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Eyewitness to the Mushroom Clouds: A Dorchester Native, the Bomb, and Its Power to Transform an Ordinary Life

ANITA C. DANKER



Abstract: *The nuclear testing program the United States conducted in the Pacific a half-century ago was a national event with life-altering consequences for ordinary citizens who participated in the undertaking. This is the story of Dick Clayton, a Dorchester resident who struggled for years to find meaningful employment before securing his dream job at a local electronics firm with links to the Manhattan Project. Clayton's career took off during an economic boom fueled by the expansion of defense spending after World War II; on assignment at Eniwetok in the Marshall Islands during the height of the atomic age, he engaged in the important work he had always craved. He paid a price for his unexpected brush with history—his health suffered in the aftermath—but he also discovered his life's work and became a productive member of his community. Anita C. Danker is a retired associate professor of education at Assumption College, where she still teaches a course on multicultural education to both graduate and undergraduate students.*

* * * * *

A half century ago, on July 26, 1963, President John F. Kennedy delivered a moving address to the nation announcing one of the most significant achievements of his abbreviated tenure in office, the finalization of a nuclear test ban treaty. To a nation living with the fears and uncertainties of the Cold War, his words were poetic and reassuring: “Yesterday a shaft of light cut into the darkness. Negotiations were concluded in Moscow on a treaty to ban all nuclear tests in the atmosphere, in outer space, and under water.”¹ The president went on to explain that while limited in that it still permitted underground testing, the treaty would prohibit the United States, the United Kingdom, the Soviet Union, and all future signatories “from engaging in the atmospheric tests which have so alarmed mankind.” Though the treaty would have its critics among those who questioned how well it could be enforced as well as those who believed it did not go far enough, it was clearly a step forward in the drive to reduce hostility among the major powers of that tension-filled era.²



Dick Clayton
(undated photo)

For Dorchester native Dick Clayton, a private citizen largely unknown outside of his family and small circle of friends and colleagues, the end of atmospheric nuclear testing marked the conclusion of a series of work-related journeys to the Pacific Proving Grounds (PPG), an exciting and rewarding chapter in his otherwise unremarkable life. In light of his humble background as a high school dropout, aimless young adult, and chronic tinkerer and hobbyist, Clayton’s participation in a number of the atomic missions the United States government undertook in the late 1950s and early 1960s was largely unexpected. As with so many of those who were connected in some way to the development of nuclear weapons, he would pay a price for his part in one of the most consequential—and later controversial—projects of the Cold War era. On balance, though, he seemed to have been grateful for the opportunity; he craved to “do worthwhile things,” to be “a useful man and helpful citizen,” and to prove himself worthy of his wife Abbie.³ Coming of age in the late 1920s and early 1930s, he was too young to serve in World War I but not quite young enough for World War II; Clayton’s story is one shaped by a grinding struggle to find his way during the Great Depression and, eventually, a lucky break. That break, during the boom period of the Cold War when the military industrial complex was running at full tilt, came in the form of expanding opportunities for men of his generation with

a bent for technology. His is also the quintessential story of how an ordinary life is unalterably changed by a somewhat accidental brush with history.

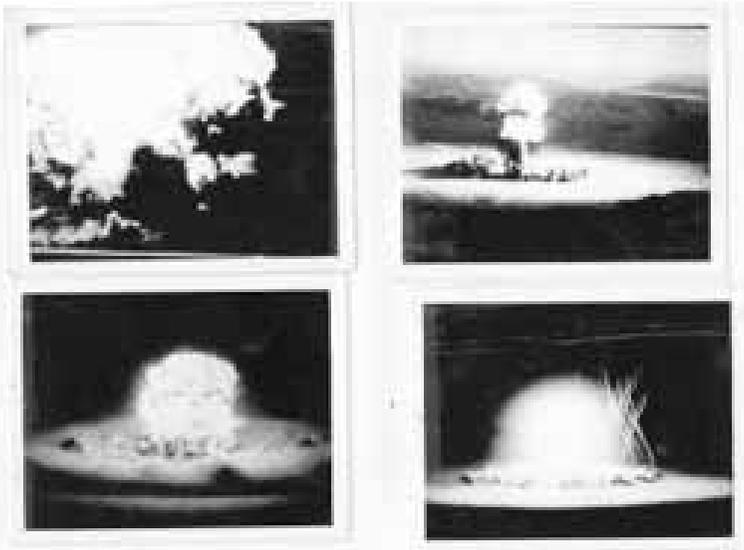
A TIME OF FEAR AND WONDER

The nation was just about a decade into the nuclear age when Dick Clayton reported for duty to the Boston site of a relatively young and growing electronics firm, one that had benefitted immensely from the race to develop nuclear weapons. After years of secretive research into the explosive power of the atom, a successful test of the bomb that became known as Trinity had been carried out in the New Mexico desert in the summer of 1945, and so began the official launch of the atomic era.⁴ The fear-tinged excitement that swept through the group of scientists, military personnel, and their families gathered at the Los Alamos research community in the heady days of the Manhattan Project eventually permeated the larger society so desperate for relief from the long years of depression and war that the nation had endured throughout the 1930s and early 1940s. In the developmental stages, the general public had for the most part been kept in the dark about the exact nature of the experiments that led to the creation of the bombs released over Hiroshima and Nagasaki, more deadly than any the world had ever seen before. In the exhilaration that followed the Japanese surrender, Americans for the most part assumed an air of resignation that the decision to use such powerful weapons had been the right one.⁵ Soon after, though, as the reality of the awful destruction that had been wrought in pursuit of peace sunk in, the mood of the nation changed somewhat to reflect the fear and apprehension about what had been unleashed and its portents for the survival of life on the planet.

The scientific community that Dick Clayton was about to join in 1954 had been of divided opinion leading up to Trinity, and this division continued. On the one hand, the researchers were propelled by an unstoppable need to uncover all that could be learned about the potential of nuclear energy in both its destructive and peaceful aspects, while on the other, they were fearful and guilt-ridden concerning the horrific consequences of their discoveries.⁶ For a short time, many of the very scientists responsible for the research and construction of the first nuclear weapons orchestrated a largely unsuccessful campaign to promote the sharing of information among the major players in the international community. They argued that the destructive potential of their creations necessitated a cooperative rather than a competitive worldview. In the end, the widespread fear of Communism throughout the United States, the strong anti-Soviet stance of government officials, and the

national pride at being in the forefront of the atomic revolution resulted in the casting aside of the scientists' arguments, which were largely dismissed as left-wing propaganda.

