Witnesses of Trinity:
The first atomic bomb,
July 16, 1945, New Mexico

A senior project by Jessica Bradshaw
College of the Atlantic
Class of 2003

Witnesses of Trinity:

The first atomic bomb, July 16, 1945, New Mexico

By Jessica Bradshaw

Karen Waldron

Senior project director and academic advisor

Bethany Murray

Student advisor

Abstract

During my senior project, I researched the history of the first atomic bomb, code-named Trinity, which was tested on Monday, July 16, 1945, at 5:30 A.M., in southern New Mexico. In this paper, I looked at how people who witnessed the explosion reacted to it, based on what they knew about it. Most of the witnesses were civilians, military personnel, and scientists. I compared witnesses' immediate reactions and their reflections after the Japan bombings or years later. Witnessing the test affected people in powerful ways, no matter how much they knew about it. Trinity opened a new page in history, and the people who saw it realized how completely vulnerable humans are.

Acknowledgments

• I did a lot of research at Morris Library at Southern Illinois University and at the National Archives in College Park, MD. Thanks to those who helped me, especially at the Archives, which was very intimidating when I first arrived.

• I could not have done this without the library staff at COA. Thank you all for letting me have my home away from home. Thank you for all the ILLs and for my book box – even though I first said "Oh, I won't have *that* many books!"

• Thanks to Brent and Howdy for telling me to sleep, giving me rides home, and just being there in those wee hours early in the terms when no one else was around.

• Thanks, of course, to my family, for reminding me not to procrastinate, asking all the parental questions, and putting up with me at home (last winter and all the years before).

• Thanks to Todd Little-Siebold and Dave Feldman, for being my advisors without getting any real credit for it. Thank you, Todd for all the history advice and Dave for all the science advice.

• Thank you to Bethany Murray, for being my student advisor, giving me rides home late at night, giving me loads of support, telling me to stop procrastinating (or procrastinating with me), staying up late with me, and being a great friend.

• Thanks to Andy for being my study buddy (and practically my only human contact) over spring break, even if it was just my first draft. Thanks to Kim for being my study buddy in the spring, no matter how many times the library staff tried to kick you out.

• Thanks to Sonya for staying awake with me and disagreeing with everyone who said that I needed to sleep! And thanks to Emily for her week nine bake sale extravaganza and for being yet another late-night worker.

• To all the 29 Ledgelawners, an especially big thanks. You're my best friends, and although I never got to live there, I always felt like I belonged. Thank you!

• A huge thanks to Karen Waldron, who has been my everything for the past four years: advisor, teacher, work-study supervisor, reader, supplemental mother, and friend. Words cannot approach my appreciation for you, and you know how inarticulate I can be at my worst (and how I can be at my best).

Table of Contents

Appendices

Bibliography

Introduction

The year is 1945. World War II is drawing to a close, but slowly – Japan keeps fighting. President Roosevelt has died, but so has Hitler. Despite the world's troubles, you are taking a short vacation this July. You have left your home and your family cattle ranch in southern New Mexico. You are in Nevada on July 16 when you hear that there was an accident at an ammunitions dump in southern New Mexico. You cannot tell where based on the news accounts. No one died, but the news says that the Army may need to evacuate a few people from their homes. On the way back home, you stop by a movie house in Denver and watch the newsreel. When you see the area around the blast, you realize that it is right near your ranch![1] You live next to the Alamogordo Bombing Range, where the Army trains pilots before sending them overseas, but you never thought it would cause any danger. Your neighbors were relocated about three years ago because the Army said they needed that land. It was wartime, and they had complied, signing a lease to get it back in some years. Some of them were upset about the decision, and now you can see how, with this dangerous explosion.

Three weeks later, on August 6, you hear the news: a city in Japan, Hiroshima, is destroyed by a new, super powerful bomb, an atomic bomb. The city disappeared in a flash. Perusing the paper, you read that the first such bomb was tested nearby, on the Bombing Range, on July 16! The story of the ammunitions dump explosion was a cover up! In northern New Mexico, at a town called Los Alamos, scientists been working on the bomb, in a secret government project called the Manhattan Engineer District. You had noticed a lot of military personnel in town, but you always thought they were from the Bombing Range. Now you know why they never talked about their work. They were not pilots at all, but scientists. You try to remember other things you noticed, and begin to realize all the things that have been going on right underneath your nose.

Or imagine you are a military police officer involved in the secret work of building the atomic bomb. You do not know a whole lot about this new weapon these scientists are talking about. (They call it "the gadget" – you think it is a bomb, but you do not quite know. You have also heard rumors that it is a new super submarine). All you know is that if the gadget is built, it will end the war. Your brother is in Okinawa now, fighting on the ground.

You have not heard from him, but you know from others that it is hellish, much worse than Europe was. You know that if the Project does fail, you might end up in Japan, too.

Or imagine you are a scientist. You know a lot about the "gadget," but you are forbidden from saying the word. You just work in the lab, so you are not up at the top with Fermi, Bethe, or Teller, but you are glad because they get all the flak from Groves, the Project director, and Oppie, the Lab director. You are not supposed to know as much as you do – you are only supposed to concentrate on whatever task is at hand – but you know what is going on. Tonight, you are going to watch the test of the gadget from a hill where most of the lab workers will be, about 30 miles away from Zero (another code). You have been working extra hard lately to be ready by the deadline, and you have contributed your part to the design – why should you not get to see the test? Everyone has been talking about it: Trinity this, Trinity that.

So there you are, in the desert at night, with other scientists, military personnel, governmental representatives, and other special guests. No matter who you are, you are excited and nervous. Some people place bets on how big the bomb will be: some say it will be a dud, others say it will be 20, even 40 kilotons. You are getting increasingly nervous as the countdown continues. Then, it is zero time.

> And then without a sound, the sun was shining; or so it looked. The sand hills at the edge of the desert were shimmering in a very bright light, almost colourless and shapeless. This light did not seem to change for a couple of seconds and then began to dim. I turned round, but that object on the horizon which looked like a small sun was still too bright to look at. I kept blinking and trying to take looks, and after another ten seconds or so it had grown and dimmed into something more like a huge oil fire, with a structure that made it look a bit like a strawberry. It was slowly rising into the sky from the ground, with which it remained connected by a lengthening stem of swirling dust; incongruously, I thought of a red-hot elephant standing balanced on its trunk. Then, as the cloud of hot gas cooled and became less red, one could see a blue glow surrounding it, a glow of ionized air . . . It was an awesome spectacle; anybody who has ever seen an atomic explosion will never forget it. And all in complete silence; the bang came minutes later, quite loud though I had plugged my ears, and followed by a long rumble like heavy traffic very fast. I can still hear it.[2]

It really is too much for words, you think. Chills run up your back, goose bumps rise on your arms, your entire body shudders. You think, for an instant, about what may have happened to any animals near the center. When the light dims, you see (or, rather you do not see) that the 100-foot steel tower that the bomb was on is completely gone. Then you realize "we've done it!" and you say it in a subdued voice to your buddy next to you. You are still

staring at the fireball. Or, rather, now it is a cloud. It looks like a mushroom, you realize – a mushroom-shaped cloud. You realize how exhausting the past few weeks have been, and now it is over. An image crosses your mind for a brief second, of what will happen to a city this gadget is dropped on. But, for now, it is time to celebrate! The gadget worked! The war will end and the secrets will end, too!

Three weeks later, the latter will come true: two bombs are dropped on Japan, bringing the war to an end. By some estimates, over 210,000 people died in these attacks.[3] Some died instantly; others suffered before dying; a few lived, but with severe medical problems. You may or may not feel guilty about this. Your thoughts return to that morning in the desert and how big the bomb was. You will never forget that sight, nor the sound, nor the smell of death that lingered in the air for weeks afterwards. You were a witness to the first atomic bomb.

••••

You probably have not seen an atomic bomb, but you know what it looks like. The people whose minds you were just in did not know what an atomic bomb would look like until they saw it. The term "mushroom cloud" meant nothing. The Trinity bomb that exploded on Monday, July 16, 1945, at 5:29 A.M., will never be forgotten by the people who witnessed it. But even people who did not see the bomb are fascinated by it. Many people have written about the bombings of Japan and the Manhattan Project scientists who built the bombs. Even more has been written on the military decision to use the bombs and the effect they have had on Japan. Survivors of the bombings at Hiroshima and Nagasaki have written about their experiences. A fair amount has been written on the Trinity test; the most recent full account is Ferenc Morton Szasz's The Day the Sun Rose Twice (1983). However, the Trinity story has not been revisited in a while, at least since the fiftieth anniversary in 1995. And no one has looked in depth at what impact the Trinity test had on its eyewitnesses. This analysis is an important piece of the history of Trinity and the atomic bomb. No one has collected all the stories of witnesses in one place; unfortunately, this is not something I can claim completely because most of the witnesses have disappeared from history.

However, during this project, I have collected witnesses' stories to analyze their

responses to the Trinity test. Most stories about Trinity focus on the official witnesses, especially the top scientists. I wanted to look at all perspectives of the story, tying together pieces that I found about female scientists from Their Day in the Sun, by Caroline L. Herzenberg and Ruth H. Howes; local witnesses mentioned in Szasz; eyewitness accounts written by scientists; and many other sources. My sources for this project were all written or otherwise recorded (sound, photographs, video). In addition, I conducted some research at the National Archives. This paper is a witness analysis based on the pieces of the Trinity story/history I collected.

The Trinity test deserves this new examination for several reasons. First, it is often overlooked in our cultural and societal history today. Not many people know that before the U.S. dropped two bombs on Japan, we exploded one in New Mexico – without residents' knowledge. Second, Trinity is important because it was the *first* atomic bomb. No one knew what to expect; even the scientists' calculations did not prepare them for the experience. This relates to a third reason: the makers of the bomb actually got to see it. They did not get to see the ones dropped on Japan and only a few scientists traveled to Japan to survey the damage. In addition, a variety of people witnessed the Trinity test, without the utter death and destruction, that occurred in Japan. This part of the Trinity story – the actual witnessing – is what I am interested in analyzing. How did the knowledge witnesses had or did not have about the bomb influence their reactions to the Trinity blast? In this paper, I will outline witnesses' responses to the bomb, from the civilians who did not know an atomic bomb even existed, to the top scientists, who were intimately involved. I will show that witnesses reacted to the test differently based on their levels of knowledge.

One of the distinctions I have made in this project is between witnesses and non-witnesses. In some ways, this was a difficult task; everyone who lived during the test and who has lived since then could be called a witness to Trinity. We have all seen the results of Trinity; we are all, as the name of Tad Bartimus and Scott McCartney's book claims, Trinity's Children. However, in the case of the Trinity test, there was a lot of power in the event for the actual eyewitnesses – people who saw the bomb explode. For this reason, I distinguish between witnesses, who saw the explosion, and non-witnesses, who noticed or have lived with its effects. Depending on their proximity to the test, witnesses saw the

fireball, heard and felt the thunder of the shock wave, and felt the heat on their skin. For these reasons, "witnesses" in this project means just that: people who *saw* the explosion.

Only certain people would have seen the Trinity test: those who knew what was going on or early rising residents. The people who knew what was going on were involved with the Manhattan Project. These eyewitnesses were invited or required to view the bomb: scientists, military personnel, government representatives, one Monsanto Company representative, and one journalist. Some Los Alamos scientists who were not officially invited snuck in to the area or watched from afar. Some military personnel were assigned to posts to view it from afar. Several local residents saw the explosion but did not know what it was. There were also non-human witnesses who have poignant stories, because they had no understanding of what was happening. Not only did people react differently to Trinity based on how much they knew, but on how prepared they were (which generally went along with knowledge). As knowledge of the bomb increases, reactions to and reflections upon the Trinity test are tinged with a sense of responsibility.

All of these groups of people had very different kinds of experiences with the Trinity bomb, and each individual had a unique experience as well. No one who witnessed the Trinity test could ever forget it. Besides just making them feel special ("I *saw* it with my own two eyes."), something as big – literally and figuratively – as the Trinity test makes them realize how puny humans really are. The act of witnessing also forms a powerful connection between people; witnesses have a special bond, which is stronger in some groups (like between top scientists). Everyone who witnessed the Trinity bomb shares a page in history, no matter if they were residents, scientists, or military personnel. What follows is my analysis of what Trinity meant to the people who saw it and how they expressed their knowledge of it.

Before Trinity: A brief history

Before getting into the Trinity test, it is important to have an idea of what was happening in the world, both politically and scientifically, leading up to the production of the first atomic bomb. Nuclear science was a burgeoning field in the early 1900s. But it was not connected to weapons or energy until nuclear fission came along. In September 1938, Otto Hahn and Fritz Strassman discovered that uranium atoms, when bombarded with neutrons,

released a lot of energy and turned into lower mass barium – or so they thought. In December 1938, Lise Meitner, who had worked with Hahn, and Otto Frisch, her nephew, did some theoretical calculations that explained the release of energy. Meitner and Frisch realized that the atoms were splitting in half and named the new process nuclear fission. Scientists soon realized that this release of energy could be used to make weapons.

Shortly after, the world went to war. World War II began on September 1, 1939, when Germany, under the rule of Adolf Hitler, invaded Poland without declaring war. Britain, France, and other European Allied powers declared war two days later on Germany. Italy and Japan soon joined Germany to become the Axis powers, and the Soviet Union joined the Allies. The U.S. stayed out of the war until December 7, 1941, when Japan attacked Pearl Harbor, Hawaii.

President Franklin D. Roosevelt knew about the possibilities of an atomic bomb before Pearl Harbor. Albert Einstein had written a letter to the President warning him that Germany had stopped selling uranium and that physicists were engaged in uranium research. He recommended that the President assign someone to lead a U.S. effort to build the bomb first. Many scientists, including Einstein, Bohr, and Frisch, had escaped to the U.S. or Britain from Nazi-occupied countries, but they knew that their colleagues back in Europe were working on the same research they were. The research into the possible use of nuclear fission as a weapon was motivated by the war.

After the U.S. entered WWII, President Roosevelt decided to go ahead and investigate the possible military use of nuclear fission. He delegated the responsibility to the Army Corps of Engineers, which set up the Manhattan Engineer District (MED), or Manhattan Project, on June 17, 1942. The MED was kept very quiet – even then-Vice President Harry Truman did not know about it. The Corps director (General Brehon Somervell) appointed General Leslie R. Groves director of the MED in September 1942. Groves selected three sites to help build a nuclear weapon: Oak Ridge, Tennessee; Hanford, Washington; and Los Alamos, New Mexico. Los Alamos was the site for scientific research; the other two were for processing uranium and plutonium, the two known fissionable elements at the time. Workers at the other plants did not know much about what they were working on, but scientists at Los Alamos knew. By the end of the war, over

120,000 people were employed at the three sites, including 6,000 at Los Alamos. By the end, the Project had cost $20 million, in 1990 dollars.[4]

The Trinity test was a project of the Los Alamos Laboratory, which was under the direction of J. Robert Oppenheimer. Many of the top physicists came to Los Alamos; many other physicists ended up there right after graduating from universities like the Massachusetts Institute of Technology (MIT), Princeton, Harvard, and the Universities of California and Chicago. Physicists who had escaped Nazi-occupied countries in Europe and several British scientists worked on the MED at Los Alamos with U.S. scientists.

Los Alamos scientists figured out two potential designs for an atomic bomb. The first, a uranium bomb, worked by a simple gun/firing mechanism and was smaller in size, so it was nicknamed "Little Boy." The other type of bomb was plutonium, and worked by implosion. It was larger, thus nicknamed "Fat Man." Since the plutonium bomb was more experimental, scientists wanted to test it before using it.

The Test

The test planning began in earnest in March 1944. Oppenheimer appointed Kenneth Bainbridge, a physicist from Harvard, as test director. Oppenheimer christened the project "Trinity" as a code name. Oppenheimer did not say, in 1945, where he got the name from, so rumors flew until historians found a letter he wrote to Groves.[5] Smith and Weiner explain:

> In 1962, replying to General Groves' query about the origin of the name, Oppenheimer wrote: "I did suggest it . . . Why I chose the name is not clear, but I know what thoughts were in my mind. There is a poem of John Donne, written just before his death, which I know and love. From it a quotation:
>
> . . . As West and East
> In all flatt Maps – and I am one – are one,
> So death doth touch the Resurrection.
>
> That still does not make Trinity; but in another, better known devotional poem Donne opens, 'Batter my heart, three person'd God.' Beyond this, I have no clues whatever."[6]

Trinity touches on the Christian Trinity of the father, son, and holy ghost, and these relate to the idea of birth coming from death and resurrection. Donne played with this idea in his idea of a "three person'd God" and as "death doth touch the Resurrection" (i.e., the resurrection of Christ). Donne was dying when he wrote the first poem, and he describes his connection to everything, with "I am one" and everything is one. He believed his death was but a new

life. The connection between death and birth is a recurring theme in thinking about the atomic bomb. Oppenheimer and others would return to it when they saw the bomb explode.

After Oppenheimer appointed Bainbridge, one of Bainbridge's first assignments was to find a site for the test. After surveying eight potential locations in the western U.S., he settled on the Alamogordo Bombing Range in southern New Mexico. The Range was isolated, already under Army control, flat, and about 200 miles south of Los Alamos (which kept the secrecy, yet made transportation easy). The site, "with its bake-oven heat and its waterless expanse of bleached white desert, had been given an early prescient name by the early Spanish explorers: Jornada del Muerto," or Journey of the Dead.[7] Many Spanish explorers had died there; looking back, the name seems prescient because it would soon host a precursor to a bomb that would cause many deaths in Japan. It was a desolate place. Bainbridge chose a spot near the northeastern corner of the Range for the exact site, actually closest to the town of Carrizozo, not Alamogordo.

