

The Japanese Village at Dugway Proving Ground: An Unexamined Context to the Firebombing of Japan

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Abstract

This paper explores a previously unexamined context to the firebombing of Japan. Analysis of the decisions leading up to construction and military testing conducted in 1943 at the Japanese Village at Dugway Proving Ground in Utah allows important insights into the evolution of US bombing strategy. The shift in US strategy from precision to carpet bombing, the testing and development of incendiary weaponry, and the institutionalization and rationalization of pursuing civilian targets throughout Japan are considered alongside this untold history. Additionally, a broader appreciation of World War II timelines is suggested.

Keywords

Napalm, firebombing, Dugway Proving Ground, Japanese Village, World War II, precision bombing, civilian bombing, Tokyo air raids.



Standard Oil Development Co.

M-69 incendiary tests on Japanese style structures at Dugway Proving Ground. This and all subsequent images are from Standard Oil, *Design and Construction of Typical German and Japanese Test Structures at Dugway Proving Grounds, Utah, 1943*. Via JapanAirRaids.org

"The M69/M69X bomb was designed to lodge in the most flammable part of the building—the ceiling beams."

- U.S. Army Dugway Proving Ground, *Historical Fact Sheet*, p. 1

"Initially, it often seemed a home was unaffected, until the windows began to shine from within and then glowed 'like a paper lantern' from a ball of fire that sprouted tentacles that danced out from beneath the eaves to envelope the house until it crumbled inward upon itself."

- Richard B. Frank, describing an M-69 in the Tokyo air raid of March 9-10, 1945, *Downfall* pp. 7-9

"And, when I saw Japanese Village [at Dugway Proving Ground, Utah], it was burning. It went. It was gone. [It] was built in such a, you know, material, nothing like German Village, it was burnt. It burnt to the ground. All you find out there was a few pieces of wire, or something like that. Maybe some nails. That's all that's left of Japanese Village."

- Ethnographic Interviewee [name withheld], employee at Dugway Proving Ground, *Interview #4 Transcript*, p. 5

Introduction¹

Dugway Proving Ground is a U.S. Army post roughly 90 miles southwest of Salt Lake City, Utah. It is located between the Salt Lake Desert and Dugway Valley in Tooele County. The gas station-less road from Salt Lake City to the army post (a site larger than the state of

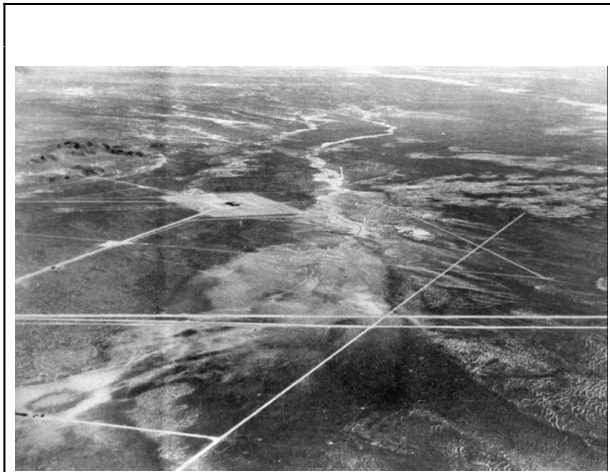
Rhode Island) is unfenced open range filled with wildlife, cattle, blind curves, and vision-impeding hillsides. Isolated more than twenty miles beyond the gate of Dugway Proving Ground lies the remains of German-Japanese Village, where replicas of German and Japanese buildings were constructed, bombed at least 27 times (see Table 1), and rebuilt in order to test incendiaries for use in World War II. Even today special clearance is required to get to what remains of the testing site, and locating it amid the interconnecting labyrinth of seemingly nameless and featureless roadways is difficult even with online maps.²

Geographic isolation aside, the German-Japanese Village project, started in 1943, was the result of a multifaceted effort, the origin, development, operation, implication, and overall significance of which is anything but trivial or simple. Surprisingly, very little, if any, research has been conducted directly about it.³

German-Japanese Village was born of two interwoven developments before and during World War II. The two developments that this paper explores are 1) the doctrinal switch by the Army Air Force from precision to carpet bombing, and 2) the development of incendiary weaponry. This paper will use Japanese Village at Dugway as a lens through which to understand these developments, as well as their historical contexts and implications. Dugway is an understudied and symbolic turning point in this international history. It is neither the first nor the last representative case studying the effects of civilian bombing, nor of incendiary weaponry development, but it is a unique, concrete example of official government endorsement at a critical moment in the evolution of US bombing strategy.⁴

Japanese Village is rarely referenced directly, and when it is referenced, it is usually as a footnote in a history of some other facet of the American war effort. It is rare to find a book or article that devotes more than a paragraph or

two at most to the project (John Dower's *Cultures of War*, E. Bartlett Kerr's *Flames Over Tokyo*, and Tom Vanderbilt's *Survival City* are some notable exceptions). This paper, with its emphasis on international and U.S.-Japanese history, will attempt to consolidate some of those perspectives and historical footnotes.



Aerial view shows the isolated German-Japanese Village site.



A closer aerial photo of German-Japanese Village where the viewing bunker can be seen.

Where (and from whom) did the idea of

incendiary carpet-bombing come from? This decision is a good example of rapid change as a result of the U.S. entry in World War II. In fairly short order, US military planners went from little to no knowledge of “the physical processes by which bombs, whether high-explosive or incendiary, caused damage” to strategic incendiary bombing. Upon American entry into the war, the means of testing and measuring the efficacy of what explosives they had was surprisingly crude.⁵

Dugway Proving Ground’s Japanese Village illustrates the convergence of several interrelated histories. Its context reveals much about the origins and development of U.S. approaches to civilian bombing and total war as linked to weapon development and international historical timelines of the end of World War II.

Laying the Foundation for the German-Japanese Village

Firebombing Japan was not a new concept before Dugway Proving Ground. As Patrick Coffey writes in *American Arsenal*, “Gen. Billy Mitchell had suggested the possibility of burning Japan’s ‘paper and wood’ cities as early as 1924. In 1939 the Air Corps Tactical School already emphasized, in their instructional courses, Japanese urban vulnerability to incendiaries.⁶ By November 1941, George Marshall had threatened to ‘set the paper cities of Japan on fire’ if war came.”⁷

Such ideas, too, had grown stronger leading up to the war, so much so that the destruction of “industry” had become a kind of institutionalized shorthand for indiscriminate bombing.⁸ Near the end of the war American understanding doubled-down on this line of reasoning: “Noting the Japanese government’s announcement that all men from fifteen to sixty and all women seventeen to forty would be called up for defense...the Fifth Air Force’s intelligence officer declared on July 21 [1945]

that ... ‘There are no civilians in Japan.’⁹ Although he didn’t originate the idea, General Curtis LeMay, the commander of Army Air Force operations against Japan, summed up American rationalization of carpet-bombing in his succinctly blunt manner in his memoirs:

No matter how you slice it, you’re going to kill an awful lot of civilians. Thousands and thousands. But if you don’t destroy the Japanese industry, we’re going to have to invade Japan. ... Do you want to kill Japanese or would you rather have Americans killed?¹⁰