In the year following the conclusion of World War II, a monumental battle over who would control the research and development of nuclear weapons and related uses of atomic energy in the United States played out in Congress. Eventually, a bill introduced by Brian McMahon, Democratic senator from Connecticut, won out, but not before going through a number of changes that represented a compromise between those who advocated for civilian control and those who favored continuing the wartime policy of military ownership.⁷ Signed into law on August 1, 1946, the bill established the Atomic Energy Commission (AEC), a body of five civilians to be appointed by the president, as well as a powerful Military Liaison Committee composed of representatives from the Army, Navy, and Air Force. In addition, there were provisions for the establishment of a Joint Congressional Committee



These photographs were found among Dick Clayton's belongings, in an album marked "Memorabilia from Atomic Tests." Participants were instructed not to bring their own cameras to the testing sites, so it is unclear if these photographs were taken by Clayton or one of his colleagues.

on Atomic Energy and a group of appointed advisors to provide scientific and technical expertise.⁸ The Military Liaison Committee was charged with making recommendations to the AEC concerning the production of future nuclear weapons, while the Commission overall was to oversee both private and government research and the development of atomic energy projects. Despite the continuing military involvement, the fact that the AEC shifted control to civilians was a relief to many concerned citizens and underscored the hope that atomic energy need not forever be associated with destruction and war. It was in this climate of anticipation with respect to the potential of atomic innovation and a widespread belief in the promise of science to shape a better future that research-based enterprises such as Edgerton, Germeshausen, & Greer (EG&G), the Massachusetts firm that gave Dick Clayton his opportunity, were destined to flourish.

NATIVE SON

Although born in Cape Breton, Nova Scotia, on September 8, 1908, while his parents, Richard Anthony Clayton and Almena Bisset Clayton, were visiting relatives, Dick Clayton (né Richard Wilfred Clayton) lived nearly his entire life in Massachusetts, largely in Dorchester's sheltered Clam Point neighborhood.⁹ The family had moved there from Newton in 1919 to be closer to his mother's twin sister and to seek new employment opportunities for his father, previously a spinner who had worked in the woolen mills along the Charles River. By age forty, the elder Clayton had developed asthma, shortness of breath, and a chronic cough, telltale symptoms of white lung disease, a condition common among textile workers. After the move, he worked as a laborer at various construction sites and as a tree surgeon—hardly easy jobs, but nonetheless outdoors and away from the dust and grime of the woolen mills. Clam Point was and is a neighborhood of contrasts, with pretty tree-lined streets, a mix of handsome Victorian homes and tired triple-deckers, a landmark gas tank, gritty city beaches, and constant buzz of traffic from Boston's congested Southeast Expressway.¹⁰ When Dick Clayton was growing up there in the early decades of the twentieth century, the area was more bucolic, home to a diverse group of families, many of them immigrants from Ireland, Italy, Poland, and Canada. One of those families, the Cardillos of Mill Street, would provide a haven for him during his troubled youth.¹¹

Upon moving to Dorchester, young Clayton enrolled at the Mary Hemenway School, where he completed the eighth grade and ended his formal education. His adolescence was not an easy one, as his parents, constantly seeking to improve their standard of living, moved from one modest rental

to another. Eventually, they settled on Faulkner Street, behind the elevated railroad tracks in the tough Fields Corner section of Dorchester, within easy walking distance of the more suburban Clam Point. Being uprooted time and again could not have been easy for Clayton and his three sisters, and he constantly battled with his father, who was deeply disappointed at his only son's seeming lack of initiative and his inability to hold down a job after leaving school. Unlike his father, who, as a young working-class youth, had relied on the textile mills in his hometown of Lowell and elsewhere in Massachusetts for employment, Clayton did not have this option. By the mid-1920s, textile and manufacturing jobs were heading south or drying up altogether.¹²

At one point, Clayton's parents ordered him out of their home until he could contribute to the support of the struggling family. Probably through his Sampson cousins, children of his mother's twin sister who had settled in Dorchester, he struck up a friendship with the Cardillo boys. A large, close-knit family, the Cardillos lived in a huge, aging Victorian mansion across the street from the beach in Clam Point on property adjacent to the sprawling Sampson house. Ciriaco "Jerry" Cardillo, the patriarch, was an Italian immigrant and entrepreneur, whose fortunes rose and fell with the business climate of the times. Perhaps because of the hostility Cardillo had encountered as a young newcomer to the mean streets of Boston's North End when he arrived from Italy in 1900, his attitude and that of his wife Alice toward the numerous friends and outcasts their eight children brought home from time to time for a meal and a place to sleep was generous and welcoming.¹³ Consequently, they took Clayton in and gave him shelter during his late adolescence and early adult years.

It was around the Cardillo dinner table that Clayton became fascinated by Abbie, the lively oldest daughter and her father's favorite. Soon their mutual attraction became the subject of gossip and speculation among family members and neighbors.¹⁴ The principal barrier to their relationship appeared not to be that Clayton, with his blue eyes and Anglo name, was of a different cultural background than the Cardillo family. It was rather the fact that he had a reputation for laziness due to his inability to find steady employment. His work record from 1922, when he left school, through 1934, when he and Abbie eventually married, indicates that he tried his hand at a variety of jobs from shoe salesman to railroad clerk and that he was laid off from nearly all of them. Abbie, on the other hand, attended Bryant and Stratton Business Institute and worked as a bookkeeper. Although she never completed the requirements for her high school diploma, she was accepted into the program, and her doting father paid the tuition. Given that the

later years of this unproductive phase of Clayton's life were set in the Great Depression, when nearly everyone had a hard time finding and keeping a job, his spotty work record might not have seemed such a flaw to Abbie and her family. She recorded in a diary entry a few months after their marriage that though they started with "absolutely nothing," she had faith that her husband was "going to be a great man someday."

In all likelihood, Abbie based this belief at least in part on the fact that Clayton—unlike Abbie's brothers and other males in her working-class social circle, who often eschewed education in favor of more colorful enterprises, including bootlegging during Prohibition—did try to better himself, making limited attempts to gain knowledge and training in some newer fields such as radio technology and electronics. Clayton enrolled in programs at both the Massachusetts Radio School (1927–1928) and the Curtis Technical Institute (1933–1934), studying at each for several months but not graduating. His rocky relationship with his father notwithstanding, Clayton seemed to have inherited from him a curiosity about how things worked and how to fix them, interests that would eventually lead him to his life's work.¹⁵ In keeping with this predilection, Clayton also completed a photography course at the Franklin Union Technical Institute in Boston, from which he received a certificate in 1937. These experiences, though not impressive in terms of paper credentials, did provide him with technical skills that would eventually lead him to a meaningful job—and would send him on the great adventure of his life. Throughout the 1930s and into the early 1940s, however, he continued to engage in only periodic work in the building trades. Clearly, such jobs did not translate into a stable career that made the best use of his aptitude and training.

