

JB-2: AMERICA'S FIRST CRUISE MISSILE

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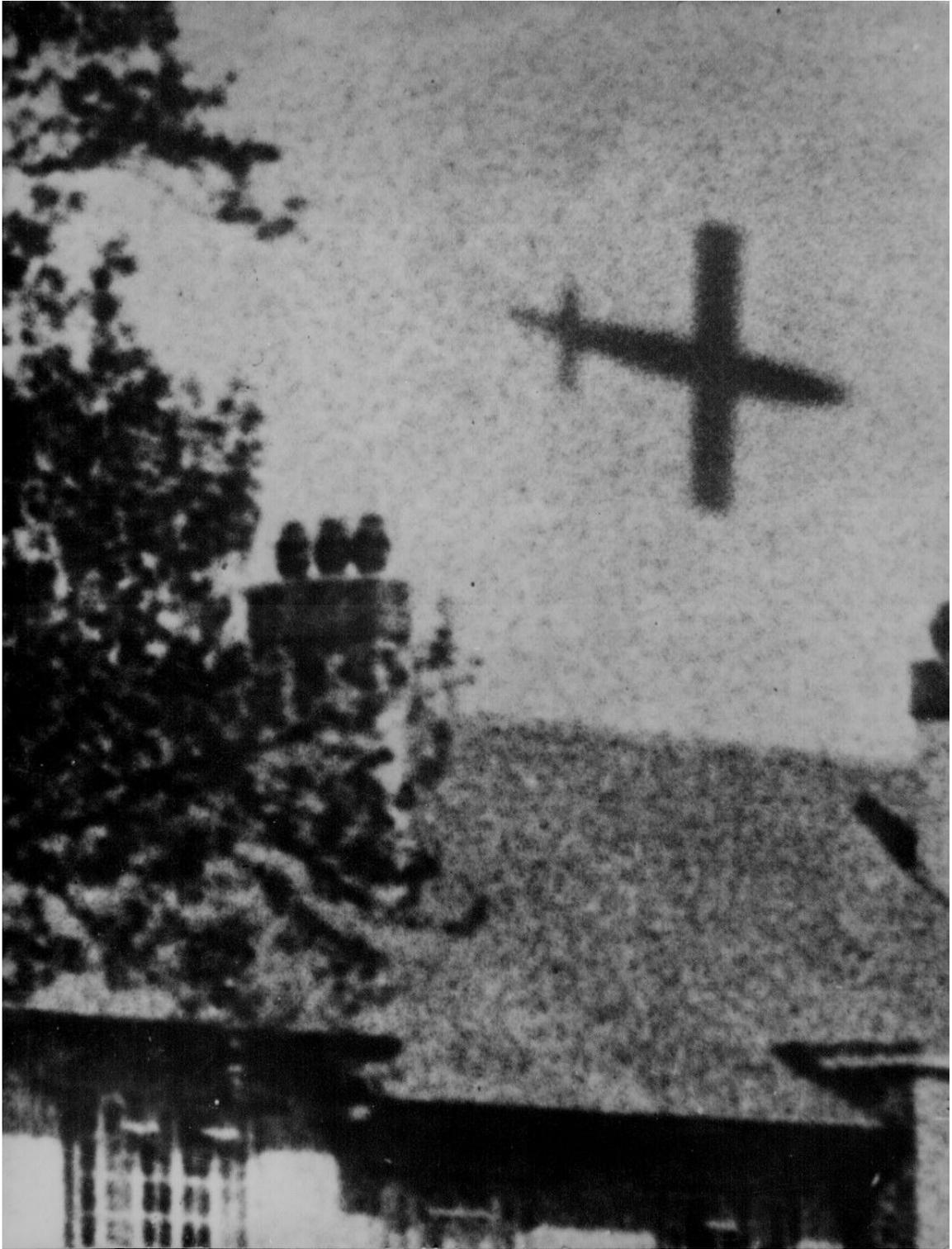
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German V-1 missile in terminal dive over London, 1944.¹

¹“Science Photo Library,” accessed November 26, 2013, <http://www.sciencephoto.com/media/334538/view>.