Construction at the Trinity site began in November 1944. The Corps and later the Ted Brown Construction Company built several bunkers, earthen shelters, a base camp, housing, and two towers. There were several spots to view the test from. The base camp was about 11 miles from Zero; three shelters were about 5.7 miles away in three directions; a hill nicknamed Compañia Hill overlooked the site from about 20 miles away. Most nonessential personnel and distinguished guests would watch from Compañia Hill. (See Appendix 2 for the map.) Equipment, including video and still cameras, was set up in various places all around the tower. Many miles of wires laced the desert floor. A lot of work had to be done to prepare for the test at the site, which involved military personnel and the civilian company; scientists would not be at Trinity until closer to the zero hour.

Meanwhile, scientists at Los Alamos were working on the theoretical aspects of the test. As explained above, they had figured out the plutonium bomb had to work by implosion. The design of the plutonium bomb was frozen in February 1945, in order for the bomb to be ready by the summer. Hans Bethe, head of the Theoretical Division, estimated that the explosion would be about 5 to 7 thousand tons of TNT equivalent. The test date was initially set for July 4. As the deadline for the test approached, the pressure was on to simply get ready; Groves had set the date. There was enormous political

pressure on the scientists to push ahead. One of the preparations the scientists took was a pre-test test. On May 7 (coincidentally, the same day that Germany surrendered), Trinity personnel exploded 100 tons of TNT. It was the largest human-made explosion to date. But it was next to nothing compared to the explosion to come.

Groves was pressuring Oppenheimer and the scientists in part because he was being pressed politically to test the bomb. In April 1945, less than two weeks after President Roosevelt died, Adolf Hitler had committed suicide and the Nazi Empire had begun to collapse. Japan, however, was still fighting. President Truman, Prime Minister Winston Churchill, and Premier Joseph Stalin were planning to meet to draft an ultimatum for Japan's surrender. Truman wanted to wait until he knew the results of the test. While waiting, Truman postponed the meeting numerous times; Churchill knew what for, but Stalin did not. Finally, Truman set the date for the "Big Three" conference, which would take place in Potsdam, Germany (on the outskirts of Berlin), in mid-July. That became the deadline for Trinity as well. Despite bad weather predictions as the date approached, Groves set the test for July 16, right when the Potsdam Conference would begin. When Truman heard about the test (and that it exceeded expectations for its yield), he was ecstatic; it definitely changed the tone of the negotiations. The declaration demanded that Japan unconditionally surrender or face "prompt and utter destruction." While many consider Potsdam the end of Trinity's legacy, the story was just beginning for the witnesses of the Trinity bomb.

Civilians

Several local residents witnessed the Trinity test without knowing, at the time, what they had seen. All they knew was that they saw some sort of explosion. They would not know the significance of what they had seen until after the U.S. dropped the bombs on Japan and released the secret of Trinity. Their reactions to the bomb were different from those of witnesses who were part of the Manhattan Project. Yet despite their similar circumstances, the civilian witnesses had varied responses to Trinity, mostly based on where they were that morning and where they lived.

First, it is important to have some background on the area surrounding the Trinity site. Most of the residents who saw the explosion were scattered around; there are very few towns in the area. Most residents in that region of New Mexico are also ranchers, either by trade or to supplement their income. As noted earlier, the Trinity test took place on the Alamogordo Bombing Range, much of which was land that the government had leased from local residents at the beginning of the war. Most families had complied with the government's request, some less willingly than others. Obviously, the government could not give the land back after the war; the Trinity site is now a National Historic Landmark. Even after a lengthy legal battle, some families still do not feel adequately compensated. A lot of the Trinity land was owned by the McDonald family, who have been very outspoken against the Army for taking their land. Their ranch house, unbeknownst to them at the time, hosted the core of the Trinity bomb, only about 2 miles away from Ground Zero. These conflicts set the background for some of the civilians' reactions to the explosion – on land that many witnesses felt they still owned.

Not many people lived in the area near the Trinity site, which is one reason why the MED decided to locate it in this desert. However, the bomb's notice extended far beyond even state borders. The town closest to Trinity, Carrizozo, is about 30 miles away and had a population of 1,500. Alamogordo is at the other end of the Bombing Range, 85 miles from the Trinity site. Albuquerque is about 100 miles away. (See Appendix 4 for a map of New Mexico.) William Laurence gathered reports on the extent of the bomb's notice:

> The flash lighted up the sky at Albuquerque and was seen as far as Amarillo, Texas, 450 miles east of Zero. At El Paso, 150 miles to the south, persons saw the flash and heard the blast and two successive echoes. Residents of Silver City, New

> Mexico, 200 miles to the southwest, and at Gallup, New Mexico, 235 miles to the northwest, reported that their windows rattled, and those at Gallup stated that they had also heard two explosions.[8]

Obviously, if the explosion extended that far, in a radius extending over 400 miles, people who were closer witnessed to an extreme. For people who lived nearby, it was hard *not* to notice the blast; it woke up some people. If the sight did not wake them up, the sound or rumbling could have. Szasz estimates that "several hundred people saw the explosion."[9] There were eyewitnesses all over the state and into other states, which makes it difficult to know how many civilians saw, much less heard or felt, the test.

No civilians were supposed to be warned about the test, which made the shock even greater. Although everyone working with the Manhattan Project was told to keep a low profile, some slips did occur. José Miera, the owner of the Owl Bar and Cafe, a popular stop in San Antonio, NM (about 35 miles northwest of Trinity), was woken up that morning by several MPs. They told him that "if he came outside he would see something no one had ever seen before."[10] Miera did not exactly get the run-down of what this new thing was, but since it was coming from MPs, he knew it must be some new weapon. After all, this was World War II, and there was a Bombing Range nearby. His reactions were never reported, but his granddaughter, Rowena Baca, has since told her story. She remembers "my grandmother shoved me and my cousin under a bed . . . because she thought it was the end of the world."[11] Baca opened her eyes at one point "and the whole room was red."[12] Her grandmother realized it was a new weapon – it involved the military – so she assumed it was dangerous. Baca had a child's fascination with something new and dangerous, so she peeked out to get a glimpse of the explosion. As Baca's story shows, once the secret of the bomb was out, witnesses no longer discussed what they thought the explosion had been when they first saw it. They know what it is now, as does the rest of the world, including their interviewers, so they do not say what they thought it was at the time of the explosion. Now, they are proud enough just to say that they saw the first atomic bomb.

Even with the advance warning that something was going to happen, the explosion was quite a shock. Bartimus and McCartney recall a story similar to Miera's.

> Frank Martin, who lived about twenty miles southwest of Trinity Site, had received a strange warning from an army lieutenant about a week before the test. "He said it

was going to be something really big, and he hoped to hell it didn't kill us all," Martin said.

The blast blew Martin out of bed. "You didn't have to be very smart to know that was something new." (13-14)

There is something that makes Martin's and Miera's stories different from those of other witnesses: because they knew the explosion was some new weapon, they did not seek any explanation for what it could have been. They knew more than other civilians, but they did not know enough to make sense of what they had seen. Martin says that it did not take much to know that the explosion was something new, but he also has the benefit of hindsight. Martin was in the unique position of being warned further in advance but not knowing just when this "really big" thing would be. He, like others, noticed increased activity on the Bombing Range, but unlike anyone else, he was given an explicit tip. And although Martin knew more than other civilians, he was still shocked enough to jump out of bed. Everyone had to wait a few weeks to find out exactly what had happened, including Martin and Miera. Miera and Martin were warned, but did not know enough to make sense of what they had witnessed.

Other civilians may not have received explicit warnings, but had noticed increased activity at the Bombing Range. Since all of the personnel and equipment for Trinity came from Los Alamos, it passed through a lot of small towns. In addition, as Miera's story implicates, many of them stopped at businesses in those towns. The military personnel and scientists stood out in the small towns surrounding Trinity. Two MED personnel, Joseph Hirschfelder and John Magee, recorded one such instance. They were out monitoring the radioactive cloud after the test.[13] That afternoon, they stopped at a small crossroads store in Bingham, about 15 miles north of Ground Zero. An old man, looking curiously at their white coveralls and equipment, "broke out laughing and said, 'You boys must have been up to something this morning. The sun came up in the west and went on down again.'"[14] The old man was obviously saying this with tongue-in-cheek. He knew these outsiders were up to something on the Bombing Range. The old man and other residents would have seen the Army trucks driving through and the May 7 100-ton explosion. Residents knew a war was going on and that the Alamogordo Bombing Range was nearby. The old man's story illustrates how, although he did not know what the blast

was, he knew that it was war-related. Because he could connect the blast and seeing these men, although he did not know what the blast was, he knew enough not to ask questions and that whatever they were doing would benefit the war.

Even at fifty miles away, Dave McDonald had noticed the increased activity at the Bombing Range. As Bartimus and McCartney illustrate with his story, the blast was a surprise, but, looking back, not as big a surprise as witnesses thought at the time. Dave McDonald later put together all the things that he had noticed.

> Dave McDonald was cooking breakfast before dawn on the other side of the Oscuro Mountains, fifty miles from ground zero. Searchlights to guide observation planes had been waltzing across the sky, so he knew something was going on over at the bombing range. When the nineteen-kiloton blast went up, he thought a trainload of dynamite had exploded on nearby tracks. It lit up the sky, and his house, as if a giant flashlight had been turned on in his kitchen.[15]

No one warned him explicitly, but McDonald had noticed the preparations for the test. Nevertheless, McDonald, like most others, sought an explanation for the explosion, thinking first of nearby train tracks. And despite being close to the Bombing Range, McDonald and others did not know of any bomb that could cause such a big explosion.

One woman did claim later that she knew the explosion was a bomb. Szasz discusses "a nearby Lincoln County woman [who] dismissed the whole [cover-up] story as nonsense" but her story was not published until after the war. She said that "she knew a bomb when she observed one. She could hardly miss it, she said, when it shook the whole house and threw things down from the top of her kitchen cabinet."[16] It is hard to tell, in many of these stories, what people really thought at the time of the explosion. These stories did not surface until after the war, so who knows what people really thought for those three weeks between the Trinity blast and the Japan bombings. This is not to say that her and others have lied intentionally, but just that they could not have guessed, before the Japan bombings, how different and new the atomic bomb was. This woman says that she knew a bomb, but this bomb was unlike any other bombs. In addition, not many interviewers or witnesses are interested in what she and others *guessed* the explosion was; both witnesses and interviewers have focused more on the fact that the people saw the first atomic bomb. A lot of civilians mix this pride with contempt for the military testing it so close to them (not to mention the ongoing land disputes); you can sense a bit of that

contempt in her statement. Thus, it is difficult to know – both for historians and the witnesses themselves – what they really thought when they first saw the blast.

Other people have said that they did not believe the official explanation/cover story. General Groves released a carefully crafted press statement to try to quell rumors and curiosity. The statement – one of many versions written ahead of time – said it was an explosion at an ammunitions dump, which contained "a considerable amount of explosives and pyrotechnics," along with some gas shells.[17] Since the explosion was noticed from so far away, this statement satisfied their curiosity, but it was not enough for at least some people who saw the explosion closer. Even the Alamogordo News, despite being told to print the exact statement only, reported the local consensus that "some experimentation was going on in explosives which required an isolated terrain such as the explosion occurred on." [18] The paper is right, in that it was an experiment that necessitated the isolation, but this was not just any normal explosion. The atomic bomb was so entirely new that no one could have ever guessed that was it. Again, some people maintain they never believed the press release: "'Everybody knew something had happened,' recalled Beatrice McKinley of Alamogordo. 'The stories they told were very clumsy.'"[19] However, would McKinley have believed anything else? Even if someone had told McKinley and others what it was, they would have had a difficult time believing it until they saw it again, in actual use. The atomic bomb was so new that no one could have possibly foreseen it. There was nothing else like it and nuclear fission was not well-known. Civilians knew something was happening, but nothing would have satisfied their curiosity – except the truth, and they could not have possibly guessed what that truth was.

But the above stories are exceptions to the norm. Most civilians who witnessed the Trinity blast did not think of bombs, or at least not in the context that the above people did. "Lewis Farris of Carrizozo ran up the main street of town shouting, 'Hell's broken out someplace. Maybe it's the Japs.'"[20] The war was obviously on peoples' minds. Interestingly enough, however, Farris is about the only one (mentioned in Szasz or elsewhere) who thought about another Japanese attack. This shows how little people were worried about an attack, even though we were at war. If an explosion that large happened in war-torn Europe, people probably would have reacted more like Farris had, running up

the street yelling because they might be under attack. Despite the war, most people were fairly calm, compared to the mass panic that could have resulted if the blast had happened in Europe. War had not really affected people in the U.S. That is, it was on most people's minds, but not in the same presence as it was in Europe. War was on everyone's mind, but, except for Farris, not in terms of the possibility of attack.

Most people sought explanations based on what was around them, which covered a wide variety of possibilities. Some people thought the blast was a meteor crash; Szasz said that was "the consensus in Roswell."[21] That seems like a rational explanation, although those witnesses would have to fill in a hole because there was no descending meteor. Similarly, many witnesses thought it was a plane crash. "Members of the crew and passengers aboard a Santa Fe railroad train near Mountainair, about seventy miles to the northeast, thought they saw a bomber explode and burn in the sky."[22] The Los Alamos book also says that a rancher who was between Alamogordo and the bomb said: "I thought a plane had crashed in the yard. It was like somebody turned on a light bulb right in my face."[23] Like the meteor, there was no plane falling. But this shows the power of imagination – people tend to fill in holes in their mind. People understand new experiences in terms of what they already know or have experienced. There was not much happening in the area, and the shock must have been greater since it was so early in the morning. Thus, witnesses filled in the missing pieces to try to rationalize what they had seen.

Some people thought of what was near them and thought that the explosion was a lot closer than it was. Waiting for a train about 50 miles away that morning, Richard Harkey recalls: "Everything suddenly got brighter than daylight . . . My dad thought for sure the steam locomotive had blown up."[24] Again, people tried to put the event into context of what they knew. At fifty miles away, the Harkeys were distant enough for the explosion to seem big, but no bigger than if a train had exploded near them. They were expecting a train, so that was what they thought of first. Pat Withers told a similar story. He lived near Carrizozo, about 50 miles away, next to the malpais – a black, hardened lava flow. He recalls: "The explosion was loud enough that I jumped out of bed . . . I thought the malpais had blowed up. It wasn't on fire, so I went back to bed."[25] Withers reacted similarly to others; when nothing else happened, they assumed the danger had passed and they went

back to whatever they were doing. The Los Alamos book also reports a man in Carrizozo who said "It sure rocked the ground. You'd have thought it went off right in your back yard."[26] The blast was so powerful that people thought they were a whole lot closer to the source than they were. In that instant of reaction, they did not know what it was, and the first thing that jumped to mind was something near them.

To most civilians, the explosion was just confusing and shocking. They did not know what they had seen, felt, or heard, and it all happened very quickly. Whatever it had been, it was over. Bill Gallacher, who was 15 at the time, remembers that shock. Thompson writes about Gallacher's experience: "He remembers the blast, that it lighted up the sky and the rooms in his house, much brighter than a bolt of lightning. His father, evidently a man of few words who was just getting out of bed, simply said 'Damn.'"[27] When nothing else happened, witnesses had only their reactions left to ponder. It was dumbfounding. There was nothing to do after the blast was over. No one knew what it was, but they did not know how to find out or what to do. It was not like an emergency situation; it was more like an earthquake – after it is over, it is over. As Gallacher said, "It was a sort-of-sudden deal . . . especially before you've had your morning coffee."[28] Neither he nor his father knew what to do. There was no way for witnesses to know that the blast was a significant event. Whatever it had been, it was over before they could think twice.

The most popular and poignant story of civilian witnesses is that of Georgia Green. Her brother-in-law, Joe Wills, was driving her to a music lesson in Albuquerque that morning. They were just north of Socorro, about 40 miles away, when the bomb went off. She grabbed Wills' arm and asked "What was that?" – which might not be unusual, except for the fact that Green was blind. Robert Cahn elaborates: "The flash she had seen was brighter than any daylight Georgia had known in the years before she had lost her sight. Her brother-in-law, of course, did not know what had happened. He pulled off the road for a moment and considered whether or not to return home. When nothing else happened, they went on to Albuquerque."[29] They were both confused by what they had seen, but since nothing else happened, they continued. Many civilian witnesses responded this way. As Richard Harkey later said, "when you see something like that you're so flabbergasted that you just let it go."[30] The entire thing unfolded rapidly; the explosion was over and there was

no apparent danger, so people continued on their way. Since civilians did not know that this blast was significant, they did not watch the fireball, except only to tell if they were in any danger. Green's story is repeated often because it testifies to the literal intensity and otherworldliness of the blast.

Children reacted very differently to the explosion. It was scarier for them because they did not have any context to put it in. Thomas Treat, an eight-year-old, "ran for his Methodist parents, and they solemnly considered if this might be the end of the world."[31] Such a young kid did not understand the war and the possibility that the U.S. could be attacked. Children also did not make the connections that adults could, like with the Bombing Range, or the strange caravans and people who had passed through their towns. Treat's reaction clearly illustrates how people's reactions differed based on their knowledge. He instinctively ran for his parents. If they had noticed the strange happenings at the bombing range and perhaps knew something about science, they would have, like the old man, noticed the scientists' clothing and instruments and made the connection, even if they did not know it was an atomic bomb. Children, though, could not connect those occurrences with the explosion. Even if they noticed the new people in town, they reacted instinctively to the blast and ran for their parents, or were just too surprised to think about what they had seen before. Children did not have any context to put the explosion into.

Animals reacted even more instinctively to the explosion than children. The land that ranchers sold to the government was mostly ranching land; some herds of cattle still grazed there. Also, a few ranchers on outlying, nearby land were still actively ranching. Szasz interviewed rancher Holm Bursum. "A sheep herder for Holm Bursum lay sleeping on a cot about fifteen miles from Zero when he was awakened by the flash and blown off his cot. Bursum's foreman, Julian Jaramillo, had just saddled up his horse when the blast occurred. The horse fled into the hills, and it took Jaramillo two hours to catch it."[32] The blast was much more shocking to them: they were not only fairly close to the bomb, they were also out in the open. Like many locals, the two ranchers realized that something war-related was going on. They were used to the Bombing Range activity. The horse, however, followed its instinct. It could have no understanding of the Bombing Range or the war, or even think of plane crashes or meteors. Other animals who witnessed the blast reacted somewhat

similarly. Roosters started crowing in Thomas Treat's yard. Monitors Magee and Hirschfelder also noticed a mule that must have seen the blast, about 25 miles from the site. "Its jaws were wide open, its tongue was hanging out, and it seemed temporarily paralyzed. Later it ran away."[33] Animals were petrified (and unlike children, they did not have parents to run to). They did not have the knowledge of a war going on. They just knew that the blast was not something normal and that it was dangerous.

