Conscience on Atomic Jobs: The Manufacturers of Nuclear War

By Lucie Genay

Abstract: Through examples and testimonies spanning different contexts of World War, Cold War, and peace, this article confronts the experiences and memories of individuals across the spectrum of bomb-making, from participants in the Manhattan Project to the technicians assembling nuclear weapons during the US-Soviet arms race. Two installations have been selected for this analysis: the Los Alamos laboratory in northern New Mexico, where the atomic bomb was born, and the Pantex plant in northwest Texas, where nuclear weapons are assembled and disassembled. Los Alamos and Pantex were both born in war and funded by the federal government on astronomical budgets; they have equally attracted the admiration and gratitude of nuclear deterrence supporters as the ire of peace advocates and antinuclear activists. Likewise, the people who work behind the gates have been in turn celebrated as protectors of democracy and vilified as makers of doom. This text centres on the moral and ethical questions raised by these people's line of occupation to identify throughlines, be they in terms of rhetoric, emotional reaction, or concrete action. What inner struggles do nuclear weapons workers express and how do they address them? From the bomb's creators to the anonymous workers on the nuclear assembly line, this article examines the moral strategies scientists, engineers, and technicians have developed to rationalise their jobs and the role they played in the atomic age in various capacities and at various levels of responsibility.

Keywords: *nuclear weapons*, *Manhattan Project*, *Cold War*, *Los Alamos*, *Pantex*

"Now I am become Death, the Destroyer of Worlds": Robert Oppenheimer's quote from the Bhagavad Gita is surely the best-known sentence in the history of nuclear weaponry (Hijiya 2000). The scientific director of the Manhattan Project pondered these words after witnessing his program's culmination, the world's first atomic explosion at Trinity in the *Jornada del Muerto* of New Mexico on 16th July 1945. Since then, the ruminations of father of the atomic bomb have been the source of much speculation. Did they reveal a guilty conscience?

From the project's participants to the technicians assembling the most dangerous weapons on earth during the Cold War, many have been confronted with the moral and ethical questions raised by their line of occupation. This analysis centres primarily on two installations: the Los Alamos National Laboratory (LANL) in northern New Mexico and the Pantex plant in northwest Texas. Los Alamos was the world's first atomic research lab officially

established in 1943, thirty-five miles northwest of Santa Fe, where the greatest scientists of the time, many of them European refugees, worked to design and test a nuclear weapon before Nazi Germany could. At the end of the war, rather than being decommissioned, the site expanded to undertake new missions. More and mightier weapons had to be designed and assembled after the first Soviet atomic test in 1949. Two years later, the Pantex plant, a conventional ordnance plant, which had been shut down in 1945, was reopened by the Atomic Energy Commission (AEC) to assemble the new nuclear bombs and manufacture the high explosive charges encasing their core.[1] Since the closure of another site in Iowa, every nuclear weapon in the US arsenal has been assembled in the Panhandle of Texas (hence the name Pan-Tex), nineteen miles east of Amarillo.

Los Alamos and Pantex represent opposite ends of the nuclear weapons production chain: from design to assembly (and disassembly, since Pantex also dismantles obsolete weapons).[2] Both born in war and funded by the federal government on astronomical budgets, those installations have equally attracted the admiration and gratitude of nuclear deterrence supporters as they have the ire of peace advocates and antinuclear activists. The people who work behind the gates have been in turn celebrated as protectors of democracy and vilified as makers of doom. How have these nuclear weapons workers rationalized their jobs and the role they played in the atomic age? This article explores the inner struggles expressed and addressed in various ways by the manufacturers of nuclear war, the "destroyers of worlds", who made nuclear warfare a possibility. What moral strategies have scientists, engineers, and technicians developed to deal with their concerns and perhaps qualms about the impacts of the product they participated in making, in various capacities and at various levels of responsibility?

Through examples spanning different contexts of World War, Cold War, and peace, selected from the existing literature, published and unpublished oral histories, as well as other primary sources, this text examines testimonies from individuals across the spectrum of bomb-making to identify throughlines, be they in terms of rhetoric, emotional reaction, or concrete action. A first part focuses on some of the bomb's creators who gained fame not only for their participation in the atomic odyssey, but also for embodying the tremendous dilemmas their invention entailed. The second part addresses how patriotism, faith, and the principles of nuclear deterrence were at the heart of most workers' moral justifications for their jobs during the Cold War, up to a certain limit (Lee 1985). Finally, what seemed to affect people's opinions the most in the end was the physical, rather than ethical, price they paid for their careers in the

nuclear bomb industry.

1. The creators: controlling the "angry genie"[3]

The scholarship on the Manhattan Project and its participants is extensive. Consequently, this section does not aim at summarizing exhaustively all that has been said and written about the nuclear scientists' moral struggles. Rather, the objective is to emphasize a few salient examples as a reminder that ethical consideration of the bomb had begun before the device came into existence.