INTRODUCTION

I have been observing for the past two weeks the most ingenious and simplest contraption that has come to my attention during this War, and that is the German pilotless aircraft bomb. ...What I should like to bring your attention to is the potentialities of this flying missile, ...Its best qualification is that it can fly in any kind of weather, and is entirely expendable. ...I am firmly of the opinion that we should in the United States complete some of these gadgets copying the present one as nearly as possible with American materials and controls which are already available. It is a job, however, for a clever sheet metal worker and not an airplane designer. ...The thing cannot be jammed by any kind of radio impulse, and apparently the only way to get rid of it is to shoot it up or shoot it down, or destroy the launching bases or the points of manufacture. It is the best guided missile that has been produced, ...I have watched these pesky things miss the ridge pole of the house in which I am living at all hours of the day and night in all kinds of weather, and it is my opinion, for what it may be worth, that every resource you direct should be applied to the manufacture of a similar unit with or without direct control, and get it into production at the earliest possible moment.²

So wrote Hartley Rowe, Technical Adviser to General Dwight D. Eisenhower, on June 30, 1944, to Dr. Vannevar Bush, Director of the Office of Scientific Research and Development (OSRD) in Washington, D.C. An eminent industrial engineer serving in London with the National Defense Research Committee (NDRC), Rowe's World War II *vitae* included direct involvement with the Manhattan Project (The United States' clandestine development of the world's first atomic bomb). No doubt voicing the opinions of many, Rowe's communiqué is an integral part of the genesis of the JB-2 (Jet Bomb model number 2), America's first operationally successful, mass-produced guided missile; a direct copy of the German V-1. From 1944 to 1953, this "ingenious and

² Hartley Rowe, Technical Advisor to General Dwight D. Eisenhower, Headquarters, United States Strategic Air Forces in Europe, Advisory Specialist Group, APO 633, to Vannevar Bush, Director, Office of Scientific Research and Development, June 30, 1944, Record Group 218, U.S. Army, Entry 343A, Army Missiles, Box 3, File "OSRD 1944," National Archives and Records Administration, II, College Park, Maryland. Hereafter cited as RG 218, Entry 343A, NARA II.

simplest contraption” advanced from a weapon of jealous reprisal to a technological touchstone guiding future development of United States cruise missiles and drones.³

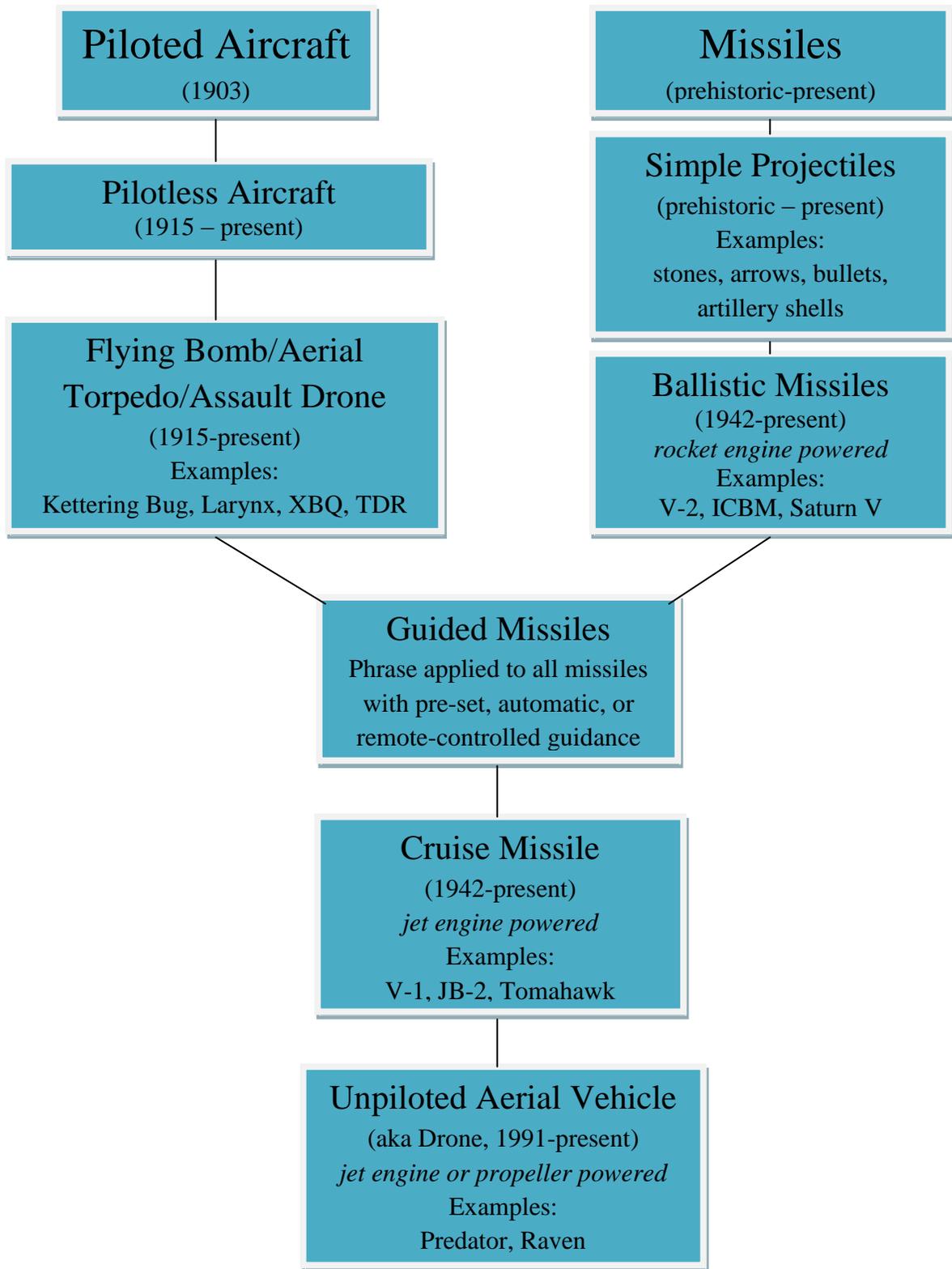
The terms pilotless aircraft, aerial torpedo, flying bomb, assault drone, guided missile, cruise missile and ballistic missile are used often in missile nomenclature, and the following discussion of terms will be helpful in illuminating differences between them. A **pilotless aircraft** is a craft capable of sustaining aerodynamic flight (having wings for lift and moving surfaces for control) with a mechanical or electronic automatic system that eliminates the need for a human being aboard to provide control. In the twenty-first century, the terms **UAV** (unmanned aerial vehicle) and **drone** have virtually replaced the term **pilotless aircraft**. Most present-day drone designs are used for reconnaissance in military, law enforcement, and civilian applications. An **aerial torpedo, flying bomb** or **assault drone** is a pilotless aircraft with an automatic control system and ordnance aboard that is designed to: 1) detonate upon impact of the entire craft with a desired target or, 2) fire armed projectiles to destroy a precise target (in the case of twenty-first century assault drones). Whereas a **missile** is “any object propelled to strike a distant target,” and includes a broad range of projectiles from a hand-thrown stone, arrow, bullet, or a single or multi-stage rocket, a **guided missile** is:

