THE NAZI ATOMIC BOMB:

THE MISTAKEN ASSUMPTION THAT STARTED THE COLD WAR

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“Now I am become death, the destroyer of worlds.” According to his interview for the 1965 documentary *The Decision to Drop the Bomb*, these are the words, translated from the *Bhagavad Gita,* that ran through the head of the Manhattan Project’s chief physicist Dr. Robert Oppenheimer upon witnessing the first successful detonation of an atomic warhead. Less than a month later, the Japanese cities of Hiroshima and Nagasaki were devastated by similar weapons, and the Second World War officially ended with Japan’s surrender. During the course of its existence, the Manhattan project, the government program that created the atomic bomb, employed over 150,000 people and cost two billion dollars ($26.66 billion in 2016 currency.). It drew upon the knowledge of the most advanced scientists in the world, and was bankrolled by the world’s largest economy. Why was this expenditure of capital and manpower deemed appropriate? The answer is simple: to prevent Nazi Germany from doing it first. Why then, were atomic weapons used after Germany had been defeated and against Japan, a country with no atomic weapons program?

It was known during the war that the Japanese were not capable of building atomic weapons; the quality of their physicists and their access to the necessary raw materials were deemed inadequate. The perceived threat came from Germany, whose physics program was the best in the world. After Germany fell, it became apparent that the Allies had not needed to fear a nuclear-armed Nazi state, as the German atomic program had been years away from being able to build and deliver a weapon, and it had at no point during the war been all that high a priority. In the facility in Britain where they were interred in the summer of 1945, hidden microphones recorded the reactions of ten captured German scientists, all experts in their fields and all having performed atomic research during the war, when they heard the news of the bombing of Hiroshima on August 6, 1945. They expressed shock and disbelief that the Americans had managed to construct such a device where they had failed.

However, until shortly before Germany's surrender, the Allies did not know there was no threat. It was this uncertainty, coupled with fear of a worst case scenario, that drove the Allies to go to such great lengths to obtain information about German atomic research, impede it wherever possible, and most importantly, to develop an atomic weapon first. Information on the scientific progress within Nazi Germany was predictably difficult to obtain, and the process for doing so involved the extremely complex task of analyzing small amounts of intelligence from a wide variety of sources. Each individual source's contributions alone were fragmentary. As a result of this incomplete information, the Allies made the mistaken assumption that the government of Germany was trying to develop an atomic bomb, and they took steps to do the same. Once the atomic bomb became available, the fact that Germany had both not been close to building one and had already been defeated were irrelevant, as its application had shifted from a means to ending the current war to an instrument of dictating terms to the world that came after.

It is important to note that, while the moral justification for using an atomic bomb has been debated hotly and continuously since before the war even ended, for the Allies, the justification for building one was not questioned. For Germany, however, which did not develop an atomic bomb, the moral standing of the German physicists performing atomic research has been the subject of considerable controversy. World renowned Nobel Laureate and physicist Werner Heisenberg issued several statements condemning the use of an atomic bomb, in what can only be presumed as attempts to absolve himself and his colleagues from the moral weight of having tried to build one for Germany. He has continually taken the moral high ground, despite the inherent hypocrisy of this stance coming from a man working for the Third Reich. He repeatedly claimed that he and his colleagues committed acts of deliberate passive resistance to prevent Nazi Germany from having an atomic weapon. *Heisenberg's War* author Thomas Powers is somewhat sympathetic to this cause. Other

authors such as Arnold Kramish have cast these attempts at self-exoneration in exceedingly critical light, the most extreme views being that the failure of the German atomic program was due to the incompetence of its scientists.

It is of course much more complicated than that. There has been considerable analysis of the progress of German physics in the years leading up to and during the Second World War, and step by step descriptions of the many factors that led to the lack of German atomic weapons, which, despite their nonexistence, have taken on a life of their own, haunting the past as a specter of what could have been. In particular, Mark Walker's books *German National Socialism and the Quest for the Atomic Bomb* and *Nazi Science: Myth, Truth, and the German Atomic Bomb* provide extremely thorough explanations of what German science was and was not capable of during the war, and make it absolutely clear that for several reasons there was no realistic chance of Germany producing an atomic weapon, regardless of the moral objections or complicity of its scientists. Germany at no point during the war devoted the necessary resources to the task. Whether Germany could have been successful had their government made that effort, as the Allies did, is a matter of speculation and hindsight. The most important factor that drove the Allied atomic program was that they lacked a complete picture of what the enemy was doing.

This paper does not attempt to analyze why Nazi Germany was not capable of building an atomic weapon. Instead, this is designed to illuminate the great lengths the allies were willing to go *because* they did not know the state of German atomic research. This anxiety and the massive dedication of manpower and resources that were undertaken as a result will herein be shown to have been wholly understandable under the circumstances at the time. Additionally, it will be made clear that the conditions that prompted the atomic bomb's construction did not necessarily require its use, but as the bomb entered development, it became a tool of the politician, not the scientist. From a political standpoint, its very existence made its use

inevitable. It went from being a threat from Germany that had to be countered, to being the new super weapon for the United States, one with both military and diplomatic applications. Therefore, the assumption that Nazi Germany was building a nuclear weapon, far from being a dismissible error, is actually one of the most critical events of the 20th century. Despite being factually incorrect, this assumption led directly to the bombings of Japan, the Cold War, and the state of paranoia concerning nuclear weapons that remains one of the greatest concerns in the world today.

I

”Deny the powerful and their warriors entry to your workshops, for such people misuse the holy mysteries in the service of power.”

In 1919, simultaneous with the drafting of the Versailles Treaty, which formalized the end of the First World War but sowed the seeds of the Second, Cambridge physicist Ernest Rutherford published the results of an experiment that would cast a shadow over the following course of human history. Rutherford had managed, by bombarding nitrogen with alpha particles, to transform it alternately into hydrogen and oxygen. While the implications of this were not universally clear at the time of their publishing, what they meant was nothing less than that what had been thought to be cosmically concrete was in fact capable of being separated, and matter, which Einstein had called “frozen energy,” could be exploitatively thawed.[1]

The implications of these discoveries were excitedly discussed by physicists at three primary locations: Cambridge, where Rutherford taught; Goettingen, at the laboratories of Max Born, James Franck, and David Hilbert; and Copenhagen, where Niels Bohr worked.

[1] Robert Jungk, *Brighter than a Thousand Suns,* trans. James Cleugh (New York, Harcourt, Brace, and World, Inc. 1958) 3-7.

These physicists communicated with each other by telegraph, but whenever possible, held conferences at universities in Europe to discuss their latest findings. Far from acting in isolation, at this time the scientific community was using collective intelligence to unlock atomic questions. Even the Soviet Union encouraged its scientists to participate in the international discussion and had its own publications translated into German, French, and English.[2]

In the 1930s, however, the cracks began to appear in this unified scientific community. First, the presence of Soviet scientists in Western Europe decreased dramatically after Stalin came to power, foreshadowing the divide of East and West that was to split Europe in half after the war. In Germany, the rising anti-Semitism that was to become the hallmark of the Third Reich began to make its presence known. The Nazis strove to emphasize scientific progress made by Aryans alone: these "national researchers" attempted to dismiss studies based on Einstein and Niels Bohr's work as "Jewish physics."[3] Brilliant physicists Eugen Wigner, John von Neumann, and Leo Szilard, and over a hundred other scientists, many of whom would contribute to the Allied atomic weapons program, were variously persecuted and censored until they fled. Some went to Britain, but most immigrated to the United States, which was able to offer refuge and employment to the scientists fleeing an increasingly hostile Germany. Ironically, it was the Nazi Party's rhetoric of racial supremacy that delivered into the hands of their enemies many of the men who would finally succeed in building an atomic bomb.[4]

While the Nazis were rising to and consolidating their power in Germany, the scientific community made the series of discoveries that lead directly to atomic weapons. The first was the 1932 discovery of the neutron, which, by virtue of being electrically neutral, can penetrate

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[2] Jungk, 6,7.
[3] Lenard and Johannes Stark and their followers, adherents of the pseudo-science known as *Deutchphysik*, or German/Aryan Science.
[4] Jungk, 30-47.

the millions of volts of electrical repellence of an atomic nucleus.[5] Italian physicist Enrico Fermi, whose contributions to atomic physics would become substantial in the 1940's, proposed that radioactive isotopes could be artificially formed by bombarding their nuclei with neutrons, while similar findings resulted from experiments by Frédéric and Irène Joliot-Curie at the University of France in Paris. However, the truly earthshaking discovery was made by Otto Hahn at the Kaiser-Wilhelm Institute in Berlin in December of 1938: the bombarding of uranium with neutrons caused the atoms to split, resulting in barium. In addition to turning one element into another, momentous in its own right, this process also liberated a tremendous amount of energy. Hahn and Strassman's follow up paper proposed that by splitting uranium into barium and krypton, a number of neutrons would also be emitted, capable of causing the fission of adjacent atoms, resulting in what we now call a nuclear reaction. According to the London *Times,* Fermi, who had by this time fled Italian Fascism and emigrated to the United States, used the Columbia University cyclotron to test this discovery, and achieved "the largest conversion of mass into energy that has yet been obtained by terrestrial methods, …6,000 million times more energy was liberated by the fission than was necessary to create it." Years later, when Hahn heard about the American bombing of Hiroshima, he confided to his colleagues that when the destructive potential of atomic fission dawned on him, he had seriously considered suicide.[6]