One scientist stands out: for being the only participant to leave the Project on grounds of conscience in October 1944, British-naturalized Polish physicist Joseph Rotblat became a symbol of conscientious rebellion (Braun and others 2007; Brown 2012; Landau 1996; Underwood 2009). Rotblat had come to Los Alamos with the British Mission and his friend James Chadwick, the discoverer of the neutron. When he first became aware of the possibility of an atomic bomb in 1939 while working on the emission of neutrons in fission, Rotblat's immediate concern was Nazi Germany. Being privy to such knowledge and deciding whether to act upon it was "mental torture." He later confided that no other circumstances than the World-War context could have ever enticed him to join the program; it was for him the only acceptable moral justification. By the fall of 1944, Germany was increasingly unlikely to mobilize the enormous resources required to develop the weapon while waging a war it was now losing. Two "eye-openers" precipitated Rotblat's decision to leave: first, hearing General Leslie Groves (the military head of the Project) over dinner with the Chadwicks make it plain that the bomb's purpose was "to subdue the Russians"; second, conversations with renowned Danish colleague Niels Bohr, who already feared a post-war nuclear arms race with the Soviets and was actively pushing for international cooperation on nuclear matters among the allied powers (Rotblat 1985; Id. 1989; Leslie Groves quot. in Bird&Sherwin 2005, 284).

After the war, Rotblat dedicated his career to advocating for the abolition of nuclear weapons, notably through the foundation of the Pugwash Conferences, with which he would jointly be awarded the Nobel Peace Prize in 1995. His Nobel Lecture titled "Remember Your Humanity" was given "as a scientist, but also as a human being" about his "efforts to avert a mortal danger to humanity created by science." Although the politicians and military leaders make the ultimate call, he argued the technicians in the laboratories have a "significant role" to play: "the ivory tower was finally demolished by the Hiroshima bomb" (Rotblat 1995). In accordance, he favoured a Hippocratic oath for scientists, who

would pledge not to "use [their] education for any purpose intended to harm human beings or the environment" and to "consider the ethical implications of [their] work before [they take action]" (Rotblat 1999, 1475). For many at the time, however, taking such a political stand ran counter to a long tradition of neutrality.

By early 1945, few could still ignore that Germany had lost the atomic arms race, and more became concerned with the responsibility entailed by victory. A second popular symbol of conscientious objection is Leo Szilard, the Hungarian physicist who had first imagined the possibility of a chain reaction and convinced Albert Einstein to sign the 1939 letter to Franklin D. Roosevelt urging the US President to launch an atomic program in the first place (Hawkins and others 1987; Lanouette 2013; Szilard 1980). By June 1945, Roosevelt had been succeeded by Harry Truman and the atomic bombing of Japan seemed ever likelier. Aware that he did not have the ear of the military, Szilard encouraged 1925 Nobel laureate James Franck to chair a Committee on the Social and Political Implications of the Atomic Bomb at the Metallurgical Laboratory "Met Lab" at the University of Chicago (Lemmerich 2011). Together, and upon a commission by the head of the Met Lab, Arthur Compton, they released a famous text later known as the "Franck Report" against a surprise attack using nuclear bombs in Japan, which would sacrifice worldwide public support, precipitate an arms race, and jeopardize future attempts at international cooperation to control the new weapons. They favoured instead "a demonstration in an appropriately selected uninhabited area." The authors highlighted their "duty" as members of "a small group of citizens cognizant of a grave danger for the safety of this country as well as for the future of all the other nations, of which the rest of mankind is unaware." Acknowledging that it was hardly new for science to furnish instruments of warfare, they stressed the unique nature of the new destructive force that could lead to "total mutual destruction" (Franck and other 1991, 140-147). The report failed to convince the Interim Committee, which was to decide on the bomb's use (see below).

Szilard continued his campaign with a petition he redrafted on the day following the Trinity test. In the accompanying letter, he expressly indicated "opposition on moral grounds to the use of these bombs" and compared nuclear scientists to the Germans who "share the guilt" for their government's actions, "because they did not raise their voices in protest" (Szilard 1991, 172; Id. 1945). Interestingly, the same argument would later be used by antinuclear peace activists who refused to act like "good Germans" – one might remark here that the choices made by citizens under democratic and fascist regimes can hardly stand comparison (Terry Larimore quot. in Trout 1985, 3A).[4] Szilard

circulated the petition at the Met Lab, where seventy scientists signed it, and at the Oak Ridge Laboratory in Tennessee, until the military authorities stopped it as a security risk. At Los Alamos, Oppenheimer convinced Hungarian Edward Teller (soon-to-be father of the hydrogen bomb), upon whom Szilard had counted, not to circulate it. Stuck in the meanders of Army channels, the text eventually reached the desk of Secretary of War Henry Stimson's assistant, who classified it. Truman never saw the document.