an unmanned vehicle whose course may be altered in flight by a self-contained mechanism controlled via a radio signal, built-in target seeking radar, inertial guidance, or (in the broadest sense) preset controls.⁴

The following diagram presents my own “family tree” of missile development:

³ F.G. Gosling, *The Manhattan Project: Making The Atomic Bomb* (Washington, D.C.: United States Department of Energy, 1999), 42; Donald J. Hanle, *Near Miss: The Army Air Forces’ Guided Bomb Program in World War II* (Lanham, MD: The Scarecrow Press, 2007), 261; Steven J. Zaloga, *V-1 Flying Bomb 1942-1952* (Oxford, UK: Osprey Publishing, 2005), 39-41.

⁴ Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force 1945-1960* (Washington, D.C.: Office of Air Force History, United States Air Force, 1990), 1.



Pilotless aircraft, aerial torpedoes, flying bombs, and assault drones are all guided missiles. The term **cruise missile**, is a later development and distinguishes those guided missiles that have the capability of aerodynamic flight (have wings, and control surfaces that may be altered during operation), are continuously propelled by an air-breathing engine (jet), and are constantly controlled automatically and/or remotely. Conversely, a **ballistic missile** is rocket powered (solid or liquid fuel, not air-breathing), not continuously guided (accuracy is based on a planned trajectory), cannot sustain aerodynamic flight, and in many cases leaves the atmosphere following launch and re-enters the atmosphere on descent. The German V-2 rocket (also known as the A-4) of World War II is considered the first practical ballistic missile. The German V-1/American JB-2 is the progenitor of all cruise missiles.⁵



German V-1 cruise missile undergoing preparation for launch, 1944.⁶

⁵ Ronald Huisken, *The Origin of the Strategic Cruise Missile* (New York: Praeger Publishers, 1981), 3; “Wernher von Braun: Feature Articles,” accessed October 7, 2013, <http://www.earthobservatory.nasa.gov>. Wernher Von Braun, often considered the greatest rocket scientist in history, designed the V-2. Following World War II, as a naturalized American citizen, Von Braun helped lead the development of intercontinental ballistic missiles and the space program in the United States until his retirement from the National Aeronautics and Space Administration (NASA) in 1972.