When World War II broke out, Clayton was a thirty-three-year-old married man with a five-year-old son. Unlike three of Abbie's four brothers and others of his generation, he did not enlist in the military. However, he did serve his country through employment at the Fore River Shipyard in Quincy, Massachusetts, where more than ninety naval vessels were constructed during



1958 Passport Photo

the war.¹⁶ He also joined the United States Signal Corps and was sent to radar schools in Baltimore and Philadelphia for several weeks of training. His increasing knowledge of electronics, communications, and photography, as well as his ongoing technical training, should have helped make him more employable, but his sporadic work record continued into the 1940s. When the war ended, so did Clayton's job at Fore River. He was unemployed for several months and went back to working in the building trades, mostly painting houses.

For the next six years, his frequent job changes proved to be a constant source of friction between him and Abbie, who was concerned about their lack of financial stability and their only child's future. Her faith that her husband would someday be a great man was beginning to falter. Clayton had neither physical disabilities nor impediments such as alcoholism or chemical dependencies to explain his unstable work record. However, he was clearly held back by his lack of a high school education and his inability to fully engage in the relatively low-level jobs he pursued or that were open to him during the first decades of his work life. He wanted something more, and, thanks in large measure to the improving business climate for just those industries in which he was interested, he was able to find his calling.

The fortunes of the Clayton family were about to change dramatically for the better in the early 1950s as the Massachusetts economy began to benefit from the Cold War arms race between the United States and the Soviet Union. As historians Brown and Tager explain: "The combination of government contracts, private venture capital, and the research facilities of the area's universities resulted in the development of an up-to-date industrial base in Massachusetts, which increased per capita income and generated widespread employment."¹⁷ One of the companies whose fortunes improved with the demand for products related to the military was Raytheon.

Originally founded in Cambridge, Massachusetts, in 1922, to develop motors, appliances, and tubes for radios, Raytheon Manufacturing Company evolved into a defense-contracting firm during World War II and a developer of missiles in the post-war period.¹⁸ In 1951, Clayton applied for employment at the company's Boston location and was probably more surprised than anyone else when he was hired as a technician. His stint there continued for three years, during a period of unprecedented expansion for the company. Raytheon's profits from its defense-related divisions were soaring, and new company sites in Massachusetts sprang up in Bedford, Lowell, Quincy, and Waltham.¹⁹ By this time, Raytheon was widely regarded as a well-established company, employing more than twenty thousand workers worldwide. Despite Raytheon's success in the early 1950s, Clayton was laid

off in the fall of 1954. No reason is given in his employment record, but as Alan R. Earls and Robert E. Edwards note in their illustrated history of the company, Raytheon's attempts to become a leader in consumer electronics were "modest footnotes" during the post-World War II period and subject to the boom and bust uncertainties associated with the consumer market.²⁰ While at Raytheon, Clayton made a number of contacts who urged him to apply for a position at the then-thriving EG&G, which eventually hired him. This proved to be the opportunity he had been waiting for all his adult life; it turned out to be his most challenging job, his most fulfilling, and his last.

Clayton was hired by EG&G in November 1954 as a laboratory technician with few credentials save his brief and somewhat scattered studies related to electronics and photography, the radar training he acquired during the war years, and his three-year stint at Raytheon. Given the nature of the projects in which EG&G was involved, these various experiences, haphazard though they were, no doubt helped him gain entry into the young but promising company. The fortunes of EG&G at that time were inextricably linked with the nuclear testing the United States government conducted during the 1950s and 60s when Clayton began his tenure there.²¹ Thus it was largely coincidental that he became a small but not inconsequential player in the Cold War drama of atomic experimentation.

THE COMPANY

The early history of EG&G is somewhat cloudy and illustrates how the unique technical knowledge of its founders—along with happenstance more than any clear-cut plan—shaped the organization and the course of the company's development.²² The origins lie in the laboratories of the Massachusetts Institute of Technology (MIT) where, as a young professor in the 1930s, Dr. Harold Edgerton worked to perfect electronic flashes, or strobes, used in photography. He collaborated with two of his graduate students, Kenneth Germeshausen and Herbert Grier, and together they sought to design useful products based on their strobe research. They were hired as consultants by various industries, from printing to advertising, and created a convenient flash for cameras used by news photographers, an invention that was further developed by Eastman Kodak.²³ The partnership of the three scientists took an unexpected turn toward military applications during World War II, when their research was linked to aerial night photography that was essential for various combat missions. Ultimately, Edgerton's work was instrumental in the Normandy campaign, while Germeshausen focused

on radar, and, perhaps most significantly, Grier became involved in the Manhattan Project.

Arguably one of the most outspoken of the founders was a fourth scientist, one whose name did not become part of the company brand but whose involvement was fundamental to the course of EG&G's progress. Bernard O'Keefe, a young naval officer with technical training, was sent on a covert mission to Los Alamos, New Mexico, during World War II and became involved in the so-called Project Y. Under the direction of General Leslie Groves and the controversial scientist J. Robert Oppenheimer, this enterprise eventually produced the first atomic bomb.²⁴ In short, from the start, O'Keefe was involved with the Manhattan Project, and, when the war was over, he accepted a post at MIT while at the same time continuing as a private consultant for the ongoing nuclear research being conducted at Los Alamos. While at MIT, O'Keefe worked as a project manager for Grier and became invaluable to the EG&G partnership when they left academia and formally incorporated in 1947. Over the next several years, according to a 1964 advertisement in MIT's *Technology Review*, the company expanded from a workforce of "less than a score of people" at its founding to "more than 2000 employees in the Greater Boston area, Las Vegas, Nevada, Santa Barbara, California, and Albuquerque, New Mexico."²⁵

Hoping to end their involvement with the development of weapons of mass destruction and to focus on commercial products during the post-war period, the founders of EG&G were nonetheless propelled back into the military orbit. They agreed to accept a government contract to build the firing mechanisms needed for the nuclear testing scheduled to be conducted in the Pacific after the creation of the AEC. O'Keefe had previously worked on firing systems at Los Alamos, and while in Boston, Grier had been the architect of the actual mechanism that triggered the first atomic weapons.²⁶ Though they might have chosen otherwise had the government not come calling, the principal players in the creation of EG&G and their company became forever identified with the darker side of the nuclear age.