The striking imbalance of technological power between the U.S. and Japan is exemplified in the work undergone at Dugway. Compared to the “thousands and thousands” LeMay references as being killed in the American air raids on Japan (a low estimate), the incendiaries developed simultaneously with a crude Japanese aerial campaign that quite literally involved firebombs attached to balloons and set off haphazardly across the Pacific Ocean. In May 1945, these firebombs killed six people in south-central Oregon—“the only mainland civilian American casualties of World War II.”¹¹ The effect of the U.S. employing such dramatic power was as much militaristic and economic as it was psychological, as David M. Kennedy writes in *The Origins and Uses of American Hyperpower*.¹² Japanese sources, too, it seems, had “anticipat[ed] the events to follow.” As Mark Selden observes in *A Forgotten Holocaust*:

The most important way in which World War II shaped the moral and technological tenor of mass destruction was the erosion in the course of war of the stigma associated with the systematic

targeting of civilian populations from the air, and elimination of the constraints, which for some years had restrained certain air powers from area bombing.¹³

Nonetheless, it is wrong to think that the US military was committed to carpet-bombing as a tactic or as a policy at the outset of the war. In fact, quite the opposite is true. Roosevelt, in a 1939 appeal, called civilian bombing “inhuman barbarism.”¹⁴ By 1943 however, Roosevelt’s opinion had abruptly changed, commending rather than condemning the firebombing of Hamburg as an “‘impressive demonstration’ of what America might achieve against Japan.”¹⁵ By that time German-Japanese Village experimentation was already underway in Utah. Furthermore, in a grimly ironic way, the machines most responsible for the implementation of civilian air bombing (the B-29s) were initially “designed with precision bombing in mind.”¹⁶

Why the shift in bombing approaches? Partially, the answer lies in the rigidity of Army Air Force policy and mindsets inherited from World War I. “Throughout the interwar years American airmen had no incentive to develop an incendiary weapon” due to their already established emphasis on precision bombing.¹⁷ Between 1939 and 1941 the British Air Force, as a result of consistently ineffective daylight precision bombing attempts, as well as the newly introduced goal of “breaking down of German morale,” shifted their tactics to area-bombing.¹⁸ Despite pressure from Britain, early on the U.S. Army Air Force clung to the “precision doctrine.” According to Lynn Eden in *Whole World on Fire*, they did this for a multitude of reasons, among them: 1) the (overly) ambitious and visionary nature of the concept; 2) fear of domestic and political backlash as a result of mass civilian bombing; 3) early legislation theoretically restricting the Army Air Force to a defensive role in war; and,

perhaps most importantly 4) existing planning, training, and equipment were already oriented for precision—not area—bombing.¹⁹

Air Force notions about the accuracy of aerial bombardment turned out to be appreciably overestimated. By at least one account of World War II, of the bombs dropped using technology intended for precision raids, only 5% fell within even one mile of their targets.²⁰ Other early reports state that only one bomb in five landed within a five-mile radius of its target.²¹ “The main difficulties arose,” as John Kreis writes in *Piercing the Fog*, “from a combination of crew inexperience, operating the aircraft at extreme range limits, and, worst of all, atmospheric conditions over the targets.”²² US attempts to respond to these complications, as we will see, can be traced to Dugway and German-Japanese Village. By the end of World War II, it seems fair to say that Japan, more than most countries (perhaps any country) suffered the consequences of total war (warfare that considers civilian targets legitimate), and in the history of total war with Japan, Dugway is an undeniable, understudied stepping stone. Although precision bombing continued in the ensuing years, the testing done at Dugway made a substantial impact on modifying prewar bombing doctrines.

We can better understand the context leading to German-Japanese Village by looking at the history of U.S. incendiary development. E. Bartlett Kerr organizes these developments succinctly in *Flames Over Tokyo*. It wasn’t until 1940 that the Air Corps acquired its first incendiary bomb, the M-47. In 1941 the U.S. got its second incendiary bomb, a British innovation referred to as the M-50. In 1942 the U.S. developed the M-69 incendiary bomb that would be most utilized in the firebombing of Japan near the end of the war.²³

Material limitations played a key role in defining incendiary development. For example, rubber was an essential part of the first US

incendiary bomb, the M-47. This incendiary device relied on predominantly rubber and gasoline, but shortly after the onset of the war, in 1940, the U.S. was cut off from international rubber supplies. Sensing an opportunity, the Standard Oil Development Company of New Jersey (the same company that would have a large part in making Japanese Village at Dugway a reality), headed by chemist Robert Russell, “observed this expanding market [for development] with great interest.”²⁴ The second incendiary available to the U.S., the M-50, was adopted from Britain’s Air Force in 1941. This weapon, which had also been used by the Germans, relied on magnesium. Henry Arnold, the commanding general of the U.S. Army Air Forces spurred on by similar shortages in magnesium, pushed for “development of incendiary munitions which were to be at least as effective as the German Kilo magnesium bomb and readily capable of mass production...”²⁵

By late 1941, The National Defense Research Committee (NDRC), an organization that focused on scientific development for national security purposes, and the Chemical Warfare Service, a branch of the U.S. Army charged with development and testing of chemical weaponry, as well as the Army Air Force, had seen the writing on the wall: rubber and magnesium sources in the Pacific, threatened by the Japanese, might soon come to an end as well.²⁶ Before that, though, scientists and engineers had organized under the guidance of the newly created NDRC: by October, 1940, in light of incendiary developments in Europe and an increasing threat from Japan, a meeting was held at Harvard University. In attendance were the president of MIT, the president of Harvard, as well as an MIT chemical engineer Hoyt C. Hottel and Harvard organic chemist Louis Fieser (both of whom were to become important to the developments at Dugway Proving Ground), and Robert Russell, the president of Standard Oil Development Company.²⁷

The program to develop a reasonable incendiary alternative was formalized by the Chemical Warfare Service in late 1941. Louis Fieser headed the Harvard group in an attempt to solve this problem, and the NDRC paired with Standard Oil to facilitate development.²⁸

Hoyt C. Hottel, an MIT graduate in chemical engineering, during the war became Section Chief on Fire Warfare for the NDRC. Hottel, a very important figure in the field of fire research during and after World War II, was associated with Standard Oil even before the October 1940 meeting. Prior to Pearl Harbor, he was already engaged in developing flamethrower technology that would also be tested at Dugway for use against Japanese cave fortifications. In an interview with the Chemical Heritage Foundation some years later, Hottel provided a clear explanation about the timeframe leading up to war: “Come 1939, a lot of people thought that the war was something we’d be in sooner or later and our state of preparedness was poor.”²⁹

Similarly, Louis Fieser, an organic chemist and professor emeritus at Harvard, soon to be known as the inventor of napalm, was also drawn to the field of incendiary development. By summer 1941, he had been drafted by the NDRC (much to his chagrin) and ordered to “terminate work on explosives and to work instead on poison gases, vesicants.”³⁰ Fieser considered this shift to toxic gas inhumane.³¹ The toxic gas program was eventually delayed, and Fieser, in the interim, started thinking about a gelled-fuel incendiary in earnest. This was the genesis of napalm.³² Subsequently, he headed the Harvard group of scientists charged with developing an alternative incendiary thickener.

The means of testing incendiary efficiency were in their infancy. Standard Oil initially tested their prototype incendiary bombs “against specially designed targets simulating attics.” These A-frame attics were essentially, as Hottel

put it, “two-by-fours forming the frame and a few boards laid over them and on the floor.” Even before Standard Oil had begun their testing, however, Fieser had been “building small wood structures and putting thickened fuels under them.”