⁶ “Cruise Missiles,” accessed September 25, 2013, <http://www.century-of-flight.net/Aviation%20history/WW2/images5/15.jpg>.



German V-2 ballistic missile undergoing preparation for launch, 1944.⁷

The United States Army Air Forces (USAAF) initiated ten jet-engine powered guided missile projects during World War II, numbered sequentially in order of approval by the War Department as JB-1 through JB-10. Only the JB-2, precisely copied from the German V-1, reached production. Air Force Technical Service Command cancelled the remaining JB efforts in the design phase, or judged those that reached prototype testing as failures.⁸

⁷ “Forgotten Cradle of the Space Age,” accessed September 25, 2013, http://newsimg.bbc.co.uk/media/images/45155000/jpg/_45155419_v2_nasa_226.jpg.

⁸ “Progress Report—AAF Guided Missiles Status and Availability,” Assistant Chief of Air Staff, Materiel and Services, Materiel Division, April 5, 1945, RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II; “Summary Handbook of Guided Missiles,” Guided Missiles Committee, Joint Committee on New Weapons and Equipment, Joint Chiefs of Staff, July 1, 1945, 1-10, RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II; Andreas Parsch, “Directory of U.S. Military Rockets and Missiles; Appendix 1: Early Missiles and Drones; JB Series,” accessed January 26, 2012, <http://www.designation-systems.net/dusrm/appl/jb.html>. The United States Army Air Forces (USAAF) formed on June 20, 1941 from its predecessor, the United States Army Air Corps (USAAC).

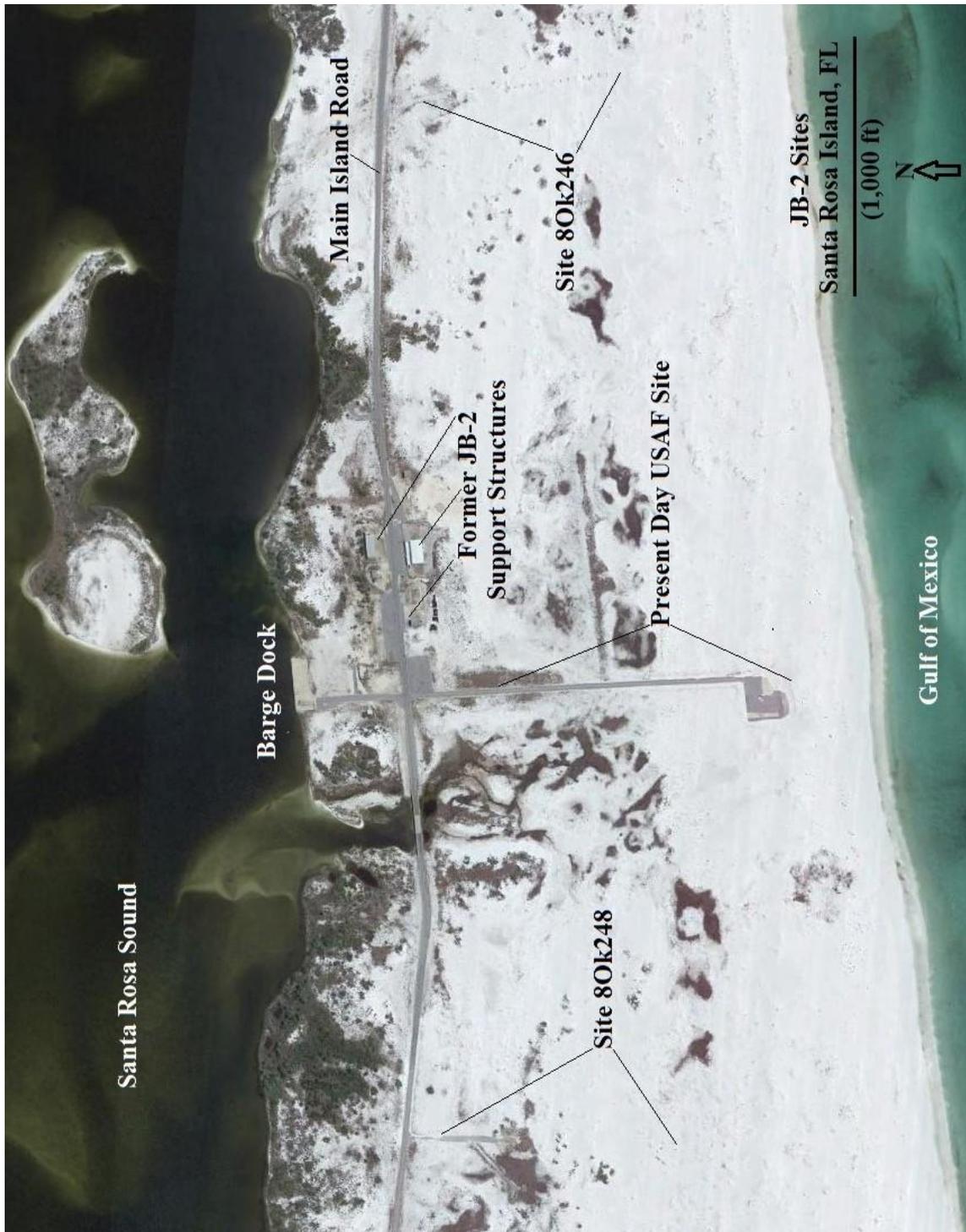
Hartley Rowe wrote to Vannevar Bush during the first wave of V-1 attacks on London that began in the overnight hours of June 12 and 13, 1944. German propaganda radio broadcasts began using the term “V-1” to describe the little pilotless aircraft on June 23, 1944. The “V” abbreviated *vergeltungswaffe* which means “retaliation weapon” or “reprisal weapon” and the number “1” indicated the first of many such threats that would be unleashed against England. Such retaliation in the form of the world’s first successful cruise missile rose in response to the Allied invasion of June 6 at Normandy. With the allied armies having successfully established a beachhead from which they would drive toward Paris, the German high command hoped the V-1 would force a re-deployment of a significant portion of military resources away from supporting the invasion back to the defense of England. The V-1 did succeed in forcing a redistribution of defenses in the United Kingdom, but not in affecting support for the invasion of Fortress Europe.⁹