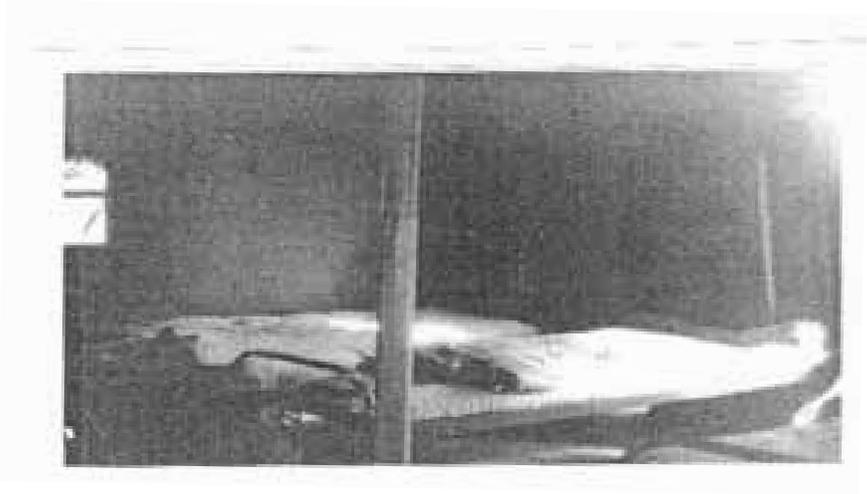
In 1947, the United States government conducted Operation Sandstone at the Eniwetok test site in the Pacific. The purpose was to improve on the earliest nuclear weapons and add to the growing stockpile that officials considered necessary for national security.²⁷ EG&G played a pivotal role in the project in that its personnel were engaged to work on the all-important devices for timing and firing the weapons. O'Keefe, who was on location in the Pacific during the mission, describes the immensity of the task as follows:

A nuclear weapons test is a massive undertaking. Thousands of people and hundreds of ships, boats, motor vehicles, and aircraft were organized under the military command of a Joint Task Force, with Army, Navy, Air Force, and civilian scientific task groups. All equipment, to the last nail and screw, was assembled months before the test, and transported thousands of miles to these remote Pacific islands. Additional towers were constructed to house photographic operations on distant islands. . . . Heavy concrete bunkers covered with sand were needed to protect instrumentation from blast and radioactivity. Miles of underwater cable were laid to connect the various instruments to the timing and firing system.²⁸

The high-powered scene at Eniwetok that Dick Clayton would enter a few years later was far removed, in both geography and character, from the quaint neighborhood in Dorchester where he had spent most of his adult life. If he had any misgivings or apprehension about becoming a direct, albeit low-level, participant in the nuclear age, he did not reveal them to his extended family and indeed seemed to relish the opportunity to shift into the mysterious and risky world of atomic weapons.

EYEWITNESS

Dick Clayton's decade plus at EG&G began on November 29, 1954, when he was hired as a technician at an hourly rate of \$1.80.²⁹ The following year, the then-vice president of the company, Bernard O'Keefe, sent him a congratulatory letter praising his performance and authorizing a raise in pay. His employment card indicates that he subsequently received regular raises and was promoted to senior technician in August of 1956. He also acquired his radio telephone operator permit from the Federal Communications Commission in January of 1955, which most likely was related to the work he was doing or about to be engaged in for EG&G. Several months prior to his first promotion, Clayton learned that company officials had selected him to participate in the government's nuclear testing project in the Pacific. He was assigned to Task Group 7.1 and began to prepare for his first overseas mission. Dick Clayton had been an employee at EG&G for a little over a year, and in that relatively short period of time he had established himself to the extent that he was invited to contribute to a complex and sensitive project with monumental consequences for himself, his colleagues, and the



Housing in the Pacific Proving Grounds
Date unknown.

larger society. He could not possibly have imagined how his life was about to change.

In February of 1956, along with his task group assignment, Clayton received a memo with lengthy travel instructions from Herbert Grier. In addition to administrative details concerning airline tickets, baggage restrictions, and travel allowances, the company memo reminded participants that they would be “working under conditions quite different from those at home,” and that they had a “legal obligation to maintain security and to avoid loose talk.” The following month, the Department of the Army contacted task group members to inform them about regulations pertaining to the purchase of military clothing, which was to be worn strictly according to prescribed codes. Additional instructions to members of Clayton’s task group warned against carrying weapons, binoculars, telescopes, and photographic equipment to the Pacific Proving Grounds (PPG).

The instructions also addressed health and safety issues. Orders directed participants to update immunizations and to carry their records with them at all times. Further directives advised task group members to protect themselves against sunburn, to be on the alert for poisonous sea creatures, to drive cautiously on the rocky and unfamiliar roads, and to avoid overeating and excessive alcohol use, common temptations during long periods of inactivity. The highly sensitive nature of the work that the EG&G contingent would be engaging in was underscored by the carefully detailed directives members were issued concerning the classified notes they would be sending and receiving throughout their stay at the PPG.

Clayton’s first nuclear mission was Operation Redwing, conducted in 1956 at the Eniwetok and Bikini Atolls in the northwestern region of the Marshall Islands. The United States government had gained control of this territory from the Japanese during World War II and had been using the site since the late 1940s as an alternative to the continental testing grounds due to its relative isolation, scant population, and tranquil weather.³⁰ The official (declassified) history of Operation Redwing reassuringly notes that:

Eniwetok contained the characteristics needed for a test site. . . . A large space of open sea around the atoll could receive the deposit of radiological debris, and the ocean currents would carry radioactive particles hundreds of miles before affecting inhabited land masses. Violent storms were most unusual. The prevailing winds minimized radiological hazards for the small populations on neighboring islands.³¹

Here the official historians appear to be downplaying the risks involved in the operation and underestimating possible environmental damage and threats to human life in the region.

The sixth in the extensive atmospheric nuclear testing series carried out before the Nuclear Test Ban Treaty of 1963, Redwing included seventeen detonations, all with names relating to American Indian tribes. The specific purpose of the tests was to gauge the effects of “high-yield thermonuclear devices that could not be tested in Nevada.”³² A number of the Redwing experiments, which ran from early May through mid-July 1956, attempted to measure how powerful the explosions were and to determine their possible military effects. EG&G’s primary responsibility during Operation Redwing was to provide and maintain much of the electronic equipment, no small task. The company also conducted experiments involving high-speed photography utilizing Edgerton’s Rapatronic shutter camera to capture the nuclear tests in progress.³³

As for Dick Clayton’s role, he was assigned to the communications contingent, where he did not disappoint his superiors. A letter of commendation sent from Task Group 7 headquarters in Los Alamos to EG&G at the conclusion of the testing notes “outstanding cooperation in this field from certain EG&G personnel.”³⁴ The

letter singles out five individuals who exceeded all expectations and routinely performed their services willingly, efficiently, and cheerfully on a twenty-four-hour basis. Dick Clayton’s name is among them. His prior training in the communications field as well as his diligence and exacting nature obviously served him well in this important aspect of the project.

Due to the classified nature of the work he was engaged in during Operation Redwing and subsequent missions, Clayton did not leave much of a paper trail describing his life at the PPG. If he sent letters home relating to his duties, they were not preserved. One personal note that does survive



Redwing Identification Badge

This government-issued identification badge for Operation Redwing is dated 1956.

is one that he wrote to his twenty-year-old son, then a student at Harvard College.³⁵ In it, Clayton congratulates him on passing his driving test, gives him some pointers about how to care for the family car, and advises him not to be in a hurry to sign up for military service. The letter could be from any parent working away from home for an extended period of time. Clayton was clearly following orders from EG&G management not to reveal the nature of his work to outsiders. Despite these restrictions, relevant evidence can help reconstruct a picture of Clayton's daily life in the atolls.