By 1942 the incendiary bombs were available “in sufficient quantities for airborne testing.”³³ The question remaining was: what was the best formula for the M-69? Among the groups involved, three formulas for incendiary munitions became dominant: Standard Oil’s Formula 122—nicknamed “applesauce” for its appearance; Fieser’s jellied gasoline called napalm (a word originating from its chemical components: *naphthenate* and *palmitate*); and an alternative developed by the Du Pont incendiary program called the IM-gel (short for isobutyl methacrylate).³⁴

It was decided that airborne tests were necessary by Standard Oil and the NDRC operating under the Chemical Warfare Service, and so large-scale tests were set up at Jefferson Proving Ground in Indiana from July 11th to the 21st, 1942.³⁵ For the scientists, this test was also to determine which of the three formulas to use for filling the new bombs. This was the first airborne test on appropriately sized targets and it entailed the bombing of condemned buildings such as “a deconsecrated Catholic church, some stores, a banker’s home, some chicken coops, pig pens, rail fences” among other structures.³⁶ In these tests, B-25s and dive-bombers dropped the bombs and a group representing NDRC (including Hottel) judged the results.³⁷

Firsthand accounts of both Fieser and Hottel reveal the development of a bitter rivalry among the groups of scientists. In the end, Du Pont’s IM-gel incendiary received the highest ranking, with Fieser’s napalm a close second. The IM-gel, however, was subsequently judged inferior due to problems with transport.³⁸ Standard Oil’s “applesauce” was

also soon forgotten, and Fieser's napalm became the weapon of choice.³⁹

In September, 1942, Standard Oil's Robert Russell responded to concurrent German and English incendiary raids as well as results at the Jefferson Proving Ground tests by saying "the possibilities inherent in incendiary bombing have greatly brightened in recent months. The mass raid has made its first appearance; its practicality as a destructive offense is now clear. Better and better incendiaries are becoming available—though not yet in full production..."⁴⁰The results of the tests were still, however, considered preliminary, according to the Office of Scientific Research and Development's book *Chemistry: A History of the Chemistry Components of the National Defense Research Committee 1940-1946*: "Although the Jefferson [Indiana] tests added to the knowledge of functioning of the bombs in an airborne attack, the nonrepresentative character of the target led to some question as to the significance of the results."⁴¹

Therefore, in the overall historical trajectory leading to civilian fire-bombing in Japan, there were three important developments: 1) weaponry development testing had indicated the beginning of a shift away from reliance on precision bombing; 2) substantial progress had been made towards selecting and testing new incendiary devices; and 3) representative testing that would come to define Army Air Force policy and tactics was deemed necessary.

Dugway Proving Ground's German-Japanese Village

Things began to happen very quickly in the United States after the attack on Pearl Harbor on December 7th, 1941. Dugway Proving Ground was no exception. On December 8th, 1941, the United States declared war on Japan. On the 3rd of January 1942, Major General William N. Porter, the chief of the Army

Chemical Warfare Service, sent Major John R. Burns to Salt Lake City to "investigate the possibilities of a testing ground in Utah."⁴²Once there, Major Burns met with the Army's district engineer and Chief Quartermaster Elmer Gwyn Thomas and began making plans for a site "anywhere on the desert."⁴³

When the survey was completed, Major Burns submitted his report to General Porter and by no later than January 14th, 1942, the Chemical Warfare Service requested the President to secure the 126,720 acres of land Thomas and Major Burns had selected.⁴⁴On February 6th, 1942, a mere two months after Pearl Harbor, President Franklin D. Roosevelt withdrew the initial acres in Tooele County, Utah from the public domain for use by the War Department (Executive Order 9053). By April the President added an additional 138,180 acres; completing the site the government also purchased land from private owners and the State of Utah in early 1942.⁴⁵Dugway Proving Ground, commanded by Major Burns, was officially established on March 1, 1942.⁴⁶

The initial construction of Dugway Proving Ground was disrupted by the logistics of putting together such a large operation in such an unforgiving topography. Nonetheless, by April 1, roads were paved and general construction of the army depot had started.⁴⁷Dugway Proving Ground had been chosen as the site for building representative German and Japanese structures because of frequent days of clear visibility. An even more immediate reason for choosing Utah was that Edgewood Arsenal in Maryland, the other potential site for the village, "offered little room for further development or field testing."

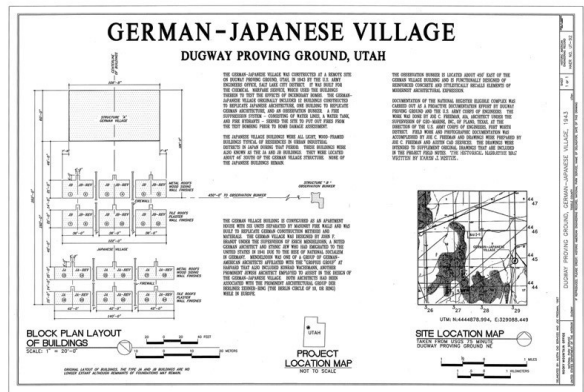
Planning for the structures began in February, 1943.⁵⁰Between March 12th and 18th, 1943, the Chemical Warfare Service Technical Division contracted Standard Oil to create full-scale representative test structures at Dugway Proving Ground.⁵¹Under the auspices of

Fieser's Harvard group, Hottel and the NDRC, the Chemical Warfare Service, and Standard Oil, a meeting was set in March 1943 in Elizabeth, New Jersey to consult leading architects. Among the architects were Eric Mendelsohn (who would design German Village) and Antonin Raymond (who would design Japanese Village).

Mendelsohn's correspondence and archives have left no first-hand accounts of his involvement with German-Japanese Village, but more studies have been done of German Village.⁵² Several biographies of Mendelsohn make no mention of his wartime involvement. The reverse seems to be true of Antonin Raymond. Although he spoke about his work at Dugway in his autobiography, "official" records provide little detail about the Japanese Village.

In the interwar years, Raymond had designed the Standard Oil Company of New York's headquarters and staff housing in Yokohama, Japan. This connection, his availability, and his lengthy history in Japan made him the logical choice as architect for the Japanese Village at Dugway.⁵³

Only 10 days after being contracted to create the German-Japanese Villages, on March 28th, 1943, Standard Oil broke ground on the construction project.⁵⁴ Over \$530,000 was allotted for the German-Japanese Village, but actual costs ran over one million dollars. Furthermore, "due to the urgency of the project, the contractor was able to recruit prisoners from Utah jails to work with the craftsmen." By May 11th, 1943, just 44 days after construction began, both German Village and Japanese Village were completed.⁵⁵



Blueprint of German-Japanese Village compiled by the National Park Service's Historic American Engineering Record.



Workers utilize traditional Japanese architectural styles in the Utah Desert, 1943.

All in all, 12 Japanese double-dwellings consisting of 24 tenement-style residences and 6 German apartments were constructed. These structures were designed, according to Standard Oil, to represent living quarters in Japanese industrial districts. No structure meant to represent industrial facilities was built. Emphasis was exclusively on civilian populations.