Several wild animals witnessed the blast, too, and not all of them survived. Although the desert was considered empty and void of life, it was inhabited by several small species. Szasz said that "Every living thing within the radius of a mile was annihilated – plants, snakes, ground squirrels, lizards, even the ants. The stench of death lingered about the area for three weeks."[34] The explosion had fused the desert sand into glass. This substance, nicknamed "Trinitite," was green and very radioactive; Trinitite also made the area uninhabitable. Plants could not take root again for a few years.[35] Some animals were permanently scared away, even if there had been desert sand to come back to. William Laurence and others saw a herd of antelope running away during the blast. "A herd of antelope that had been grazing several miles away had vanished completely. It is believed that they started on a mad dash that ended in the wilds of Mexico."[36] If the antelope were close enough for Laurence and others to see them, then they were within the ten miles where Laurence was. Again, they reacted the same way domestic animals did: by following their instincts and running away. Animals provide a good comparison to other witnesses, because they knew absolutely nothing about the explosion or its context.

The significance of the explosion that civilians saw on July 16 did not hit home until after Hiroshima, about three weeks later. Once "the nuclear cat was safely out of the bag," as Szasz put it, people realized they had witnessed the birth of the atomic era.[37] New Mexico residents found out about both Los Alamos and Trinity. The revelation of the bomb answered a lot of questions. Indeed, some people think it was good that the U.S. actually used the bomb because, otherwise, all of those secrets would not have been disclosed. Afterwards, everything was out in the public. People could finally connect the dots between any suspicious behavior they had seen. New Mexico residents were proud of having the winning weapon created there, but they also felt cheated because much had been going on

in their state without their knowledge. Nonetheless, the residents who had witnessed the explosion felt very proud that they had seen the first atomic bomb, once they knew about it. Most of all, though, Hiroshima answered witnesses' questions about just what they had witnessed.

Military personnel

Military personnel played a variety of roles in the Trinity test. The Manhattan Project was, after all, under military control. Laurence estimates that "about 250 military personnel were engaged in carrying out the security and protective measures" around Trinity.[38] According to Larry Calloway, "250 lab workers and 125 soldiers" were at the test.[39] Yet the only two military personnel who are ever discussed in the literature are General Leslie R. Groves, the director of the Manhattan Project, and his assistant, Brigadier General Thomas F. Farrell. Their accounts accompanied Groves' official report to the President. Since their accounts are the only "official" ones, they are repeated most often and they command the most authority. While Groves' and Farrell's accounts are quite thorough, the scientists get most of the attention, and no one has done a book or study about military reactions. The sources for their reactions are scattered and incomplete. Military personnel played important but often overlooked roles in Trinity. Their accounts provide a crucial middle ground of knowledge between civilians and scientists.

The roles that members of the military had at Trinity determine how much they knew about the test. Some of the military personnel at Trinity were members of the Special Engineering Detachment (SEDs). They were in the Corps of Engineers, but had more scientific training that regular Corps members; some SEDs even had doctorates in science. They helped the scientists set up equipment and complete other similar tasks. The MED also required military personnel for security. Military police (MPs) had been patrolling the site since January 1945. There were a variety of other military personnel, including 150 troops standing by the morning after the test in case evacuation was necessary. Military personnel did not know much at all about Trinity because they did not need to; even the SEDs were often given simple tasks that did not require much information about what they were working on. Unfortunately, the literature does not often say how much a military person knew about the test. If this were mentioned, the patterns among military personnel and how much they knew about Trinity would be clearer. But despite the lack of clarity, some patterns do emerge among the military witnesses and their responses to the test.

Though the military personnel were involved in preparations at the Trinity site, they did not know as much about it. They knew that the "gadget" was a new, powerful weapon,

and that was enough. "William Hartshorn was piloting one of the two B-29s that had been sent aloft from Kirtland Air Base to track the [radioactive] cloud. 'We didn't know exactly what to expect,' he recalled, 'but we didn't have to be told that huge mushroom cloud boiling up was what we had been waiting for.'"[40] It is obvious that he said this at least a month after the day of the test, because the term "mushroom cloud" did not catch on until then. Hartshorn did not know much about the weapon, but when the blast went off, it was pretty obvious that that was it. The sound was more shocking for some military personnel. Most scientists were prepared; forty seconds after detonation, the scientists "put their fingers in their ears." However, the military personnel were not: "Captain Larkin of the United States Navy was surprised by a sudden sound, like a 'crack of thunder.'"[41] Larkin, for one, was not ready and therefore was suddenly shocked by the sound. Trinity was surprising for the uninitiated, as shown by the civilians. The military personnel tried to prepare for this new weapon, but it still held some surprises.

The military personnel were in the middle in terms of knowledge about the test: they knew more than civilians but not as much as the scientists. There are important differences among them as well; the SEDs knew more about the gadget than the MPs. The military personnel did not know as much as the scientists, but were more prepared for the explosion than the civilians. Many of the military personnel witnessed the test alongside the scientists in the official viewing areas. Physicist Victor Weisskopf recalled that "We were ordered to lie on our stomachs turned away from the center. Only the military personnel observed these rules. We scientists were not going to be cheated of our chance to witness the test in all its glory and frightfulness."[42] The military personnel were not only somewhat frightened of the bomb, they also understood the terror of war and weapons more than the scientists, who were looking at the test as more of one big science experiment. Weisskopf's quote illustrates one thing that no other witnesses had: the experience of being in war. At least some military personnel had experienced war. No wonder they took cover when told to. They knew what conventional explosives were like. They had knowledge about war that no one else did.

The military personnel who had not been in combat before were terrified. For example, Felix de Paula, an Army private who was 18 at the time, said that before Trinity,

he had "never seen anything more than a firecracker." De Paula had been sound asleep that morning; someone woke him up just before the test. "All of a sudden it went off, and the whole area completely lit up like it was daylight," de Paula recalls. "Then we felt the shock wave and the heat wave [from] something that [was] 10 to 15 miles away."[43] Not only was de Paula not prepared for such a big explosion, he had also woken up right before, so he had less time to mentally prepare. Military personnel had the knowledge to figure out that something that necessitated hiding in a ditch over 10 miles away would be bigger than any conventional bomb. And since de Paula had not seen a conventional bomb, the shock of seeing the atomic bomb was even greater.

The bomb scared the military personnel more because they knew that this could be what they faced in the future. For new recruits like de Paula, this was just the beginning of their military career. If Japan had the atomic bomb, or if atomic bombs became the conventional weapons of future wars, some of them potentially would be fighting in those wars. Indeed, modern warfare has gotten a lot worse since nuclear weapons, even if no nuclear bombs have been used since WWII.

The reactions after the Trinity bomb test showed excitement. At the official viewing posts, Calloway writes, there were many exclamations and congratulations, such as "Now we've got the world by the tail" and "We've done it!"[44] The end of the war was now assured. James Abarr adds: "A soldier who was part of the Army security team seemed to remember why the monster weapon had been developed when he announced to a companion: 'Buddy, you've just seen the end of the war.'"[45] Abarr is editorializing some, but he is right: in all the excitement, it would be easy to forget what was to come. The military personnel knew the end of the war was assured because they knew how much bigger the atomic bomb was compared to other bombs. But they also knew there was more work to be done – some would have to be doing that work soon. The bomb meant that there would be no bloody invasion. Dropping the bomb would only endanger one flight crew. The atomic bomb was a swift, simple attack for the U.S. military.

Some of the military personnel were skeptical about the scientists and the bomb. This skepticism worked two ways: the military were either not sure the bomb would work at all or thought it would work *too* well. Most often, it was the latter. As mentioned earlier,

civilian Frank Martin had received a warning from an army lieutenant: "He said it was going to be something really big, and he hoped to hell it didn't kill us all," Martin recalled.[46] Obviously, military personnel were feeling insecure about the possibility of the bomb getting out of control. Scientists had discussed the possibility, for example, that the bomb could ignite the atmosphere. Enrico Fermi, a top physicist, had joked that he was taking bets on whether the Trinity bomb would merely destroy New Mexico or the world. While the scientists could easily joke about this possible annihilation, the jokes did not help military personnel.

> In Albuquerque, Capt. Tom Jones's hotel room lighted up as if a photo-flood lamp had been turned on. "Wonder if anyone is still alive at Trinity, Tom?" Phil Belcher said to his roommate. Then, realizing the significance of his remark, Belcher tried to contact Trinity base camp. After a suspenseful minute, a voice on the phone answered calmly, "All is well."[47]

Jones and Belcher must have heard the gallows jokes at Trinity and panicked at the thought that they could be right. According to Sid Moody, however, "GIs of the Special Engineering Detachment made a gallows joke that the bomb . . . would knock Earth off its axis."[48] The SEDs could joke more easily than other military personnel because they knew more about science and figured that the bomb would not really do that. Then again, no one, not even the scientists, knew for sure that the bomb would not result in some cataclysm that they could not foresee. Even General Groves was afraid that, if something went wrong, there would be no one left to carry on the Project. For that reason, Groves did not ask K.D. Nichols, his deputy district engineer, to attend the test.[49] Despite everyone's worst fears, nothing went wrong with the Trinity test. The scientists were willing to take the risk of atmospheric ignition because they were so involved in the work, but the military personnel not only knew less about this small risk (and thus overestimated it), they also were not as involved in the project and so were not as willing to take the risk. The military personnel were genuinely worried about the possibility of the bomb being bigger than predicted.

Military personnel at Trinity also focused on the fact that this was the winning weapon. A quicker end to the war was exciting most of all for military personnel. It meant that they and their friends and family would not have to go overseas. The idea that the bomb would end the war sooner was generally accepted then and is still the generally accepted truth now. The Army had plans to invade Japan on November 1; if the war had

not ended before then or if the atomic bomb had failed, the invasion was ready to go ahead as planned. The Army calculated and figured out that the death toll would be higher in an invasion, on both sides (American and Japanese), than dropping the bomb. Some historians have recently reopened that question, however. Some claim that Japan was ready to surrender before Hiroshima, and definitely before Nagasaki; some say that the calculations for invasion deaths were wrong. But the consensus in July 1945 (among people who knew about the atomic bomb at all) was that the atomic bomb was the best and fastest way to end the war. They also shared a sense of pride, therefore, in having succeeded.

The military personnel's reactions differed based on how much they knew about the bomb and how involved they had been in its preparation. The MPs who were at Trinity for security purposes were not as prepared as the SEDs. If they did not need to know what was going on, they were not told. But the focus for all of the military personnel was the fact that the bomb, if it worked, would end the war. This was the uniting idea behind all of the military witnesses: what they had just seen was the end of the war. No matter how well they understood the bomb, they knew it was new, big, and a sure winner. They shared a sense of pride in having witnessed the first atomic bomb, the weapon that they figured won the war and demonstrated American power.

The Generals

General Leslie R. Groves, the director of the Manhattan Project, and his assistant, Brigadier General Thomas F. Farrell, were two important Trinity witnesses. Groves and Farrell's roles should not be excluded or underplayed. Their accounts are two of the few near-instant accounts of the test. Groves wrote an official report on the Trinity test that was passed on to Secretary of State Henry Stimson and President Truman, who were in Potsdam, Germany, after the test, negotiating for Japan's surrender. Groves asked Farrell to write up an account as well; Farrell's description is probably the one most often quoted. "General Groves and General Farrell sat up nights writing these reports, got a fast little courier plane, and rushed them to Potsdam. These reports, as General Farrell said later, probably 'hit the Potsdam conferees with an impact almost equal to that of the bomb itself upon those of us who had the opportunity of seeing it in New Mexico.'"[50] Both accounts provide valuable comparison to other witness accounts; they both knew about the bomb and had some idea of what it would be like, but they did not have the theoretical background of scientists.

Farrell's responses to Trinity come through in his report, but he also had an immediate response that many people recorded. He smoothly never revealed his immediate response in his report. Farrell's report was written very lyrically. Szasz thought that "Farrell possessed a genuine literary flair" in the report.[51] He did not concentrate so much on the image of the bomb, as most others did, but on how people acted. As Lifton and Markusen point out, "In his *official* report . . . Farrell sounded less like a tough, high-ranking military engineer than an awed religious supplicant who felt himself overwhelmed by a vast supernatural force."[52] He echoed many of the feelings that scientists had had throughout their work, which did approach the level of being a religion. He said "We were reaching into the unknown and we did not know what might come of it. It can be safely said that most of those present – Christian, Jew and Atheist – were praying and praying harder than they had ever prayed before."[53] His mention of "reaching into the unknown" is reminiscent of the religious undercurrent that Oppenheimer and some other scientists found in the bomb. He was even less sure, however, of what would come of it – what a new world would bring. Also, he knew less than the scientists, so he simply did not know what to expect. Farrell discusses

other people's reactions but does not discuss his own. As is typical in many witnesses' writings, he uses "we" instead of just himself – which is natural, because it includes the readers and makes them see things from another perspective, but it also disguises his own response. As Lifton and Markusen see it, he "had a more immediate, nakedly fearful response, which echoes to this day: 'The longhairs have let it get away from them!'"[54] This immediate response shows Farrell's underlying fear, like other military personnel, that the bomb might get out of control. It also shows just how big the bomb was – Farrell knew, to some extent, what to expect, and he thought it was getting out of control. He does show some of the awe that he felt in the report, however. He ended the report by saying that the blast "warned of doomsday and made us feel that we puny things were blasphemous to dare tamper with the forces heretofore reserved to The Almighty. Words are inadequate tools for the job of acquainting those not present with the physical, mental and psychological effects. It had to be witnessed to be realized."[55] Farrell was still processing his experience when he wrote this. Although he found words to describe it better than some people, he did not think they even came close to describing it. Witnessing the bomb obviously had quite a powerful effect on Farrell.

Farrell had been through his share of experiences, so he had plenty to compare the atomic bomb to. "The last few seconds [of the countdown] were described by General Farrell as much worse than any he had experienced during zero hour in the front-line trenches in World War I."[56] Farrell knew what conventional war and weapons were like, so he knew how much bigger the atomic bomb was, both literally and psychologically. Farrell almost sounds like he was reconsidering his work: "There was a feeling in that shelter that those concerned with its nativity should dedicate their lives to the mission that it would always be used for good and never for evil."[57] He did not want the bomb to get into the wrong hands, like so many movies have since depicted. He obviously was thinking that the bomb could be used for good, like in their situation. He then said "As to the present war, there was a feeling that no matter what else might happen, we now had the means to insure its speedy conclusion and save thousands of American lives."[58] The war, especially in Japan, had been brutal for the soldiers fighting it. The atomic bomb was like a holy savior to many military personnel. Farrell was shocked by the bomb, but believed it was much safer

and better than being in combat on land (at least on his end).

Farrell let thoughts of what was to come escape him momentarily at the Trinity test. He had a brief conversation with Groves, which Laurence overheard and recorded:

> Ten minutes after the explosion the following dialogue took place between General Farrell and General Groves:
> General Farrell: "The war is over!"
> General Groves: "Yes, it is over as soon as we drop one or two on Japan!"[59]

Farrell, like many others, was thinking of the future, with a sense of hope. Groves was already thinking of what he still had to do. Farrell was caught up in all the excitement, but his job was not over yet, either. His responses show one of the main differences between the military and scientist's responses. The war was essentially over as far as the scientists were concerned, but the military still had work to do. Farrell let his upcoming work escape him for a moment, but the rest of his job overshadowed any celebrations at Trinity.

General Groves was obviously impressed with the bomb; he exclaims "And what an explosion!" He cannot find the words to express the experience. As Farrell said, words are no match for having actually seen the bomb. Especially since he wrote his report just a few days after the test, Groves did not have time to process what he had seen. Furthermore, the fact that the bombs would have to be used precluded any reconsideration of his job, as the scientists could do. In addition, this report was addressed to Secretary of War Henry Stimson, so he had to attend to his responsibility for the work to come if he wanted to continue his military career. Groves felt the weight of the bombs to come more than anyone else. He had the responsibility to assure that they were used on Japan. He did not have the time, nor the inclination, to process his experience during the Trinity test.

Also, his task at hand was to send this report to Secretary Stimson, who was at the Potsdam Conference with President Truman (negotiating for Japan's surrender). Thus, Groves focused on communicating the experiences at Trinity to impress his audience: President Truman, Stimson, Winston Churchill, and other politicians. He knew what would impress his superiors; he feels the weight of carrying the message to them. If the President and others were either too scared to use the bomb or not impressed enough, the project would have failed, and it all would have been blamed on Groves. Luckily, he knew how to speak the language of politicians and military directors. Groves said "I no longer consider the

Pentagon a safe shelter from such a bomb."[60] He knew this would impress upon his specific audience the fact that the atomic bomb was new, different, and powerful. The report is full of details; Groves mentions that one of the locals who noticed the explosion "was a blind woman who saw the light."[61] He is obviously wanting to impress upon his audience how much power the bomb holds. Groves sticks to his business, though, saying "We are all fully conscious that our real goal is still before us. The battle test is what counts in the war with Japan."[62] He tries to include everyone in this statement, by saying "we," but the scientists were celebrating as if the war had ended already. Groves was about the only one who was saying, at that point, that the hardest part was yet to come. His main job was just beginning.