One source is a revealing twelve-minute set of informal film clips from Edgerton's digital collection.³⁶ These include such varied scenes as the military base at Eniwetok with its tents, vehicles, and corrugated metal barracks; a set of fish tanks containing examples of shellfish from the local waters; and EG&G workers adjusting cameras and loading equipment. Clayton appears in one brief scene helping to load gear into a departing jeep. As if to underscore the upbeat frame of mind of company executives, several clips show Edgerton, his wife, and others in their party enjoying the good life on the beaches of Hawaii. They appear to be typical vacation scenes and do not hint at the serious nature of the work the men in the group would soon be undertaking.

Another interesting source is a memoir of former army private Michael Harris, who describes the year he spent at the PPG during which Operation Redwing was in full swing. Harris relates a story of life on Eniwetok that is at once alarming, ironic, touching, and hilarious.³⁷ With a degree from Brown University fresh in hand, the twenty-two-year-old draftee was assigned to a support unit and packed off to the PPG, where he was charged with helping to edit the daily newspaper, *The Atomic Times*. In his official capacity, Harris proved to be a perceptive participant observer. His memoir includes much that would hardly be appropriate for the pages of a publication meant to uplift the spirits of lonely men far from the familiar and to present a positive slant on strange and often bizarre events. He writes of the three-eyed fish that inhabited the sweltering lagoon where military personnel routinely went swimming, the drenching rains that regularly interrupted the evening outdoor movie screenings, the cost-saving decision to cancel the purchase of protective goggles for the lower ranks of military observers, and the pounding headaches that began for him a few weeks after his arrival. Harris describes the bleak environment as follows:

This was a barren spot surrounded by ocean, a desolate concrete desert that deserved the name men gave it, the same as another security post-Alcatraz, the maximum-security prison. Eniwetok

and the famous San Francisco penal institution were alike in a number of ways. One of them was what the men living in both places called their home: The Rock.³⁸

Among Dick Clayton's memorabilia from Operation Redwing is a copy of *The Breeze*, a civilian counterpart to the military's *Atomic Times* for which Harris wrote. The June 28 edition—a simple, double-sided, typed yellow sheet—contains a mix of international, national, and entertainment news along with major league baseball scores, movie and television listings, church services, jokes, and the dining hall menu. With his twenty-four-hour on-call status and demanding communications duties, Clayton probably did not have much time to engage in the recreational activities mentioned in *The Breeze*, but the fact that they were offered may have helped make the harsh and unfamiliar surroundings less disquieting to him and the other members of his group.

In addition to the newspaper, Clayton also preserved a number of black-and-white photographs, which help to illustrate his activities during missions to the PPG. Taken by an unidentified photographer, the images fall into three categories: those illustrating the environment, those involving work, and those recording off-duty activities. The photos showcase the barren landscape and rough barracks, with their small beds, thin mattresses, and lack of privacy. The all-male task group members are shown building flimsy shelters, loading trucks, and reading instrument panels. Clayton appears in a number of the shots, laughing with a colleague, and sharing a drink with fellow task group members outside a simple structure that must have served as a club or recreation hall. The pictures reveal a middle-aged man who is far from home but enjoying his work and the camaraderie of his associates. Among these seemingly innocuous photos, however, a few stand in stark contrast to the others. These are the four that capture the nuclear explosions detonated at the PPG, including one of an unmistakable double-mushroom cloud.

Back in the labs at EG&G in Boston after his participation in Redwing, Clayton, now a senior technician, assisted in a number of projects. He helped develop equipment such as stepping switches for the communications industry and air drop timers for the military. Clayton was subsequently assigned to three additional nuclear testing projects between 1958 and 1962, including Operations Hardtack I and II and Operation Dominic. He received certificates of participation for each and preserved a number of related documents. Hardtack I was a massive undertaking during which thirty-four detonations were recorded, more than the combined total of

all the previous explosions that occurred at the PPG.³⁹ Incongruously, the intimidating weapons, built for the purpose of terrifying adversaries with their potential to obliterate targets, were referred to by the labels of some of nature's most treasured trees and shrubs, such as "Butternut," "Dogwood," "Magnolia," and "Sycamore."

Unfortunately, some participants in this series of tests were exposed to elevated levels of radiation. Clayton may have been among them, as he was overseas in May when a troubling incident occurred. Records indicate that the May 14 explosion at Eniwetok resulted in fallout that lasted considerably longer than anticipated. Evidence that he was overseas during the period of prolonged radiation can be found in a communication sent to Clayton from EG&G, dated May 20, 1958, informing him that he had been promoted to the position of laboratory supervisor and had been given a raise in pay. The letter concludes with a personal note in which the EG&G representative states his hope that "everything is going well with you out there."⁴⁰ While Clayton's whereabouts cannot be pinpointed on the day the fallout exceeded expected limits, what is certain is the fact that in his later years he was plagued by a strange skin condition that puzzled his doctors and required hospitalization. The lesions, along with the persistence of the ailment, were consistent with having been exposed to radiation.⁴¹

Operation Hardtack II, the next atomic testing assignment for Clayton, was conducted in Nevada in the fall of 1958. This series was particularly urgent because of an upcoming moratorium on atmospheric testing slated to begin in November of that year.⁴² The goals for this relatively limited but nonetheless critical operation included assessment of delivery systems for smaller nuclear mechanisms as well as of military equipment designed to survive future detonations. Among Clayton's papers is a trip report covering his mission to Nevada, which lasted from September 17 to October 11, 1958. Again he was assigned to a radio communications group, and, as with similar past projects, appeared to have had a successful outing. Clayton's report is interesting in that it mentions for the first time his expectations and mental state at the outset. Probably somewhat road weary at this point, he notes feeling a bit depressed upon his arrival, before there was much work to do. He writes that after talking about his negative emotions with project mates, he learned that "everyone had experienced the same feeling and after a short period of acclimation one got into the swing of things and work progressed smoothly."⁴³ Although in the memo he commends his coworkers at EG&G's field office for their "courteous and efficient attention to the welfare of the Boston people," he does complain somewhat crankily about the poor airline service. The tone of his report overall reveals perhaps some disillusionment or

fatigue resulting from the strain of extended periods of travel and engagement in taxing and hazardous missions.