An array of different roofing styles was utilized

for comprehensive penetration testing. Additionally, authentic design, construction methods, materials, and furnishings were also considered. Forty-foot wide firebreaks and firewalls were constructed to protect the structures.⁵⁶

Significant care went into construction and development. Narrow roads were built between the Japanese structures to represent the congestion in urban centers of Japan. The percentage of roof-area coverage was modeled after the “large industrial centers” listed as: Tokyo, Yokohama, Kyoto, Kobe, Nagoya, and Osaka. The resulting fire-bombings, however, would extend far beyond this initial list. More impressively, the “usual American stud-frame type” construction was done away with in favor of the traditional and “complicated keyed or mortised joints” of typical Japanese structures. It is a testament to the surreal underpinnings of this project to imagine prisoners from Utah carefully reconstructing unfamiliar and complicated Japanese architectural styles. Authentic *shoji* and *fusuma* screens and panels were also produced. Appropriately comparable wood was carefully selected and even dried to represent typical moisture content in Japan.

The cultural “sensitivity” of this project did not end there.⁵⁷ According to the official Standard Oil report, for the purpose of accurately measuring flammability, furnishings provided included: *tansu* (storage chests), *futon* (bedding), *zabuton* (sitting cushions), *hibachi* (stoves/braziers), low tables, and radios. The report further reflects such cultural nuances as the placement of shoe storage in the hallways since shoes are not worn in the house in Japan, and recognition that *futon* are stored in the closets during the daytime. Additionally, tests were conducted with the *amado* shutters open (in daytime) and closed (at night) to measure the different effects. As a testament to the quality of the furnishings, one of the soldiers who was stationed at Dugway later stated that he and his friends stole the *futon* sleeping mats

from the Japanese Village for furnishing their own apartments. The most notable inclusion on the list, however, is *tatami* (straw floor mats).



Interior furnishings of Japanese Village structures.

Tatami mats were considered vital, because *tatami*, more than any other element of furnishings, affected the way bombs penetrated the floors.⁵⁸ At Standard Oil’s insistence a factory was set up to produce facsimile mats; further, “without military orders and without any evidence,” a tremendous surplus of *tatami* were “acquired” from Japanese-American homes, temples, stores, and clubs in Hawaii.⁵⁹ (The “typical” furnishing of the German structures, in comparison, is somewhat more disturbing in its blunt acceptance of the civilian nature of the project: reports not only included beds, closets, sofas, and dining sets, but also cribs.)⁶⁰

With the villages constructed and furnished, initial testing of the incendiary weaponry began on May 17th, and ended on July 16th, 1943, but additional tests were conducted into 1944 to refine the M-69 into cluster bombs.⁶¹ In total, the structures were destroyed and completely rebuilt at least three or four times.⁶² Parts, when applicable, were cannibalized and reused.⁶³

Planes dropped a variety of bombs on the structures, including the M-50 and M-52 thermite-based bomb, as well as the M-69 napalm-based bombs. Although attempts were made for high altitude bombing, according to Hottel's firsthand accounts, these approaches proved fruitless and were abandoned in favor of low-altitude testing at approximately 5,000 feet.⁶⁴ Additionally, some tests were not conducted by plane but utilized tall scaffolding and utility poles, as one employee recalled.⁶⁵ Compared to other sites running tests on simulated structures, Dugway had a slightly different approach that skewed the results compared with those of other groups.

According to one British Intelligence report, at Dugway, the emphasis was on the speed with which fires could be extinguished; at the other sites emphasis was placed on how well fires could be started. In other words, at Dugway, "hits" were almost guaranteed, but elsewhere the landing of the incendiary was not definite. Reviews of Dugway Proving Ground's efforts by the Military Intelligence Division of Great Britain in late 1943 showed great reservation about adopting the M-69 against Germany and that more tests would have to be done to prove their worth in the European theater. Regarding using M-69's in Japan, however, the Military Intelligence Division had this to say about the Dugway results:

There is no doubt that for attack in Japanese and other Far Eastern targets the M.69 bomb in a satisfactory projectile cluster would be more suitable than the 4-lb. incendiary bomb, and that if attacks on forests or crops from medium or high altitude were again to become a requirement this bomb should be at least as effective as anything used hereto.⁶⁷

Table 1 - 1943 Comparative data reproduced from British Intelligence: Tests where incendiaries landed indoors.

Site	No. of Tests	"A" Fires	"B" Fires	Total "A" + "B"	Percentage of "A" Fires	Percentage of "B" Fires
B.R.S. (Static Tests)	12	0	3	3	0	25
Edgewood (Static Tests)	12	6	3	9	50	25
Dugway (Static Tests)	35	29	6	35	83	17
Dugway (Dropping Tests)	27	23	2	25	85	7

Table 2 - 1943 Comparative data reproduced from British Intelligence: Tests where incendiaries landed near furniture

Site	No. of Tests	"A" Fires	"B" Fires	Total "A" + "B"	Percentage of "A" Fires	Percentage of "B" Fires
B.R.S. (Static Tests)	4	0	2	2	0	50
Edgewood (Static Tests)	9	6	3	9	67	33
Dugway (Static Tests)	14	10	4	14	71	29
Dugway (Dropping Tests)	18	16	2	18	89	11

Table 3 - 1943 Test Results at Dugway - Hits Recorded on Representative Structures

Fire Class	Japanese Houses			German Houses		
	M-50	M-52	M-69	M-50	M-52	M-69
A	22%	26%	68%	0%	0%	37%
B	20%	14%	13%	26%	18%	16%
C	58%	60%	19%	74%	82%	47%

Results were categorized in three ways: "any fire beyond control of the well-trained and properly equipped fire guards in 6 minutes was classified an A fire; a fire which was ultimately destructive if unattended was a B fire; and a fire judged nondestructive was a C fire." The M-69 produced 37% A fires in German structures and 68% in the Japanese structures, and was judged overall to be the best. (In both cases, the other bombs produced no A fires.) As a result, plans for using the bomb on Japan were drawn up by the Army Air Force as early as the fall of 1943.⁶⁸ Tables 1, 2, and 3 summarize comparative data from the UK and US testing, and show how Dugway's testing could have been readily interpreted as the most effective.



The completed German-Japanese Village.



Incendiary testing on Japanese Village.



Spectators view the incendiary testing on Japanese Village.

Ultimately the testing erased most of the German-Japanese village. As described by Hottel at a Fire Research Conference in 1983, a large portion of Japanese village met its demise at the hand of a surveyor who waited too long to give the signal for extinguishment. Sometime thereafter, a large portion of German-Japanese Village burned down, consuming the Japanese Village in its entirety. The only remnants of Japanese Village are a few charred but repurposed rafter beams in the two German Village structures left standing today.⁶⁹ Workers at the time said now there's "nothing there other than some...scraps." Judging by several interviews with Dugway employees, it seems clear that Japanese Village existed until at least 1950, but was gone by 1952, and that when it did burn down "it burned down so fast and so

hot that...they couldn't contain it."⁷⁰

The tests at Dugway Proving Ground's German-Japanese Village directly impacted the war. Before the testing had even finished in late 1943, the NDRC is quoted as writing "it might be worthwhile getting some thought started along these lines in General Staff circles in advance of the tests [at Dugway], so that quicker action can be taken if the tests give confirmation to the fire-raising possibilities."⁷¹ **The Ramifications of German-Japanese Village**