It is necessary to understand, at least to a limited degree, the events that formed the background to the race—for it was absolutely seen as such by the scientists involved—to build an atomic weapon. Hahn's discovery, monumental as it was, caused more alarm than excitement for members of the scientific community. At the time, the threat of war hung like a storm cloud over Europe. Under Hitler and the Nazi Party, the rights of minorities, particularly Jews, had been curtailed in Germany. The bloodless annexations of Austria and

[5] Discovered By James Chadwick at Cavendish Laboratory, Cambridge
[6] Thomas Powers. *Heisenberg's War(*New York, Alfred A. Knopf, Inc. 1993), 437

Czechoslovakia had temporarily avoided war, but tensions remained high. In light of this uneasy and ominous state, any physicist who understood the potentially destructive implications of nuclear fission found the thought of its use as a weapon by this increasingly repressive state fairly sobering. Whether attempting to keep this from the public, or trying to will it from their consciousness, Niels Bohr, Otto Hahn, and Albert Einstein all published statements denying the possibility that nuclear fission could be used as a weapon.[7]

Whether or not those claims were meant as a public reassurance or an act of self-delusion is a matter of speculation. It is difficult to believe that any of these accomplished scientific minds had any doubts about the feasibility of atomic explosives. Other letters sent to the governments of their respective countries showed that the physics community was well aware of the military applications of these recent discoveries. In England and Germany in particular, scientists informed policy makers who recognized what was at stake. One reached Professor Esau, President of the Reich Bureau of Standards in Germany. Esau called a conference on April 29, 1939 in Berlin, which resulted in the ban on exports of uranium compounds from the Reich, and in the appropriation of radium from the Joachimsthal mine in Czechoslovakia, which had been annexed by Germany the previous year.[8] In England, Sir Henry Tizard, Chairman of the Committee for the Scientific Survey of Air Defense, approached the British Treasury and Foreign Office and recommended that steps be taken to deny German access to uranium. Tizard even suggested planting false information about the British atomic weapons program, which was at the time nonexistent, for the sole purpose of causing the Germans the same anxiety felt by western scientists. Perhaps fortuitously, this proposal never generated any action, as once the Allies actually began their atomic weapons programs, they took great pains to make sure their existence remained a secret from Germany.[9] While the majority of politicians and policy makers had yet to acknowledge the threat posed by atomic fission,

[7] Jungk, 71.
[8] Wilhelm Groth and Paul Harteck.
[9] Powers, 69.

those who did understand it were already concerned with monopolizing its component materials, or more prophetically, using it to add a threatening element to international relations. Both these aims were to gain considerable prominence over the course of the war, and become cornerstones of international relations in the postwar era.

The world's fears were confirmed when Germany invaded Poland on September 1, 1939. For the scientific community the commencement of open hostilities served to intensify the growing anxiety about the military applications of atomic fission. The first consequence was the abrupt and total cessation of information transfer between German scientists and those of the rest of the West, and this silence would expand to include the countries Germany would conquer in 1940. What had been a unified community exchanging ideas on the subject now became smaller isolated circles, confined by law, fear, or patriotism from contacting anyone outside their country or its allies. While the United States showed no indication of joining the war, there were many scientists, including over a hundred European refugees from the Reich, who had an understanding of the threat posed by atomic weapons, and who felt a growing need to sound the alarm. Leo Szilard, the Hungarian physicist who fled to Britain from the anti-Semitism in Europe and then moved to the United States in 1938, urgently desired to bring the threat of atomic warfare to the attention of the American government. To that end, he personally enlisted the help of Albert Einstein, in hopes that the respect held for the father of relativity would attract the notice of the president. Szilard visited Einstein and the result was a letter to President Roosevelt. It was dated August 2, 1939, the day after Germany invaded Poland.[10] In this letter he warned that "[a nuclear reaction] would lead to the construction of bombs, and it is conceivable—although much less certain—that extremely powerful bombs of a new type may thus be constructed." However, while the President took notice of this letter, his immediate response was not the rise to action that Szilard was hoping

[10] Einstein later said that Szilard had the letter when he arrived at Einstein's home in Long Island and he had merely signed it, Szilard claims that Einstein dictated it himself.

for.[11] At this point, American government in particular was unwilling to devote significant attention to physics theories. The stakes were not yet high enough.

The reaction of the United States in the years prior to the attack on Pearl Harbor was perceived by the embattled British and the scientific community to be sluggish at best. There were a few reasons for this lack of alarm across the Atlantic. First, there was a prevalent sense of isolationism in the United States, and atomic science was considered, like the war itself, a European concern. The second was the sense that the effort and cost of the bomb program would take too long for it to affect the current war. Estimates were either that the war would be significantly shorter or, the process of developing a bomb would take longer than it actually did. Had the Manhattan Project not received an unlimited budget upon the United States' entry into the war this might have proved accurate. This proved to be the case in Germany, where at no point did the atomic research program ever receive enough funding to have a hope of succeeding. Third, there was no unified proposal on how to proceed. At the time, there were five different methods proposed for the enrichment of fissionable uranium, each monumentally expensive and not guaranteed to produce the desired results, and all competing for funding. The combination of these factors resulted in an absence of the sense of urgency felt in particular by the scientists who had fled Germany, who had seen first-hand the malevolent face of Hitler's Reich and could better envision the ramifications of that regime possessing atomic weapons.[12]

However, at this time the press began reporting on the possibility of atomic power. On July 10, 1940, *The Los Angeles Times* printed the headline "First to Tap Power of Atom May Emerge Victor in War." The article explained some of the background of atomic physics and in clear terms expressed the vastly larger energy potential of atomic fission over coal or gasoline. The reporting hinted at weapons, but although it predicted that such weapons were

[11] "Atomic Heritage." *Atomic Heritage Foundation.* (2015): http://www.atomicheritage.org/history/einstein-letter-1939
[12] "Atomic Heritage." *Atomic Heritage Foundation.* (2015): http://www.atomicheritage.org/history/early-government-support

unlikely be ready in time to affect the current war, it allowed that the chance was worthy of consideration. The impression was still clearly prevalent that the war was confined to Europe, however, and not a pressing American concern.[13] Earlier that year, on May 6, *The Hartford Courant* reported that a "New Power Source in Uranium Nears Possibility." Once again, mention of its destructive potential appeared as did the assertion that, reprinted from the previous day's *New York Times,* "Every German scientist in this field… [Has] been ordered to drop all other researches and devote themselves to this work alone," still, it quoted a Yale professor John Zeleny as saying "practical application appears to be far in the future, if ever."[14]

In February 1941, the *Los Angeles Times* reported that German scientists had "discovered a method of extracting and concentrating explosive uranium, a substance many believe will usher in an age of atomic weapons." The article claimed its basis was a scientific publication that made its way to the California Institute of Technology, and was written in jargon so technical that "only a scientific specialist could have detected its…sensational import." Despite this threat, the article asserted that this discovery had "been made too late to win the present war." Assumptions that atomic weapons would lack relevance to the current war may have been based on the idea that it would be over quickly, or that they would prove to be too costly or difficult to build.[15] Either way, while falling far behind the sense of urgency felt by the science community, these articles showed at least the earliest stages of public awareness of what was to come.

Prior to the outbreak of the war, the relatively small number of physicists working in the field of atomic science were all in contact with each other, becoming collectively aware of new developments. Based on an informed appraisal of the abilities of the physicists who remained in Germany, their peers believed the threat of a German atomic weapon was

[13] Barton, Willial S, "First to Tap Power of Atom May Emerge Victor in War," *Los Angeles Times*, July 10, 1940.
[14]"New Power Source in Uranium Atom Nears Possibility," *The Hartford Courant,* May 6, 1940.
[15] "New Uranium Weapon Seen for Germany," *Los Angeles Times,* Feb. 16, 1941.

soberingly real and that the Allies had every reason to be alarmed. This anxiety was, at its core, a vote of scientific confidence in Dr. Werner Heisenberg, Germany's top physicist and the man universally presumed to be in charge of their atomic research program, coupled with an expression of uncertainty about his the ethical standing.