Clayton's final expedition into the world of atmospheric nuclear testing was Operation Dominic, the last to be conducted by the United States government. His travel orders authorized a stay of approximately sixty-three days to commence on April 3, 1962. The EG&G travel arrangements memo did not differ significantly from those for previous operations, stressing responsible personal conduct and routine processing procedures. Operation Dominic was particularly difficult for EG&G officials as it was a hastily planned project in response to Soviet advances and in anticipation of the execution of the test ban treaty.⁴⁴ Once again the company was called upon to set aside promising commercial ventures and to provide support for a grueling set of tests, this time including the Polaris missile system and the United States Navy's nuclear anti-submarine rockets. One task of note that Clayton engaged in during this assignment was completed at Barber's Point in Hawaii, where he and some colleagues performed electrical tests on defective photographic equipment that had been transferred from Johnston Island, the site of several detonations during Operation Dominic. He and his colleagues identified a number of problems and left a report for those in charge of repairs. While on assignment, Clayton received word from Boston that he had been promoted to the salaried position of technical supervisor. His letter of confirmation concludes with the following congenial message: "Have a cold one for me and we'll see you when you get back."⁴⁵

IN THE AFTERMATH OF THE BOMB: A "HELPFUL CITIZEN"

When Clayton did get back from his last assignment in the Pacific, he resumed his everyday work and private life without seeming to miss a beat. He and his family had moved to a new home on Everdean Street in the old neighborhood, not far from the house on Mill Street where Abbie had grown up. If Clayton had any reservations about the moral and ethical ramifications of the projects at the PPG or the continental site in Nevada, he did not express them openly among members of the family. He continued on as a salaried technical supervisor with engineer status and received regular, albeit modest, pay increases. He joined the ranks of the "10 Year" circle at EG&G and was celebrated at a luncheon in the Silver Room of Boston's storied Hotel Kenmore in 1964. There were some signs during this period that Clayton was also beginning to find his voice as a well-informed and engaged member of the larger society. He seemed at last on his way to realizing the lifelong goal that he had written about to his young wife in a long ago letter, when he had

expressed frustration at not finding worthwhile work and affirming his desire to be a helpful citizen.

One early example where Clayton asserted his opinion with respect to public matters occurred at work in 1962, not long after he returned from Operation Dominic, when he composed a lengthy inter-office memo on the subject of holiday contributions. In it, he asked the company to support two causes he considered worthwhile.⁴⁶ The first was WGBH, Boston's educational television station, which had suffered losses in a fire the previous year and was soliciting funds to help rebuild. His second charitable project for 1962 was a clothing drive organized by a fellow employee on assignment for EG&G in a remote area of the South Pacific and who was shocked when he observed the needs of the natives and the missionaries who were working with them. Clayton concluded his appeal as follows:

Most of the activities planned for our employees . . . are directed toward pleasure and rightly so; but we should not completely overlook the pleasure to be derived from contributing to the aid of the worthy causes mentioned herein.⁴⁷

The charitable endeavors that Clayton singled out and urged coworkers to support are telling in that one is educational and the other is humanitarian. He may well have had such inclinations prior to his engagement in the nuclear projects, but no evidence exists among his personal papers that he had previously gone on record to champion these or any other public causes.

Regrettably, during the same phase of his life when Clayton was enjoying his status as a long-standing employee and a veteran of the atomic testing projects, he was also experiencing a number of serious medical setbacks that required hospitalizations and lengthy periods of sick leave. Among the more common ailments related to aging that Clayton was inconvenienced by during the mid 1960s, one is unusual in that he suspected it was a consequence of his exposure to radiation at the PPG. In 1966, he was confined for an extended period at Massachusetts General Hospital due to a serious skin condition on both his hands; the ailment was debilitating and did not respond to outpatient treatment. Similarly, others who were onsite during the Redwing, Hardtack, and Dominic testing projects were plagued by strange skin maladies. Lerager's photographic history shows a number of such cases, including some involving serious gastrointestinal conditions, which Clayton also experienced.⁴⁸ The latter were severe enough to require surgery and a long period of recuperation. After several years of attempting to fulfill his work responsibilities in the face of an ongoing set of health

problems, including a heart condition, Clayton took early retirement at the age of sixty.

His suspicion that many of his health issues stemmed from the radiation he may have come in contact with between 1955 and 1962 is documented in a series of communications between Clayton and the United States Department of Energy (DOE) requesting his exposure history. Curiously, Clayton's letters of inquiry as well as responses from Reynolds Electrical & Engineering Company, the primary contractor compiling information concerning civilian exposure during the nuclear testing at the Nevada and Pacific sites for the DOE, are preserved among Clayton's papers, but not the actual report, which was mailed to him in the spring of 1980. One possibility is that he provided the document to his doctors as part of his medical history. Many of his health-related expenses had been covered by EG&G, which provided disability benefits, payments to Massachusetts General Hospital, and reimbursement for physicians' and pharmacy bills during his last days with the company.⁴⁹

Despite his ongoing medical concerns, Clayton's later years were productive. He kept busy pursuing a number of his lifelong hobbies and developed one new one of note: organic gardening. Nearly every day, from early spring through late fall, he worked in his backyard garden, which evolved into a showplace in his Clam Point neighborhood. In a letter to a publication dedicated to organic gardening, he noted that he always made it a point to return the residue of everything he grew back to the earth and that he scrupulously avoided the use of chemical sprays.⁵⁰ Perhaps because of the potential for destruction he had witnessed firsthand in the Pacific and in Nevada, along with persistent questions concerning the consequences for humans and the environment from exposure to chemicals and radiation, Clayton became committed to preserving and enhancing his immediate surroundings in ways that did no damage. In addition, he became something of a spokesperson for his community with respect to issues that he believed required the attention of local government.

Clayton kept a file containing drafts of letters he had composed to various public servants, including Boston's mayor, Kevin White, as well as formal and informal responses from the recipients. White had been elected mayor in 1967 and served for sixteen years, a time period that was nearly identical to Clayton's retirement. The mayor's tenure, coinciding as it did with the period in Clayton's life when he had the time and confidence to express his opinion on public issues, may have bred a sense of camaraderie with the mayor that resulted in a series of exchanges between 1969 and 1983 that underscore White's conciliatory and personal leadership style. They also illustrate both



the scope of the problems that concerned Clayton and the thought that went into his suggested solutions. The topics of his letters to White and other local officials ranged from the petty to the grand—from the presence of litter and the use of fireworks in his otherwise quiet neighborhood to plans for a major community renewal project in a blighted section that saw delay after delay.

Although the city of Boston during the White administration experienced dramatic changes, Clayton's Clam Point community remained largely the same as it had always been.⁵¹ Bridging the often-conflicting concerns of Boston's many insular neighborhoods and those of the city's business interests was a major goal for White, who was largely regarded as a peacemaker with a polished approach to problem solving. His leadership was tested by a number of crises, the explosive 1974 school busing controversy arguably being the most wrenching.⁵² This violent episode was in part the result of anger at and resistance to the city's changing demographics that in the eyes of many residents threatened to alter the character of their familiar neighborhoods.⁵³ While sections of the city such as Charlestown and South Boston (not far from Clam Point) were torn apart by the violence that accompanied the implementation of court-ordered busing, Clayton's neighborhood was not deeply affected.