This fact becomes apparent in a report that followed the first. Groves addressed this report to Chief of Staff George C. Marshall, dated July 30. It looks at "the probable effects of the combat bomb which will be exploded about 1800 feet in the air."[63] The July 30th report attempts to take an objective look at what the bomb will do in combat. Groves estimates, among other things, that "practically all structures in an area of one or two square miles should be completely demolished." The scientists had set out many instruments to measure the blast effects of the Trinity bomb. Groves also discusses the injury to "personnel": "Between 2500 and 3500 feet, blast effects should be extremely serious to personnel."[64] The point of this report was to assess the military power of the bomb, but it is somewhat sickening to read in the aftermath of the Japan bombings. Groves stuck to his objective to use the bomb and saw it through to the end. He had to do this analysis of the bomb's damage in order to convince Marshall that the bomb was worth using. He had to use his knowledge of military strategy and analysis to get Marshall to use the bomb. This was a task that no one else could do because no one else had the knowledge for it.

Whatever effect Trinity had on Groves, he did not show it much, then or later. He was relieved that the bomb worked because he knew what would happen if it had not – with the invasion of Japan already planned. He also knew it would ruin his career, possibly lead to Congressional investigations (about all the money the military spent on a failed project), and otherwise ruin his life. In his report, he said that he "personally thought of Blondin crossing Niagara Falls on his tight rope, only to me this tight rope had lasted for

almost three years and [he thought of his] repeated confident-appearing assurances that such a thing was possible and that we would do it."[65] He had been stressed out about the Trinity test and its success (or failure). Although he had appeared confident, to provide support and optimism to Oppenheimer and others, he admits here that it was a facade. He would have suffered the consequences if the Project had failed, and he felt that fact creeping upon him at Trinity.

Groves never publicly showed any doubt about his decision to use the bomb. He did not have a change of heart like many of the scientists did. Unlike the scientists, who got swept up in the war, Groves had chosen his career in the military before WWII and stuck with it. When his tenure as Manhattan Project director ended, he remained in the military for a few more years. In 1962, he published his autobiographical history of the Manhattan Project, Now It Can Be Told. He explained in the preface: "I am recording here a number of facts that I feel should be known, together with some of my opinions and my reasons for holding them. I do this in order that there can be no doubt about the ways in which I tried to carry out my responsibilities for the conduct of the project."[66] He knows that people will be reading this in the future, wondering about the Manhattan Project, and looking for his personal beliefs about the use of the bomb. Groves had a lot of responsibility, both for carrying the project, as he mentions, but also for using the bomb. After all, with a cost of $20 billion (in 1990 dollars), the Manhattan Project would have been considered a failure, if the bomb had not been used in the war, even if the bomb still worked at Trinity. No matter what anyone now may say about the decision to use the bomb, there was no other option, especially from Groves' perspective. He had to use the bomb; he knew what would have happened if he did not.

For Generals Groves and Farrell, there was no doubt that the bomb would be used against Japan. This knowledge overshadowed any thoughts about the effects the bombs would have on Japan. Groves, especially, felt an enormous sense of pride in having directed the winning weapon program. They were right up there with the scientists, beaming like proud parents, but, unlike for the scientists, Trinity would not have meant anything to them if they had not used the bombs against Japan. The scientists had time to reflect, but the generals did not. There was no time for doubting their positions on the nature

of war, and even afterwards, Groves makes it clear that he never regretted his actions. Groves and Farrell did not think about the suffering that the atomic bomb would cause, because they were in the military and knew that this was a fact of war.

The Lab Scientists

Most of the people whose reactions to the Trinity bomb you hear about are the top scientists – the Nobel Prize winners, the Lab directors, and university chairs – such as J. Robert Oppenheimer, Enrico Fermi, Sir James Chadwick, Edward Teller, and Ernest Lawrence. Students of science have heard these names before. The top scientists played key roles in Trinity, and will be discussed in the next section. But the main workforce of Los Alamos, including Trinity, was comprised of other scientists: the young ones who were fresh out of college or pulled from college to Los Alamos, where they studied and worked with the luminary scientists. Many of these scientists would go largely unnoticed during and after the Project, but they played important roles. For example, very few people have heard of Kenneth Bainbridge, the director of the Trinity test. And other scientists, like Joan Hinton, a graduate student in physics, or Norma Gross, a chemist, did not even get that much recognition. They and others were unofficial witnesses of the Trinity test. They snuck up into the hills overlooking the Jornada del Muerto valley below. These lab scientists knew as much as the other scientists did, but were not supposed to see the test.[67] They knew what they were working on, they knew specifics of Trinity, and they were as anxious to see the bomb's success as the top scientists were.

Although, like the military personnel, lab scientists were not told much about the specifics of the test, they were closer to the action, so they knew a lot about the specifics of the bomb. They knew it was an atomic bomb and understood the physics of it, because they had helped solve the problems and had worked on the details of the bomb. The lab scientists worked for the top scientists, so they were under the same pressure to prepare for the test. Even if they had not heard about the test, they could find out from friends about the specifics. Joan Hinton said that before the test, security got tighter, but she still knew what was going on.

> The graduate students doing basic experiments with the water boiler were not formally involved in the first nuclear test, but they shared laboratory space with the group that had produced the plutonium for the test, so Hinton and her friends knew very well what was happening – including the time and place of the detonation.[68]

The lab scientists were a close community. Information spread quickly. Everyone knew that there would be a test, but not many knew where or when. The test, unfortunately for the

unofficial witnesses, was postponed from 4:00 to 5:30 that morning.[69] But most of them had intended to stay all night after making the trek to a place to view it from. Norma Gross and her husband did. They "drove to a wooded site with a view of ground zero and camped out through the long night. She claims that all the maintenance workers at the lab knew where and when the test would occur, so there was no problem getting there."[70] The lab scientists knew about the test even if they were not directly involved in it. So much for secrets; many more people saw the explosion than Groves had intended.

Non-scientist residents of Los Alamos knew about the test, too. By the end of the war, about 6,000 people were living at Los Alamos.[71] Most Los Alamos residents knew something was going on, even if they did not know just what it was that scientists were going to test. Laura Fermi, top physicist Enrico Fermi's wife, recalled:

> By July 15 nobody who was anybody was left in Los Alamos, wives excepted, of course. On the afternoon of the fifteenth a woman physicist had told me that she, her husband, and some other young people would drive south to the Sandia Mountains near Albuquerque. They would climb on a peak and camp overnight. If they managed to stay awake, they might be able to see something of the test that would be carried on some hundred miles farther away.[72]

These witnesses were far away, but they still witnessed the test. Unlike civilians further away, the scientists were more impressed with their experience because they knew what they had seen. Many others watched from distances around the state, even at Los Alamos. The orders to stay away were not obeyed. As one military official said, "You might as well try to hide the Mississippi River."[73] Rumors and facts spread like fire in Los Alamos. There were many more witnesses of the Trinity bomb than there were supposed to be. The lab scientists were determined to see the test because they had worked on the bomb and they knew where and when the test would be.

Everyone had been told before that anyone not invited would be deemed trespassers. Victor Weisskopf, an invited physicist, recalls:

> To insure that only those with clearance would be there, it was announced that army patrols would comb the hills around the site. In spite of this, a number of people determined to witness the shot hid in the hills, waiting for the moment of detonation . . . . Many of those who stayed reported hearing suspicious movements during the night, which they thought were the army search patrols. But there were no patrols; the army had never gotten around to deploying them. What the people heard were other would-be spectators trying to avoid detection.[74]

In all the excitement, security slackened a bit. Lab scientists were so determined to see the test that they took the risk at being caught by the patrols (although some people watched from further away). Unfortunately, not many of those viewers admitted to having seen the test later, so there are not many accounts from these lesser-known scientists. Joan Hinton decided to go to a hill 25 miles away. Her account is one of few from the lab scientists. "Dodging Army patrols, Hinton and a friend rode to the mound at sundown on the friend's motorcycle. They hid the cycle, then waited all night; the detonation, which had been planned for midnight, was delayed by thunderstorms."[75] In the morning, Hinton and her friend saw 10 to 15 other people around them. As Herzenberg and Howes say, "Great minds, apparently, think alike."[76] It was more than that, though: the great minds that helped create the bomb wanted to see it come to fruition.

All the scientists began to reflect upon their work during or after Trinity. Because they knew a lot about the bomb and had helped build it, they felt responsible. Although the lab scientists were not as involved in the bomb's creation as the top scientists, they still felt some responsibility. That feeling began to sink in after Trinity. Joan Hinton felt it, as she and others began discussing the sight before them, after the first few moments unfolded in a silent awe: "We suddenly started talking out loud and felt exposed to the whole world."[77] Hinton and others like her had the technical knowledge to understand the bomb as they saw it explode, more so than civilians and military personnel. With that knowledge, some scientists have felt, comes certain responsibilities. The scientists could not ignore how their invention would be used; they had the responsibility for it. Thus, after the bomb was used, some scientists felt responsible and felt badly about how their invention was used, so they stopped working on nuclear weapons. They changed the path they had set upon at the beginning of WWII, often looking back to Trinity as the beginning of their change. However, with the lab scientists, stories of change did not come out much. The top scientists have received most of the attention, but some lab scientists also changed. Herzenberg and Howes highlight Joan Hinton as an example: "Joan Hinton worked with colleagues at Los Alamos to send samples of the glass-like substance formed from melted sand and equipment in the crater left by the Trinity test to the mayors of the country's largest cities. The samples were accompanied by a message that read in part, 'Do you want this to

happen to your city?'"[78] Hinton had the knowledge and ability to have an effect on other people, with her access to and participation in Trinity. She knew what would affect people and used her access at Los Alamos to get the Trinitite. Hinton stayed at Los Alamos, but worked from the within the lab to affect people in the outside world. She used her knowledge of nuclear weapons to inform others without that knowledge. Hinton, like other scientists, changed her opinion on the use of nuclear weapons, even if she did not leave Los Alamos. Trinity obviously affected her attitude; she knew that using its remains would affect others.

The Los Alamos scientists who were not directly involved in Trinity were not invited to view the explosion, but many of them were determined to see it. After all, although they may not have been the top scientists, they helped create the bomb. They felt a lot of pride in that, and some of them felt partially responsible after the Japan bombings. They had some of the same feelings that all scientists did. They were determined to see the bomb they had helped create, though they did not get as much glory as the top scientists. The lab scientists who witnessed the Trinity test knew almost as much about the bomb as the top scientists and reacted similarly.

The Top Scientists

The top scientists provide the most evidence of how the act of witnessing such an extraordinary occurrence as the Trinity bomb can affect a person. In this category, I have included any of the scientists who viewed the test from the official observation posts. The top scientists felt many of the same feelings of pride and satisfaction as everyone else involved with the Project. But their pride was multiplied many times, because many of them helped the MED begin in the first place, or at least worked on the main parts of the project, including leading different divisions or labs at Los Alamos. The scientists' reactions to Trinity were similar at first, but began to differ as they reflected upon the bomb and the bombings of Japan. While I could go through all of the top scientists because they each responded to Trinity somewhat differently, a few of their accounts highlight the main varieties of responses to Trinity.[79] Because they knew so much about the bomb, they felt the most pride and the most responsibility.

The first thought in every scientist's mind was that the bomb had worked. It was obvious, but that is what they first remarked. After waiting for what seemed like an eternity, something clicked in their minds and they began to realize that the bomb was there. Although they were prepared for the sight more than other witnesses, the scientists still went through some shock, to actually have finally seen the bomb that they had been working on for so long, that they reacted to its presence after a brief delay. The simplicity of this realization struck Frank Oppenheimer, Robert's brother and fellow scientist. They were side by side during the blast. Frank later tried to recall that moment: "And I wish I would remember what my brother said, but I can't – but I think we just said, 'It worked.' I think that's what we said, both of us. 'It worked.'"[80] That was the only thing they could say. Many scientists describe that morning like it was as if they were in a daze. Their experiment had succeeded. "Meteorologist Jack Hubbard quickly felt himself to make sure he was still alive."[81] The first thirty seconds or so unfolded in silence – both because the sound wave took a while to hit them and because no one dared speak. After the initial daze came the feelings of elation, which Szasz describes:

> Both William Laurence and General Farrell were amazed at how the explosion momentarily turned the distinguished scientists into little children. . . . At South 10,000 a group formed a spontaneous chorus line and danced around in a snake dance.

> One after another the scientists got on the PA system and began howling jubilantly. . . . the group on Compañia Hill had actually applauded.[82]

The scientists were just overjoyed, beyond all imagination. They knew that the war would soon end, and they were happy that their bomb worked and was even bigger than they expected. As many have said, the morning's events were beyond words, and that includes scientists' reactions. The scientists lived it up. They had succeeded. A member of the military, Robert Van Gemert, reflected to Calloway some of the scientists' reactions: "I'm just amazed how those scientists whipped out so many bottles of gin or whatever they could find. And it was rapidly consumed, I can tell you that."[83] Everyone involved shared in a common sense of pride, having worked for a common goal, but the scientists' elation was beyond the others. The scientists had realized their goal and it made them absolutely ecstatic. They knew that they had succeeded in building the bomb and would end the war.

But the scientists were yet in awe of the bomb, even as they celebrated. It was mesmerizing, dazzling, and striking. No one would forget it, nor feel able to give the sight full credit in words or pictures. The sound was as striking as the sight, as well as the blast wave that knocked down some people. Kenneth Bainbridge summed it all up in one sentence: "No one who saw it could forget it, a foul and awesome display."[84] As many others would describe it, the sight was beautiful and yet terrible. It was beautifully colorful, behaved as scientifically predicted, soft and cloud-like, and the realization of their goal/dream. But it was terrible because of what it was, or what it would do, and because of all it was destroying, even in the desert void, a plume of dust coming up, later coming down on top of them. After all that elation, the scientists' responses began to differ and that is what is really interesting. Although they all saw just about the same thing, they each had unique, yet similar, reactions to the test (i.e., they thought of different analogies but with similar roots).

The celebrating lasted for a while, but afterwards, many scientists began to reflect upon what they had witnessed. The bomb had vastly exceeded their expectations. Victor Weisskopf summarized his feelings well: "Our first feeling was one of elation, then we realized we were tired, and then we were worried."[85] Part of this may have occurred to Weisskopf with the benefit of hindsight. The actual morning's events were more chaotic. All of the scientists would agree with the first two feelings, but the third one is where some split

off. Even those that worried were not all worried for the same reasons. That is, not everyone regretted their work, not everyone thought international control of atomic weapons was best, not everyone was against the bombings of Japan. Some people thought that the first bomb was necessary, but not the second, for example. Others thought that the bomb was the only way to end the war, so they supported the decision to use it, but thought that the bomb was too terrible to ever use again. Some reconsidered their work, but, once it was obvious that a Cold War would begin, stuck to the nuclear program. A few scientists completely changed their science-orientation, switching to cosmology or biology (coupled with x-ray technology, for example). Most stayed dedicated to physics or chemistry. Many simply wanted to return to teaching once the war was over; whether they were against nuclear weapons, in favor of international control, or regretted their work or the decision to drop the bombs, they did not necessarily say. They simply returned to teaching. With few exceptions, all of the scientist reflected upon the atomic bomb.

Knowing how they had helped cause the destruction in Japan, several scientists vowed to never work on nuclear weapons again. Trinity, if not the complete turning point, was a point of reflection or an image that would not leave them. After all, this was the only image of the bomb they had; because they had witnessed it with their own two eyes (and ears, and felt it with their bodies), it was much more powerful, especially when considering it in connection with the Japanese victims. Three scientists in particular, Victor Weisskopf, Robert Wilson, and George Kistiakowsky, highlight the group of scientists who changed their attitude toward the bomb, after or upon reflection of Trinity.

Victor Weisskopf returned to teaching and being an advocate for arms control. He taught at MIT and became outspoken about his decision to redirect his efforts. In 1991, he wrote The Joy of Insight: Passions of a Physicist. At Trinity, Weisskopf had been a major consultant on theoretical problems. He summarizes: "Since I had been in charge of calculating the various effects of the bomb, I was one of the very few theorists sent out to the Trinity site."[86] Weisskopf watched the test from Base Camp, because he "wanted to experience the full impact of the blast."[87] He insisted on putting his whole being into witnessing it, even using the term, as mentioned before: "We scientists were not going to be cheated of our chance to witness the test in all its glory and frightfulness."[88] He felt the

same dichotomy that Bainbridge did, between the foul and awesomeness of the bomb. As the fireball rises, he describes a blue halo that reminds him, "in spite of an inner resistance to such an analogy, of a painting by the medieval master Matthias Grünewald. Part of the altar piece at Colmar, the painting depicts Jesus in the middle of a bright yellow ascending sphere surrounded by a blue halo. The explosion of an atomic bomb and the resurrection of Christ – what a paradoxical and disturbing association!"[89] Weisskopf sees the duality between the beauty and horror in the bomb, and his own thoughts scare him. He continues:

> We had made it. There is no use denying the joy, pride, and satisfaction we all felt after that impressive testimony to our success. We had set free for the first time the immense cosmic forces hidden within the atomic nucleus. It was ironic that our aim in all this was the development of the most destructive engine of death ever conceived.[90]

Weisskopf's reactions caught him off guard. As he said above, the concerns kicked in later, after the elation and exhaustion. Even in hindsight, Weisskopf uses the same language he and others were using from the start of the project, like that they had "set free" the atom. From the scientists' creation comes death – the irony and dual nature of this paradox between creation and destruction does not escape Weisskopf. He hints at his concerns in his book and he would speak about them for the rest of his life. Weisskopf spoke at the fortieth anniversary of Los Alamos, which took place right when Szasz was writing his book. Szasz ends the book with Weisskopf's observation that the creation of Los Alamos scientists "'has become the unintended cause of the world's predicament.' 'Forty years ago we meant so well,' Weisskopf continued, 'but it did not turn out so well.'"[91] Weisskopf does not regret his decision to work on the bomb. The scientists meant well, by ending WWII, but the events after that, with the Cold War and increasing number of nuclear weapons, was not what they (or he) intended. Many of the scientists had hoped that the atomic bomb would bring in a new world; with the United Nations forming, it seemed possible. They figured that the bomb would bring an end to war, because the risk of nuclear annihilation would be too great, which is sort of what happened during the Cold War. Weisskopf did not regret his decision to participate in the Project, but had hoped it would make the world better. With his view of the bomb as playing a dual role between creation and destruction, as he realized at Trinity, he was hoping that a better world would rise out of the atomic

bomb's ashes.