The history of the JB-2, America’s first successful cruise missile, is not widely known, and it is this circumstance that led me to pursue a small jet-powered pilotless aircraft as the subject for this thesis. I am eager to present something fresh to the historical record, particularly for public consumption. Regardless of my knowledge of the history of aviation, and my archaeological survey and excavation fieldwork on several aircraft wreck sites, the JB-2 remained unknown to me until 2007. Having accepted an invitation to Eglin Air Force Base at Fort Walton Beach, Florida, to discuss the

⁹ Zaloga, *V-1 Flying Bomb*, 9, 18; Bennett Archambault, Director, National Defense Research Committee, London Liaison Office, to Vannevar Bush, Director, Office of Scientific Research and Development, June 16, 1944, RG 218, Entry 343A, Box 3, File “OSRD 1944,” NARA II. Archambault’s communique informs Bush that the V-1 attack “is designed to occasion a withdrawal from the Normandy beachhead of at least part of our aerial support.”

possibility of performing further archaeological testing on two former missile sites on Santa Rosa Island, I found myself carefully walking through white beach sand dunes strewn with the rusting remains of American “buzz bombs.”

There are differences and similarities in the methods employed by historians and archaeologists, and this essay offers insight on how these disciplines may work closely together. With a boot in both camps, my graduate studies and most of my work experience are in public history, but I’ve managed to concurrently accumulate a significant amount of archaeological fieldwork. In general simplicity, historians concern themselves primarily with the written, visual, and oral record of the past, attempting to understand and interpret change. Maintaining uncomplicated definition mode, archaeologists concern themselves primarily with three-dimensional objects and landscape features of the past, above and below ground, attempting to understand and interpret change. Historians are limited in their pursuit to the era of recorded thought, activity and imagery, whereas archaeologists may examine cultural remains before humans recorded their lives (at least in ways we general understand in the present) and throughout millennia to the present day. Yet there are historians who study artifacts, structures, and landscapes, and archaeologists who conduct impressive archival research. One of the similarities in the methodologies of both disciplines is thorough research, documentary, in the field, or otherwise. The primary difference between historians and archaeologists lies on and in the dirt. Historians usually don’t dig it, or scrutinize its surface. Archaeologists search the ground visually, in shovel tests, and in controlled excavations for data in the form of artifacts and features. The work below is an example of historical research enhanced by a detailed archaeological surface reconnaissance.