The Massachusetts-based companies that provided Clayton with his entry into the world of scientific innovation and enabled him to enjoy a middle-class lifestyle and comfortable retirement in his Dorchester home continued to thrive during this period, thanks to government contracts for defense enterprises and public faith in technology. The limited nuclear test ban treaty that President Kennedy had initiated in the early 1960s was followed by a number of additional attempts by the United States and other world powers to avoid a nuclear disaster.⁵⁴ These did not, however, curtail government spending for military projects. Raytheon and EG&G were among the many high tech Massachusetts enterprises that prospered from defense contracts during the 1970s and 1980s.⁵⁵ Among Raytheon's innovations were the Lark Missile, which could successfully intercept objects in motion; the AIM-7F that enhanced the military's ability to engage in air combat; and the highly publicized Patriot Missile that saw action during the Persian Gulf War.⁵⁶ The underground testing program that was permitted under the terms of the 1963 test ban treaty actually opened up avenues for EG&G's continued participation in the theater of atomic experimentation. The company went on to develop photographic equipment capable of checking underground test activity before the first shock waves were recorded.⁵⁷ EG&G continued to design nuclear monitoring systems, and company personnel were among those who went to Russia to participate in joint verification experiments at a testing location there.

Meanwhile, both companies continued to advance in diversified areas of scientific research and to create products driven by consumer demand. Raytheon-built computers helped to steer the spacecraft that landed on the moon, while EG&G's founder Harold Edgerton collaborated with undersea explorer Jacques Cousteau to search for treasure and scout out the elusive Loch Ness monster using the firm's sonar equipment.⁵⁸ In the 1970s, EG&G engineers designed a flash tube that could be utilized in the photocopying process, while its environmental division focused on energy conservation projects. During Dick Clayton's lifetime, EG&G experienced some costly missteps related to developing nuclear power for consumers, efforts that fizzled after the end of the oil embargo in the mid 1970s. However, the company continued its prominence in the competition to land government contracts; its peak year was 1988, when sales and profits reached record levels.⁵⁹

Dick Clayton had passed away from a heart attack a few years earlier in 1985, while tending his beloved garden. Although the period of his life immediately following his missions was marred by poor health characteristic of those exposed to radiation, he had lived on well into his seventies and succumbed to the most common of chronic illnesses. In many respects, his life was an ordinary one revolving around family, friends, and hobbies, save for one defining difference. Although he did not find his professional calling until mid life, it proved to be a markedly adventurous one that allowed him to participate in scientific experiments of great public consequence. These experiences arguably provided him with the confidence and informed world view to evolve into the committed and respected citizen he always hoped to be in the community that had nurtured him for nearly seven decades. His life in part reflects the experiences of a generation of poorly educated working-class men who came of age in Massachusetts when factory jobs were drying up during the deindustrialization of the 1920s and whose aspirations were further discouraged by the widespread scarcity of opportunity in the 1930s. Clayton's journey took an auspicious turn during the post-World War II and Cold War eras when the federal government's demand for products related to defense sparked the unprecedented growth of an electronics industry in the region. Companies such as Raytheon and EG&G, which might otherwise have passed over lightly qualified individuals like Clayton, were willing to offer them opportunities to prove themselves in the boom climate of the nuclear age. In so doing, they provided these individuals with a highly valued path to the middle class.

Notes

¹ John F. Kennedy, “Address to the Nation on the Nuclear Test Ban Treaty, 26 July 1963,” accessed July 18, 2012, <http://www.jfklibrary.org>.

² Richard Hofstadter and Beatrice K. Hofstadter, eds., *Great Issues in American History*, vol. 3 (New York: Vintage Books, 1982), 553. The editors maintain in their notes on the 1963 address that Kennedy considered the Nuclear Test Ban Treaty his greatest accomplishment, although in the end it may have influenced the Soviet Union to embark on a dangerous missile building effort.

³ Richard W. Clayton to Abbie Clayton, Undated letter in the author’s possession.

⁴ For a concise technical description of the development of the first atomic bomb, see Howard Ball, *Justice Downwind: America’s Atomic Testing Program in the 1950s* (New York: Oxford University Press, 1986), 3 – 19. For a social history of the development of a unique community at Los Alamos during the Manhattan Project, see Jon Hunner, *Inventing Los Alamos: The Growth of an Atomic Community* (Norman, OK: University of Oklahoma Press, 2005), 12 – 80.

⁵ Paul Boyer, *By the Bomb’s Early Light: American Thought and Culture at the Dawn of the Atomic Age* (Chapel Hill: University of North Carolina Press, 1994).

⁶ Boyer, *Bomb’s Early Light*, 93 – 106.

⁷ Richard G. Hewlett and Oscar E. Anderson, Jr., *The New World 1939/1946*, vol. 1, *A History of the United States Atomic Energy Commission* (University Park, PA: Pennsylvania State University Press, 1962).

⁸ Ball, *Justice Downwind*, 20 – 24.

⁹ Richard A. Clayton, Notarized Statement in the author’s possession, December 15, 1941. The fact that his parents were American citizens, his father by birth and his mother through marriage, while he was born in Canada, ostensibly because his mother wanted to be with her family during her pregnancies, would pose difficulties later in his life when Clayton sought employment at companies with government defense contracts such as Raytheon and EG&G.

¹⁰ The area is also known as Harrison Square, and its boundaries are imprecise. A 1978 Boston Landmarks Commission preservation survey notes that it is “described by many Dorchester residents as being located somewhere between Field’s Corner and the gas tanks.” The individuals highlighted in this article who lived in the community most frequently referred to it as Clam Point.

¹¹ Details of Clayton’s personal life are based on vital records, official documents, and personal correspondence in the author’s possession, as well as first-hand knowledge and family stories. He was the older brother of the author’s mother and was married to her father’s younger sister. The author grew up in the same house where Dick and Abbie Clayton lived for a number of years.

¹² Richard D. Brown and Jack Tager, *Massachusetts: A Concise History* (Amherst: University of Massachusetts Press, 2000), 246.

¹³ For a description of how the North End evolved from a grimy undesirable neighborhood populated by the city’s poorest immigrants to one of popular cafes,

high rent apartments, and tourist attractions see Alex R. Goldfeld, *North End: A Brief History of Boston's Oldest Neighborhood* (Charleston: The History Press, 2009).

¹⁴ Informal conversation between the author and a neighbor, 2008.

¹⁵ His children noted that their father had one indulgence, his Model T Ford. His favorite weekend pastime was disassembling it, polishing the parts, and putting them back together again.

¹⁶ Anthony F. Sarcone and Lawrence S. Rines, "A History of Shipbuilding at Fore River," accessed July 19, 2012, <http://www.forerivershipyard.com/historylong.php>.

¹⁷ Brown and Tager, *Massachusetts*, 275.