By November 1943 requirements had been "revised sharply upward" for incendiary production.⁷² And "by the end of the war" as James Baxter writes in *Scientists Against Time*, "approximately 30,000,000 M-69 bombs had been produced." In March, 1944, 20 tons of M-69 bombs were dropped on Japanese-occupied Ponape (Pohnpei) Island, but it wasn't until December 13th or 22nd, 1944 that the first M-69 was dropped on Japan in Nagoya. On December 18th, 1944, however, 511 tons of M-69 bombs were used in China at Hankow (modern Wuhan) under the explicit directions of General LeMay (who at the time was in charge of air operations in China and India). LeMay, as quoted in Robert Neer's excellent work *Napalm, An American Biography*, said "everything which was hit burned like crazy. And I think there was a vast similarity to the type of construction in Japan."⁷³ After taking over air operations for Japan, but before the Great Tokyo Air Raid on March 9-10, 1945, LeMay had already dropped over 600 tons of incendiary devices on Japan.⁷⁴

While LeMay definitively put the firebombing concepts to use, Dugway Proving Ground's tests at German and Japanese Village impacted his decisions. The M-47 incendiaries were also included in the March 9-10th Tokyo firebombing, but these were meant to be the initial bombs that marked targets for the B-29s hauling their immense loads of M-69s. As

demonstrated definitively at Dugway, planes flying at night at altitudes between five and ten thousand feet, and dropping M-69 incendiary bombs for maximum impact, were highly effective.⁷⁵

Two thousand tons of predominantly M-69 bombs were dropped in the March 9-10 Tokyo air raid. The flames were said to be visible over 150 miles away, almost 16 square miles (or 267,000 buildings) were razed, and even the most conservative estimates put deaths at over 83,000. “The violence of the firestorm...on Japan,” as John Dower writes in *Cultures of War*, “was not replicated until Hiroshima five months later.”⁷⁶ In addition to raids on major cities, between the 17th of June and the 14th of August, 1945 as many as 60 incendiary missions were launched against major cities in Japan.⁷⁷

Patrick Eckman, a newspaper reporter in Salt Lake City, was the first allowed in to see and report on the German-Japanese Village project. Coincidentally, his article was published on the same day as the Tokyo firebombing: March 10th, 1945. In his article, titled *Dugway Mystery Depot to Continue Test Work*, he refers to the German housing, not as German but as Nazi Villages, and he details the supreme secrecy of the project: those stationed at Dugway were not allowed to write home, he says, and even the highest ranking officers needed special clearance to visit the construction site.

Instead of architects, Eckman refers to “private construction engineers” who spent years “in the enemy territories” but “managed to return to the United States before the outbreak of war,” and instead of Japanese apartments, he refers to “pagoda-type” structures. Compared to the M-69, which Eckman acknowledges as the most effective incendiary weaponry developed at Dugway, other weapons “provoked a cry of ‘inhumanity’ from the Japanese.” The test site, unlike its enemy

counterpoint, is, here, painted as something glorious, which “rise[s] invincibly from its own ashes like the famous fabulous phoenix—a feat which its prototypes could not duplicate.”⁷⁸

How are we to assess these comments. Are we to understand that, to Eckman, the M-69 is somehow more merciful than other incendiaries, which prompted such cries of inhumanity? And are we then, also, to understand Dugway’s German-Japanese Village as something “invincible,” “famous,” “glorious,” and “fabulous,” unlike the houses bombed in Japan? These incongruous conclusions are a testament to a common paradoxical logic of the time. Such reasoning was utilized to both glorify American technological advancements and to justify civilian bombing in Japan.

In spite of the dispassionate tone of the testing, the human implications of the German-Japanese Village project were not lost on everyone involved with the project. Raymond, the architect of Japanese Village, said of the construction: “It certainly was not an easy task for me and my wife to be instrumental in devising means of defeating Japan. In spite of my love for Japan, I came to the conclusion that the quickest way to terminate this war was to defeat Germany and Japan as quickly and as effectively as possible.” Yet Raymond admits in his autobiography to looking down his nose at the lack of cultural understanding in the contemporaneous British designs meant also to simulate Japanese dwellings, saying “I immediately saw that the designer had never been to Japan.”⁷⁹ Professor Ken Oshima of the University of Washington writes about Raymond in his dissertation *Constructed Natures of Modern Architecture in Japan*, portraying the architect as a tragic and conflicted figure who could not escape the gravitational pull of the war.⁸⁰ Some biographical texts about Raymond go so far as to see the experience at Dugway as somehow artistically transformative.⁸¹

Encountering difficulty in getting to Japan immediately after the war, Raymond contacted General MacArthur directly “telling him I would like to return to Japan and help in my capacity as an architect-engineer.” Raymond received a direct reply from MacArthur urging him to come posthaste to help with civil engineering projects. In an ironic twist, Raymond noted that “there was nothing left but twisted steel and broken concrete” of the centers he had helped to create for Standard Oil in Yokohama. Soon after he personally received approval from MacArthur for rapid development of industrial projects in order to rebuild Japan.⁸²

Workers who encountered Japanese Village, when asked to describe any unique experiences at the site, said “well, I guess being an American, the whole thing was strange.”⁸³ Employees called it “a rather unique place” and “spooky,” and described the various ways, after the war, that the structures had been reused: as an artillery range, machinery storage, a pigeon roost (for testing nerve gas), mannequin storage, and even as a small-scale laboratory. Some of the only tangible history remaining of those people involved are in the form of graffiti in the observation bunker outside of the testing site and carved into the concrete where the water tower used to be. Some who had been there, less impressed, described Japanese Village as “some wooden structure, is all it was.”⁸⁴ None acknowledged or seemed aware of Dugway’s place in establishing American bombing policies or the resulting firebombing of Japan.

Undoubtedly the most colorful (and perhaps slightly exaggerated) account of the events at Dugway Proving Ground come in the form of Jack Couffer’s (autobiographical) book *Bat Bomb: World War II’s Other Secret Weapon*. Couffer, who served in the army in 1943, recounts the strange story of the development of a bat-based incendiary device (also tested at Dugway), but, most importantly for the purpose

of this research, he describes German and Japanese Village, as well as its emotional impact on him, in detail. As one of the most vivid accounts, I reproduced some of Couffer’s observations on German and Japanese village here:

Far out in a remote area of the Proving Ground two remarkable installations had been constructed, simulated Japanese and German villages. . . .The sterile towns stood several miles apart on the otherwise empty Utah plain, like abandoned movie sets picturing the aftermath of a devastating plague. Dust-devils swirled through the powdery lanes, curling high into the blue sky, and tumbleweeds rolled past the empty doors—as if the art director had made a mistake and built an old western ghost town with the wrong kind of houses...

Casting aside that mental picture it was easy to imagine without emotional involvement the torching of this sterile village, which resembled nothing so much as a museum model in full scale. But when again I saw in my mind’s eye the town as it really would be, my flesh crawled. I was very glad I was seeing it in this way, without people. I could watch our little incendiaries do their dirty work without hearing the screams, the cries of pain, the yells of hysteria, the clanging of the fire carts, the roar of burning paper and wood, the sobs of mothers and fathers and sons and daughters.⁸⁵

Nonetheless, such emotional recounting points to Dugway and German-Japanese Village’s

place in memory and culture. Couffer's somewhat theatrical metaphor is not misplaced here, because Hollywood prop developers were contracted for the furnishings of the projects.⁸⁶ It is impossible to say with any certainty, of course, but perhaps this extended notion of theatricality helped workers and scientists to rationalize their actions.

