initially approved Operation Olympic in the Spring of 1945, which was the first stage of invasion of the Japanese home islands, but a couple of months later, the successful detonation of the plutonium bomb known as the gadget was completed at Los Alamos, and Truman's options expanded considerably.<sup>67</sup> The hope that the bombs could be used, as well as other means of pressure would force Japan to surrender. When the Japanese did not immediately surrender after the first two atomic detonations over Hiroshima and Nagasaki, General Marshall began to formulate plans of tactical drops for the Japanese invasion to wipe out beach defenses.<sup>68</sup>

Truman as vice president had only a vague idea what was being built at the Manhattan project, the expenses being hidden from the Senate committee he headed. He was inaugurated as President following Roosevelt's death on April 12, 1945. It wasn't until April 25, did Stimson and Groves give Truman a full briefing on the weapon. When Truman was informed of the developments of the atomic bomb, he found an interim committee that included Byrnes, Stimson, and Oppenheimer. The purpose of the group was to determine an effective strategy to demonstrate the weapons capabilities, and end the war. One of the first assignments he gave them was to pick out four possible cities in Japan that could be bombed, and the method in which they would be bombed.<sup>69</sup>

The underlying assumption when Truman came into office was that these bombs would be used, as soon as they became available. The only thing to determine was strategy

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<sup>67</sup> George Moffett, "Truman's Atom-Bomb Dilemma," *Christian Science Monitor* 87, no. 171 (July 31, 1995): 1-4.

<sup>68</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 49.

<sup>69</sup> *Ibid.*, 50.



## ATOMIC ECONOMICS

and tactics. An idea came forth, that they demonstrate to the Japanese what they were capable of doing, but the fear that it could be a dud and waste the precious material, or that the Japanese would transport American POWs to the sight, or that the plane could be shot down, prevented them from considering the idea.<sup>70</sup> Stimson succinctly summed up the committee's plans: "The Japanese would not be warned of the incoming bombing. The United States would not concentrate on a civilian area but the target would provide enough psychological trauma to demonstrate seriousness of intent, and the most desirable target would be a military city that had many plants and workers, and their families."<sup>71</sup>

A petition went around among some of the scientists from Los Alamos. They desired that the atomic bomb not be utilized in active combat. It was headed by James Franck and Leo Szilard, they asked that the bomb be used on an isolated island, believing that the direct use in combat would start an arms race after the war. Oppenheimer refuted them, stating that a technical demonstration would not have the same desired effect that a military example would. To build up a nuclear arsenal, with the factories that the United States possessed running at full capacity it took three months to produce enough material to build a uranium bomb, but to build a plutonium bomb three could be built in a month, it would be a slow process to replace material.<sup>72</sup>

The first plan of the invasion of Japan was Operation Olympic, the invasion of Kyushu and then Operation Coronet, the invasion of Tokyo. Truman said that was the hardest

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<sup>70</sup> Ibid., 50.

<sup>71</sup> Henry L. Stimson, "The Decision to Use the Atomic Bomb," *Decision to Use the Atomic Bomb: Academic Search Complete* (2009): 1-12.

<sup>72</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 52.

## ATOMIC ECONOMICS

decision he had to make, determining if he should approve either operation. The amount of American casualties that either operation would yield was his primary concern.<sup>73</sup>

Former president Hoover asked Truman to settle for a negotiated peace with the Japanese, believing that a million American lives would be lost in the event of an invasion of Japan. Marshall dismissed that number as far too high, but refused to give Truman an estimate on potential American casualties in the event of an invasion. Truman approved Operation Olympic, but sorely hoped that the casualty total would not be an Okinawa from one end of Japan to the other.<sup>74</sup>

Intercepted telegrams decrypted through the MAGIC program, which specialized in diplomatic communications, received a message that the Japanese minister Togo sent stating that anything like unconditional surrender would not be acceptable to the Japanese. The Japanese also contacted the USSR, as a third party to negotiate a settled peace, but the USSR blocked talks in preparation for their own declaration of war.<sup>75</sup> This is not an example of the bombs being unnecessary, the Japanese desired to maintain their emperor and much of their conquered lands in their demands for peace, which would have been unacceptable to the United States. ULTRA the program that decrypted Japanese military encryptions since 1943 received communications of massive troop buildups in the Kyushu region, far beyond anything the military planners had estimated before Truman had approved Operation Olympic. The casualty total in the event of an invasion would be much higher than

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<sup>73</sup> Harry S. Truman, "Atomic Bombing of Hiroshima Announcement," *Public Papers of the President (Harry S. Truman)* (August 6, 1945): 197-200.