¹⁸ Raytheon Company, "History," *Raytheon Company Milestones*, accessed September 11, 2011, <http://raytheon.com/ourcompany/history/milestones/index.html>. For a detailed history of Raytheon from its founding through the early 1970s, see Otto J. Scott, *The Creative Ordeal: The Story of Raytheon* (New York: Atheneum, 1974).

¹⁹ Scott, *Creative Ordeal*, 249.

²⁰ Alan R. Earls and Robert E. Edwards, *Raytheon Company: The First Sixty Years* (Charleston, South Carolina: Arcadia, 2005), 36. 65. Newspaper advertisements included in the book illustrate that those targeting female workers during World War II at the site in Boston where Clayton was hired a few years later stressed the clean and pleasant work environment, while those appealing for men emphasized electronics as a "Field with a Future."

²¹ Peter Zavattaro, interview by Mary Palevsky, Nevada Test Site Oral History Project, University of Nevada, Las Vegas, May 31, 2005, accessed October 2, 2011, <http://digital.library.unlv.edu/>.

²² Bernard J. O'Keefe, *Nuclear Hostages* (Boston: Houghton Mifflin, 1983); Peter Zavattaro, *EG&G: Historic Involvement in the Nuclear Weapons Program* (Las Vegas: NTS Historical Foundation, 2007). Long time employees wrote both accounts. O'Keefe was a co-founder and served as chief executive from 1965 – 1983 and as chairman from 1972 – 1985. Zavattaro was hired right out of college in 1959 and worked at the Boston site until 1970 when he transferred to Los Alamos and later to Las Vegas where he was the general manager of the company's complex there.

²³ The Edgerton Digital Collections (EDC) Project, "Strobe in Industry," *Visionary Engineer: Harold "Doc" Edgerton*, accessed October 11, 2011, <http://edgerton-digital-collections.org>.

²⁴ O'Keefe, *Nuclear Hostages*, 51 – 89.

²⁵ Edgerton, Germeshausen & Grier, Inc., "Contributing Significantly to Boston's Science-Industries and the Community," *Technology Review* 66, no. 8 (June, 1964): 1.

²⁶ Zavattaro, *EG&G*, 3.

²⁷ Los Alamos National Laboratory, *Operation Sandstone*, accessed December 29, 2011, <http://lanl.gov/history/postwar/sandstone.shtml>.

²⁸ O'Keefe, *Nuclear Hostages*, 137.

²⁹ Details concerning Clayton's tenure at EG&G, including his overseas assignments, are based on his personal collection of work-related documents in the author's possession.

³⁰ Martin Blumenson and Hugh D. Hexamer, *A History of Operation Redwing: The Atomic Weapons Tests in the Pacific, 1956* (Washington, DC: Joint Task Force Seven, 1956).

³¹ Blumenson and Hexamer, *History*, 8.

³² Trinity Atomic Web Site, *U.S. Nuclear Testing From Project Trinity to the Plowshare Program*, accessed November 4, 2011, <http://www.cddc.vt.edu/host/atomic/trinity/index.html>.

³³ The Edgerton Digital Collections (EDC) Project, "A.E.C. Operation Redwing, EG&G Participation in Off-Continent Nuclear Tests, HEE-FV-162," *Visionary Engineer: Harold "Doc" Edgerton*, accessed July 25, 2012, <http://edgerton-digital-collections.org>.

³⁴ E.A. Luche, Colonel USA, to Edgerton, Germeshausen, & Grier, Letter in the author's possession, July 31, 1956.

³⁵ Richard W. Clayton to Richard W. Clayton, Jr., Letter in the author's possession, May 5, 1956.

³⁶ The Edgerton Digital Collections, Operation Redwing.

³⁷ Michael Harris, *The Atomic Times: My H-Bomb Year at the Pacific Proving Ground* (New York: Presidio Press, 2005).

³⁸ Harris, *Atomic Times*, 16 – 17.

³⁹ Trinity Atomic Web Site, 34.

⁴⁰ Edgerton, Germeshausen, and Grier to Richard W. Clayton, Letter in the author's possession, May 20, 1958.

⁴¹ Jim Lerager, *In the Shadow of the Cloud: Photographs and Histories of America's Atomic Veterans* (Golden, Colorado: Fulcrum, 1988).

⁴² Trinity Atomic Web Site, 38.

⁴³ R. W. Clayton to Edgerton, Germeshausen & Grier, Inc., Report in the author's possession, October 14, 1958.

⁴⁴ O'Keefe, *Nuclear Hostages*, 216.

⁴⁵ Senior Technical Supervisor to Richard Clayton, Letter in the author's possession, May 11, 1962.

⁴⁶ R.W. Clayton to E.A.C., Inter-office memorandum in the author's possession.

⁴⁷ *Ibid*, 2.

⁴⁸ Lerager, *Shadow of the Cloud*, 16, 36, 48, 52, 74.

⁴⁹ Industrial Relations Manager to Richard Clayton, Letters in the author's possession, December 21, 1966, January 3, 1966 and January 13, 1967.

⁵⁰ Richard W. Clayton to *Organic Gardening and Farming*, Letter in the author's possession, 1969.

⁵¹ In 2002 the Harrison Square/Clam Point neighborhood was listed on the National Register as a Historic District. Dorchester Atheneum, *Harrison Square*

District, accessed August 11, 2012, <http://www.dorchesteratheneum.org/page.php?id=592>.

⁵² Brown and Tager, *Massachusetts*, 297 – 300.

⁵³ See J. Anthony Lukas, *Common Ground: A Troubled Decade in the Lives of Three American Families* (New York: Vintage, 1986) for an in-depth study of the impact of policy decisions on individual families in three different neighborhoods of Boston.

⁵⁴ See U.S. Department of State, *History of the CTBT*, accessed August 8, 2012, www.state.gov/t/avc/rls/1592673.htm for a brief overview of the 1968 Nuclear Non-Proliferation Treaty, the 1974 Threshold Test Ban Treaty, and the 1996 Comprehensive Nuclear Test-Ban Treaty. A more detailed account is Thomas Graham, Jr., *Comprehensive Nuclear Test Ban Treaty New York, 10 September 1996*, accessed July 27, 2012, www.un.org/law/aul.

⁵⁵ Brown and Tager, *Massachusetts*, 286 – 287. Largely due to growth in both the high tech and service sectors of the economy, the state's unemployment rate in 1987 was only 3.2 percent.

⁵⁶ Raytheon, *Company Milestones*.

⁵⁷ Zavattaro, *EG&G*, 26.

⁵⁸ Zavattaro, *EG&G*, 40.

⁵⁹ “EG&G Incorporated, *Funding Universe*, accessed August 23, 2011, <http://www.fundinguniverse.com/company-histories/EG&G-Incorporated-Company-History-html>. EG&G was sold to San Francisco-based URS Corporation in 2002. Raytheon, which is still headquartered in Waltham, Massachusetts, celebrated its 90th anniversary on July 2, 2012.