JB-2 Missile Launch Sites (80k248 and 80k246), Santa Rosa Island.¹⁰

¹⁰ "Google Earth," accessed February 25, 2014, <http://www.google.com/earth/>, map text/graphics by Gary F. Quigg.

Following two visits to the cultural landscape on Santa Rosa Island, I accepted a contract with Prentice Thomas & Associates (PTA) through The International Group for Historic Aircraft Recovery (TIGHAR) to conduct archival research and archaeological fieldwork. I was specifically tasked with completing an assessment of significance and condition of surface artifacts at archaeological sites 8Ok246 and 8Ok248 (JB-2 missile launch sites) and submitting a report on my findings that might assist Eglin AFB in making better informed decisions regarding the management of these sites. Upon delivering my narrative to PTA in July 2012, I realized I used only a small portion of over one thousand pages of archival material. The end of my search for a thesis topic that combined my life-long interest in aviation with my education and work experience in public history and historic archaeology lay in the stacks before me. I found myself uniquely qualified to examine the cultural significance of the JB-2 program in a thesis informed directly by my own immersion in its history and field investigation of its material remains.¹¹

My work at the sites on Santa Rosa Island was limited in scope to the evaluation of the deteriorating missile remnants and allowed only for a cursory review of the historical significance of the JB-2, but it provided helpful insight for the development of this essay. The more traditional approach to a public history thesis relies solely on documentary evidence in the form of primary and secondary sources. My approach is somewhat unique for its inclusion of archaeological data, using material culture as an added body of historical evidence, to present an argument and conclusions enlightened by

¹¹ Gary F. Quigg, "Assessment of Significance for Archaeological Sites 8Ok246 and 8Ok248 (JB-2 Missile Launch Sites)" (work for hire report, The International Group for Historic Aircraft Recovery, Wilmington, DE, 2012), 1-29. This report is the source of all archaeological field observations on Santa Rosa Island in the following pages.

interdisciplinary study. Although the development of the JB-2 may be explained through the interpretation of the written record alone, this explanation is abstract. The term *material culture* refers to the way human beings ascribe meanings to the objects we make, beyond their utilitarian purposes, “The things we make reflect our beliefs about the world; the things around us affect the way that we understand the world.”¹² Certainly the test site remnants of America’s first successful cruise missile exemplify the concerns of the government, and its citizenry, in the early Cold War period and their apprehension regarding global events. Employing material culture, examined through archaeological study, in an historical examination of the JB-2 program allows the reader a more tangible, complete conception.

Material culture includes *cultural landscapes*, areas intentionally changed by humans, which also have meaning other than their practical function. The JB-2 sites on Santa Rosa Island are important not only for their historical association, but also for what they represent symbolically. The cultural meaning of these military installations lies in American values of the early Cold War era that motivated their creation. Such societal feelings, beliefs, and pressing needs, included fear of the spread of communism and renewed global conflict, a reliance upon proven armed forces for defense and preparedness, the preservation of self, and lifeways, in a threatening world, and a faith in new technologies to resolve concerns and sustain prosperity. The material culture of the JB-2 sites on Florida’s “Emerald Coast” is evocative of such values.¹³

¹² Lance Winn, “So What is it? Material Culture Studies Unmasked,” University of Delaware Center for Material Culture Studies, accessed May 29, 2013, <http://www.materialculture.udel.edu/resources.html>.

¹³ U.S. Department of the Interior, “What is Material Culture?” accessed March 30, 2014, http://www.nps.gov/archeology/AforI/whisar_matc.htm.

This work is both public history and public archaeology, as it presents information derived from both disciplines that will be disseminated world-wide online. Both history and archaeology conducted in and for the public are perhaps more accurately described as applied history/archaeology. The use of the word “applied” meaning the information gleaned from research within these disciplines is utilized outside academia for real-world issues. For example, the historical and archaeological research I have completed thus far on Santa Rosa Island produced information that is now being used by Eglin AFB to help guide the ongoing management of archaeological sites 8Ok246 and 8Ok248 (JB-2 launch facilities) as cultural resources.¹⁴

In two chapters, along with this introduction, a conclusion, and appendix, I examine the JB-2 missile program chronologically from its inception in 1944 to its demise in 1953. First, this thesis will provide a historic context from which the significance of JB-2 cultural remains may be recognized, thereby illuminating the untold story of the weapon. Second, the following pages explain the historical importance of the JB-2 to the development of modern missile technology, highlighting the missile’s role in World War II and the early Cold War period within the United States. Third, primarily in the conclusion and appendix, I will connect the history of this missile program with the present-day significance of the archaeological remains in Florida as cultural resources on the National Register of Historic Places (NR), linking “traditional” archival research with