George Kistiakowsky taught at Harvard after the war and became very outspoken against nuclear weapons, especially after he became President Dwight Eisenhower's science advisor in 1959. He tackled nuclear problems by working from within the government. This is always a difficult decision for socially conscious scientists: whether to work from the outside in, or from the inside out, to effect decisions. Also, some scientists stay out of politics completely, as many did in the decision of whether or not to drop the bomb on Japan. Some scientists had said that it was not their job to decide those matters. But one thing that many scientists realized after the use of the bomb, if they had a change of heart, was that they should have a say in such matters, since it is their work being used. Kistiakowsky was not involved in any of the scientist committees that discussed whether or not to bomb Japan. But he made up his mind to contribute politically later, and was very daring about it. In the midst of the Cold War, Kistiakowsky, who was born and raised in Russia and fought in the Russian Revolution, "steadfastly endorsed a program to limit armaments" as Eisenhower's adviser.[92] The Cold War undoubtedly silenced some pro-arms control scientists. The scientists all had different levels of outspokenness – some said enough by leaving Los Alamos and writing an article why, for example, while others took similar routes to Kistiakowsky, speaking out from their positions within the government, or, like Joan Hinton, from within Los Alamos. Kistiakowsky was not silenced by the anti-Communist, patriotic fervor. His reaction to Trinity does not show an immediate change; like Weisskopf, the feeling came to him after a while. He was just elated at Trinity. He was an explosives expert, so he was under a lot of pressure: if the bomb failed to detonate, it could be his fault. He was a chemist, not a physicist, so he did not quite belong. But he was at least as overjoyed as others when the bomb exploded. Looking back at the Trinity test later, however, "Kistiakowsky felt this was the nearest thing to doomsday that one could imagine. 'I am sure,' he said, 'that at the end of the world – in the last millisecond of the earth's existence – the last men will see what we saw.'"[93] This is a somber note for the birth of a new age. Again, looking at what the scientists had hoped and knew about the potential future of the world – a world with this new weapon – Kistiakowsky knew about these hopes, but did not discuss them. He focused not on the beginning, but on the end that

Trinity signaled. He did not seek hope in the new world, but saw a depressing end to an innocent world. He could not sit out any more on political matters. It was an end to his nuclear work, as well as an end to the illusion of the innocence of science.

Robert Wilson also left nuclear weapons research and went instead into high-energy nuclear research. His change of heart happened during the Trinity blast. The Bulletin of Atomic Scientists, in memorial to Wilson after his death in 2000, repeated this story:

> Richard Feynman, a colleague of Wilson's at Los Alamos, later recalled that after the successful Trinity test . . . Wilson did not join in the celebration. Why not? asked Feynman. "It's a terrible thing that we made," was the reply.
>
> Wilson later wrote: "I determined at that moment that having played even a small role in bringing it about, I would go all out in helping to make it [nuclear science] become a positive factor for humanity."[94]

Mary Palevsky interviewed Wilson in 1999 and discussed his response to the Trinity test. She cites something he wrote, similar to his point above, in which he adds that he felt his "scientific and technical responsibilities literally just slide away: we had done our job. My second reaction, almost simultaneous with the first, was one of horror at what we had done, at what such a bomb could do!"[95] Similar to Weisskopf's reactions, he felt a combination of relief and horror. But his first feeling is slightly different; the job was done, so his scientific responsibilities were gone. Instead, he does not say, but it is clear, he now began to feel some responsibility to the wider world, looking at what they had created. Palevsky asked him about what he wrote and he said:

> [Trinity] certainly was an epiphany. And whenever else would you have an epiphany except at seeing the first atomic bomb? From then on I certainly took myself more seriously. Up to that point I thought of myself as a physicist and what I could do was physics. Now I was concerned with what we could do, what a group of people, and what I in particular could do, about passing the word along and trying to have an effect to get people to take it [the bomb] seriously.[96]

Wilson's reaction was much quicker and stronger than anyone else's. For Wilson, witnessing the test really was an epiphany – as he says, when else would that happen? He is the only one to describe an epiphany at Trinity. Others reacted to Trinity, but he had a sudden realization, as from a divine intervention, and looked at himself and his role with the bomb differently from then on. Part of what he realized is that his physics could not happen in a vacuum. Once the scientific responsibilities left – that is, once he realized the bomb worked – he realized that he could not do this physics objectively. The research he had done had

not happened in a vacuum; after Trinity, the military took their discovery and made it into something that Wilson realized he did not like. The bomb had to be taken seriously now – it was not just science anymore. Wilson does not include others in his plan, however, unlike Weisskopf. He is very particular about himself, as he says, what he could do. Also, since he was about the only one to begin reflecting immediately after the test, and did not join in the celebrating, he must have felt alone. It was a personal transformation – more personal than most others' reconsiderations. To begin "passing the word along," Wilson helped organize the Association of Los Alamos Scientists and what is now the Federation of American Scientists. He helped out on the Bulletin of Atomic Scientists, too, and later taught at Cornell. He did not exactly say the words "regret" in the above, but he worked so hard to counter what they had done that it would not surprise me if he had. He felt responsible, and felt that high-energy physics could give back to the world what the atomic bomb had taken away.

Not every scientist had a change of heart after Trinity or after the war. Some scientists never changed their minds about nuclear weapons at all; some advocated for more. The most outspoken member of this group is Edward Teller. At Los Alamos during the MED, he was already working on the theoretical possibility of thermonuclear or fusion bombs. He later became known as the "Father of the H-bomb." He describes his response to Trinity in his memoirs, Memoirs: A twentieth-century journey in science and politics. Although Teller continued to work on nuclear weapons after WWII, his response to Trinity is similar to those who changed their career paths afterwards. "Eventually, [the cloud] became a many-mile-long question mark. We returned to the buses with hardly a word. We knew that the next nuclear explosion would not be an experiment."[97] The Trinity test always comes back to this – the next bomb was not a test. Even with the elation of having successfully completed the big science experiment, the scientists all must have pondered the macabre future of their discovery. Teller continues on this somber note:

> As the sun rose on July 16, some of the worst horrors of modern history – the Holocaust and its extermination camps, the destruction of Hamburg, Dresden, and Tokyo by fire-bombing, and all the personal savagery of the fighting throughout the world – were already common knowledge. Even without an atomic bomb, 1945 would have provided the capstone for a period of the worst inhumanities in modern history.[98]

Although Teller was not remorseful about any of his work, he put it into the context of the horrors of his lifetime. Like many of his colleagues, Teller had narrowly escaped the Nazis. But he did not feel guilty about adding another thing to the list of inhumanities. In the context of the times, the bomb made sense to him and others. In response to Oppenheimer's later statement that "physicists have now known sin and that is a knowledge they cannot forget," Teller told Calloway in 1995: "'I believe the idea of sin, etc., has been oversold.' When the bomb went off at Trinity, he said . . . 'I did not think about any sin, although I was worried about this being used in earnest in the near future.'"[99] Many others have said that the idea of sin is ridiculous – physicists simply did what they did; what happened to their discovery afterwards was not their concern. Oppenheimer's statement was a very strong critique of physicists; sin is not something to be taken lightly, so it is no wonder that Teller reacted with equal strength. Especially against the back drop of the horrors of WWII, as Teller described above, it is understandable why Teller did not like this condemnation. Teller knew how horrible WWII is, and he did not think the bomb was so awful to be considered a sin.

But even Teller went through a short period after the war in which he reflected upon the weapon that he had helped create. As Rhodes said, "There [in 1946] ensued a curious period of optimism in Teller's life."[100] No one but he can explain it, but he became very optimistic about the future, then lost it. Teller initially left Los Alamos after the war to work at the University of Chicago. At the same time, he worked on several scientific papers, was a consultant at Los Alamos, and wrote articles in the Bulletin of Atomic Scientists. In one of these, for example, he said "Nothing that we can plan as a defense for the next generation is likely to be satisfactory, that is, nothing but world-union."[101] He called for an end to secrecy in pure science. This continued for a year, and he continued to write: "the effects of an atomic war will endanger the survival of man."[102] One of his students, Freeman Dyson, wrote about Teller that he was "a good example of the saying that no man is so dangerous as an idealist."[103] In 1947, when Russia rejected a plan for international control, the stage was being set for the Cold War. But Teller was still hopeful, for a while. Rhodes guessed that Teller's sense of security came from the fact that the U.S. had sole possession of the bomb. Teller was visiting Los Alamos in 1949 when the news came that the Soviet Union had tested their first bomb.[104] This was essentially the beginning of the Cold War nuclear

arms race and Teller left his teaching job at Chicago to return to Los Alamos. He said "The best contribution I could make would be to go back to Los Alamos to help develop weapons – something I knew about and that could yield concrete results."[105] He dedicated himself then to trying to build a hydrogen bomb. He had the most knowledge of that bomb, so he used it to work on beating the Soviets to the next bomb. He continued to work on new weapons on into President Ronald Reagan's Star Wars program in the 1980s. Teller went back to work on nuclear weapons, but not without first considering his work, like many of the scientists, and weighing the optimism he had with the work that he knew best. Teller reflected upon his experience at Trinity and knew after that how awful the bomb was, but continued to work on nuclear weapons.

Teller became the most outspoken proponent of nuclear weapons advances, even after Trinity, but he was not the only one who continued working on them. Norris Bradbury, for example, became the director of the Los Alamos Lab after Oppenheimer left in October 1945. Bradbury kept the Lab going, even as the government was not sure what to do with it.[106] He remained director until he retired in 1970. Bradbury, a Navy Lieutenant Commander, was a Ph.D. graduate of Berkeley when he came to Los Alamos. He was with the Navy, but was soon working on the scientific aspects of Trinity, helping Kistiakowsky in the explosives division. Like most scientists, his response to Trinity was just elation that it worked. But he is a unique witness because he is both a scientist and military commander. Like most military personnel, he did not pause after Trinity to process or think of the consequences of his actions and, indeed, he does not think anyone thought of that at the time. He later recalled: "For that first 15 seconds the sight was so incredible that the spectators could only gape at it in dumb amazement. I don't believe at that moment anyone said to himself, 'What have we done to civilization?' Feelings of conscience may have come later."[107] He says these feelings *may* have come later; he does not admit that some witnesses did have those feelings of conscience. In other words, as Bradbury said in 1981, "we were at war and the damned thing worked."[108] Whether or not Bradbury reflected on his work after the war ended, no one knows. When Oppenheimer asked him to replace him as director of the Lab, he took it as a contingency plan, just until they found a "real" director. But he stayed. If he had been contemplating whether or not this work was best, he

did not admit it publicly. He expanded the Lab's scope into other weapons, including nuclear rockets and missiles. Bradbury has called the hydrogen bomb the Lab's greatest achievement since Trinity.[109] Bradbury is within the unique position of having the scientists' involvement in making the bomb, but not being able to process or reconsider his career path, because he was in the military (and was being somewhat tossed into the position of directing the Lab). Although he had a science background, he was also a Navy commander. His conviction to the military kept him separate from the other scientists, who reflected upon Trinity and the bombings of Japan as they considered their futures after the Project ended. He watched the Trinity test with the eyes of both perspectives and had the scientific knowledge of the bomb, but also the military knowledge of the reality of war. He used his scientific knowledge to carry on the Lab, and his military knowledge to keep from thinking and having misgivings too much about the effect of the bombs.

The scientists' initial responses to the Trinity test show the direction in which they went after WWII ended, or vice versa. The scientists were almost all impressed yet sobered by the Trinity test. They knew that the bomb would soon be used against Japan, but at the same time, the scientists knew that soon the war would be over. Most people celebrated that fact, although some, like Wilson, could not celebrate the deaths of thousands of people. It is so difficult to analyze right and wrong in that time period, or in any condition of war, because there is no real good on either side. One thinks their activities are better than the other side's; it is all about measuring the lesser of two evils. The bombings of Japan were horrible, but as Teller pointed out, so were the concentration camps, the fire bombings, the invasions, and the war in general. Perhaps Hans Bethe had the right idea – after the war ended was when the next struggle would come. Indeed, while many historians try to answer the question of whether or not the atomic bomb was "good" or "bad," we really need to simply look at the history of the bomb and learn from it, so that the mistakes of the past are not repeated. That is precisely what many of the scientists decided to do. After witnessing Trinity, the ones who changed knew that the bomb was too atrocious for them to work on it anymore, or to be used again. Teller, though he did not change, reflected upon Trinity and the atrocity of the bomb, too, but continued with his work on the hydrogen bomb because he did not feel that, in the context of WWII and a potential war with the

Soviet Union, the bomb was not so awful. Similarly, Bradbury, as a military commander, could use his knowledge of war and his chosen military career to put the atomic bomb into context of war. The scientist witnesses knew all about the bomb – they knew how hot the bomb got, how destructive it would be, and how much they were responsible for it – but they could either contextualize and excuse it, or could not contextualize it and could not excuse at least their role in it.

The Journalist

Journalist William Laurence was the only person not directly involved in science, the military, or the government to witness the Trinity test. He was there because General Groves did not think having his and other people's impressions of the Trinity explosion would be enough. He wanted a journalist to record the event; he asked Laurence to do it because Laurence had been a persistent reporter on nuclear science. Laurence was a science reporter at The New York Times when he had noticed that nuclear scientists seemed to have disappeared off the face of the earth. He had reported in 1940 that he expected that uranium could be used to power cities, ocean liners, and set off a destructive blast more powerful than thousands of tons of TNT. He was right on top of the Project:

> After Pearl Harbor Laurence noticed that scientists in the United States working in this field began to refuse to talk to him. He became convinced that the Allies were involved in a secret atom bomb project. This was confirmed in the summer of 1942 when the United States Office of Censorship wrote to him asking him not to write articles on the potential of nuclear power.[110]

Laurence had been trying to find nuclear scientists to interview, but they all refused to talk to him, if he could even find them. But his persistent writing paid off. Groves looked for a journalist who knew about nuclear science and Laurence's articles aroused his attention. Laurence's suspicions were completely confirmed in April 1945, when Groves contacted him about doing a special report on a new weapon. Laurence agreed not to report anything until after the bomb was used, however, and the Office of Censorship would read over his stories. In exchange, Laurence witnessed the Trinity test, and was told he would be on the planes for both Hiroshima and Nagasaki. He was not able to go on the plane to Hiroshima, but he did accompany the one to Nagasaki, and he surveyed the damage at Hiroshima. He also interviewed the scientists and the crews that dropped the bombs. Laurence wrote two books on his experiences, including Dawn Over Zero, in which he describes the Trinity test. A lot of the material is taken from the press releases that he prepared right after the test, which are in the National Archives. In some ways, Laurence's agreement to be involved in the Project was similar to the scientists'. Laurence agreed to abide by the government's rules in order to cover the atomic bomb stories. He did not just want to have this amazing reporting opportunity, he also wanted to know about the project and wanted to be a witness, like the scientists.

Although William Laurence had been a science reporter, he did not understand everything that the Project scientists did. He used his science background to translate science into journalistic style language. He had a general enough understanding of nuclear science to make it accessible to general readers. He did not know much more than the basics of nuclear science. Laurence knew about many of the scientists he was reunited with at Trinity, and knew Hans Bethe in particular. He had been following developments in the field, so before these scientists got whisked away to Los Alamos, he had known about their studies at least. Despite his basic science knowledge, Laurence was not prepared for the test. He did not know what to expect – how big the explosion could be, how it would behave, what the dangers might be, or how experimental the bomb was. He understood nuclear fission at least (that provided the basis for his ideas about weapons or energy). He had not been involved in the science developments since 1942, when the scientists and their research disappeared (to Los Alamos). Laurence knew some of the early theoretical findings, but did not know what to expect from Trinity (even less so than the scientists). Schweber explains: "After the bomb went off, Bethe recalls a tremendous spectacle, and after about a minute, a tremendous roar. A terribly anguished Laurence asked Bethe: 'For heaven's sake, what was that?' Bethe explained to him the difference between the velocity of sound and the velocity of light. Laurence was relieved."[111] Richard Feynman also recalls responding to Laurence's exclamation, a little tongue-in-cheek: "'That was the bomb.'"[112] Laurence's surprise was one of the more comical moments for the scientists, because he did not know what to expect, while the sound delay was a very simple scientific fact. It is hard to know how Laurence took their sarcasm. He was not a member of their group, although he was not a complete outsider. He did even understand the basic nature of sound. The Los Alamos scientists were a tightly knit group. Even if Laurence had been more prepared for the test, he would not have fit in with the scientists. He shared their position of being another witness, but he did not know much about science to really understand what he was witnessing, as far as the scientists were concerned.

Laurence could not fit in with anyone, because he was his own entity: the journalist, and the only one. This carried a lot of pressure and responsibility. He had to record the event at Trinity. He was *the* witness, as it were; he was the only person there who had not

been involved in the Project. His role was specifically observational, and he wrote about both the explosion as well as the people watching it. He was under pressure not just to record the event, for the public, but also feeling the pressure to portray the test as a great American achievement, for all of history. He knew that this was what Groves wanted and what the public would appreciate. Similar to Groves' responsibility to the future, Laurence felt responsible for how the Trinity test would be remembered. Everyone was caught up in a patriotic fervor, especially at Trinity. Laurence knew he needed to capture that feeling and feed it back into the public to continue the fervor. Laurence begins one story saying that Trinity "symbolized a funeral pyre for the Japanese Empire" and was "Biblical Handwriting on the Wall to the Japanese and all would-be future aggressors. . . . You have been weighed and found wanting."[113] In these two Trinity stories, which were to be released the day after the second bomb was dropped on Japan, Laurence described the Trinity blast very eloquently.