Heisenberg, who had won a Nobel Prize in 1932 for the invention of quantum mechanics and the uncertainty principle which bore his name, was well respected among his contemporaries, and was thought of by many in the field as the world's leading physicist.[16] Many of the men who went on to work for the Manhattan Project had known him or studied with or under him in the decades before the war, including Felix Bloch, who had been Heisenberg's assistant until he was expelled for being Jewish, Hans Bethe who had been offered Bloch's post and became the chief of the theoretical division at Los Alamos, where the American atomic bomb was constructed, and his American counterpart, Dr. Robert Oppenheimer, who had received his Doctorate in Germany in 1927.[17]

None of Heisenberg's peers held any reservations in his placement firmly in the upper echelon of contemporary scientific thinkers, but many were concerned about where he placed his loyalty. Heisenberg had made a trip to the United States on the eve of World War Two and visited several of his colleagues at American universities, including several who had fled the Third Reich. He stayed with Oppenheimer in California, but declined to discuss the political situation in Europe. He stayed with Arthur C. Compton, who would also become pivotal in the Manhattan Project, and who allegedly assured Heisenberg that the United States would inevitably join the British in fighting against Germany. In New York, Bethe, who had been offered the position of Heisenberg's assistant and was now employed at Cornell University, tried, as had several others, to convince him to stay in the United States. Shortly before his departure, Samuel Gouldsmit, who would become the chief scientific advisor for

[16] Powers, vi, 2.
[17] ibid, vii.

the Manhattan Project's espionage missions into Europe, along with Italian emigre Enrico Fermi, made this same plea. Over the course of his entire visit, Heisenberg held true to the idea that while he disapproved of Hitler, he was a German, and felt an obligation to share his country's fate in coming war. In the event of his country losing the war, which he admitted to expect, he believed it was also his duty to rebuild German science in the aftermath. Not surprisingly this was met with a mixture of cynicism and alarm, particularly by the scientists who had fled the Nazi's racial policies. He would be counted as an enemy by his former associates. Many, like Szilard, would soon be urging the American government to fear the possibility of a German atomic bomb, and to develop one of their own as quickly as possible.[18]

Roosevelt's only tangible reaction to the Szilard/Einstein letter was to form the Uranium Committee, which met for the first time on Oct 21, 1939, with Lyman Briggs, Director of the National Bureau of Standards, as its chairman. Early on, the Committee authorized funding for Szilard and Enrico Fermi to continue research at Columbia University on nuclear chain reactions. The Committee prepared a report for the president recommending a "thorough investigation" of the feasibility of atomic weapons, as bombs of this type, if they could be produced, would be a "source…of destructiveness greater than anything now known." The president apparently read the report, and then, true to the prevailing tradition of government indifference to atomic science, filed it without further action for several months.[19]

As it stood in the Spring of 1940, Prime Minister Winston Churchill, who maintained his appraisal of the threat of German atomic weapons as a bluff, and President Roosevelt, who was sympathetic to the British cause but was met with lack of popular support for the war, both treated atomic research as a low priority. Einstein sent President Roosevelt a second letter in March of 1940, trying to warn him of an "intensification of German interest in

[18] Powers, 1-12.
[19] This account is according to an account by Roosevelt's aid Edwin "Pa" Wilson, "Atomic Heritage." *Atomic Heritage Foundation.* (2015): http://www.atomicheritage.org/history/early-government-support.

uranium since the beginning of the war."[20] This was a source of alarm for scientists, especially those who had worked in Germany before the war, and who knew that uranium was the crucial ingredient in atomic reactions. The first to take action were Otto Frisch and Rudolf Peierls, both refugees who had fled to England. The Frisch-Peierls Memorandum alternates in tone between scientific and abstruse to exceedingly blunt. They explained the difference between the two uranium isotopes, U-235 and U-238, and proposed the use of U-238, which naturally occurs in a ratio of 1/139 to U-235 as the ideal product for a chain reaction. Using the term evocative term "super-bomb," they said that a device weighing 5kg would produce an explosion equivalent to many thousand tons of dynamite, and point out that in addition to the explosion itself, the radioactive fallout would be sufficient to kill anyone within miles of the device's detonation. They made a point of mentioning that, while they possessed no evidence of a German atomic weapons program, all the theoretical data that concerned the processes necessary to create one had been published, and it was no stretch to presume its likelihood.[21] Frisch and Peierls submitted their memorandum to the MAUD Committee: a new group created by the British government for the purpose of considering what actions Britain should take regarding the discovery of nuclear fission, and its potential applications in the manufacture of explosives.[22] However, the MAUD Committee would not publish their recommendations until the summer of 1941.[23] The information was available, but the people capable of exploiting it were not yet listening.

In June of 1940, shortly after the Frisch-Peierls Memorandum was submitted to the MAUD Committee, Vannevar Bush, the President of the Carnegie Institution, obtained President Roosevelt's approval to form the National Defense Research Committee (NDRC),

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[20] Jungk, 112.

[21] Frisch-Peirls Memorandum. "Atomic Archive," *AJ Software & Multimedia,* 1998. (2015): http://www.atomicarchive.com/Docs/Begin/FrischPeierls.shtml.

[22] An acronym meaning Military Applications of Uranium Detonation, although the name originated from a misunderstood reference to his son's governess Maud Ray on a telegram sent by Niles Bohr.

[23] "Atomic Heritage." *Atomic Heritage Foundation.* (2015): http://www.atomicheritage.org/history/britains-early-input-1940-41.

which was dedicated to organizing the scientific community towards the war he was certain would soon involve the United States. Bush reorganized the Uranium Committee without members of the military, freeing it from dependence on the military for funding.[24] However, the NDRC's assignment was limited to research that would be applied directly to the war at hand. Bush believed that warships powered by nuclear reactions were at best a distant possibility, and the NDRC believed that the likelihood of an atomic weapon's construction was "very remote." However, given the under prioritized but acknowledged threat of a German atomic weapon, the NDRC approved a "careful, but not elaborate or expensive program."[25]

It took an entire year for circumstances to develop to change Bush's appraisal of the situation. In March 1941, a German physicist sent a message to the United States, warning that "a large number of German physicists are working intensely on the uranium bomb."[26] The MAUD commission released its report in July 1941, and that document can be credited as being the true catalyst of the Allied atomic program. The MAUD Report made it clear that the construction of an atomic bomb was possible and gave an estimate that 25 lbs. of fissile material would yield an explosion equivalent to 1,800 tons of TNT. But the MAUD Report went into further detail designed to convey the urgency of the situation, stating that the atomic bomb was "practicable and likely to lead to decisive results in the [current] war." It recommended collaboration with the Americans and that work "be continued on the highest priority and on increasing scale necessary to obtain the weapon in the shortest possible time." The Commission also reminded the world that nuclear fission had been discovered in

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[24] "Atomic Heritage." *Atomic Heritage Foundation.* (2015):. http://www.atomicheritage.org/history/early-government-support.

[25] Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb* (Washington, US Army Center for Military History, 1985), 27.

[26] Richelson, Jeffrey T. *Spying on the Bomb: American Nuclear Intelligence from Nazi Germany to Iran and North* Korea(New York, W.W. Norton and Company, 2006) 29. The message in question was sent by Houtermans, via his fleeing colleague Fritz Reiche.

Germany three years previously, and that the Kaiser Wilhelm Institute in Berlin had set aside a department for atomic research in 1940.[27]

American research at this time was more geared towards developing atomic reactions as a source of power than as a weapon, which reflected the view prevalent in the United States that the war was a European problem. There was promising research being performed at Columbia and the University of California in Berkeley, where plutonium was discovered to have the same fissile properties as U-235. These experiments were not specifically or even primarily intended for military applications. This is clear from the lack of secrecy surrounding them: articles on these experiments appeared in several newspapers before the United States entered the war. The standard report resembled the May 30, 1940 *Los Angeles Times,* which suggests that a faster method of extracting U-235 would put "a new weapon in [the] hands of armies," this bombastic rhetoric seems to actually be referring to a better fuel, not a warhead. Rather than destructive potential compared to TNT that is found in the Frisch-Peierls Memorandum and the MAUD Report, this article and several others like it compare the power output of uranium to that of gasoline and coal.[28]

Mark Oliphant, a member of the MAUD commission who was alarmed by the inaction of the Americans, took it upon himself to take direct action, flying to the United States, making the uncomfortable passage in an unheated bomber in August 1941. This mission was ostensibly to discuss the development of radar, but his actual task was to find out why the MAUD commission's report was being ignored, and to attempt to fix it. Oliphant found that Lyman Briggs, the Uranium Committee's director, had read the report, but instead of sharing it with the rest of the Committee, had locked it in a safe. Oliphant met with the Committee and urged them to focus on weapons as opposed to reactors, saying in the bluntest of terms,

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[27] "Atomic Heritage." *Atomic Heritage Foundation.* (2015): http://www.atomicheritage.org/history/britains-early-input-1940-4.

[28] "Key Unlocking Vast Atomic Power Reported Found: Discovery Speeding up Extraction of 'U-235' May Lay New Weapon in the Hands of Armies," *Los Angeles Times,* May 30, 1940.

that the British lacked the budget or manpower to manufacture an atomic weapon, and, according to Uranium Committee member Samuel K Allison, they had "no right to work on anything but the bomb." While in the United States., Oliphant met with Ernest O. Lawrence at UC Berkeley, James B. Connant, Vannevar Bush, and Enrico Fermi, all who would prove sympathetic, to further this agenda.[29]

This intense rhetoric demonstrates a prioritization of development without a thought to long-term consequences. While it is a historical fallacy to prescribe hindsight to past events, it is now tragically obvious that this exact manner of discussing atomic weapons would come back to haunt anyone who spoke them. The "obligation" to work on an atomic bomb was exactly the message science was attempting to send to government, but from science's perspective, this solely served to avoid a future where the world was at the mercy of a nuclear-armed Germany. The scientific community did not predict the involvement of atomic weapons in international diplomacy that, from a political perspective, went hand in hand. Nor did they realize that in pushing for the development of these weapons, their actions would lead to the destruction of cities in countries with no comparable weapons as was the case in Japan, or their use to gain concessions from nominal allies, such as the Soviet Union. But by making atomic weapons part of the war effort, this is exactly what happened.