¹⁴ “What is Public History?” National Council on Public History, accessed May 31, 2013, <http://ncph.org/cms/what-is-public-history/>; “Archaeology for the Public: Public Archaeology Is...”, Society for American Archaeology, accessed May 31, 2013, http://www.saa.org/publicftp/public/forArchaeologists/outreach_PAis.html .

archaeological investigations recently completed at former JB-2 launch sites on Eglin Air Force Base.

The first chapter is divided into four sections that chronologically focus on the first three decades of cruise missile development in the United States and Europe (1915-1945), presenting an overview of early twentieth century development of pilotless aircraft that highlights pivotal achievements in the design of flying bombs. *The Evolution of the Cruise Missile* by Kenneth P. Werrell and *Near Miss: The Army Air Forces' Guided Bomb Program in World War II* by Donald J. Hanle both serve as competent histories of cruise missile development for the reader interested in a more complete technological application. These two secondary sources, along with numerous primary sources, proved the most useful tools in constructing Chapter I: "The Robot Bomb."

Chapter II: "Tests and Global Stress," is divided into six sections as I follow JB-2 development from the end of World War II to the cancellation of the program eight years later. I focus on the evolution of the JB-2/*Loon* as a test vehicle for the Air Force and Navy, framed within the major events of the early Cold War. Two of the secondary sources that allowed me to contextualize the JB-2 within world events, *Dawning of the Cold War: The United States Quest for Order* by Randall B. Woods and Howard Jones, and *The Cold War: A New History* by John Lewis Gaddis, will be of particular interest to those wishing a deeper examination into the socio-political matrix of the early Cold War than I could provide here.

Examining physical evidence of the Cold War in Appendix: "National Register Eligibility Assessments," I evaluate the surviving material remains (cultural resources) of

the JB-2 program on Santa Rosa Island for significance and eligibility as defined by the National Register.

The National Register of Historic Places is the official list of the Nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources.¹⁵

The National Register usually requires listed resources be at least fifty years old, and employs four criteria to determine whether or not a building, structure, object, district, or site is eligible:

Criterion A: Properties may be eligible for the National Register if they “are associated with events that have made significant contributions to the broad patterns of our history.”¹⁶

Criterion B: Properties may be eligible for the National Register if they “are associated with the lives of persons significant in our past.”¹⁷

Criterion C: Properties may be eligible for the National Register if they “embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.”¹⁸

Criterion D: Properties may be eligible for the National Register if they “have yielded, or may be likely to yield, information important in history or prehistory.”¹⁹

The two JB-2 sites on Santa Rosa Island, 8Ok246 and 8Ok248, cannot convey their historic significance under criteria A, B, or C, as most of the material culture therein

¹⁵ “National Register of Historic Places,” accessed May 23, 2013, <http://www.nps.gov/nr/>.

¹⁶ U.S. Department of the Interior, National Park Service, Interagency Resources Division, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, Patrick W. Andrus and Rebecca H. Shrimpton (Washington, D.C.: U.S. Government Printing Office, 1990, revised 1991), 12.

¹⁷ *Ibid.*, 14.

¹⁸ *Ibid.*, 17.

¹⁹ *Ibid.*, 21.

lacks structural integrity. Only the decomposed and fragmented carcasses of spent missiles, and deteriorating launch facilities, remain. However, as archaeological resources, I argue, under criterion D, that these locations have produced important historical data. The surviving material remnants of the JB-2 program are significant cultural resources worthy of inclusion on the National Register of Historic Places.

In preparation for writing the following pages, I conducted research at some of the finest repositories in the United States. I obtained original military reports, publications, correspondence, press clippings and photographs from the National Archives and Records Administration II (College Park, Maryland) as well as the Library of Congress and National Air and Space Museum in Washington, D.C. I found similar primary sources at the history offices and archives at three United States Air Force (USAF) bases, Eglin, Maxwell and Wright-Patterson.