> And just at that instant there rose from the bowels of the earth a light not of this world. . . . It was a sunrise such as the world has never seen, a great green super-sun. . . . Up it went, a great ball of fire about a mile in diameter, changing colors as it kept shooting upwards, from deep purple to orange, expanding, growing bigger, rising as it was expanding, an elemental force freed from its bonds after having been chained for two billion years.[114]

To borrow Bainbridge's terms, Laurence focused on the awesome qualities of the bomb, not the foul ones. He knew his audience was not just the American public then, but the future American public. Each story he wrote would appear in increments after the bombs were dropped, at first one or more every day. Laurence mixed together facts, sights, sounds, movements, peoples' behaviors and reactions, and metaphors. The sound was also quite amazing, as he tries to describe:

> With the flash came a delayed roll of mighty thunder, heard, just as the flash was seen, for hundreds of miles. The roar echoed and reverberated from the distant hills and the Sierra Oscuro Range of mountains, sounding as though it came from some supra-mundane source as well as from the bowels of the earth. . . . It was like the grand finale of a mighty symphony of the elements, fascinating and terrifying, uplifting and crushing, ominous, devastating, full of great promise and great forebodings.[115]

Despite his shock when he heard the sound, Laurence describes it quite beautifully. While other witnesses have thrown in a few metaphors (like Farrell), he has a specific duty to make the Trinity experience accessible to the public. Therefore, he uses metaphors to let

peoples' imaginations flow. He continues with more metaphors. He ranks the Trinity test "next to that moment of the long ago when man first put fire to work for him," comparing the first flame to this "elemental flame, the first fire ever made on earth that did not have its origin in the sun."[116] Laurence takes this scientific fact, intermingles it with metaphor, and makes a fact and an experience accessible. Laurence even likens the bomb to the moment of creation: "One felt as though he had been privileged to witness the Birth of the World – to be present at the Moment when the Lord said: Let there be Light!"[117] Laurence's descriptions, much as they differ from his immediate response, are quite profound and poetic. He tried to interpret this profound experience into poetry. Almost everyone who tried to describe the test said it was too much for words, and yet that was precisely what Laurence tried to do: put it into words, for the world to read.

Along with this pressure to record the event in words, Laurence also had a responsibility to his job as a journalist: namely, to report the news fairly and accurately. This is why some people consider his work for the government a deal with the devil, or at least a violation of the journalist's code of ethics. He did not critique the military for their decisions or discuss the lingering questions that some scientists had about the bomb. He could not be as all-inclusive as if he had simply been a journalist, but he would not have had the access. Then again, if it had not been Laurence, Groves would have invited some other journalist to record Trinity. Once the bombings happened, other journalists recorded the scenes in Hiroshima and Nagasaki; by then, Trinity was already forgotten. So with Trinity, Laurence was the only one. Thus, he carried a lot of knowledge and responsibility, to the Project and to the public, as a journalist.

After his work with the Project, though, he was back on his own. When he wrote Dawn Over Zero, he could write about his ethics and attitude toward the bomb. He worked many of the articles he had written into his book, but ended the book with a sense of hope. Like many others, he hoped that the bomb would mean an end to all wars. He saw Trinity as the beginning of that new world, and discusses the role of knowledge in that world.

> What kind of world this new world is going to be no one yet knows. But we do know that it could be a vastly better world than the one that has just come to an end. Whether the vast potentialities of this new world will ever be turned into actuality, in whole or even in part, will largely depend on what the inhabitants of this new world, you and I, make of it. That is the most important matter for all of us to think about,

> today, tomorrow, and in the years to come. Mankind now has the greatest chance it ever had in the million years of its existence on this earth. If it muffs this chance it may never get another.[118]

Laurence addresses this very clearly to the readers, saying that we must make the new world. He is saying that the reader now has this knowledge and must take some responsibility for, and act upon, this knowledge of the world that we could have. Laurence could not have included this in his newspaper articles, because no newspaper would have printed it, even if the government had approved it. After all, the time for reflection, for most people, came after the war had really ended (if it came at all), not just a few days after the bombings. In August of 1945, no one wanted to hear or think about the concerns for the future. Indeed, many people were not ready for these concerns in 1946, when Dawn Over Zero came out. Just consider Laurence's last few sentences: "Mankind must now face the reality that atomic energy is here to stay. The question is: Are we? If we are, we must find means to control it. . . . The word 'peace' has become synonymous with survival. The word 'war' has become synonymous with suicide."[119] Essentially, we must annihilate war before we annihilate ourselves. Laurence's statement may not seem extraordinary now, but for 1946, it was a radical proclamation. Atomic energy was new and exciting; no one knew about the dangers of radiation or nuclear waste. No one was ready for the reality of atomic energy, not to mention abolishing war (which is considered radical in almost any time period, even in times of peace). Laurence was ahead of his time in calling for caution in using atomic weapons. He had had time to reflect on his role in the Project by the time he published Dawn Over Zero. Laurence does not explain exactly what he was thinking at the time of Trinity, but he was obviously affected by what he saw there and in Japan, enough to be one of the first people to speak out about the dangers of nuclear weapons. He had had time to consider his role as *the* journalist at Trinity and what responsibility he had (as a journalist, to the government and to the public) to report the knowledge that he had gained.

Afterward

The real impact of Trinity did not hit witnesses right away. As we have seen, the Trinity test meant different things to different people, but the test is something the witnesses will never forget. Depending on how much witnesses knew about the bomb, they reacted differently to the explosion. Civilians, military personnel, and scientists, in that order, knew more and were more involved in the bomb. Their knowledge depended on how involved they were in the Trinity test and on where they were that morning. Not only was the test more stressful for those who knew more, but it meant more celebrations for them when the bomb succeeded and again when the war ended. However, the differences in how Trinity affected these witnesses began to arise much later, after they had time to process and reflect upon their experiences.

The scientists show much of the change after the war because of Trinity. The scientists had begun to reflect upon their decisions even by the time the war ended. Some, like Wilson, began to reflect upon their work even at Trinity. Most scientists had to get over their elation first after Trinity. They were ecstatic there. Although thoughts of what was to come crossed their minds, Bradbury is right: the real concerns came later. Wilson was in the minority. Some began to think about the use of the bomb the day or so after the test, before it was actually used. Petitions to President Truman circulated at Los Alamos, calling for a demonstration to the Japanese, or a warning, or no more bombs at all. But most scientists were still happy; some were still working, to get the next bombs ready for assembly.

Once Japan was bombed, the happiness really had ended. They could not behave like children anymore; they felt at least as responsible as the flight crews. They were not able, like the military leaders, to say that they were doing it in the context of the times, of the war. Most of the scientists were compelled to help build the bomb because they thought Hitler would do it first; Japan only came up later. Once they realized Germany did not have the bomb and that they were about to surrender, they were simply too involved in the project to stop and think about it. Only one person, Joseph Rotblat, left the Project, when it became apparent that Germany would lose soon. Once the scientists stopped to think, mostly after the war, they really began to reflect upon their experiences at Trinity. The

scientists applied their experiences to the bombs' affects on Japan.

The bomb was not just physically devastating to Japan, it was psychologically devastating as well. That was one reason why some people argued that a demonstration to Japanese leaders and people would have been enough. The idea also goes to show how witnessing can impact people. Witnessing is not just about seeing, but about experiencing change. People have to make room in their minds to accommodate new information, as we saw with many civilians. It is difficult to accept any new knowledge, especially if you are confronted with it so directly. People do not just change their minds, their thoughts, but change their behaviors and actions. The image or consciousness of this new thing holds people as prisoners in their own minds. They can no longer behave the same way. The power of witnessing is that it gets people to change, to act differently.

We saw that not just in Japan and the Emperor's instant surrender (against his military leader's wishes), but also in the way scientists changed after the war and the Manhattan Project ended. Their reactions stand in stark comparison to the military personnel's responses. That is, I should say the military leaders' responses. Many members of the military are bound to their orders. They are trained to obey; they have a duty to perform. The military cultivates this. They did not reflect upon their jobs at Trinity. Their job was to perform their duty, to their superiors and to their country. They concentrated on the fact that the bomb had ended the war, a lot sooner and with much less bloodshed than otherwise would have been possible. For whatever reasons they may have originally chosen to join the military, they were there and they were dedicated to it. The same holds true for the military leaders, too, but they had additional duties. They also had made careers out of the military. General Groves was already well-known because he had directed the building of the Pentagon. He would have a future after Trinity, after the war. After the war, he also had a public image, something he also felt he needed to keep up. Oppenheimer also felt this pressure, even though he might have begun to feel guilty about his work on the bomb – no one is sure because he tried to hide it from view. But Groves remained unambiguously positive about his work. Indeed, one of the main differences between how military personnel and scientists responded to Trinity is that the military personnel did not give themselves a chance to reflect, whereas the scientists did. They were all dedicated to their

professions: scientists to science, military personnel to the military. Thus, the military personnel did not question their military intentions, whereas the scientists did question military actions because it was not their career. Perhaps the military personnel knew that if they began to question their intentions about dropping the bomb, they would not be as unambiguous about their careers. They may have stopped to think about the horrors of atomic bombs (if so, it was all internal), but they did not think about their roles and associated potential guilt in the bombs. Scientists were not only given the chance to think about their roles in the military program, they were forced to. When Bradbury became director of the Los Alamos Lab, the government had stopped funding (thus abolishing) the Manhattan Project. When scientists first came to Los Alamos, they were told they would be able to return home after the war, free of charge; the government would pay their tickets back. The war was over; Bradbury became director and told the remaining scientists: "pack up and go, and we'll pay your way home; otherwise, stay and get down to the big job that has to be done."[120] They were already getting ready to build the hydrogen bomb. It was like getting an honorary dismissal from the military. If they had not considered their role in science before, they did now.

Scientists realized after the war that science could no longer be as innocent as it had been considered. Science, or at least physics, industry, and the military were now inextricably linked. Since then, we have seen this with the increasing strength of the military-industrial complex. Now, every scientist must choose what kind of work they want to do: work for the government, a corporation, or a college. And none of these means that you will not be helping the other. There is still a possibility of working for the government and trying, from the inside, to affect policy. But those who work outside this system say that those who work in it are copping out. This debate can never be answered; it is up to each scientist to decide on his/her own what place in science they will take. There are many ways that scientists now speak out, like Wilson's Association of Los Alamos Scientists. Even if they do not speak out about policies, they discuss concerns that they have. During the war, petitions were circling at Hanford and Oak Ridge about how Project personnel felt the bomb should be used, but the petitions never reached Los Alamos. However, some scientists did meet to discuss the use of the bomb they were creating, but not everyone

was involved, and Oppenheimer tried to stop these meetings from happening. Scientists could voice their concerns to each other at those meetings. After the war, organizations like the Union of Concerned Scientists spawned with similar goals, for scientists to voice their concerns over nuclear weapons. And immediately after the war, two scientists who had helped build the bomb began the magazine The Bulletin of Atomic Scientists, which has scientists writing about military policy on nuclear weapons. As most scientists will say, they are not taking a stance blindly, but they have considered the options and this is where they say their political ambitions lie. Now, many of these science-based organizations say that, no matter what, every scientist at least has a duty to consider what his/her work is doing. Whether scientists do that in private or discuss it with others is another thing everyone must choose. They say science is no longer objective, whether scientists like it or not. There is no such thing as innocent work, as the Manhattan Project scientists realized.

Witnessing the Trinity bomb helped scientists come to this realization. Trinity was the beginning of a new era. It may have taken the devastation in Japan for scientists to realize that new era, and maybe it took the Cold War for the public to realize that, but the world is very different now because of nuclear weapons. No one will deny that nuclear weapons have complicated many issues in our world. No matter what I or you think about military policy, we know that we do not want to be subject to nuclear weapons. Where we go from there is where difficulty arises. I do not mean to say that anything is wrong or right, either in the past or future, as nuclear weapons are concerned. Like the scientists, everyone must decide for themselves how they want to be in the world. As Mohandas Gandhi said best, "You must be the change you wish to see in the world." The Trinity witnesses were given a chance to change the world that they had seen the dawning of on July 16, 1945.

Appendix 1: Timeline

1938

December An uranium atom is split. German physicists name this new process nuclear fission.

1939

Jan. 27 Niels Bohr tells U.S. scientists about fission. He proposes that if the reaction can be controlled and increased, a huge explosion could result.

Aug. 2 Albert Einstein writes President Franklin D. Roosevelt, alerting the President to the possibility of an atomic bomb and that German scientists are already researching it.

Sept. 1 Germany invades Poland. Britain and France declare war on Germany two days later. World War II begins.

Oct. 21 President Roosevelt appoints a committee to secure uranium.

1940

May Germany invades Belgium, the Netherlands, and Luxembourg to prepare to invade France.

May New elements (atomic numbers 93 and 94) are produced at the University of California, Berkeley cyclotron.

Aug. 1 Germany attacks Britain.

Sept. 27 Germany, Italy, and Japan form a pact, called the Axis countries.

1941

Feb. 23 Chemists Glenn Seaborg and Arthur Wahl at UC Berkeley confirm the existence of element 94, which they later name plutonium. In March, they discover that it is fissionable.

June 22 Germany attacks the Soviet Union.

July A conference in Washington reports that a uranium bomb can be made and work should begin at once.

October J. Robert Oppenheimer, UCB physicist, estimates that the first atomic bomb can be ready by the end of 1943.

Dec. 7 Japan bombs Pearl Harbor. The United States enters the war.

1942

Jan. 19 President Roosevelt approves production of the bomb after he receives a

National Academy of Sciences report demonstrating that a bomb is feasible.

March 18 President Roosevelt signs an executive order that mandates the relocation of all Japanese-Americans to internment camps.

June 17 President Roosevelt instructs the Army to take responsibility for construction of an atomic weapons complex. The Army delegates the task to the Corps of Engineers, which establishes the Manhattan Engineer District.

Aug. 20 Glenn Seaborg and other scientists isolate pure plutonium for the first time, enough to be seen by the naked eye.

Sept. 17 General Leslie R. Groves is appointed director of the Manhattan Project.

Sept. 19 Groves selects Oak Ridge, Tennessee, site for facilities to separate uranium.

Nov. 16 Groves selects Los Alamos, New Mexico, as site for separate scientific laboratory to design the bomb. Groves found out about this location from J. Robert Oppenheimer, who would become the lab's director.

Dec. 2 University of Chicago Metallurgical Laboratory scientists led by Enrico Fermi achieve the first self-sustained chain reaction in a pile under the west grandstand at Stagg Field in Chicago.

1943

Jan. 16 Groves selects Hanford, Washington, as site for plutonium production and separation facilities.

Feb. 2 Germans surrender at Stalingrad.

Feb. 28 In Norway, soldiers, who are parachuted in from Britain, sabotage a power plant, which is being used by the Germans to produce heavy water for atomic research.

March 3 Oppenheimer moves to Los Alamos.

May 27 Work begins at Los Alamos.

July 25 Benito Mussolini is arrested in Italy; new government formed.

Aug. 13 U.S. and Britain agree to share knowledge about nuclear weapons, not to use them against each other, not to use them without mutual consent, and not to give any information to a third party.

October First plutonium shipment arrives at Los Alamos from Hanford.

1944

January Scientists initially recommend a test of the plutonium bomb.

Feb. 17 The Los Alamos Governing Board discusses a test at length. Afterwards,

Oppenheimer asks Kenneth Bainbridge to plan a separate organizational group within the Lab with total responsibility for the test.

Feb. 20 Norwegian and British resistance fighters again sabotage the heavy water program. They sink a ferry carrying heavy water on its way from Norway to Germany.

March Preparations begin for a full-scale test of the plutonium bomb. Oppenheimer code names it "Trinity" and appoints Bainbridge director of the test.

June 6 D-Day. Normandy coast of France invaded from the English Channel by the Allies under General Dwight D. Eisenhower.

August Bainbridge's team recommends the final test site, on the Alamogordo Bombing Range in New Mexico.

Sept. 7 The official papers for the Alamogordo site are signed.

Sept. 17 Bainbridge and team visit the Alamogordo Bombing Range to figure out exactly where to place the bomb and associated sites.

Sept. 26 Largest amount of plutonium-239 ready at Hanford; scientists expect to have a plutonium bomb in the second half of 1945.

November Soldiers start arriving at Trinity test site to begin construction.

Dec. 8 Joseph Rotblat leaves Los Alamos, claiming that it is now apparent that Germany does not have the bomb. Since he came to Los Alamos to build the bomb before them, he no longer feels the need to complete it.

Dec. 30 Sergeant Marvin Davis and his military police unit arrive at Trinity site.

1945

Jan. 27 Soviet Army liberates Auschwitz concentration camp.

February Groves orders a freeze on the design of the bomb so it can be ready by July. Scientists would have continued to work on making the design better; they could now work on perfecting that design. Los Alamos also receives its first plutonium.

Feb. 13 Allies massively firebomb Dresden.

March 9 Allies massively firebomb Tokyo.

April 1 U.S. invades island of Okinawa, establishing an air base close to mainland.

April 12 President Roosevelt dies. Harry S. Truman becomes President.

April 25 Truman is informed about the bomb; agrees to continue the project.

April 30 Adolf Hitler commits suicide in Berlin.