The secrecy and surreal nature of the German and Japanese Village projects have doubtless contributed to Dugway's strange place within a limited cultural consciousness. As evidenced by a 2013 work of fiction called *The Gods of Heavenly Punishment*, which tells the story of Anton Reynolds [sic] and his conflicted architectural work on Japanese Village, the dramatic nature of this history seems to point to Dugway as occupying some unique space in understanding between fact and fiction. For example, searches for Dugway Proving Ground on the internet yield numerous videos and reports riddled with theories that treat Dugway as a conspiratorial equivalent to Area 51, the highly classified remote detachment of Edwards Air Force Base within the Nevada Test and Training Range.

In modern times, anthrax scares, failed crashing space satellites, mass, unexplained livestock death, and some of the world's largest non-nuclear explosion testing have exacerbated and compounded this popular (mis)understanding.⁸⁷ Nonetheless, little association is commonly made between Dugway and the tremendous impact it had on Japan or on the Army Air Force policies America would continue to utilize well beyond World War II.

Conclusion

In terms of popular understanding of war in the Pacific and the end of World War II, Dugway demands a place in history. The many factors, organizations, people, agendas, and developments contributing to the efforts make Japanese Village an important nexus point in

international history. As Marine Guillaume makes clear in *Napalm in US Bombing Doctrine and Practice, 1942-1975*, tracing the "historiography of bombing can be enriched by the historiography of the weapons deployed."⁸⁸

In many timelines of U.S.-Japan history, it seems that an imaginary clock starts ticking on March 9th, 1945 with LeMay's firebombing of Tokyo and then abruptly and forever stops five months later with the bombing of Hiroshima.⁸⁹ However, the Dugway Proving Ground history more accurately sets that clock's starting point back several years, at least to early 1943 when testing at Japanese Village began. Similarly, the commonly held notion of LeMay's great "innovations" in low altitude use of napalm in the Tokyo firebombing and subsequent raids throughout Japan should likely be recast and shown to have originated at Dugway years before the general took command of the Army Air Force operations against Japan.

It is true that Dugway has a relatively small place within World War II timelines. It is also true that the minimal awareness of Dugway's Japanese Village, its history and implications, seems to have faded further over time. Moreover, any history involving air raids in Japan will necessarily have to share its attention with predominant memories and understandings of Hiroshima, Nagasaki, and their horrors. Yet that shouldn't mean the importance of events like those at Dugway Proving Ground deserve any less attention. This is a point Mark Selden articulates in his work, *Forgotten Holocaust*: "the US destruction of more than sixty Japanese cities prior to Hiroshima has been slighted both in the scholarly literatures in English and Japanese and in popular consciousness in both Japan and the US."⁹⁰

Based on this preliminary understanding of Japanese Village at Dugway Proving Ground, it is clear that a recasting of popular

consciousness of the history of American bombing is warranted. As my research to date makes evident, there are further avenues of this subject yet unexplored, but its inclusion in various histories would better contextualize understanding both of the firebombing of Japan and the US military approach to civilian bombing as inextricably linked to weaponry development.

The paradoxical nature of a situation notable both for impressive cultural sensitivities as in the architecture of Japanese village, juxtaposed with an unwavering commitment to civilian bombing—warrants further research. Today, Japanese Village is gone, and in spite of several attempts to add German Village to the National Register of Historic Places, the applications have been rejected and, consequent to a lack of funds, have allowed the site and the few remaining artifacts to deteriorate and to remain inaccessible.⁹¹

With the limited available documentation and the physical record of the Japanese Village gone forever, the curtain seems to have fallen, as it were, in the remote recesses of the Utah Desert. Perhaps it is appropriate that the project's history and far-reaching implications are now left to the researchers who, working in the shadows of the extensive histories of Hiroshima and Nagasaki, strive to document the complete story of this significant but little studied moment in international history.

Works Cited

- Arrington, Leonard J, and Thomas G Alexander. "Utah Historical Quarterly." *Utah Historical Quarterly*, vol. 32, no. 1, 1964, pp. 32-43. *Winter*.
- Baxter, James P. *Scientists against Time*. Little, Brown, 1950.
- Blanthorn, Ouida. *A History of Tooele County*. 1998.
- Bohning, James J, and Hoyt C. Hottel. "Transcript of Interviews: 18 November and 2 December 1985." *Chemical Heritage Foundation*.
- Brophy, Leo P, and George J. B. Fisher. *The Chemical Warfare Service: Organizing for War (United States Army in World War II)*. Center for Military History, 1989.
- Brophy, Leo P., et al. *The Chemical Warfare Service: from Laboratory to Field*. Center of Military History. U.S. Army, 1959.
- Brown, Matthew. "Dugway Takes Steps to Improve Its Image." *Deseret News*, 7 Apr. 2006.
- Cochrane, Rexmond C. *The First Hundred Years 1863-1963: the National Academy of Sciences*. National Academy of Sciences, 1978.
- Coffey, Patrick. *American Arsenal: a Century of Waging War*. Oxford University Press, 2014.
- Cohen, Jean-Louis. *Architecture in Uniform: Designing and Building for the Second World War*. Canadian Centre for Architecture, 2011.
- Couffer, Jack. *Bat Bomb: World War II's Other Secret Weapon*. Univ. of Texas Press, 1992.
- Crane, Conrad C. *American Airpower Strategy in World War II: Bombs, Cities, and Civilians*. University Press of Kansas, 1993.
- Craven, Wesley Frank, and James Lea Cate. *The Army Air Forces in World War II - Volume V: Matterhorn to Nagasaki: June 1944 to August 1945*. University of Chicago Press. 1953.
- Davidson, Lee. "'German Village' May Soon Crumble." *Deseret News*, 7 Apr. 2006.
- Davidson, Lee. "What Inspired Dugway N-Test Stories?" *Deseret News*, 9 Apr. 1995.
- Davis, Mike. *Dead Cities and Other Tales*. The

- New Press, 2002.
- Dower, John W. *Cultures of War: Pearl Harbor, Hiroshima, 9-11, Iraq*. W.W. Norton, 2010.
- Eckman, Patrick R. "Dugway Mystery Depot to Continue Test Work." *The Telegram*, 10 Mar. 1945. Reproduced in U.S. Army Dugway Proving Ground "The Dispatch" Newsletter (April 2017, Volume 3, Number 4A). Page 3.
- Eden, Lynn. *Whole World on Fire: Organizations, Knowledge, and Nuclear Weapons Devastation*. Cornell University Press, 2006.
- EM-Assist. "Ethnographic Interview Transcription." German Village Interactive Experience, Dugway Proving Ground, Utah. Interview #1-#8
- Fieser, Louis F. *The Scientific Method: A Personal Account of Unusual Projects in War and in Peace*. Reinhold Publishing Corporation, 1964.
- Frank, Richard B. *Downfall: the End of the Imperial Japanese Empire*. Penguin Books, 2001.
- Guillaume, Marine. "[Napalm in US Bombing Doctrine and Practice, 1942-1975](#)." *The Asia-Pacific Journal: Japan Focus*, vol. 14, no. 23, 1 Dec. 2016.
- Helfrich, Kurt Gerard Frederick., and William Whitaker. *Crafting a Modern World: the Architecture and Design of Antonin and Noemi Raymond*. University Art Museum, University of California, Santa Barbara, 2007.
- Historic American Engineering Record, National Park Service. "HAER No. UT-35: Written Historical and Descriptive Data: Dugway Proving Ground."
- Historic American Engineering Record, National Park Service. "HAER No. UT-92-A: Written Historical and Descriptive Data: Dugway Proving Ground."
- Hottel, Hoyt C. "Stimulation of Fire Research in the United States After 1940 (A Historical Account)." Fire Research Conference. 1983, Washington D.C., Washington D.C.
- Kennedy, David M. "The Origins and Uses of American Hyperpower." *The Short American Century*, edited by Andrew J. Bacevich, Harvard University Press, 2012.
- Kerr, E. B. *Flames over Tokyo: the U.S. Army Air Forces' Incendiary Campaign against Japan*. Fine, 1991.
- Kreis, John F. *Piercing the Fog: Intelligence and Army Air Forces Operations in World War II*. University Press of the Pacific, 2004.
- Llewellyn, H. M., and Military Intelligence Division, Great Britain. "Comparison of the Japanese Targets and Test Results at the Building Research Station, Edgewood Arsenal, and Dugway Proving Ground." 29 June 1945. ETF 550 E-4953
- MacFarland, Stephen L. *America's Pursuit of Precision Bombing: 1910-1945*. Smithsonian Inst. Press, 1995.
- Military Intelligence Division, Great Britain. "Dropping Trials of Incendiary Bombs Against Representative Structures at Dugway, U.S.A." ETF 550 E-2844
- MSNBC Staff. "[Genesis Space Capsule Crashes](#)." *NBCNews.com*, NBCUniversal News Group, 9 Sept. 2004.
- Neer, Robert M. "Napalm, An American Biography." *Columbia University*, 2011.
- Noyes, W. A. *Chemistry: a History of the Chemistry Components of the National Defense Research Committee 1940-1946*. Little, Brown and Company, 1948.