In the fall of 1941, NDRC Head Vannevar Bush met with President Roosevelt to discuss the future of the program. At this point, the president agreed that the program needed higher prioritization, and placed it under the Army's jurisdiction to provide it with sufficient resources. Roosevelt also contacted Churchill, suggesting that they maintain open communications about atomic developments. Churchill later recounted that the two heads of state "both felt painfully the dangers of doing nothing."[30] This is the moment where science finally succeeded in getting the attention of government, and therefore where the discussion

[29] "Atomic Heritage." *Atomic Heritage Foundation.* (2015): http://www.atomicheritage.org/history/britains-early-input-1940-41.
[30] Winston Churchill, *The Second World War* (Houghton Mifflin, New York, 1962) 4: 330

of atomic weapons began to change. From this point onwards, the highest echelons of the American government considered the atomic bomb program "an essential part of the total war effort."[31] Like a tank or bomber, it was a weapon like any other, made to be used. It was unique in that it was exponentially more destructive than any other weapon on earth, and would be given the respect it was due, but it was never going to be an idle threat.

This and what followed in the next few years is revealing of fundamental truths about the interactions between science and politics. From the perspective of the scientist, the objective up until now had been to alert the Allied governments about the threat of atomic weapons, in order to see programs established to build these weapons in the United States or Britain, but only as a mechanism of defense against Germany. The sole objective was to prevent Hitler from gaining an atomic monopoly. Actual use of one of these terrifying weapons was not what the scientists envisioned. This, while well meaning, was somewhat naïve. From the political perspective, the creation of the bomb was synonymous with the justification for its use. As revealed in declassified documents and the diary of Secretary of War Henry L. Stimson from 1941 until the end of the war, the use of the atomic bomb for securing a "diplomatic advantage" in the postwar world became increasingly central to his and President Roosevelt's concerns about its development and use, which they now assumed to be inevitable.[32]

In March 1942, Bush admitted to President Roosevelt that he had "no indication of the status of the enemy program, and [had] taken no definite steps toward finding out."[33] Great Britain, on the other hand, had been at war with Germany since the latter's invasion of Poland in September, 1939, had been predictably concerned about the possibility of a German atomic weapons program. Several initiatives had been taken to find out what the enemy was doing.

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[31] Martin Sherwin. *The Atomic Bomb and the Origins of the Cold War,* The American Historical Review, Vol. 78, No. 4 (Oct., 1973) 945-968. (2016): http://www.jstor.org/stable/1858347?seq=1#page_scan_tab_contents.
[32] Henry L. Stimson, diary, Henry L Stimson Papers, Yale University Library, as quoted in Sherwin.
[33] Richelson, 27.

The British Secret Intelligence Service (SIS) believed that sending operatives into occupied Europe would be both prohibitively difficult and dangerous, believing that the issues of nuclear physics were too complex for most agents to disseminate, and that a detailed briefing on the subject would make the agent a danger to the British atomic program if captured. So British Intelligence largely relied on agents in occupied countries who already had knowledge on the subject and were willing to pass it on to Germany's enemies. By 1942, the SIS had a source at the University of Stockholm (where Neils Bohr still worked) as well as one in Norway. The SIS was also receiving information from Germany itself, in the form of a fortuitously placed Austrian with a background in chemistry named Paul Rosbaud. Rosbaud had received a doctorate, but when he was unable to find a university position, he found work doing industrial research, and was employed by the Springer-Verlag publishing house as a science advisor. According to his biography, he was "professionally obscure" for his lack of research, but simultaneously well known in the academic and scientific communities, and superlatively well informed on cutting edge scientific developments. He also passionately hated German National Socialism, and, upon Hitler's seizure of power, vowed to "do all in his power to destroy the man who was destroying the civilization so dear to [him]."[34] Springer-Verlag was the publisher of scientific journals that included Hahn and Strassman's paper in 1939, which Rosbaud had published ahead of schedule in hopes that it might be taken as a warning by the Allies.[35] He would continue to be Allied Intelligence's steadiest and most reliable source of atomic espionage until the invasion of Europe in 1944.

Professor Frédéric Joliot-Curie took direct action from his laboratory in Paris to keep any documents and materials that could potentially aid the Germans in building an atomic weapon out of their hands. With the *Wehrmacht* closing in on Paris, he and his associates began systematically burning all the papers in his possession that would give any insight into

[34] Arnold Kramish, *The Griffin,* (Hougton Mifflin Company, Boston, 1986) 15-17.
[35] Richelson, 31.

the state of his own research. At the time of Germany's invasion, France had both a large supply of uranium oxide, and the entirety of the Europe's heavy water—a substance deemed essential for moderating an atomic reaction. While Joliot-Curie declined to leave Paris during the occupation, he took it upon himself to have the heavy water surreptitiously sent by ship to England to keep it out of Nazi hands.[36]

British intelligence made efforts to track German scientists and scientific journals, as well as to monitor the acquisition of raw materials that would aid in making an atomic weapon. They were aware of and unsettled by the revelation that in addition to acquiring the Joachimsthal uranium mine in Czechoslovakia, with the conquest of Belgium, Germany had gained possession of the Union Miniere refinery at Olen, Europe's largest supplier of uranium oxide. Edgar Sengier, the Managing director of Union Miniere, had ordered all 120 grams of his company's radium, worth two million dollars, shipped to the United States in 1939. He had tried to do the same with the uranium, but that transfer was not to be made before the German invasion. However, Sengier did manage to ship the 1,200 tons of uranium oxide from the Shinkolobwe mine in West Africa to a warehouse on Staten Island, and he proceeded to keep this a secret from everyone, including the American Government, until the United States' entry into the war.[37] However, Germany's possession of Union Miniere's uranium was to be a source of considerable anxiety. This remained unaccounted for until its seizure by the American military in the last month of the war in Europe, and until it was accounted for, there was no way for the Allies to definitively know that it was not being used to develop an atomic weapon somewhere in Germany.

In addition to the uranium inventory, a physics professor at the University of Trondheim named Leif Trondstad provided the SIS with information about the expansion of the heavy water production facility at the Norsk Hydroelectric plant at Vemork, Norway, the world's

[36] Jungk, 107-8.
[37] Jones, 25, 64.

only facility of its kind.[38] Werner Heisenberg had hypothesized that five tons of heavy water were needed to build a reactor capable of causing an atomic reaction, and in Germany, work was done only using heavy water to moderate a reaction.[39] MAUD Committee had reported increased shipments of heavy water from Vemork to Germany as early as 1941, and what its strategic application was. There followed a harrowing series of operations designed to covertly sabotage the Norsk Hydro plant. In the spring of 1942, Odd Starheim, the Special Operations Executive agent whose information had led to the sinking of the *Bismarck* in May 1941, hijacked a Norwegian costal steamer at gunpoint and had it sailed to Aberdeen.[40] One of the Norwegian volunteers who aided in this operation was Einar Skinnerland, who not only was from Rjukan, the nearest town to Norsk Hydro, but was a technician at the plant. Skinnerland was given less than two weeks training in sabotage and the sending of coded messages, and then parachuted back into Norway, where he returned to work, blaming his absence on illness and arousing no suspicions.[41]

With Skinnerland as the contact man on the ground, the SOE organized its first attempt at sabotaging the Vermork plant. This operation, codenamed Freshman, was to consist of four men as an advance party and a team of commandos who were to be transported by two gliders towed to Norway and landed on the Hardanger Plateau, by all accounts one of the most inhospitable locations on the planet. This mission failed when one of the tow bombers hit a mountain and the other lost its glider over the sea, and all 28 members of the team were presumed dead.[42]

A second attempt was made in February, 1943. Another team of commandos was parachuted this time onto the Hardanger plateau, and miraculously, located the advance party from the previous attempt, who had been living in an abandoned cabin in the wilderness

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[38] Richelson, 32-3.
[39] Due to the lack of available heavy water in the United States, graphite was more commonly used.
[40] Leo Marks, *Between Silk and Cyanide: The Story of SOE's Code War*(London, Harper Collins, 1998), 44.
[41] Marks, 44.
[42] Powers, 199.

through the middle of the Norwegian winter. What followed was a mission that sounds too fantastic not to be a work of fiction. The sabotage party climbed down a ravine in the dark, crossed the river that powered the Norsk Hydro plant, scaled the other side, navigated a minefield, and broke into the plant. There, they placed and detonated their explosives on the heavy water tanks, sending Germany's supply of this reaction moderator quite literally down the drain. The entire team suffered no casualties despite Tronstad having given them "a fifty-fifty chance of carrying out the sabotage, less than that of getting out alive." After crossing the ravine in the same fashion, splitting up on the Hardanger Plateau, some remained in Norway as part of the resistance, while the others escaped approximately 250 miles to Neutral Sweden and from there returning to Britain.[43]

American newspapers reported some of this the following month. The April 4 Sunday *New York Times* ran the headline, "Nazi 'Heavy Water' Looms as Weapon," reported on the attack on Norsk Hydro, saying that the substance had "hidden atomic power that can be used for deadly purposes…[and had] become a source of anxiety for those Allied leaders who plan attacks against enemy targets." The article expressed the presumption that the Germans were not believed to be capable of making atomic weapons, but claimed that heavy water could be added to other chemicals to create explosives, or used in making synthetic fuel or textiles.[44] The following day's *Herald Tribune* was even more vague, "discount[ing] reports from London that the rare liquid was being developed by Nazis as a super-explosive," but saying that the attack "would deprive the Germans of much of their potential ammunition supply."[45] This downplaying of the only actual application of heavy water may have been willful disinformation meant to avoid potential fears of atomic weapons, or meant to decrease the likelihood of their being a topic of discussion or investigation as a counter espionage measure. Regardless of the public's perception, the attacks on Vermork made it clear to the

[43] Powers, 201-202.
[44] "Nazi 'Heavy Water' Looms as Weapon," *New York Times,* April 4, 1943.
[45] "Discoverer Doubts Use Of 'Heavy Water' in War," *New York Herald Tribune,* April 5, 1943.