May 7	Germany surrenders; the war in Europe ends. Also, the 100-ton preliminary test is conducted. It is the largest human-made explosion to date.
June	Truman agrees the bomb should be used against Japan as soon as possible and with no warning.
June 26	The United Nations Charter is signed by representatives of 50 countries.
June 29	Truman approves plan for invasion of main island of Japan on November 1.
June 30	The Trinity test is scheduled for July 16 at 4:00 AM.
July 9	The Army changes the name of the Alamogordo Bombing Range to the White Sands Proving Ground. The Army begins to create and test new rocket and missile technologies here.
July 10	Final preliminary tests completed; Trinity test is set to go forward.
July 12	At Los Alamos, Louis Slotin and Phil Morrison load the separated eighty-pound plutonium core for the Trinity bomb into an Army sedan and escort it to the test site.
July 13	The core is encased with explosives and the bomb shell.
July 14	The bomb is lifted to the top of the 100-foot tower from which it will detonate.
July 15	The Potsdam Conference begins. Churchill, Truman, and Stalin meet in Potsdam, Germany, near Berlin. Over the course of several days, they draft an ultimatum for Japan's surrender. Originally scheduled much earlier, Truman delayed the Potsdam meeting until the test could be conducted.
July 16	Day of Trinity. Los Alamos scientists successfully detonate the first atomic bomb. The bomb has an equivalent yield of about 18.6 kilotons of TNT.
July 18	First details about the test arrive in Potsdam.
July 21	Groves' full report on the Trinity test arrives in Potsdam. President Truman has much more confidence and forcefulness in the negotiations.
July 24	The Combined Chiefs of Staff meet with Churchill and Truman; they approve the November 1 date for the invasion on the mainland of Japan. Also, in a private conversation, Truman tells Stalin that the U.S. has "a new weapon of unusual destructive force." Stalin replies simply that he hopes the U.S. makes "good use of it against the Japanese." Conference ends.
July 26	The Potsdam ultimatum is issued to Japan, calling for Japan to surrender unconditionally or face "prompt and utter destruction."
July 28	The Japanese Premier Suzuki rejected the Potsdam ultimatum, saying that it was "unworthy of public notice."

Aug. 2 Truman gives the final okay for the use of the bomb.

Aug. 6 A uranium bomb is dropped on Hiroshima, Japan, killing about 80,000 people instantly, with a total of perhaps 140,000 people dying.

Aug. 8 Truman signs the U.N. Charter, making the U.S. the first country to ratify it.

Aug. 9 A plutonium bomb is dropped on Nagasaki, Japan, killing about 40,000 people instantly; perhaps 70,000 people die in all.

Aug. 10 Japan's Emperor Hirohito unconditionally surrenders, against his military leaders' wishes.

Sept. 2 General MacArthur accepts Japan's formal surrender in Tokyo Bay on the Battleship *Missouri.*

Sept. 11 Groves, Oppenheimer, and others return to Trinity site, to give a tour to journalists. CBS Radio does program on the test and interviews scientists. The scientists have been popularized in magazines and other media since the end of the war.

Oct. 24 The United Nations Charter comes into force with 29 signatories.

Dec. 10 Eugene Rabinowitch and Hyman Goldsmith publish the first issue of The Bulletin of Atomic Scientists.

Later Years

1946 The Army detonates eight 500-pound non-nuclear bombs inside Jumbo and accidentally blows off the ends.

July 1 The U.S. begins "Operation Crossroads," testing nuclear bombs at the Bikini Atoll in the Pacific.

Jan. 1947 The Manhattan Engineer District is abolished and all atomic energy activities are transferred to the newly created Atomic Energy Commission (AEC).

Aug. 1949 The Soviet Union tests its first atomic bomb, a replica of the Trinity bomb.

1952 The AEC scrapes up and removes the Trinitite from the site; it is buried elsewhere.

Sept. 1953 About 650 people attend the first Trinity Site open house.

1958 The Army again changes the name of the area, this time to its current name: White Sands Missile Range.

May 1959 An executive order reveals the Manhattan Project's history.

1965 Monument erected at Trinity's ground zero.

1971 First regular open house at the Trinity site.

1975 The National Park Service designates the Trinity site a National Historic Landmark.

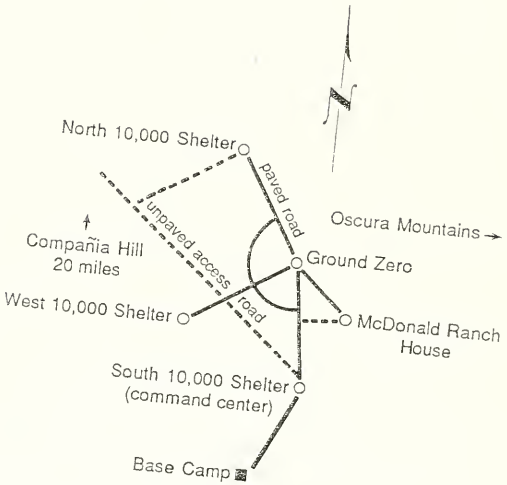
1979 Jumbo is moved to the Trinity site parking lot where it still sits today.

1982 The Army stabilizes the McDonald ranch house to prevent further decay. The National Park Service begins to restore the house, to make it appear as it did on July 15, 1945.

July 16, 1985
About 1,000 people attend the thirtieth-year anniversary of the Trinity test.

July 16, 1995
Fiftieth-year anniversary held at the Trinity site; about 5,000 people attend.

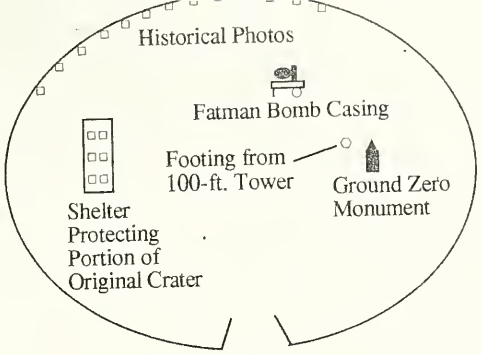
Appendix 2: Layout of Trinity site for the test.



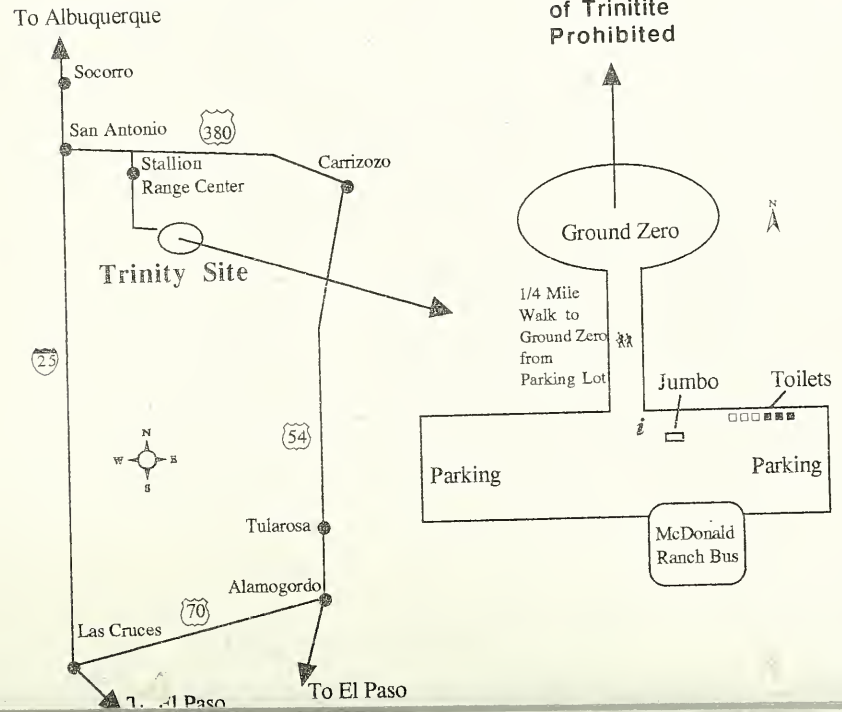
Appendix 3: Current map of Trinity site.

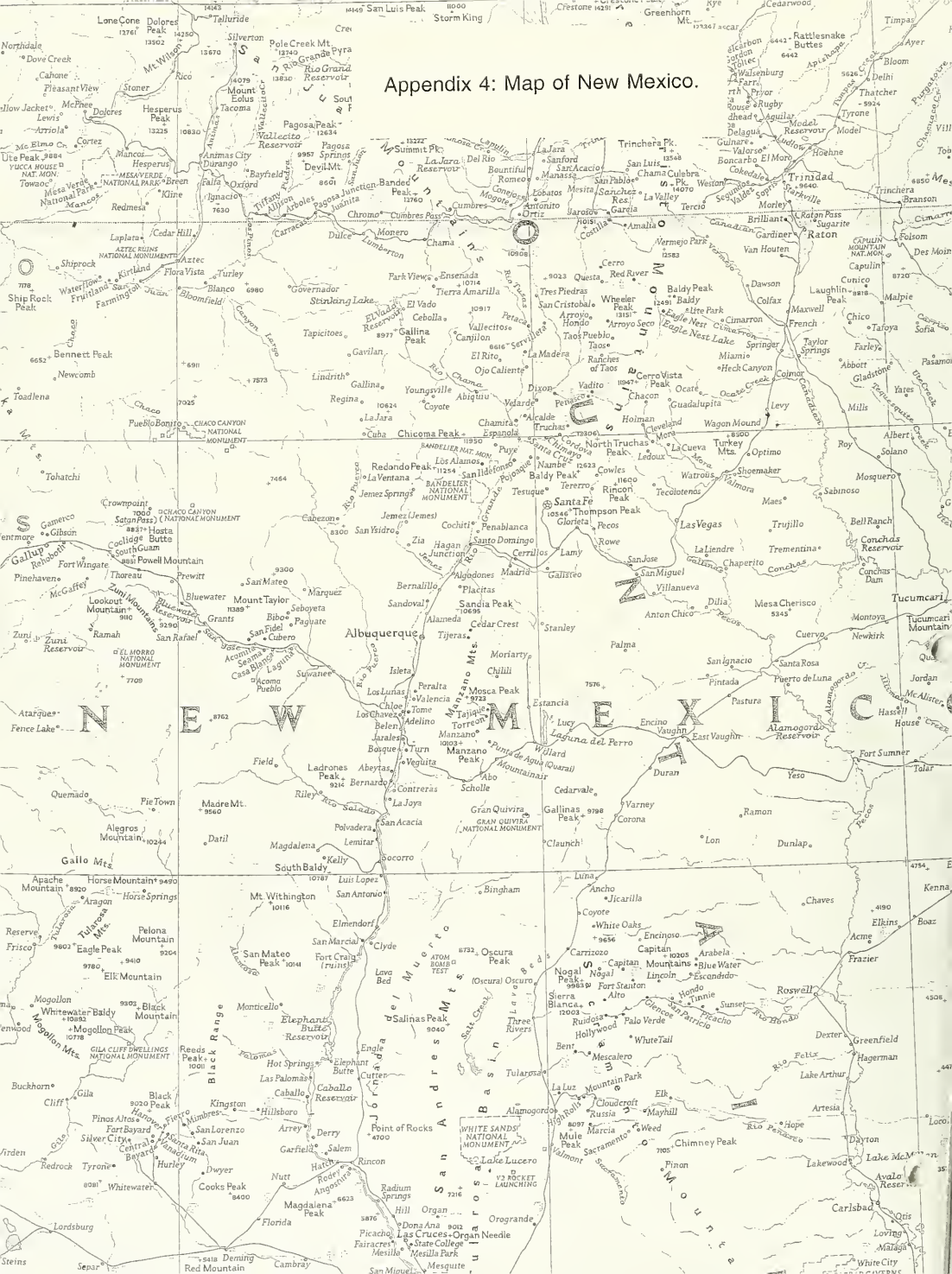
Mileage Chart

San Antonio to Stallion exit	12
Carrizozo to Stallion exit	53
Highway 380 to Stallion	5
Stallion to Trinity Site	17
San Antonio to Socorro	10
San Antonio to Albuquerque	81
San Antonio to Las Cruces	130
San Antonio to El Paso	175
Carrizozo to Tularosa	46
Carrizozo to Alamogordo	56
Carrizozo to El Paso	146
Trinity Site to Alamogordo via the caravan	85



Removal of Trinitite Prohibited




Appendix 4: Map of New Mexico.
NEW MEXICO

Appendix 5:

Press release on July 16, 1945[1]

Alamogordo, N.M., July 16 – William O. Eareckson, commanding officer of the Alamogordo Army Air Base, made the following statement today:

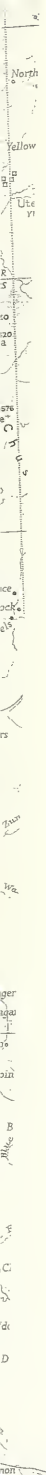
"Several inquiries have been received concerning a heavy explosion which occurred on the Alamogordo Air Base reservation this morning.

"A remotely located ammunition magazine containing a considerable amount of high explosive and pyrotechnics exploded.

"There was no loss of life or injury to anyone, and the property damage outside of the explosives magazine itself was negligible.

"Weather conditions affecting the content of gas shells exploded by the blast may make it desirable for the Army to evacuate temporarily a few civilians from their homes."

[1] This release can be found in several places, including Fermi and Samra, Groves, and Cantelon, Hewlett, and Williams. A clipping from the Albuquerque Tribune accompanied General Groves' report to the Secretary of War. In addition, the National Archives holds several variations of this release, with different possible scenarios.



[1] Based on the story of Dean Fite and Evelyn Fite Tune. Fritz Thompson, "Locals Witnessed History in a Flash," Albuquerque Journal, p. 4.
[2] Otto Frisch, qtd. in Peter Goodchild, J. Robert Oppenheimer, pp. 161-2.
[3] This estimate is from James Kunetka, City of Fire, pp. 186-7.
[4] "Trinity: 50 Years Later," Albuquerque Journal, p. 4.
[5] Rumors of potential sources for the name Trinity included: the three project centers, (Los Alamos, Hanford, and Oak Ridge); the Trinity of uranium, plutonium, and neptunium (since the latter two elements are made from uranium); and the obvious religious Trinity. In his letter, Groves suggested that Trinity came from the fact that there are western rivers and mountains named Trinity, so it would provide a good cover.
[6] Alice Kimball Smith and Charles Weiner, eds., Robert Oppenheimer, p. 290.
[7] William Lawren, The General and the Bomb, pp. 201-2.
[8] William Laurence, Dawn Over Zero, pp. 194-5.
[9] Ferenc Morton Szasz, The Day the Sun Rose Twice, p. 84.
[10] Ibid., p. 83.
[11] Qtd. in Thompson, p. 4.
[12] "Trinity: Revisiting the Birth of the Bomb," Radio Expeditions, National Public Radio, 27 Feb. 2003.
[13] MED personnel were scattered around the region to monitor the radiation in case it got too high and they had to evacuate civilians.
[14] Eileen Welsome, The Plutonium Files, p. 102.
[15] Tad Bartimus and Scott McCartney, Trinity's Children, p. 13.
[16] Szasz, p. 87.
[17] See Appendix 5 for the full report. I found it in the National Archives, but it is repeated in many sources.
[18] Qtd. in Szasz, p. 87.
[19] Szasz, p. 87.
[20] Ibid., p. 84.
[21] Ibid. I do not know if there is any connection between this rumor and the current rumors of UFO sitings and associated extraterrestrial activity in Roswell. I do not know when those rumors began, whether before or after Trinity, or before Szasz. This would be an intriguing topic for more research.
[22] Laurence, p. 195.
[23] Los Alamos Scientific Laboratory, Los Alamos: Beginning of an Era, 1943-1945, p. 54. (Hereafter noted as *LABE*).
[24] Qtd. in Thompson, p. 1.
[25] Qtd. in Thompson, p. 4.
[26] *LABE*, p. 54.
[27] Thompson, p. 4.
[28] Qtd. in Thompson, p. 4.
[29] Robert Cahn, "Behind the First Atomic Bomb," p. 74. Cahn's article is the most complete source of Green's story that I have found, although most historians/journalists mention that a blind girl saw the bomb.
[30] Qtd. in Thompson, p. 1.
[31] Szasz, p. 84.
[32] Ibid.
[33] Ibid.
[34] Szasz, p. 83.
[35] In 1947, UCLA students and faculty conducted a study of the impact Trinity had on wildlife. This was one of the first studies to document the effects of radiation on any life, including humans. It was not published until 1949 – well after radiation had been affecting survivors of the Japanese bombings. For a while after the bombings, the U.S. government refuted any claims of illnesses caused by the atomic bomb (Szasz).
[36] Laurence, p. 195.
[37] Szasz, p. 87.
[38] Laurence, p. 188.
[39] Larry Calloway, "The Nuclear Age's Blinding Dawn," Albuquerque Journal, p. 8.
[40] Szasz, p. 85.

[41] Rachel Fermi and Esther Samra, Picturing the Bomb, p. 156.
[42] Victor Weisskopf, The Joy of Insight, p. 151.
[43] De Paula, "Trinity: Revisiting."
[44] Calloway, "Nuclear," p. 8.
[45] James Abarr, "The Legacy of Trinity," Albuquerque Journal, p. 1.
[46] Qtd. in Bartimus and McCartney, p. 13-4.
[47] Cahn, p. 74.
[48] Sid Moody, "Proving Ground," Albuquerque Journal, p. 3.
[49] K.D. Nichols, Road to Trinity, p.192.
[50] Laurence, p. 202.
[51] Szasz, p. 88.
[52] Robert Jay Lifton and Eric Markusen, The Genocidal Mentality, p. 61.
[53] Qtd. in Philip L. Cantelon, Richard G. Hewlett, and Robert C. Williams, eds. The American Atom, p. 55. (Hereafter *CHW*). Farrell's account, as part of Gen. Groves' memo to Sect. Stimson, is recorded in many sources. Other than this book, it is repeated in full in Groves, Feis, Nichols, Laurence, and in the National Archives.
[54] Lifton and Markusen, p. 61. There is some debate over whether Farrell or another unnamed military person said this.
[55] Farrell, *CHW*, p. 57.
[56] Laurence, p. 192.
[57] Farrell, *CHW*, p. 56.
[58] Ibid.
[59] Laurence, p. 187
[60] Groves, *CHW*, p. 53. Before directing the MED, Groves directed the design and construction of the Pentagon.
[61] Groves, *CHW*, p. 55.
[62] Groves, *CHW*, p. 58.
[63] Groves, *CHW*, p. 59.
[64] Ibid. It is also interesting to note in the July 30th report that Groves says "No damaging effects are anticipated on the ground from radioactive materials."
[65] Groves, *CHW*, pp. 57-8.
[66] Leslie R. Groves, Now It Can Be Told, p. xiii.
[67] For the lack of a better designation, I simply call them "lab scientists." Generally, these scientists just worked in the different labs at Los Alamos, but did not have any directing positions. Lab, in this sense, is not to be confused with Los Alamos Lab; it designates the actual labs or divisions within Los Alamos.
[68] Caroline L. Herzenberg and Ruth H. Howes, Their Day in the Sun, pp. 55-6.
[69] Some sources say that the test was originally planned for midnight, but most confirm that, as of July 15, it was planned for 4:00 A.M. Either way, the delay caused some potential witnesses to miss it, and threw an element of surprise into the morning.
[70] Herzenberg and Howes, p. 87.
[71] Szasz, p. 17.
[72] Laura Fermi, Atoms in the Family, p. 238.
[73] Szasz, p. 85.
[74] Weisskopf, pp. 150-1.
[75] Herzenberg and Howes, p. 56.
[76] Ibid.
[77] Qtd. in Herzenberg and Howes, p. 56.
[78] Herzenberg and Howes, p.187.
[79] In particular, readers may be wondering why I am not addressing Oppenheimer's response to Trinity. Many historians have addressed his response and they all have different theories about what he was thinking after Trinity. But his feelings and thoughts, as always, were cryptic; therefore, I refer the reader to the many biographies of his life for more information (Goodchild in particular).
[80] The Day After Trinity, dir. Jon Else.