After Trinity, other Los Alamos scientists expressed their moral struggles. Physicist Robert Wilson, who would later refuse work requiring a security clearance, told Richard Feynman: "It's a terrible thing that we made" and remembered Oppenheimer lamenting, as he was walking to the Tech Area in July, "Those poor little people" – the future Japanese victims of the bomb (Bird&Sherwin 2005, 313, 314, and 317). Oppenheimer was on the Scientific Panel of the Interim Committee (along with Enrico Fermi, Arthur Compton, and Ernest Lawrence) charged with making recommendations on the use of the bomb and planning for the US's post-war atomic policy. They concluded that scientists were not competent advisers on political matters. Although opinions among their colleagues were "not unanimous", their recommendation was "direct military use" to save American lives and prevent future wars (Oppenheimer and others 1945). This logic was inspired by Niels Bohr, who saw in the bomb the potential to "make world war suicidal and therefore obsolete" (Rhodes 1977). Bohr's first question upon arriving at Los Alamos had been: "Is it really big enough?", meaning will it make war impossible in the future? In their chapter titled "Bohr Was God, and Oppie Was His Prophet", biographers Kai Bird and Martin Sherwin write that Bohr "spoke in deeply philosophical terms about the project's implications for humanity" and his ideas about the possibility of an "open world." It made the enterprise seem "hopeful" and Oppenheimer feel "rejuvenated" (Bird&Sherwin 2005, 270 and 272). For Bohr's vision to become true and the shock to be "big enough" though, the bomb had to be dropped.

Theories about the father of the bomb's moral standpoint were fuelled by his post-war work, notably on the ill-fated Acheson-Lilienthal Report, with the Association of Los Alamos Scientists (ALAS), and against the development of thermonuclear bombs (Teller's "Super"). As a result of his post-war stance and because of his early communist connections, Oppenheimer notoriously lost his security clearance after a hearing with the FBI in 1954 – he would be rehabilitated in 1963. "Oppie"'s unique charisma, enigmatic personality, magnetic appearance, and powerful image as a guilt-stricken, fallen hero, disgraced by those he had served, all contributed to make him something of an

icon, whose story has been told countless times in literature, theatre, opera, and cinema, latterly by Christopher Nolan in a 2023 biopic (Genay 2021). One anecdote many times told that combines the expression of his conflicted conscience and rejection from his superiors is when Oppenheimer told Truman in 1947 that he felt, "We have blood on our hands." Truman allegedly replied, "Never mind, it'll all come out in the wash" and instructed his lieutenants not to let "that crybaby in here again" (Rhodes 1996, 205).

According to celebrated nuclear historian Richard Rhodes, the author of *The Making of the Atomic Bomb* (1986), the appeal for Oppenheimer is due to the fact that he "struggled with" and "suffered for" the twentieth "century's most disturbing contradictions" while being "a man of disturbing contradictions himself." Rhodes opposes Oppie's "fierce, lively energy" to his endless brooding on death and his profound dedication to peace to his infliction upon humankind of "its most terrifying instruments of war." The historian adds, "humanly enough", Oppenheimer had sought the admiration of others in his acceptance of this difficult job (Rhodes 1977). One notices the same discursive throughline as in Rotblat's, Szilard's, and other objectors' rhetoric, which underscores the scientists' humanity: their nature as fallible men rather than their function as manipulators of exact science prone to hubris, like "men who played god" (Moss 1970). On 2nd November 1945, two weeks after resigning from his post in the midst of the post-war exodus from Los Alamos, Oppenheimer concluded a speech to ALAS in terms that Rotblat's Nobel Lecture decades later would echo, "We are not only scientists; we are men, too. We cannot forget our dependence on our fellow men. […] I mean also our deep moral dependence, in that the value of science must lie in the world of men, that all our roots lie there" (Oppenheimer 2007, 373).

The subsequent mobilization of Manhattan Project veterans to control nuclear knowledge and share their moral reflections with the public fundamentally changed practices (Smith 1965; Mian 2015). After all, physicists had "known sin" for the first time in history, "a knowledge which they cannot lose" (Oppenheimer in 1948, quot. in Thorpe 2006, 190). In his memoirs, McAllister Hull explains that physicists, engineers, and technicians usually "focused on accomplishing a specific, set task. It is not in their culture to consider the larger implications of their work." Whereas on the Project, they did everything from basic research to development and engineering; they "were well aware of the consequences all along." In a style that recalls the Bhagavad Gita quote, Hull titled his memoir *Rider of the Pale Horse*: a reference to the Book of Revelation 6:8, "Behold a pale horse: and his name that sat on him was Death." The embodiment of death is a recurring image among early nuclear

physicists who carried the guilt of being "accessory to several hundred thousand deaths." Hull was never able to look at images of Hiroshima and Nagasaki "in a purely objective manner." Sixty years later, though, as he evaluated his "own participation in the beginning of this threat to life on earth", Hull foregrounded taking responsibility rather than guilt or regret, and finding solace in adherence to the policy of deterrence and the role of moral leader embraced by the US during the Cold War:

> I believe the United States is more likely to have "sensible" leaders than all but a few other nations in the world, despite some historical and current counterexamples. […] I thus remain convinced the United States must lead in the design of new weapons so that nations who may have a dangerous capability will be restrained. As difficult as it is to contemplate their awesome destructive power, we must manage these weapons rationally. Even had I known the consequences of the bombings of Hiroshima and Nagasaki beforehand, I would still have worked as hard as I did to make the weapons a success. The personal consequence is that I have a share of responsibility for the destruction of two cities and thousands of civilians living in them. That is a responsibility I shall carry with me for the rest of my life. (Hull 2005, 13, 73, 101, and 147)

Despite the inherent contradiction of being the only nation to have ever used nuclear weapons in wartime, the belief in the US as a moral nuclear power helped assuage uneasy consciences, precisely by providing coherence with the US's founding values, the "city upon a hill" watched by the rest of the world (Doyle 2022). Throughout the decades of US-Soviet opposition, as nukespeak and markers of moral supremacy inundated political speech, nuclear workers would rely on the same better-us-than-them rationale. Preparing for war was the best way to maintain peace, or, as President Ronald Reagan put it, achieve "peace through strength" (Reagan 1983).

2. The cold warriors: *si vis pacem, para bellum*

Patriotism remained one of the prime motivators to work at one of the nuclear weapons sites during the Cold War. Los Alamos retained its status as the place where the war had been won. Other facilities likewise enjoyed the prestige of contributing to national defence, in addition to providing high, stable salaries. The nuclear scientists, technicians, engineers, etc. were a new type of soldier, waging a new kind of war. The Communists replaced the Nazis as the existential threat that justified the pursuit of ever stronger deterrence, and employees of the military-industrial complex derived "a great sense of joy"

from their job: they were doing their part "to help keep the world peace with the fear of the bomb" (Brenda Britten quot. in Cargle 2000).

Los Alamos electrical engineer and physicist Ralph Partridge called his participation in a testing series at the Nevada Test Site "the best time of [his] life", because "it was almost like combat." It was a way of proving himself, the rite of passage he was awaiting to ease his conscience troubled by inaction: "I wasn't in World War II, or Korea, or Vietnam, but I felt like I had to do something for my country. If I went out and did a job that involved a certain amount of personal danger, it made me feel better inside, that you were sharing something with the men who were out there getting shot at" (quot. in Malmgren&Matthews 2017, 118). Likewise, Franck George, an assembly line worker at Pantex, contended the dangers of working "with the most hazardous materials known to mankind" were worthwhile, because maintaining the nuclear arsenal was "a big deal". He added, "National security means a lot to me […]. I'm fairly passionate about my job." Although some would wonder if his work was "a good thing", his unequivocal answer was, "Yes, it is, because without our national security, we lose our freedom, so we do have a mission. Now, in the same breath, I've got to tell you, let's pray to God we never have to use the nuclear weapons, but let's also recognize that to keep this country safe, we may have to someday" – one might add *again*. George also emphasized a sense of filial patriotic duty: "My dad was in the Navy. […] My dad is no longer with me. This is my chance to serve my country" (quot. in Defense Nuclear Facilities Safety Board 2013, 173).

Perhaps with less verve, many approached the job with realism, or as McAllister Hull put it above, one had to consider those weapons "rationally", for the alternative would be dangerous idealism. "I don't even give it a thought", Pantex manager Charles R. Poole declared, "nuclear weapons are part of our armaments. There's no such thing as an ideal world" (Mojtabai 1986, 71). The product itself made it easy to forget its purpose: line workers sometimes "regarded the bombs like beautiful pieces of furniture. You wouldn't believe it was so destructive. They were finished to the nth degree" (Elson 1978). The principles of deterrence and massive retaliation were particularly appealing to Texan employees, who employed a logic akin to that supporting the Second Amendment to the US Constitution, the right to bear arms. Jack P. Thompson, director of classification at Pantex, thus told writer Grace Mojtabai in the 1980s, at the height of the antinuclear movement, "If Russia drops atomic weapons on us, if they think I'm not going to retaliate with atomic weapons, they're crazier than a bedbug!" Furthermore, "We enjoy Pantex […] It's part of our economic survival, and we don't think we're dirty from working out there. We think that

we're helping to protect the 223 to -4 million people that are in the United States" (Mojtabai 1986, 76). Similarly, inspector Buddy Stoner, a former Green Beret and a nuclear, biological, chemical weapons instructor, told Mojtabai the thought of taking a human life was "foreign to everything I believe in. But, at the same token, don't you break in my house, I'll kill you for it. In concept, in conviction, my moral standards, I am a conscientious objector, but I'm going to protect myself, my life, my family." Although Stoner called himself "an optimist", he did not believe world peace stood much of a chance, which he explained as "the fulfilment of prophecy […] that men become so corrupt, so evil and vile, and so obsessed with sin that one of these days – I don't want to say that God's going to run out of patience…" (77-78). This particular interpretation of Scripture, especially the Book of Revelation, to make moral sense of impending nuclear war is what Mojtabai calls "end-timing" in her analysis of relations between final assembly and fundamentalist Christianism.