<sup>74</sup> J. Samuel Walker, *Prompt and Utter Destruction: Truman and the Use of Atomic Bombs Against Japan*, Revised ed. (Chapel Hill: The University of North Carolina Press, 2005), 122.

<sup>75</sup> Rosemary B. Mariner and G. Kurt Piehler, *The Atomic Bomb and American Society: New Perspectives* (Knoxville: University of Tennessee Press, 2009), 218.

## ATOMIC ECONOMICS

previously estimated. Invasion was not an acceptable option to American planners, if they were concerned about excessive loss of life in American troops.<sup>76</sup>

Hiroshima and Nagasaki, were at the top of the list as targets for the special bombs. When asked why they weren't bombing Kyoto, Stimson replied that as the cultural center it would be hard to reconcile with Japanese in post war efforts. Japan rejected the Potsdam declaration, that provided them with occupation but their economy and government would be reestablished as time passed. The Japanese foreign minister replied with *mokusatsu*, which means, "to kill with silence" or to ignore it in a much more forgiving translation. Truman received this as he puts it, "They told me to go to hell. Or words to that effect."<sup>77</sup>

On August 6, 1945, Hiroshima was Japan's seventh largest city, an important military center, and a major port on the Honshu, the largest of Japans four main home islands. In the early morning of that same day, 'Little Boy' was dropped on the island with the equivalent of 12,500 tons of TNT. The casualties of that day were just over 80,000 people, and more than 140,000 would die by the end of the year.<sup>78</sup> Three days later, with no message of surrender, a second bomb 'Fat Man' with a plutonium core, fell from the skies onto Nagasaki. Nagasaki was an important manufacturing city, and a major port on Kyushu, Japans southernmost home island. 'Fat Man' which was 2000 pounds heavier than little boy exploded, with the force of 22,000 tons of TNT. 25,000 people died instantly, and by the end of the year 20,000 more would be dead.<sup>79</sup>

Most American's immediately after August 6, 1945 supported Harry Truman's decision of the use of atomic weapons on Hiroshima, but the first critics quickly made their

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<sup>76</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 55.

<sup>77</sup> Alexander Burnham, "Okinawa, Harry Truman, and the Atomic Bomb," *Virginia Quarterly Review* 71, no. 3 (Summer 1995): 377-92.

<sup>78</sup> Herbert Buchsbaum, "The Final Act," *Scholastic Update* 127, no. 12 (May 24, 1995): 20-22.

<sup>79</sup> Jim Holt, "Morality, Reduced to Arithmetic," *New York Times*, August 5, 1995.

## ATOMIC ECONOMICS

voices heard. A demonstration of public opinion in August of 1945, 85 percent of Americans supported the atomic bombing with only 4.5 opposed, by the 1990s one poll showed only 55 percent supporting the bombing and 39 percent opposed. This swing in opinion is due to the separation from the event, and desperation of the times, and a movement in intellectual circles that practices speculative investigation, to claim the bomb was not necessary to end the war.<sup>80</sup>

Simply put, Truman's reason for utilizing the atomic bomb was not fueled by racist motivation or in revenge. He would have been more than willing to use it on European opponents as well. He did not order the creation of the bomb, but when the option was given to him to strike decisively against the Japanese, without the loss of American life the choice was obvious. Had Americans invaded the Japanese Isles at the end of World War II, and lost a million or more men to fanatical Japanese soldiers and civilians, and we had possessed the bomb, he would have been destroyed by an American public, upon discovery of its capabilities to end the war without the loss of life. Truman made the only decision that he had at that point, and that was to use the bomb, it was developed to end the war and Truman commanded that it fulfill its purpose. Economically, the material and capital that would have been utilized in an invasion would be far greater than the cost of developing an atomic bomb. Morally to kill 200,000 citizens and soldiers of your enemy to end the war in contrast to a million of your own is a rational and utilitarian trade. In the event of an invasion the loss of life would have been in the millions for both sides. At the battle of Okinawa, marines killed five Japanese for every one casualty, if this is conservatively applied to Japan with 1 million expected casualties its not unreasonable to believe that five million Japanese would be lost in combat. The 200,000 lost by the bombs is the humane option from this perspective. Truman made the only decision he could have to use the weapon that his predecessor left him.

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<sup>80</sup> Michael Kort, *The Columbia Guide to Hiroshima and the Bomb*, 6.

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