Germans that the Allies knew the military significance of heavy water, and considered it important enough to disrupt its production.

That autumn, reliable reports confirmed that the Vemork plant had been able to continue making heavy water a few months after the attack. This time, a commando operation was rejected, allegedly because increased security made it untenable, and the Americans, now fully engaged in aerial attacks on occupied Europe, launched a bombing mission against Vemork using Flying Fortresses of the 8th Army's Third Air Division. The afternoon of November 16, 1943, 184 planes dropped a staggering 858,500 pounds of explosives on the Norsk Hydro plant and the nearby town of Rjukan. While only twelve bombs actually hit the power station, and the heavy water producer located in the basement was not damaged whatsoever, the raid convinced the German authorities to move the remaining heavy water to the relative safety of the Reich. It never made it, however. One remaining episode of Norwegian ingenuity finished what Operation Freshman had attempted. On Feb 30, 1944, the ferry *Hydro* which was carrying the shipment was sabotaged by the Norwegian underground and sunk as it crossed Lake Tinssjo, taking all of Norsk Hydro's heavy water with it.[46]

Mark Walker in particular is extremely dismissive of this series of operations as unnecessary wastes of resources and lives. He cites other forces at work in Germany which decidedly prove that they were never going to make an atomic weapon in time to influence the Second World War, and in *German National Socialism and the Quest for Nuclear Power 1939-1945,* accuses other authors of falsely portraying attacks on Norsk Hydro and the heavy water shipment as "the crucial blow by which British intelligence and the Norwegian resistance had brought German nuclear power to its knees."[47] This, while being absolutely correct, is separate from the point being made here. These operations were justified at the time for the very reason that what progress the Germans were making towards an atomic

[46] Powers, 212-213.
[47] Mark Walker, *German National Socialism and the Quest for Nuclear Power 1939-1949* (Cambridge University Press, Cambridge, 1989) 162.

weapon was not known, and anything that would keep them from building one was deemed worth the cost. As the reports on the German atomic program generally pertained to only one of its aspects, they had to be dealt with as though they were each the crucial detail of a worst case scenario. The Allies were incapable, for the time being, of bombing the atomic research facility or Union Miniere's purloined uranium oxide, as the locations of both were unknown. What they were capable of was destroying the Norwegian heavy water supply. If that had turned out to be the "crucial blow" that prevented the city of London from suffering the fate that awaited Hiroshima, the human and material cost of the raids in Norway would have been portrayed as the sacrifices that saved the western world. Hindsight alone shows them to have been unnecessary. Given the information at Allied intelligence's disposal, and fearing what they feared, it would have in no way seemed unnecessary at the time.

As previously stated, the primary source of information on German atomic scientific developments from occupied Europe to Great Britain was Dr. Paul Rosbaud. The British did not begin sharing their intelligence until late 1942, however, and the Americans had become deeply concerned about their utter lack of knowledge of the state of German atomic research.[48] This lack of reliable information was of concern to one American in particular, Major General Lesley R. Groves, who in September, 1942, was put in charge of the program that President Roosevelt had authorized the day before the United States entered the war, Manhattan Engineering District, more commonly known as the Manhattan Project. Upon his appointment to the MED he found that there was both a lack of coordination—to the point of actual friction—between the existing intelligence services. Army Chief of Staff Gen. George C. Marshall expressed his concern that the Office of Strategic Services (OSS), the Office of Naval Intelligence (ONI), and the Army's G-2 were not well informed enough to make proper assessments of potentially important information related to atomic science. More

[48] Kramish, 132.

importantly, Marshall reached the same conclusion as the British, that giving these agencies the pertinent information would make their operatives into dangerous security liabilities if captured. To preserve the necessary level of secrecy, Groves put nothing in writing when he contacted G-2, the OSS, and the ONI to inform them that he had, as Gen. Marshall had asked him, "assum[ed] responsibility for determining what the Germans were doing in the field of atomic weaponry and how they were doing it."[49] This effort was to become massive, culminating in three separate missions into Europe to hunt down the workshops and the scientists who ran them. Before that came to fruition, however, a new source provided unsolicited warnings about the German desire for an atomic weapon.

While Groves was preparing to utilize his nearly unlimited resources to finding out what the German scientists were doing, a former economics professor from Westphalia named Dr. Erwin Respondek was acting wholly on his own to inform the Allies about Nazi plans and scientific progress. Through years of civil service, Respondek had made numerous contacts in the German General Staff, industry, the Nazi Party, and the Kaiser-Wilhelm institute itself, where the atomic experiments were taking place.[50] Respondek was acquainted with Hermann Muckermann, who also collaborated against the Nazis, and he had lived with famous physicist Max Planck for two years as a student. In matters of atomic science, his most valuable contact was Herbert Mueller, who was employed by the Institute for Foreign and International Civil Law, an affiliate of the Kaiser Wilhelm Society. Mueller, devoutly anti-Nazi, in addition to providing information for Respondek, used his position to protect members of the Society deemed politically unreliable by the regime, and even to obstruct the progress of some of their atomic experimentation.[51]

In the spring of 1942, Albert Speer, the Reich Armaments Minister, had been fully briefed on the progress of atomic experiments by the Kaiser Wilhelm Institute's Uranvernin, or

[49] Richelson, 28-30.
[50] Richelson, 29.
[51] Dippel, 82-3.

Uranium Club, consisting of Germany's top physicists Werner Heisenberg, Carl von Weizsacker, and their colleagues. Speer had begun to lose confidence in the Uranvernin after Heisenberg remarked that he would not know how to spend the offered one million Mark budget. Speer's Armaments Ministry started a second program, with a five million Mark budget, to as expeditiously as possible build an atomic bomb.[52] Respondek managed to learn of this development because the program fortuitously employed two old acquaintances of his.[53] Respondek smuggled a report on this out of Germany to a contact in Switzerland, and it was cabled to Washington.[54] We now know that this program of Speer's was not sufficient to produce a weapon. But for the Americans who received this warning from Respondek, it only served to confirm that the German war effort did involve an atomic weapons program, but left its extent to their increasingly worried imaginations.

The Americans involved with the Manhattan Project had been, for lack of more substantial intelligence, operating under the assumption that the Germans working on atomic weapons knew as much or more than they did, and had a head start of over two years.[55] What the United States lacked in years working on the problem they more than made up for in available resources to apply to making sure they did not lose the race to build an atomic weapon. The international physics community had proposed five different methods to separate uranium isotopes to isolate the infinitesimally more rare but highly fissile U-235. Having finally come around to the urgency of the situation, the OSRD, instead of gambling on which method might prove successful did what only the United States was in a position to do, and what proved to be the single act that guaranteed the eventual success of the American

[52] Dippel, 86-7.
[53] Swiss physicist Walter Dallenbach, from Chairman of the German General Electric Company, (AEG) and long-time mentor of Respondek's named Hermann Bucher.
[54] Dippel, 93-5.
[55] Dippel, 96.

atomic weapons program for use in the existent conflict: devoted millions of dollars to pursuing all five methods simultaneously.[56]

In the years that led up to the full mobilization of American resources behind the development of an atomic weapon, an elite few who understood the destructive potential of recent discoveries tried to sound the alarm, in hopes that their country would develop one before the Germans. It took repeated efforts by many of the world's most brilliant scientists to make the heads of government share their sense of urgency, and it was only the threat of war on their doorstep that did the final convincing. Many of the newspaper articles published before the United States' entry onto the war talk about fission as a fuel source, and compare its power output to gasoline or coal, or even as a means for curing diseases. It was known then as it is now that atomic reactions could generate power for non-military purposes. As history shows, this was not a compelling enough reason to give it significant attention outside of its small field of experts. As in Britain, only the threat of atomic weapons being used against the United States provided the needed sense of urgency to give the program any semblance of the resources it would need to succeed. However, it will be shown that at the point that building an atomic weapon went from debate to reality, its perceived application shifted as well. For the scientists, it was a means to `avoid vulnerability to Nazi Germany, but never a weapon that the Allies would necessarily use. Once the atomic bomb program became a reality in the United States, its fundamental nature began to change. For the government, it was another product of the war effort, to be used to further the nation's international interests, in this war or what came after it.

II

"If the radiance of a thousand suns were to burst at once into the sky…"

[56] Jones, 35-37.