Faith, be it in the Bible or in the US government's policies, was an effective way for nuclear workers to make peace with their role in the preparation for nuclear warfare. Weapons expert Robert Dinegar is an interesting case, as he had originally planned to pursue religious studies to become a priest but decided instead to go into engineering in 1940, following the advice of an Army recruiter. He received a Ph.D. in chemistry from Columbia University and arrived at Los Alamos in 1950 to work on initiator explosives and detonation velocity measurements. During his thirty-seven years on the job, he continued his religious training, until he was ordained to the priesthood by the Episcopal Bishop of New Mexico. Fatalistically, Dinegar summarized his approach to bomb-making: "There is sin in the world, always has been, always will be. […] Unfortunately, one of the ways of controlling large-scale improper actions is the work that we do in Los Alamos." Quoting Norris Bradbury, Oppenheimer's successor at the head of the lab, Dinegar summed up his "theology, [his] philosophy, and the function of the Lab" as "keep[ing] the world at peace until we learn to live together in harmony" (quot. in Malmgren&Matthews 2017, 37).

For others, religiosity was the nexus of guilt and regret. Leo Vigil, who was in nuclear transport, hauling contaminated material ("hot stuff") for thirty-eight years, confessed, "If I had to have my work life to do over again, I would never be involved in anything to do with war. I hate the killing. What does the first commandment tell us? Thou shalt not kill! Oh, I'm such a good Christian. What kind of a Christian kills, for whatever reason?" When jobs first opened at Los Alamos, Vigil and other locals "jumped at them," because well-paid, stable employment was a rarity in the area, but they "really had no idea what [they] were getting into." By contrast, he believes the second generation of lab workers

could not claim ignorance as an excuse, "They know what we created and they go in with their eyes open. […] When you create something to go kill your neighbor, I don't think that's right" (56 and 59). The pressure of knowledge had therefore shifted from joining efforts to develop the science in time of war to repudiating those efforts in time of peace.

Despite the high wages locals could earn at the labs, some refused to pursue a nuclear career, such as New Mexican writer Juan Estevan Arellano after he graduated in the 1980s. His judgement of the labs was irrevocably negative: "People don't relate to Los Alamos, it is hard to love a place that creates bombs to kill people!" He "didn't fit there" and neither did the lab fit in northern New Mexico; in his mind, it was "a cancer" the war had "thrown into" the region, making "many people rich and greedy. When somebody loses their job at McDonalds, no one pays attention but when they lose their job at Los Alamos, they talk about it because he made good money and everybody cries" (Impact Los Alamos Project 1996).[5] The fact that the place generated widespread criticism, notably about being soulless and cultureless in comparison to the vibrant New Mexican traditions, actually created some cohesion. Chick Keller came from Pennsylvania in 1967 to "the town that nobody likes." He commented on the inescapable moral tarnish of the wartime achievement, "We get attacked, it does not matter what we do, it has to be wrong, because 'They built a bomb—that means everything else they do is wrong.' And the only thing that makes a community here is the fact that [the attacks are] invalid" (Chick Keller in Impact Los Alamos Symposia 1997, 68). The morality issues eventually became an integral part of the community's id.

In some rare cases, like Rotblat in 1944, ethical dilemmas drove employees to resignation. Ed Grothus, for instance, was a machinist turned antinuclear activist, who resigned ten years after arriving at Los Alamos to work on the hydrodynamics of implosion in 1949. Like many of that generation, Grothus found his political calling in the protest against the Vietnam War. He joined the Los Alamos Citizens for Peace in Vietnam and was an alternate delegate in the 1968 Democratic Convention for Eugene McCarthy, who was challenging Lyndon Johnson on an anti-war platform. His opinion of his former workplace and colleagues grew radical, describing them as "thrice screened". First, they are self-screened: echoing Arellano, "If you don't believe in the nuclear industry then you don't belong here." Second, they are highly trained in the hard sciences or engineering, and "this concentration on science ignores the liberal arts, philosophers, historians, economists." And third, they need a Q clearance, which he calls a "Q Klux clearance. Understand, they are equal opportunity destroyers, oops, employers" – LANL has repeatedly been attacked for its

discriminatory employment practices. Grothus was also something of a prankster, as he would later be investigated by the Secret Service of Albuquerque as a threat to national security for sending President Clinton a can of "organic plutonium" soup "from the reactors of Los Alamos, the home of the A-bomb, grade A approved by the AEC for quality assurance", which would give the President a halo and make his cat glow (quot. in Malmgren&Matthews 2017, 93-94). For the post-war generation of nuclear scientists, choosing a job within the nascent military-industrial complex no longer merely meant contributing to the "arsenal of democracy" (Roosevelt 1940), it became increasingly significant politically and philosophically, as an identity-defining choice.