- Oshima, Ken Tadashi. "Constructed Natures of Modern Architecture in Japan 1920-1940: Yamada Mamoru, Horiguchi Sutemi, and Antonin Raymond." *Columbia University*, 2003.
- Popple, Charles S. *Standard Oil Company (New Jersey) in World War II*. 1952.
- Preusz, Jared. "Mislabeled Vial of Nerve Agent Responsible for Dugway Lockdown." *FOX13 News*.
- Raymond, Antonin. *An Autobiography*. Tuttle, 1973.
- Roosevelt, Franklin D. "An Appeal to Great Britain, France, Italy, Germany, and Poland to Refrain from Air Bombing of Civilians." 1 Sept. 1939.
- Ross, Stewart Halsey. *Strategic Bombing by the United States in World War II: the Myths and the Facts*. McFarland & Co, 2003.
- Schaffer, Ronald. *Wings of Judgment: American Bombing in WWII*. Oxford Univ. Press, 1985.
- Selden, Mark. "A Forgotten Holocaust: US Bombing Strategy, the Destruction of Japanese Cities & the American Way of War from World War II to Iraq." *The Asia-Pacific Journal: Japan Focus*, vol. 5, no. 5, 2 May 2007
- Sherry, Michael S. *The Rise of American Air Power: the Creation of Armageddon*. University of Pennsylvania Pr., 2006.
- Standard Oil Development Company. "Design and Construction of Typical German and Japanese Structures at Dugway Proving Ground, Utah." 1943.
- Stevenson, E. P. "Incendiary Bombs." *Chemistry: a History of the Chemistry Components of the National Defense Research Committee 1940-1946*, edited by Noyes.
- Thomas, Elmer Gwyn. "Memoirs of Elmer Gwyn Thomas."
- U.S. Army Dugway Proving Ground, Dugway, Utah. *Dugway Proving Ground Newcomer and Visitor Guide. Dugway Proving Ground Newcomer and Visitor Guide*.
- U.S. Army Dugway Proving Ground, Dugway, Utah. *Historical Testing: German & Japanese Villages Fact Sheet. Historical Testing: German & Japanese Villages Fact Sheet*, Dugway Public Affairs Office.
- Werrell, Kenneth P. *Blankets of Fire: U.S. Bombers over Japan during World War II*. Smithsonian Institution Press, 1996.

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Notes

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² Alexander Arrington. *Sentinels on the Desert*. *Utah Historical Quarterly*: Winter 1964, Vol. 32, No. 1. 34. Dugway Proving Ground, U.S. Army. *Newcomer and Visitor Guide*. 3-11. Similar simulations on Japanese-type structures were also constructed slightly later at Eglin Field in Florida.

³ This is also true of Japanese Village

⁴ The official German-Japanese Villages Fact Sheet, as well as Blanthorn

⁵ Lynn Eden. *Whole World on Fire*. 63. Lynn describes early testing methods as strangely primitive, consisting quite literally of paper and plywood with holes drilled into it.

⁶ Conrad C. Crane. *American Airpower Strategy in World War II*. 168-169.

⁷ Patrick Coffey. *American Arsenal: A Century of Waging War*. 117-118.

⁸ Crane, *Ibid*.

⁹ Michael S. Sherry. *The Rise of American Air Power*. 311.

¹⁰ Curtis LeMay, quoted in McFarland, Stephen L. *America*

¹¹ David M. Kennedy. *The Origins and Uses of American Hyperpower*. 22-29.

¹² Kennedy, *Ibid*.

¹³ Mark Selden. *A Forgotten Holocaust: US Bombing Strategy, the Destruction of Japanese Cities & the American Way of War from World War II to Iraq*. 8, 15.

¹⁴ Franklin D. Roosevelt. September 1, 1939. *An Appeal to Great Britain, France, Italy, Germany, and Poland to Refrain from Air Bombing of Civilians*

¹⁵ Sherry. *Ibid*. 156.

¹⁶ Coffey. *Ibid*. 117-118, 108.

¹⁷ Werrell, Kenneth. *Blankets of Fire*. 41, 47.

¹⁸ Kerr, E. Bartlett. *Flames Over Tokyo*. 9-10.

¹⁹ Eden. *Ibid*. 70-72.

²⁰ Eden, *Ibid*.

²¹ Richard B. Frank. *Downfall*. 41-42.

²² John F. Kreis. *Piercing the Fog*. 338.

²³ Kerr. *Ibid*. 11-16.

²⁴ Charles S. Pople. *Standard Oil Company (New Jersey) in World War II*. 52-53. The

²⁵ E. P. Stevenson. *Incendiary Bombs*. In *Chemistry: A History of the Chemistry Components of the National Defense Research Committee 1940-1946*. Ed. Noyes, W. A. 388.

²⁶ Rexmond C. Cochrane. *The National Academy of Sciences: The First Hundred Years, 1863-1963*. 404-405.

²⁷ Louis F. Fieser. *The Scientific Method*. 9; Hoyt C. Hottel. *Chemical Heritage Foundation. Transcript of Interviews*. 17-19.