At the time when the American atomic program began gaining momentum in 1943, British forays into atomic science, which had never made all that much headway, had all but stagnated. They had two agencies working on the project, a program code named "Tube Alloys," directed by Michael Perrin, and the Scientific Intelligence Branch, whose director was Reginald V Jones. The heads of the two organizations met with Churchill and his scientific advisor Lord Cherwell in April of 1943. The specific discussion focused on a proposed new and much cheaper method of distilling heavy water and the possibility of using plutonium to cause the explosion (the Americans and the British did not begin openly sharing atomic secrets until the latter half of that year, or the British would have been aware of the experiments with plutonium taking place across the Atlantic, as the Americans would have been aware of Paul Rosbaud's reports about the slow pace of German atomic research). Jones in particular was concerned about these scientific developments, and if they were known in Germany as well, as he had just been warned about the German V weapon program, which was soon to be introducing the people of London to the new terror of unmanned warheads dropping out of the sky.[57] Churchill, once he came to recognize the threat of atomic weapons, had come to firmly believe that their development had to be given high priority, not just in the need to pool resources with the United States to defeat Germany, but for Britain to have atomic weapons of her own as soon as possible for postwar dealings with the Soviet Union. By the summer of 1943, the British Government foresaw the inevitable defeat of Germany, and was already committed to making atomic weapons of its own for the purpose of securing a position of prominence in the postwar world order.[58]

In October, 1943, firsthand information came to Allied intelligence when Niels Bohr finally agreed to flee to Britain. Upon hearing of the German plans to, using their favorite

[57] Jungk, 181-2.
[58] Sherwin, 951.

genocidal euphemism, liquidate all the Jews in Denmark, Bohr escaped to Sweden by boat and then flown to England hidden in the bomb bay of a RAF Mosquito. He was able to provide a more thorough report of what he knew of the state of German atomic weapons research, in particular based on a conversation that he had when Heisenberg had visited Copenhagen in 1941. By his own accounts, Bohr felt that the visit was an unwelcome intrusion by an agent of the Nazi occupation, and that Heisenberg had tried to coerce Bohr's complicity in the German atomic bomb program, or at least ascertain if Bohr knew anything about an analogous Allied program. Heisenberg also echoed justifications for the German occupation of Europe. The conversation had left a lasting negative impression on Bohr, and he was all too willing to use what he knew to help Germany's enemies. Bohr was interviewed in Britain and then sent to the United States where he related at length to General Groves, Dr. Oppenheimer, and several others all the details of his conversation with Heisenberg in an attempt to deduce where German research had been at the time, and predict to what point it had progressed.[59]

This clearly involved a lot of guesswork. Groves said the following about the presumptions under which the MED and Manhattan Project were obligated to operate,

> There was a universal respect for the quality of German science…Our scientific people were acutely conscious that European Scientists had discovered the principle of fission, and that our enemies were continually harping on their proposed use of secret weapons…Unless we had positive knowledge to the contrary, we had to assume that the most competent German scientists and engineers were working on an atomic program with the full support of their government and with the full capacity of German Industry at their disposal. Any other assumption would have been unsound and dangerous.[60]

It was for this lack of "positive knowledge to the contrary" that Groves acquiesced to General Marshall's request that he take control of all the foreign intelligence related to atomic

[59] Paul Lawrence Rose, *Heisenberg and the Nazi Atomic Bomb Project,* University of California Press, Berkeley, 1998. 154-160.
[60] Leslie R. Groves *Now it Can be Told* (New York, Harper and Row,1962), 186-7.

research.[61] As reflecting the bigger picture of atomic science that the Allied governments adopted, Groves' efforts were of a vaster scope than simply winning the current war. Much like the policies being developed in Britain, he initiated efforts designed to keep the United States's atomic program ahead of not just Germany, but the rest of the world. Historian Martin Sherwin called the Anglo-American atomic energy partnership a hasty marriage of convenience precipitated by the threat of a German atomic bomb, and this is evident when one examines the steps the two nations took with an eye to the world after Germany's defeat.[62] In 1942, Groves initiated the Murray Hill Project, which by surveying tens of thousands of documents and sending geologists to over fifty countries attempted to locate, catalogue, and, where possible, gain possession of all the world's sources of uranium.[63] He learned that while Union Miniere's uranium supplies in Belgium were out of reach, there was more at the source, the mine in the Belgian Congo. Groves took immediate steps to acquire it, as well as the secret stockpile of uranium ore on Staten Island, about which Sengier informed the American government in March, 1942.[64]

The longer term result of this attempt to control the world's supply of atomic bomb raw materials was the formation of the Combined Development Trust by the United States and Great Britain, in 1944. The Trust proceeded to buy the rights to as much uranium as it could locate, as well as supplies of thorium, which could be modified into U-233, another fissile uranium isotope. This initiative was so successful that by the end of 1945 Groves believed that the United States had control of 97% of the uranium ore and 65% of the thorium on the planet.[65]

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[61] ibid, 187. This effort was confined to Europe. Groves admits to making no effort to extend this effort to Japan, which was deemed to possess insufficient heavy industry, a lack of qualified physicists, and "not even the remotest possibility" of having enough uranium for the project.
[62] Sherwin, 948.
[63]"Atomic Heritage." *Atomic Heritage Foundation.* (2015): http://www.atomicheritage.org/history/combined-development-trust.
[64] Jones, 65, 79.
[65]"Atomic Heritage." *Atomic Heritage Foundation.* (2015): http://www.atomicheritage.org/history/combined-development-trust.

To formalize the cooperation between the United States and Great Britain about the future applications of atomic research, President Roosevelt met with Churchill in Quebec on August 19, 1943. The resulting document, the "Articles of Agreement Governing Collaboration Between the Authorities of the USA and the UK in the Matter of Tube Alloys," or as it was more commonly called, the Quebec Agreement, was an agreement of the sharing of atomic intelligence and technology, but was to become a source of anxiety for both parties, particularly the British who the agreement clearly made out to be the lesser partner. Acknowledging the great expense of atomic research, and that, of the two, only the United States had the resources for it, the treaty agreed that the atomic weapons development program would continue in the United States alone. Both parties agreed not to, in the document's words, "use this agency against each other…not to use it against third parties without each other's consent," [and forbade giving] "any information about [atomic weapons or research] to third parties without mutual consent." The clause that would come back to most intensely haunt the British stated that, because the United States bore the greater expense, "Any post war advantages of an industrial or commercial character" would be "dealt with on terms to be specified by the president…"[with England relinquishing] "any interest…beyond what may be considered by the president…to be fair and just."[66] In the words of the director of Scientific Intelligence Reginald V. Jones, "It seemed to me [Great Britain] had just signed away our birthright in the postwar development of nuclear energy."[67] This clause of the Quebec Agreement reflects a prevalent American sense that the British were more concerned with postwar industrial applications of nuclear power than with its relevance to winning the war. However, this is somewhat hypocritical, when viewed in light of the actions the United States had taken and would continue to take in regards to moderating the world's supply of fissile materials and monopolizing its scientists. In the

[66] Jones, 241.
[67] Reginald V. Jones. *Most Secret War* (London, Hamish, 1978), 474.

months before the meeting with Churchill in Quebec, Vannevar Bush and his deputy James Connant tried to impress upon Roosevelt that while "British and American atomic energy policies might coincide during the war, [they] expected them to conflict afterward.[68]

For the purpose of gaining firsthand knowledge of German atomic science, Groves assembled a special intelligence team of military personnel and scientists who would follow the American army's impending invasions Italy and Europe to "Obtain advance information regarding scientific developments…which are directed towards new weapons of war…and to secure all important persons, laboratories, and scientific information immediately upon their becoming available to our forces."[69]

The first iteration of this team, codenamed Alsos, assembled in Algiers in January 1944, but by the first week in March, all its operatives had returned to the United States. The Allied advance up the Italian peninsula had been slower than expected, and was unable to reach Rome, where the most sought after Italian scientists were located. The second Alsos mission landed in France on August 9, 1944. On August 25, the leader of the Alsos mission Colonel Boris Pash and three other agents, riding in a jeep behind the first tank, were the first members of the American armed forces to enter Paris, where they sought out Frédéric Joliot. Joliot informed the Alsos agents that he believed the Germans "had made very little progress on uranium and that they were not even remotely close to making an atomic bomb."[70] He reported that he had refused to do any military-related work for the Nazis, but several of their scientists had spent time there using the College of France's cyclotron. This inconclusive information confirmed to the Alsos operatives that the Germans did have an atomic weapons

[68] Sherwin, 950-951.
[69] Groves, 191, 192. John Lansdale, Groves' army counterintelligence aid gave the team the codename Alsos. This, when Groves was informed by a colleague was Greek for "groves (it is actually 'grove')", apparently horrified him. This violated the Manhattan Project's policy of utilizing code names designed to arouse the least suspicion possible, but Groves feared that changing the name would draw even more suspicion, so it was allowed to remain.
[70] Groves, 112.

program. They had only Joliot's presumption to go on that it was not past the experimental phase, and this was not considered conclusive.[71]

Upon liberating Belgium, Colonel Pash secured the offices of Union Minere. He found that sixty-eight tons of uranium ore were still in Belgium, and another seventy-two tons had been shipped to Le Havre before the German invasion. All but forty-two tons of the ore was eventually recovered and sent to England, but then, showing the reach of Groves and the interest by the United States to monopolize the world's supply of fissile materials, the uranium was sent across the Atlantic. The supply in Germany was still unaccounted for, however, and this unknown was enough to keep tensions about the possibility of German atomic weapons running high.[72]

As it can be seen, even the information gathered firsthand by agents in Europe about the state of the German atomic weapons program was circumstantial, speculative, or incomplete. Then as now, the absence of evidence is in no way to be taken as the evidence of absence. Both the attempts to learn what the state of German science was, and the work to build an atomic bomb in the United States continued with the highest priority.