A second example was Eloy Ramos, a forty-one-year-old Pantex employee, son of immigrant Mexican farmers and a devout Catholic. In the early 1980s, after working at the weapons plant for sixteen years, first as a janitor and then in vehicle maintenance and repair, reading about antinuclear protests in the country triggered a reappraisal of his workplace, even though his job did not directly involve weapons. The final straw was when Bishop Leroy Matthiesen from the parish of St. Francis next to the bomb factory called to Pantex workers to quit their jobs on grounds of conscience in 1981, the year Ronald Reagan announced plans to develop the controversial neutron bomb. Bishop's recommendation followed "A Catholic Call to Conscience" signed by thirty-nine theologians in August 1980, enticing Catholics engaged in the production of weapons of mass destruction to seek other, morally acceptable occupations. Despite having a large family of seven children and no other job, Ramos refused any financial help to make his decision "a complete act of faith" (Squyres 2012; *Pantex Ex-Worker Still Jobless* 1982). He became head of the maintenance department at the diocese and later commented, "When I go outside and see the beautiful world and I imagine what would happen if nuclear weapons were used, I know I made the right decision" (Lee 1984-1997). Bishop Matthiesen wondered then, "Were there other troubled souls among the silent? Could an appeal to conscience overcome practical economic realities?" (Mojtabai 1982, 27). Experience had shown him that it seldom did.

Robert Gutierrez, an assembly operator at the plant, had come close to making a similar decision before Ramos, as he was following a program to become a permanent deacon. Gutierrez had consulted Matthiesen about the morality of his job, for which he had long prayed, hoping to provide for his family and enjoy the benefits Pantex had to offer, such as health insurance and scholarship programs. He had therefore believed his hiring was a sign of God's blessing. The position of the Catholic Church, however, made him re-evaluate

this interpretation. Matthiesen encouraged him to look for employment elsewhere, since the "Church law forbade a cleric to work in a bomb factory", yet Gutierrez never found any (Matthiesen 2005, 136). According to a *New York Times* reporter, Gutierrez acknowledged that he had done "considerable soul-searching over his Pantex job" and come to the conclusion "that he was doing nothing wrong" and preferred "to become an inactive deacon rather than give up his livelihood." Economic realities had trumped conscientious objection. In the end, Ramos was the only Pantex employee who ever answered the Bishop's call, while Gutierrez secured the blessing of Pope John Paul II on a pilgrimage to Rome (Briggs 1981). Yet for many morally concerned workers across the nuclear weapons complex, staying on the job was not solely at the expense of their conscience. Some paid a heavier price.

3. The sacrifice: paying the price of producing nuclear deterrence

Although the Cold War remained "cold" between the US and the Soviet Union, the conflict claimed many casualties in proxy wars around the globe and among the populations of the two superpowers in their pursuit of nuclear supremacy (e.g., downwinders, atomic soldiers, uranium miners, and victims of plutonium experiments). From the early days of atomic science, the hazards of radioactivity were known (Hacker 1987). During the Manhattan Project, the urgency that dictated an intense work pace and the obsession with secrecy often collided with safety rules, which were defined as the work progressed. Many participants subsequently battled with disease, especially cancers. Yet due to the multiplication of substances now identified as carcinogenic, establishing a correlation between a diagnosis and exposure to various radioactive materials is extremely complicated and still debated, except in cases of accidents or definite epidemiological data. After all, it was customary for employers, including the nuclear labs, to distribute cigarettes to workers. Probably the most well-known early accidents at Los Alamos led to the deaths of Harry Daghlian in August 1945 and Louis Slotin in May 1946, both occurring while they were handling the "demon core" and "tickling the dragon's tail" in nuclear lingo (Wellerstein 2016; Hacker 1987). Those were spectacular, memorable deaths, but there have been countless other anonymous ones other the years, remembered by family members and surviving co-workers.

Peter Malmgren interviewed over 150 Los Alamos workers for the book he co-authored with Kay Matthews, *Los Alamos Revisited*. At the end of each interview, he asked the same question: "If you had to do it over again, would you have followed the same path that led you to Los Alamos?" He found that

about half the group responded positively, emphasizing all the benefits derived from their job for them and their children, while the other half answered they would have stayed away and would not encourage their children to work there: "Their health was too high a price to pay for job security" (Malmgren&Matthews 2017, 127). He concluded that the main distribution factor into either group was the interviewees' experience with occupational illnesses and death. Several testimonies highlight the fact that they are the only survivors from a particular team who worked in certain areas of the lab. Ruben Montoya, for instance, kept a list of forty-eight workers who had died after working in the Sigma building alongside him, most of them in their forties and fifties and mainly of various forms of cancer. Illnesses mentioned by Los Alamos and Pantex employees include lung diseases, pulmonary stenosis, lymphatic leukaemia, Hodgkin's, various tumours that had to be removed, sometimes at birth, miscarriages and birth defects, Arnold Chiari malformation, craniostenosis, mercury poisoning, myasthenia gravis, Parkinson's, and berylliosis or beryllium sensitization.