- ²⁸ James Phinney Baxter, III. *Scientists Against Time*. 290.
- ²⁹ Hottel. *Transcript of Interviews*. 18. Hottel was a giant in the field of fire research during and after WWII.
- ³⁰ Fieser, like Hottel, went on to be (and was) famous in his own right: he later received the Nobel Prize for medicinal advancements.
- ³¹ It's interesting to note that Fieser, in spite of this, refused to accept any moral responsibility for napalm. He is quoted in a January 5th 1968 issue of *Time Magazine* as saying "I have no right to judge the morality of napalm just because I invented it." See [here](#).
- ³² Louis F. Fieser. *The Scientific Method*. 14.
- ³³ Hottel. *Transcript of Interviews*. 22-23; Baxter. *Ibid.* 291-292.
- ³⁴ Fieser. *Ibid.* 45-49. The Du Pont program is one that I have seen no other references to other than in Fieser and Hottel
- ³⁵ Leo P. Brophy. *The Chemical Warfare Service: From Laboratory to Field*. 184.
- ³⁶ Hottel. *Transcript of Interviews*. 23-24.
- ³⁷ Fieser. *Ibid.* 45-52.
- ³⁸ Hottel, *Ibid.* Fieser, *Ibid.*
- ³⁹ Though counterfactual by nature, it is interesting (especially in retrospective light of Vietnam) to note how close the U.S. Army Air Force came to not having napalm.
- ⁴⁰ Ronald Schaffer. *Wings of Judgment*. 108.
- ⁴¹ Stevenson. *Ibid.* 392.
- ⁴² Fisher Brophy. *The Chemical Warfare Service: Organizing for War*. 135.
- ⁴³ Thomas. *Memoirs*. 50.
- ⁴⁴ Arrington. *Ibid.*
- ⁴⁵ Ouida Blanthorn. [A History of Tooele County](#). 263; Dugway Proving Ground, U.S. Army. *History*. Arrington. *Ibid.*
- ⁴⁶ Brophy. *Ibid.*; *Historic American Engineering Record*, National Park Service. *Written Historical and Descriptive Data: Dugway Proving Ground*. HAER No. UT-35. 15. Some sources claim, contrary to this, that the site was actually established as early as February 12th, 1942.
- ⁴⁷ Arrington. 34-36; Thomas. *Ibid.*
- ⁴⁸ Stevenson. *Ibid.* 393.
- ⁴⁹ *Historic American Engineering Record*. *Written Historical and Descriptive Data*. HAER No. UT-35. 18.
- ⁵⁰ Kerr. *Ibid.* 29. This initial planning stage is also cited in *Noyes History of Chemistry*, p. 392.
- ⁵¹ Standard Oil Development Company. *Design and Construction of Typical German and Japanese Structures at Dugway Proving Ground, Utah*. 1-2. In 1943, Standard Oil wrote the cited article for the Technical Division of the Chemical Warfare Service. In 1945, Standard Oil drafted a detailed analysis of German Village called *Penetration and Performance Tests of Small Incendiary Bombs in a Typical Central German Structure*, not for the Chemical Warfare Service, but for the Office of Scientific Research and Development. No similarly detailed documentation has been uncovered based exclusively on Japanese Village.
- ⁵² Jean-Louis Cohen. *Architecture in Uniform*. 232, 239.
- ⁵³ Kurt G. F. Helfrich and William Whitaker, ed. *Crafting a Modern World: The Architecture and Design of Antonin Raymond and Noemi Raymond*. 47, 53.
- ⁵⁴ Standard Oil Development Company. *Ibid.*

- ⁵⁵ Dugway Proving Ground. Historical Testing: German & Japanese Villages. 1. The cost is also corroborated by Elmer Gwyn Thomas
- ⁵⁶ Standard Oil Development Company. Ibid; Historic American Engineering Record. Written Historical and Descriptive Data. HAER No. UT-92-A. 10.
- ⁵⁷ I use the word "*sensitivity*" deliberately. By using it I do not mean to imply that the work undergone at Dugway was somehow a culturally positive thing, but that it was predicated on cultural awareness and in-depth knowledge of Japan.
- ⁵⁸ Kerr. Ibid. 31.
- ⁵⁹ Hottel. Transcript of Interviews. 25; Kerr. Ibid. 30.
- ⁶⁰ Standard Oil Development Company. 1-2, 10-14. Figure 12. EM-Assist. Ethnographic Interview Transcript: Interviewee #8. 14.
- ⁶¹ Popple. Ibid. 129; Dower, John. Cultures of War. 176.
- ⁶² Mike Davis. Dead Cities and Other Tales. 67; Patrick R. Eckman. Dugway Mystery Depot to Continue Test Work.
- ⁶³ EM-Assist. Ethnographic Interview Transcript: Interviewee #6. 4.
- ⁶⁴ Hottel. Transcript of Interviews. 27.
- ⁶⁵ EM-Assist. Ethnographic Interview Transcript: Interviewee #4. 5, 7.
- ⁶⁶ H. M. Llewellyn. Military Intelligence Division, Great Britain. Comparison of the Japanese Targets and Test Results at the Building Research Station, Edgewood Arsenal and Dugway Proving Ground. 2.
- ⁶⁷ Military Intelligence Division, Great Britain. Dropping Trials of Incendiary Bombs Against Representative Structures at Dugway, U.S.A. 2.
- ⁶⁸ Stevenson. Ibid. 393-394.
- ⁶⁹ Hoyt C. Hottel. Stimulation of Fire Research in the United States After 1940 (A Historical Account). 4; Dugway Proving Ground. Ibid. 2.
- ⁷⁰ EM-Assist. Ethnographic Interview Transcript: Interviewee #2. 4; Interview Transcript: Interviewee #6. 3. Interview Transcript: Interviewee #4. 7.
- ⁷¹ Kerr. Ibid. 25.
- ⁷² Sherry. Ibid. 228.
- ⁷³ LeMay, quoted in Robert Neer. Napalm. 165-166. Baxter. Ibid. 293. Kerr. Ibid. Appendix B and D.
- ⁷⁴ Schaffer. Ibid. 124-125.
- ⁷⁵ Kerr. Ibid. 157-158.
- ⁷⁶ Dower. Ibid. 179-182.
- ⁷⁷ Wesley Frank Craven and James Lea Cate. The Army Air Forces In World War II Volume 5: The Pacific - Matterhorn To Nagasaki June 1944 To August 1945. 674-675.
- ⁷⁸ Eckman. Ibid.
- ⁷⁹ Antonin Raymond. An Autobiography. 188-189.
- ⁸⁰ Ken Oshima. Constructed Natures of Modern Architecture in Japan. 401.
- ⁸¹ Helfrich. Ibid. 55.
- ⁸² Raymond. Ibid. 198, 206-207.
- ⁸³ EM-Assist. Ethnographic Interview Transcript: Interviewee #3. 5.
- ⁸⁴ EM-Assist. Ethnographic Interview Transcript: Interviewee #6. 6-8; Transcript: Interviewee #4. 6, 13; Transcript: Interviewee #3. 2-3. Transcript: Interviewee #2. 6.

⁸⁵ Jack Couffer. Bat Bomb. 208-209.

⁸⁶ Historic American Engineering Record, National Park Service. Written Historical and Descriptive Data: Dugway Proving Ground. HAER No. UT-92-A. 9.

⁸⁷ Jared Preusz. FOX13 News. [Misabeled Vial of Nerve Agent Responsible for Dugway Lockdown](#), 0,4633684.story; Brown, Matthew. Deseret News: April 7, 2006. Dugway Takes Steps to Improve its Image; MSNBC Staff. [Genesis Space Capsule Crashes](#); Davidson, Lee. Deseret News: April 9. 1995. What Inspired Dugway N-Test Stories?

⁸⁸ Marine Guillaume. Napalm in US Bombing Doctrine and Practice, 1942-1945. 12.

⁸⁹ Stewart Halsey Ross. Strategic Bombing by the United States in World War II. 6.

⁹⁰ Selden, Mark. Forgotten Holocaust. 3.

⁹¹ Lee Davidson. Deseret News: April 7, 2006.