In addition to what progress the German scientists had made, the biggest question was where they were conducting their research The first clue to the location of Germany's scientific facilities had come from an unusual OSS operative in the form of a Princeton and Columbia-educated New York lawyer, foreign language protégée, and former catcher for the Boston Red Sox named Morris Berg. Berg, who had also been sent to Italy at the same time as the Alsos mission, had interviewed a number of Italian scientists, and while not learning anything particularly significant about German atomic research, absconded with a postcard written by Heisenberg himself to Italian Physicist Gian Carlo Wick.[73] As the Allies were well aware, the Kaiser Wilhelm Institute had been not only the foremost facility or atomic

[71] Groves, 110-114.
[72] Groves, 219-220.
[73] Nicholas Dawidwolf. *The Catcher Was a Spy* (New York, Random House, 1994), 169-179.

research in Germany, but in the entire world before the war. The Allies had been informed by the Norwegian resistance, however, that the intensifying air raids on Berlin had forced the scientists to move, but this source could not tell them where. In the spring of 1944, the postmark on Wick's postcard, an intercepted letter from a prisoner of war, and information from a Swiss scientist, all pointed to Werner Heisenberg's having relocated to Hechingen, near Germany's Black Forest. Presumably the rest of Germany's top scientists would be there as well, and discussion began on how to penetrate it.[74]

For over two years, American intelligence officers had speculated on the possibility of kidnapping or assassinating Heisenberg, or, as it had been delicately put, to "deny Germany his brain."[75] It was announced in December, 1944, that Heisenberg would be lecturing at Eidgenossische Technische in Switzerland on the 22nd. Groves had established an information source in Switzerland, and was informed shortly before this appearance that Heisenberg was going to be leaving the confines of Germany. The mission was assigned to Morris Berg. Nothing was put in writing, but Berg, having been given a briefing on physics and key phrases to look for, left for Zurich with the orders to attend the lecture and kill Werner Heisenberg if at any point he gave the impression that Germany might be in imminent possession of an atomic weapon. Berg knew German, but had not studied it in twenty years, and would have had trouble following the complex lecture given by Heisenberg even if it had been in English, so he studied the reactions of the rest of the audience, and based on their lack of alarm and Heisenberg's unthreatening demeanor, kept his gun in his pocket.

Thanks to the political leanings of Paul Scherrer, the director of the Physics institute at the Eidgenossische Technische and presumably Groves's information source in Zurich, Berg was invited to a dinner, which Heisenberg would also be attending. At this dinner, confronted by

[74] Groves, 216-217.
[75] Dawidoff, 193.

the unfriendly remark that Germany's defeat was imminent and inevitable, Heisenberg is purported to have answered, "Yes, but it would have been so good if we had won."[76] Berg took this as an admission of defeat by Heisenberg, and by extension an admission that no atomic bomb or other super weapon would appear at the eleventh hour to save Germany. Berg timed his departure to match Heisenberg's and walked in conversation with him, alone and unsupervised through the barely illuminated Zurich night, but he again concluded that there was no cause to end the physicist's life, and let him leave unmolested.[77]

We now know that Berg's appraisal that German atomic weapons were not a serious threat was correct. However, this in no way changed the forces that had been set in motion by the fear that it might be. The war against Germany certainly was not conducted any less thoroughly. The Manhattan Project did not exert any less effort in building an American weapon. There was not even any notable decrease in attempts to locate the German research facilities. It was not that intelligence was going unheeded, but that these programs had been given momentum and direction, and reflecting the total war mentality of the time, they were not to be discontinued until they were deemed unsuccessful, or had been completed.

In addition to human operatives on the ground, Allied intelligence used cutting edge technology to attempt to deduce scientifically if Germany had any working atomic facilities. As the Allied invasions secured footholds on the European continent, this became a much more feasible scenario. As the Alsos team made its way across France towards the Low Countries, an Alsos operative used a bucket to obtain a sample of the water from the lower Rhine to be analyzed for any evidence of radiation. Had radiation been discovered, it would have indicated that the river was being used to cool a reactor located somewhere closer to the river's source, but the water tested negative.[78] Royal Air Force photographs of Joachimsthal

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[76] Dawidoff, 201.
[77] Dawidoff, 206-7.
[78] Charles A, Ziegler and David Jacobson. *Spying Without Spies: Origins of America's Secret Nuclear Surveillance System* (Westport, Praeger. 1995), 8.

were analyzed by the Office of Strategic Services, who used a mining expert to discern that it had not accelerated production at that particular mine. At Groves' behest, Manhattan Project scientist and future Nobel Prize winner Dr. Luis Alvarez at the University of Chicago developed atmosphere sampling equipment to be mounted in the nose of an airplane, which was to be flown at suicidally low altitude over suspected atomic facilities and then analyzed for radioactive components. Alvarez's equipment turned up no evidence of radioactive byproducts over Germany, but was "to become a cornerstone of the United States' effort to monitor Russian atomic progress during the Cold War."[79] Aerial recognizance did discover a series of hastily erected identical buildings along with new railroad spurs and a slave labor camp in the Hechingen-Bisingen area, which, by the possibility of them being "Germany's equivalent of [American atomic research facility] Oak Ridge," apparently gave Groves a few days of white knuckle terror, before they were concluded to be a desperate attempt by petroleum-starved Germany to extract low grade oil from shale.[80] Aircraft had also been employed in 1944, in the high altitude bombing of IG Farben's chemical plant at Merseburg, thought to be doing heavy water research, and the Peenemunde weapons research facility on the Baltic. This attack may have been a result of information from Respondek and Woods in July and August of While it is now known that Peenemunde was not performing atomic research, any of these leads had to be taken seriously and the sites either infiltrated or destroyed.[81] The Royal Air Force had attacked Peenemunde in 1943 as well, but their interest in it had been due to its actual purpose as a site developing rockets to launch at London.[82]

There seems to have been minimal detail of this activity made public, which at this point in the war is not at all surprising. However, despite censorship, some managed to see publication. In late 1944, there were somewhat fantastic reports of a new German secret

[79] Ziegler and Jacobson, 5. This same Alvarez also invented Teflon, which served as a sealant for his work on a reactor.
[80] Richelson, 50.
[81] Dippel, 113.
[82] Jones, 342.

weapon, which the *Christian Science Herald* called an "atom splitting bomb" which "resembles an airplane of considerable size and is filled with a mass of complicated machinery [and] fired from special sites like the flying bomb, and is guided either mechanically or by radio." The article lessened the impact of this by continuing, "The Germans readily admit that atomic bombs are as yet largely unmanageable and dangerous."[83] In December, the *New York Herald Tribune* reported that German radio broadcasts intended to frighten Belgians (and presumably the Americans fighting around Bastogne in what was later named the Battle of the Bulge) boasted that the Germans had used an atomic weapon at St. Vilh despite it being "the type of bomb on which the Allies had claimed a monopoly." The alarmist (and as we now know, wholly fabricated) announcement claimed that "wherever such a missile is dropped, all animals and plants cease to exist. Huge areas of land are scorched, woods are consumed, and any human being caught in the hurricane is shattered to smithereens."[84] These reports were few and far between, as in the United States there was a prohibition in place against reporting on developments in atomic research. The day after the bombing of Hiroshima announced to the world the existence and success of the Manhattan Project, Byron Price, the Director of the Office of Censorship admitted that keeping this information secret had been his primary occupation. Two years earlier he had issued a memorandum to various editors asking that "no mention be made or broadcast of 'production or utilization of atom smashing, atomic energy, atomic fission, atomic splitting, or any of their equivalents.'"[85] This censorship must have been fairly effective. The Soviet Union was aware of American atomic research, via spies in the University of California in Berkeley, but

[83]Peter Lyne, "V-2 Proves 'Bust'?—Nazis turn to Atom Splitter: Resembles an Airplane," *Christian Science Monitor,* Oct. 1, 1944.
[84] "Nazis Boast of Atomic Bomb" *New York Herald-Tribune,* Dec 29, 1944.
[85] "Well Kept Secret: Atomic Bomb was Pain to Censors," *Washington Post*, Aug 7, 1945.