Despite having lost most of his co-workers to cancer, Manuel Salazar still "loved working there" because he "made a good living. Everything we have we bought and paid for with our jobs in Los Alamos." He had two sons working for the labs too. For him, "There's no way of proving" a connection between those deaths and his workplace. The only real danger he saw was when five or six workers "got blown up" when they sled high explosive material across the metal bed of a truck, creating a spark that ignited the material and resulted in explosion (144-145). Like the fate of Daghlian and Slotin, this was an accident without room for speculation. Sometimes, risks were knowingly taken by the workers. Technician Phil Schofield, for example, described working with gloveboxes to handle sensitive material. To avoid the hassle of taking off their anti-contamination gear, they would have their coffee break in the room: "We drank it right there in the hot area. […] We knew what we were doing was dangerous, we knew some of us were probably going to pay the ultimate price. But what could we do? This was our life, our career. We had worked ourselves into a box that we couldn't walk away from. We had families, we had bills, and you pay the piper" (149). In most cases, as we have seen, and as happens in many occupations, the financial factor was the ultimate decision-maker that superseded qualms and fears. In other cases, it seemed nothing could make a dent in the unfailing faith workers had in the merits of the mission. At a public hearing on a compensation program for occupational illnesses in 2000, Franck George recognized, "Protecting our country and our national security has not been without a significant cost" of sickness and death (Franck George quot. in

Cargle 2000). Rather than deterring him from the industry though, the human cost increased his devotion and dedication, as a safety representative, to improve working conditions. Twice did he repeat, "I will die making sure Pantex is safe" (George quot. in Defense Nuclear Facilities Safety Board 2013, 173-174). Depending on who was asked, sacrifice was therefore either the result of exploitation or of loyalty, and the bomb manufacturers were executioners or victims.

Testimonies have revealed that the highest risk was often taken by employees at the bottom of the nuclear hierarchy: the decontaminators, the janitors, and the technicians (as opposed to the managers and the scientists). Anthony Montoya, a radiological control technician, testified that the scientists were "God" in the early days: "during my time they ruled. They were getting that bomb and they didn't want to hear anything from anybody. Sometimes we'd have to clean up after them ourselves" (quot. in Malmgren&Matthews 2017, 125). Decontaminator Leo Vigil recalled the underground tests conducted on the road toward Bandelier National Monument and how "one time a bunch of radiation came out of one of these holes" and "a lot of labourers, especially from Chimayó, were exposed." Vigil checked himself routinely with his Geiger counter. Once, when he found out he was "hot", he insisted until someone from the AEC eventually came to his house to check for contamination, which they found on the sofa. After decontamination, he still got "a lot of rashes" whenever he was in contaminated areas. The company doctor advised "a little baby oil" (56-59). Contaminated employees were also told to drink beer to wash out the radioactivity from their bodies (Cargle 2000).

Lab doctors were notoriously unhelpful and still ignorant of the effects of radiation on the body. They tended to tell their worried patients their ailments were a product of their imagination, so those who could afford it sought a second opinion, whereas others simply went back to work after decontamination, i.e. stripping down and being scrubbed with cleaning agents such as Versene and acetone. In 1996, Phil Schofield was put on long-term disability. Doctors believed his health problems were occupational but refused to say so on record. He recalled,

> One of the supervisors at that time told us we were "expendable assets". We knew where we stood. He couldn't give a damn about our safety. At one time, under the Cold War scenario, we were at war in a sense. Russia was busy developing more weapons, and we were busy doing the same thing. […] In a sense, this guy was telling the truth, we were expendable. Scary but honest. At that time, production of weapons material was more important than human life. (quot. in Malmgren&Matthews 2017, 149)

The theme of dehumanization reappears, this time not in reference to the bomb's creators, who were expected to be infallible, but to its often-nameless victims.

One particularly hazardous task was disassembly of old weapons. Pantex technicians had to remove the "physics packages" and separate the conventional High Explosives (HE) from the deteriorating (crystalizing and changing colour) plutonium pits in a glove box. This work was conducted under "gravel Gerties": gravel suspended above the workers' heads to ensure that no radioactive contamination would escape in the event of an accidental explosion of the HE. Rubber mats covered the floor as well (Dubose 1997). The gravel would be released from above and entomb the disassembly workers with the fissile material. "We know that if the HE goes, we're paste. […] It's our graveyard", one technician testified. Workers wore radio-sensitive dosimeters, and their blood and urine were tested regularly for tritium, thorium, plutonium, and other contaminants (Dubose 1998, 13). Concerns were also later raised about the strong chemicals used without protection in the early days to clean components after disassembly (Alodine, Molykote, MEK, toluene, trichloroethylene, acetone). Those solvents were nauseating, especially in a confined area.