[81] Szasz, p. 87.
[82] Szasz, p. 90.
[83] Qtd. in Calloway, "Nuclear," p. 8.
[84] Kenneth Bainbridge, "A Foul and Awesome Display," p. 46.
[85] Qtd. in Szasz, p. 91.
[86] Weisskopf, pp. 148-9.
[87] Weisskopf, p. 151.
[88] Ibid.
[89] Weisskopf, p. 152.
[90] Weisskopf, pp. 152-3.
[91] Szasz, p. 177.
[92] Szasz, p. 175.
[93] Szasz, p. 89.
[94] "Remembering Robert Wilson," Bulletin of Atomic Scientists, p. 3.
[95] Qtd. in Mary Palevsky, Atomic Fragments, p. 144.
[96] Ibid.
[97] Edward Teller, Memoirs, p. 212.
[98] Ibid.
[99] Calloway, "Moral," p. 7.
[100] Rhodes, p. 765.
[101] Qtd. in Rhodes, p. 765.
[102] Qtd. in Rhodes, p. 766.
[103] Qtd. in Rhodes, p. 766.
[104] This bomb, called Joe I, was a replica of the Trinity bomb. The U.S. would later discover that a Russian spy, Klaus Fuchs, was at Los Alamos, and there were other spies, including Julius and Ethel Rosenberg, who were later convicted and executed. Fuchs had confessed and spent nine years in prison. Fuchs was a Trinity witness.
[105] Qtd. in Rhodes, p. 767.
[106] It is now the Los Alamos National/Scientific Laboratory, still operated by the University of California, for the National Nuclear Security Administration of the U.S. Department of Energy.
[107] Qtd. in *LABE*, p. 54.
[108] Qtd. in Szasz, p. 90.
[109] Ken Johnson, "A Quarter Century of Fun," The Atom, p. 18.
[110] "William Laurence," Spartacus Educational, p. 1.
[111] S.S. Schweber, In the Shadow of the Bomb, p. 231.
[112] Qtd. in Fermi and Samra, p. 143.
[113] National Archives, Manhattan Engineer District Records, Record Group 77, "General Correspondence," Entry 5, Box 31, Laurence file, Story No. 11, p. 1. (Hereafter designated MED 31.5, Story 11 or 11). Laurence wrote several stories; only these two are about Trinity specifically (They are untitled). Laurence edited these stories before publishing them, however; they also appear in slightly different form in Dawn Over Zero. Many of these quotes have been repeated in other sources as well (Szasz 88-89, Lifton and Markusen 82).
[114] MED 31.5, Story 10, p. 10.
[115] MED 31.5, Story 10, p. 2-3.
[116] MED 31.5, Story 10, p. 1.
[117] MED 31.5, Story 10, p. 10.
[118] Laurence, p. 270.
[119] Laurence, p. 272.
[120] Qtd. in Johnson, p. 17.

Works Cited

Abarr, James. "The Legacy of Trinity." Albuquerque Journal 28 Oct. 1999. 12 Mar. 2003. <http://www.abqjournal.com/venue/day/heritage13.htm>.

Bainbridge, Kenneth T. "A Foul and Awesome Display." Bulletin of Atomic Scientists 31.5 (May 1975): 40-46.

Bartimus, Tad, and Scott McCartney. Trinity's Children: Living Along America's Nuclear Highway. New York: Harcourt Brace Jovanovich, 1991.

Cahn, Robert. "Behind the First Atomic Bomb." Saturday Evening Post 16 Jul. 1960: 16+.

Calloway, Larry. "Moral Fallout." Albuquerque Journal 9-11 Jul. 1995: 7. 1 May 2003. <http://www.abqjournal.com/trinity>.

---. "The Nuclear Age's Blinding Dawn." Albuquerque Journal 9-11 Jul. 1995: 1+. 1 May 2003. <http://www.abqjournal.com/trinity>.

Cantelon, Philip L., Richard G. Hewlett, and Robert C. Williams, eds. The American Atom: A Documentary History of Nuclear Policies from the Discovery of Fission to the Present. 2nd ed. Philadelphia: U of Pennsylvania P, 1991.

Childs, Herbert. An American Genius: The Life of Ernest Orlando Lawrence. New York: EP Dutton, 1968.

The Day After Trinity. Dir. Jon Else. Videocassette. KTEH-TV, San Jose. 1980.

Donne, John. "Hymne to God, My God, in My Sickness" and "Holy Sonnet 14." The Complete Poetry and Selected Prose. New York: Modern Library-Random, 1952.

Feis, Herbert. "The Secret That Traveled to Potsdam." Foreign Affairs Magazine Jan. 1960: 300-317.

Fermi, Laura. Atoms in the Family. Chicago: U of Chicago P, 1954.

Fermi, Rachel, and Esther Samra. Picturing the Bomb: Photographs from the Secret World of the Manhattan Project. New York: Harry N. Abrams, 1995.

Goodchild, Peter. J. Robert Oppenheimer, 'Shatterer of Worlds'. London: British Broadcasting Corp, 1980.

Groves, Leslie R. Now It Can Be Told: The Story of the Manhattan Project. New York: Harper and Row, 1962.

Gusterson, Hugh. "Los Alamos: Summer Under Siege." Bulletin of Atomic Scientists 55.6 (Nov./Dec. 1999): 36-41.

Herzenberg, Caroline L., and Ruth H. Howes. Their Day in the Sun: Women of the Manhattan Project. Philadelphia: Temple UP, 1999.

Kunetka, James W. City of Fire: Los Alamos and the Atomic Age, 1943-1945. Albuquerque: U of New Mexico P, 1979.

Johnson, Ken. "A Quarter Century of Fun." The Atom. Los Alamos Scientific Laboratory. Sept. 1970: 1-24.

Laurence, William. Dawn Over Zero. New York: Alfred A. Knopf, 1946.

Lawren, William. The General and the Bomb: A Biography of General Leslie R. Groves, Director of the Manhattan Project. New York: Dodd, Mead, and Company, 1988.

Lifton, Robert Jay, and Eric Markusen. The Genocidal Mentality: Nazi Holocaust and Nuclear Threat. New York: Basic Books, 1990.

Los Alamos Scientific Laboratory. Los Alamos: Beginning of an Era, 1943-1945. Los Alamos: Public Relations Office, n.d. (LASL-79-78).

Los Alamos Scientific Laboratory. "Trinity: Completion of the Wartime Mission." 31 Jan. 2003. 1 May 2003. <http://www.lanl.gov/worldview/welcome/history/24_trinity.html>.

Michelmore, Peter. The Swift Years: The Robert Oppenheimer Story. New York: Dodd, Mead, and Company, 1969.

Moody, Sid. "Proving Ground." Albuquerque Journal 9-11 July 1995: 3. 1 May 2003. <http://www.abqjournal.com/trinity>.

Nichols, K.D. Road to Trinity. New York: William Morrow, 1987.

Palevsky, Mary. Atomic Fragments: A Daughter's Questions. Berkeley: U of California P, 2000.

"Remembering Robert Wilson." Bulletin of Atomic Scientists 56.2 (Mar./Apr. 2000): 3-4.

Rhodes, Richard. The Making of the Atomic Bomb. New York: Simon and Schuster, 1986.

Schweber, S.S. In the Shadow of the Bomb: Oppenheimer, Bethe, and the Moral Responsibility of the Scientist. Princeton, NJ: Princeton UP, 2000.

Smith, Alice Kimball, and Charles Weiner, eds. Robert Oppenheimer: Letters and Recollections. Cambridge: Harvard UP, 1980.

Szasz, Ferenc Morton. The Day the Sun Rose Twice. Albuquerque: U of New Mexico P, 1984.

Teller, Edward. With Judith L. Shoolery. Memoirs: A Twentieth-Century Journey in Science and Politics. Cambridge: Perseus, 2001.

Thompson, Fritz. "Locals Witnessed History in a Flash." Albuquerque Journal 9-11 July 1995: 1+. 1 May 2003. <http://www.abqjournal.com/trinity>.

"Trinity: 50 Years Later." Albuquerque Journal 9-11 July 1995. 1+. 1 May 2003. <http://www.abqjournal.com/trinity>.

"Trinity: Revisiting the Birth of the Bomb." Radio Expeditions. Host Alex Chadwick. Natl. Public Radio. 27 Feb. 2003. 1 May 2003. <http://www.npr.org/programs/re/archivesdate/2003/feb/trinity>.

United States. Dept. of Defense. Trinity Site, 1945-1995. Washington: GPO, 1995.

United States. National Archives at College Park, MD. Manhattan Engineer District Records, Record Group 77. "General Correspondence," Entry 5, Box 31, Laurence file.

Weisskopf, Victor. The Joy of Insight: Passions of a Physicist. New York: BasicBooks-HarperCollins, 1991.

Welsome, Eileen. The Plutonium Files: America's Secret Medical Experiments in the Cold War. New York: Dial-Random, 1999.

"William Laurence." Spartacus Educational. 20 April 2003. 1 May 2003. <http://www.spartacus.schoolnet.co.uk/2WWlaurence.htm>.

Works Consulted

Alperovitz, Gar. Atomic Diplomacy: Hiroshima and Potsdam. 3rd ed. Boulder: Pluto P, 1994.

---. The Decision to Use the Atomic Bomb and the Architecture of an American Myth. New York: Alfred A. Knopf, 1995.

Anders, Rodger M. "The President and the Atomic Bomb: Who Approved the Trinity Nuclear Test?" Prologue: The Journal of the National Archives 20 (1988): 268-82.

Anderson, Herbert L. "Fermi, Szilard and Trinity." Bulletin of Atomic Scientists 30.8 (Oct. 1974): 40-47.

Atomic Cafe. Dir. Pierce Rafferty, Jayne Loader, and Kevin Rafferty. Videocassette. Archives Project. 1982.

Badash, Lawrence. Scientists and the Development of Nuclear Weapons: From Fission to the Limited Test Ban Treaty, 1939-1963. Atlantic Highlands, NJ: Humanities P, 1995.

Bainbridge, Kenneth T. "Prelude to Trinity." Bulletin of Atomic Scientists 31.4 (Apr. 1975): 42-46.

Bhaktivedanta Swami, A.C., ed. Bhagavad-Gita As It Is. Los Angeles: Bhaktivedanta Book Trust, 1972.

Blumberg, Stanley A., and Louis G. Panos. Edward Teller: Giant of the Golden Age of Physics. New York: Charles Scribner's Sons, 1990.

Borman, Stu. "Chemists Reminisce on 50th Anniversary of the Atomic Bomb." Chemical and Engineering News. 17 Jul. 1995: 53-63. 7 May 2003. <http://pubs.acs.org/hotartcl/cenear/950717/art02.html>.

Bracchini, Miguel A. "The History and Ethics Behind the Manhattan Project." 30 Apr. 1997. 7 May 2003. <http://www.me.utexas.edu/~uer/manhattan/index.html>.

Brown, Anthony Cave, and Charles B. MacDonald, eds. The Secret History of the Atomic Bomb. New York: Dial/James Wade, 1977.

Buck, Pearl. Command the Morning. New York: Pocket Books-Simon and Schuster, 1967.

Bureau of Atomic Tourism. "Trinity Site." 24 Sep. 2001. 7 May 2003. <http://

www.atomictourist.com/trinity.htm>.

Caulfield, Catherine. Multiple Exposures: Chronicles of the Radiation Age. Chicago: U of Chicago, 1989.

Dannen, Gene. "Atomic Bomb: Decision." 15 Aug. 2000. 7 May 2003. <http://www.dannen.com/decision/index.html>.

Dietrich, Bill. "Fifty Years From Trinity." The Seattle Times. 1995. 7 May 2003. <http://seattletimes.nwsource.com/trinity>.

Fisher, Phyllis K. Los Alamos Experience. Tokyo: Japan Publications, 1985.

Goldberg, Stanley. "Groves Takes the Reins." Bulletin of Atomic Scientists 48.10 (Dec. 1992): 32-39.

Groueff, Stephanie. Manhattan Project: The Untold Story of the Making of the Atomic Bomb. Boston: Little, Brown, and Company, 1967.

Hilgartner, Stephen, Richard C. Bell, and Rory O'Connor. Nukespeak. San Francisco: Sierrra Club Books, 1982.

History Channel. "Trinity Bomb Site." 2 Oct. 1999. 7 May 2003. <http://www.historychannel.com/exhibits/trinity>.

Horowitz, Sarah. "Atomic Tours Growing in Popularity." Bulletin of Atomic Scientists 56.4 (Jul./Aug. 2000): 8-9.

---. "Sculpture from Scrap." Bulletin of Atomic Scientists 56.5 (Sep./Oct. 2000): 6-8.

Kistiakowsky, George B. "Trinity: A Reminiscene." Bulletin of Atomic Scientists 36. 6 (June 1980): 19-22.

Lamont, Lansing. Day of Trinity. New York: Atheneum, 1965.

Lewis, Richard S., and Jane Wilson, eds. Alamogordo Plus Twenty-five Years: The Impact of Atomic Energy on Science, Technology, and World Politics. New York: Viking, 1971.

Maag, Carl, and Stever Rorher. Defense Nuclear Agency. "U.S. Project Trinity Report." 15 Dec. 1982. 7 May 2003. <http://www.jollyroger.com/library/U.S.ProjectTrinityReportebook.html>.

Massachusetts Institute of Technology Faculty, and Dennis, Jack, eds. The Nuclear

Almanac: Confronting the Atom in War and Peace. 3rd ed. Reading, MA: Addison-Wesley, 1985.

McNamee, Gregory. "Growing Up Nuclear." Tucson Weekly. 31 Jul 2000. 7 May 2003. <http://weeklywire.com/ww/07-31-00/tw_feat.html>.

Morrison, Philip. "Recollections of a Nuclear War." Scientific American Aug. 1995: 42-46.

Morrow, Bradford. Trinity Fields. New York: Viking-Penguin, 1995.

National Atomic Museum. "Trinity." 2003. 7 May 2003. <http://www.atomicmuseum.com/tour/trinity.cfm>.

Norris, Robert S. Racing for the Bomb: General Leslie R. Groves, the Manhattan Project's Indispensible Man. South Royalton, VT: Steerforth P, 2002.

Nuclear Age Peace Foundation. "The Trinity Test." 2002. 7 May 2003. <http://www.nuclearfiles.org/redocuments/docs-trinity.html>.

Nuclear Weapons Cost Study Project Committee. "Four Trillion Dollars and Counting." Ed. Stephen I. Schwartz. Bulletin of Atomic Scientists 51.6 (Nov./Dec. 1995): 32-52.

Rearden, Steven L., and Samuel R. Williamson, Jr. The Origins of U.S. Nuclear Strategy, 1945-1953. New York: St. Martin's, 1993. p. 11.

Rose, Wendy. "Robert." The Halfbreed Chronicles and Other Poems. Washington, DC: West End, 1985.

Rosenberg, Howard L. Atomic Soldiers: American Victims of Nuclear Experiments. Boston: Beacon, 1980. p. 21-22.

Schisgall, Oscar. "Background of the Bomb." Liberty. 13 Oct. 1945: 40+.

Silko, Leslie Marmon. Ceremony. New York: Penguin, 1986.

Society for the Historical Preservation of the Manhattan Project. "Directory of Articles." 28 Feb. 2003. 7 May 2003. <http://www.childrenofthemanhattanproject.org/HICC/HICC_AR.htm>.

Stafford, William. "At the Bomb Testing Site." Stories That Could Be True: New and Collected Poems. New York: Harper and Row, 1984.

Tankard, Jim. "The Unofficial Trinity Site Page." 25 Mar. 2000. 7 May 2003. <http://members.aol.com/JTankard/trinity/home.html>.

Truman, Harry S. Year of Decisions. Garden City, NY: Doubleday, 1955.

United States. Dept. of Energy. Office of Environmental Management. "Nuclear Age Timeline." 15 Nov. 1999. 7 May 2003. <http://www.em.doe.gov/timeline>.

United States. National Park Service. White Sands Administrative History. "Chapter 4: Global War at White Sands, 1940-1945." 22 Jan. 2001. 12 May 2003. <http://www.nps.gov/whsa/adhi/adhi4i.htm>.

Vonnegut, Kurt. Cat's Cradle. New York: Bantam Doubleday Dell-Laurel, 1963.

White Sands Missile Range. Public Affairs Office. "Trinity Site." 2003. 7 May 2003. <http://www.wsmr.army.mil/paopage/Pages/Trinst.htm>.

Young, Peter, ed. The World Almanac of World War II. New York: World Almanac-Pharos, 1992.

Zindel, Paul. The Gadget. New York: HarperCollins, 2001.