Germany did not know that the United States was developing atomic weapons until they were used in 1945.[86]

The third Alsos team entered Germany on February 24, 1945. The majority of the sites the Alsos mission was targeting such as Hechingen, where all information suggested was the epicenter of German atomic research, were located in the path of the French advance, and it was deemed necessary to try and get there first (a special case was made for Oranienburg, near Berlin, which was summarily obliterated from the air to keep it from being of any use to the Soviet Union). General Groves felt it essential that these sites and scientists fall to the Americans. Groves obtained permission from both General Eisenhower and General Marshall for Operation Harborage, a clandestine strike to retrieve the scientists and any transportable files or equipment, and destroy whatever they couldn't carry off before the French arrived. Despite being an ally whose country had just been liberated from the Nazis, France was still counted as a party not to be trusted in matters of atomic intelligence. With Germany's defeat so eminent, the Alsos mission's focus was clearly geared towards taking scientists, documents, and supplies into American custody with an eye to what would happen after Germany's surrender. The Alsos mission apprehended the remainder of the targeted German scientists culminating with Heisenberg's arrest on May 3, 1945, as well as recovering the remaining cache of Union Minere's missing uranium ore.[87] Germany surrendered unconditionally on May, 7, 1945.

III

Aftermath: The Shadow of Atomic Fear

[86] Sherwin, 956.
[87] Groves, 239-249.

After the permanent anxiety of the perceived—but as it turned out wholly nonexistent—threat of a German atomic bomb, the end of the war should have brought a sense of calm. However, as the war against Germany and Japan turned towards their inevitable defeat, forward thinking minds began to look and plan for what the world would look like afterwards. More than once, Groves described his mission as having begun to shift from defeating Germany to keeping any weapons research related equipment or scientists out of the hands of the Soviet Union.[88] This was just an extension of the overall view of atomic science by the American government: both a weapon for use during the current war, but to at least an equal degree a means to influence, which clearly meant dominate, postwar diplomacy.

The bomb's use against Japan was viewed as inevitable by the top American policy makers.[89] How best to utilize it involved defeating Japan just as much as it involved establishing the desired diplomatic relationship with the Soviet Union. To a considerably higher degree than the Anglo-American alliance, the alliance with the USSR was a matter of convenience and a shared enemy, but the USSR lacked all the common cultural ancestry of Britain and the United States, and was not trusted by either of the Western democracies and actively disliked by Churchill. The Soviet Union's interest in the American atomic weapons program was known, and their procurement of their own weapon was viewed as only a matter of a few years away. Vannevar Bush and James Conant took great pains to stress to President Roosevelt that while the United States was currently in the lead as far as atomic weapons development, this situation was temporary, and could not be counted on to last all that long once the war ended. Additionally, they foresaw the possibility of hydrogen bombs,

[88] Groves, 242.
[89] Jungk, 181.

and unlike uranium, heavy hydrogen was almost infinitely abundant. They knew that other countries' building nuclear weapons was only a matter of time. [90]

Some made the argument that the Soviet Union should be told about the bomb's development, to promote a sense of good will and prevent an arms race. On June 16, 1945, a panel consisting of Robert Oppenheimer, Ernest Lawrence, Arthur Compton, and Enrico Fermi recommended informing the USSR as well as Britain, France, and China, of the progress the Manhattan Project had made, for these same reasons.[91] Niels Bohr was particularly concerned about this possibility and stressed this need to both Roosevelt and to Churchill, the latter unflatteringly becoming suspicious that the Danish physicist might be a Soviet spy.[92]

Others argued that the bomb should not be used at all. At this late hour, Leo Szilard realized that his interventions had led to the construction of a bomb that the United States planned to use, and together once again with Einstein submitted a memorandum to President Roosevelt that any "momentary military advantage [of using the bomb on Japan] would be offset by grave political and strategic disadvantages." It is unknown whether or not Roosevelt read this before his death on April 12, 1945.[93] Szilard, along with over 60 other Manhattan project signatories submitted a petition to President Truman on July 17, 1945, urging him to consider the postwar ramifications of using the atomic bomb. Tragically, Szilard foresaw the future once again, and his appeal was not based on feeling of particular sympathy for Japan, but to avoid setting a new low standard for acceptable human conduct. In short, he feared that using an atomic bomb

[90] Vannevar Bush and James B. Conanant to Secretary of War Henry L. Stimson, Sept. 30, 1944 Record Group 77, Records of the Army Corps of Engineers (2016):, Manhattan Engineering District (MED), Harrison-Bundy Files (H-B Files), folder 69 (2016): http://nsarchive.gwu.edu/NSAEBB/NSAEBB162/1.pdf.
[91] Oppenheimer, Robert et al, "Recommendations on the Immediate Use of Nuclear Weapons," RG 77, MED Records, H-B files, folder no. 76, (2016): http://nsarchive.gwu.edu/NSAEBB/NSAEBB162/19.pdf.
[92] Sherwin, 959, 963.
[93] Jungk, 179.

on Japan without warning would cause a profound loss of American moral high ground, and put the human race one step closer to obliteration.[94]

He was not alone in invoking apocalyptic rhetoric when describing the coming atomic age. The OSRD memorandum in 1944 predicted that if these types of weapons became common, as they were expected to in the coming years, "every center of the population in the world in the future is at the mercy of the enemy that strikes first."[95] In his report to Truman where he informed the new president about the atomic bomb, Groves cautioned that "if misused it can lead our civilization to annihilation."[96] Secretary of War Stimson warned Truman that with the advent of nuclear weapons, "modern civilization might be completely destroyed."[97] But the fear that the technological terror they had created could quite literally end humanity's existence did not prevent its use.

For reasons that have been analyzed in great detail elsewhere, President Harry S Truman authorized the atomic bombings of Hiroshima and Nagasaki on Aug 6 and 9, 1945. The two main goals were to force Japan to surrender unconditionally to the United Sates, and to gain a dominant diplomatic position in the world to come. General George A Lincoln voiced the concern that the devastation of Germany had left the Soviet Union the dominant power in Europe, and it was feared that destroying Japan by invasion would give the USSR disproportionate influence in Asia as well.[98] This diplomatic concern was considered of equal importance as preventing a million potential American casualties in an invasion of Japan. Together, they provided

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[94] Leo Szilard, et al, "A Petition to the President of the United States", RG 77, MED Records, H-B files, folder no. 76. (2016): http://nsarchive.gwu.edu/NSAEBB/NSAEBB162/34.pdf

[95] Vannevar Bush and James B. Conanant, 2.

[96] Lesley Groves, "Memorandum to the Secretary of War: Atomic Fission Bombs, April 23, 1945, RG 77, Commanding General's file no. 24, tab D. (2016): http://nsarchive.gwu.edu/NSAEBB/NSAEBB162/3a.pdf.

[97] Henry Stimson, Memorandum discussed with the President, April 25, 1945.
Henry Stimson Diary, Manuscripts and Archives, Yale University Library, Henry Lewis Stimson Papers.

[98] General George A. Lincoln to General Hull, June 4, 1945**,** Record Group 165, Records of the War Department General and Special Staffs, American-British-Canadian Top Secret Correspondence, Box 504, ABC 387 Japan,. (2016): http://nsarchive.gwu.edu/NSAEBB/NSAEBB162/13.pdf.

justification for dropping the atomic bomb. It took only three years for the bombings of Japan to be first identified as "not so much the last military act of the Second World War, but the first major operation of the cold diplomatic war with Russia now in progress."[99]

The weapon intended for defense against Germany, ostensibly providing security and insuring a world safe for democracy, in fact ushered in an era of unrivaled global fear and uneasiness. It was clear to all involved with atomic research that there was no going back to the status quo of the 1930s, a revelation that in truth applied to all aspects of society. The fact remains that atomic weapons changed life on this planet, and the fact that in 1945 they were possessed by only the United States was an important, albeit temporary one of what would come to be called the Cold War. The arms race that Bohr and many others foresaw did of course become reality in the 1950s. The Quebec Accord, The Combined Development Trust, and the bombing of Oranienburg were just three examples of many showing that the anxiety over nuclear war, originally confined to scientists, had become an extremely central concern to the highest levels of the government and the military. On a global scale, fear of an armed Germany morphed into fear of an armed Soviet Union, and then a fear of atomic weapons anywhere in the world. Paranoia about the use of atomic weapons, which began amongst a tiny enclave of the scientific elite, came to infect the entire population of every successive generation of the human race. The fact that this started with the wholly unnecessary concern over Germany is irrelevant. That incorrect assumption triggered quite possibly the most important events of the 20th Century, and the fear of war has been augmented by the fear of actual human extinction. From duck and cover drills and the Cuban Missile Crisis, to the nuclear paranoia of the 1980s before the collapse of communism,

[99] Patrick M.S. Blackett, *Fear, War, and the Bomb, Military and Political Consequences of Atomic Energy,* (Whittlesey House London, 1948), 139.

and up to the current concerns about North Korea and Iran, the invention of atomic weapons came hand in hand with the mortal fear that anyone else might have them. *Rise and Fall of the Third Reich* author William L. Shirer poignantly summed up the status quo as he saw it in 1960,

> In our new age of terrifying, lethal gadgets, which supplanted so swiftly the old one, the first great aggressive war, if it should come will be launched by suicidal little madmen pressing electronic buttons. Such a war will not last long and none will ever follow it. There will be no conquerors and no conquests, but only charred bones of the dead on an uninhabited planet.[100]

Recent rhetoric about "smoking guns" and "mushroom clouds" clearly illustrates that this anxiety, which was made a part of the public consciousness in the 1940's, remains prevalent today.

[100] William H. Shirer *The Rise and Fall of the Third Reich* (New York, Simon and Schuster, 1960), xii.

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