Some employees, like at Los Alamos, blamed management for dishonesty and lack of protection. Robert Gauna claimed, "The supervision department is downplaying the role […] of the hazards." He mentioned parts "treated with contaminated beryllium, and some are uranium and beryllium. We have dust that we take home with us. Our hands, our bodies and faces were red, you know, when we opened these parts" (Cargle 2000). One of their major concerns was how the substances they were taking home on their clothes and bodies might affect their families. John Bell had "a couple of tumours" and squamous cell carcinoma of the lung from inhaling and ingesting uranium dust in the cells without a respirator. He blamed the company who "tell you you didn't get a significant amount to hurt you; don't worry about radiation, it won't bother you; you won't get enough. They don't tell you about the latent part of it […] the roughest part of it. You slowly go down, and you don't know […] what it is that's doing it." The invisible threat and the lack of answers is probably what the workers struggled the most with. Ted Shutt worked for Pantex from 1979 to 1998 "with all types of radiation, beryllium without any – ever being offered any type of protection" until the last decade. He believed himself to be "as healthy as a horse" when he left. Then, in December 1999, he underwent a lung

lobectomy and concluded without much certainty, "I guess with the past history, it probably led to that, I would think" (Bell and Shutt quot. in Cargle 2000). More sourly, Thomas Pace, who worked on the guard force from 1963 to his early retirement at age fifty-five in 1995, accused the company of unfair treatment and of covering up "incidents of contamination by destroying documents" that proved he had twice been contaminated, making it hard to obtain insurance for his disability. He was "somewhat bitter that I gave a company thirty-five years of my life and was treated this way as the end result." The end of the Cold War opened the valves to a torrent of damning revelations about the way nuclear workers had been treated. In turn, the outpour of information and testimonies led to legislation, such as the 1991 Radiation Exposure Compensation Act for downwinders and uranium miners and the Energy Employees Occupational Illness Compensation Program ten years later. Showing evidence of exposure to be eligible for compensation proved to be the next challenge for claimants in Los Alamos and Pantex, as records are indeed rare.

Conclusion

Conscientious objection to nuclear weapons is transgenerational and has been felt and expressed across the nuclear production line since the Manhattan Project. The main throughline emerging from this analysis is the extent to which the advent of nuclear weaponry made people involved in its creation and development reflect upon what being a member of the human species means, from the most philosophical to the most prosaic considerations. Among those considerations, the economic factor is also a striking recurrence, probably because it connects to the first level of Maslow's hierarchy of needs: physiological needs come before safety needs. Interestingly, the sign that greets employees on the road that leads to the Pantex plant reads, "Our Jobs And Our Lives Depend On Safe Operation Of The Pantex Plant. Work Safely Today" (Elson 1978). The order of the words puts jobs before lives, income before safety. Changing jobs on moral grounds in areas of the US where good employment is scarce was a luxury that many nuclear workers, similarly to employees in other dangerous and morally challenging industries, did not have. Although some moral struggles were shared, other factors than conscience played into leaving or staying on a nuclear job. Graduates from the best higher learning institutions in the country, who moved specifically to northern New Mexico, the Texas Panhandle, or other locales hosting nuclear weapons facilities, had the option to find work elsewhere if they desired it, as many

Manhattan Project participants did at the end of the Second World War. Most of the blue-collar workers hired locally, however, would find it more difficult, or inconceivable even, to renounce such advantageous positions close to home, especially in harsh economic times. It took an act of faith. Equally, working for the industry could also be construed as an act of faith in the US and in nuclear deterrence as the best prevention of war. For those who paid the price of bomb-making with their health, their sacrifice was either made in patriotic support for their country or for the financial comfort of their families (sometimes both).

Today, stockpile stewardship and weapons modernization remain a thriving industry and both facilities remain well-funded: DOE has announced over 4.5 billion dollars for LANL and 1.1 billion for Pantex in its budget for fiscal year 2023, in both cases substantial increases from 2022 (1.127 billion and 170 million respectively) (US Department of Energy 2022). As the war in Ukraine unfolds, fear of nuclear war "has returned with a vengeance", according to global security specialist Nina Tannenwald. "We are in a period of nuclear excess rather than restraint", she contends. The issue is that to most of the populations of nuclear powers, "the scary realities of the Cold War and 'duck and cover' are the stuff of history books, rather than lived experience" (Tannenwald 2022). Even though none of the leaders of today's nuclear states were alive when the bombs were dropped in Japan and the main World-War-II atomic sites (Los Alamos, Oak Ridge, and Hanford) are now memorialized as the Manhattan Project National Historical Park, the preparation of nuclear warfare and the ethical questions it poses are not humanity's past. They are its present and its foreseeable future.

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1 The high explosives concerned implosion-type plutonium weapons, such as the one tested at Trinity and dropped on Nagasaki (Fat Man), rather than the gun-type uranium bomb dropped on Hiroshima (Little Boy).

2 Uranium miners and nuclear waste managers should also be included in this production chain, yet the length constraint of this article compels me to focus on the shortened design-to-disassembly portion.

3 In reference to Morgan (1999).

4 On this rhetorical tool, which I call "historical hyperbole," see "The Peaceniks' Moral Crusade" in Genay (2022, 96-118).

5 On relations between Los Alamos and *Nuevomexicana/os*, see Gómez (2022).