While no secondary sources focus exclusively on the JB-2, recent relevant publications of merit have dealt with the larger historiographical issues within which the story of this pivotal missile unfolds. The great appeal of this topic is its obscurity, and thus the opportunity to present original research. Other than a chapter, or less, in guided missile histories, USAF cultural resources publications, and a few small websites, the public remains largely unaware of the JB-2 and its historical significance. The status of this early cruise missile as an “unknown soldier” of late World War II and the early Cold War provides an exciting opportunity for interpretation in and for the public. With a lack of secondary sources addressing the history of the JB-2, this thesis cannot relate to nor lead off from existing literature. Only three such resources, *The Rise of American Airpower: The Creation of Armageddon* by Michael Sherry, *The Evolution of the Cruise*

Missile by Kenneth P. Werrell, and *Near Miss: The Army Air Forces' Guided Bomb Program in World War II* by Donald J. Hanle, assist in answering my research questions that relate specifically to the historical significance of the JB-2. As such, I rely heavily on primary sources for the arguments of significance. The remaining secondary sources assist in providing an understanding of the social and political era in which the missile developed, and thereby help me answer how the JB-2 program was affected by Cold War events and related to cultural phenomena until its termination in 1953. My research questions neither build on the arguments within the following secondary sources nor refute them, as they present no arguments specific to the JB-2: *Dawning of the Cold War: The United States Quest for Order* by Randall B. Woods and Howard Jones, *The Cold War: A New History* by John Lewis Gaddis, *Homeward Bound: American Families in the Cold War Era* by Elaine Tyler May, *The Culture of the Cold War* by Stephen J. Whitfield, and *Parting the Curtain: Propaganda, Culture and the Cold War, 1945-1961* by Walter L. Hixson.

Specifically, the research questions addressed within this thesis include:

- How was the JB-2 utilized by the United States during World War II and in the early Cold War period?
- How was the JB-2 program important to developing United States missile technology?
- How was the JB-2 program affected by the social climate and political matrix in the United States?
- Why is the significance and interpretation of the JB-2 missile remnants and launch sites at Eglin AFB important?
- Why is the JB-2 historically significant?

My research provides a historical and archaeological context for this thesis, in which I argue the JB-2 missile is historically significant as a unique example of the rapid duplication of enemy technology for both physical and psychological retaliation, as a crucial link in the chain of development for America's cruise missile program, and for its role in early Cold War deterrence. Jet Bomb model number 2 (JB-2), America's first operationally successful, mass produced cruise missile, developed as a direct copy of the German V-1, with slight variation in manufacture due to differences between German and American components, machinery and tooling. Continuing modifications of the JB-2 during its service life led to improvements in performance, control, and accuracy. From 1944 to 1953, the JB-2 transitioned from a weapon quickly prepared for wartime deployment to an essential test vehicle for the United States Army, Air Force and Navy while supporting the U.S. policy of containment during the early Cold War.

CHAPTER ONE: THE ROBOT BOMB (1915-1945)

Early Development of the Cruise Missile

The cruise missile concept ascended during World War I. The notion of a propelled missile formed centuries ago, when the Chinese first used such rocket-powered weaponry in the twelfth century. Missiles remained without in-flight guidance and long-range capability, simply being aimed and fired, until 1915. Warplanes used over the Western Front required at least one pilot, and large bomber aircraft demanded an entire crew of trained personnel, to employ destructive powers. As World War I progressed, along with horrific losses of pilots and crew members, airmen on both sides of the conflict queried whether or not the same damage could be achieved with pilotless craft. Field commanders who voiced this developing hypothesis hoped for all-weather usage, realizing that while both artillery and piloted aircraft required good visibility for accurate targeting, a flying bomb could be preset with range and bearing to a target (and timed to engage it upon arrival) without any visual reference necessary. While European air forces attempted to answer the question, the United States began to address the problem as well, two years before declaring war on Germany.²⁰

Noted American inventors Peter C. Hewitt and Elmer A. Sperry undertook the first recorded practical efforts to create an aerial torpedo, or pilotless flying bomb, in a fruitful, self-funded collaboration begun in April 1915. Developing an automatic control system and testing it on two different aircraft, the pair felt the invention was ready for official review by the summer of 1916. Sperry wrote to the United States Army Signal

²⁰ Kenneth P. Werrell, *The Evolution of the Cruise Missile* (Maxwell Air Force Base, Alabama: Air University Press, 1985), 7.

Corps in August but received no reply. Thus Sperry and Hewitt arranged a meeting with the Navy, and on September 12, 1916, a seaplane under automatic control took off with Sperry's son Lawrence as pilot in command (if not in control) and Lieutenant T.W. Wilkinson Jr. as pilot observer. The aircraft held a set compass course, climbed to a preset altitude, flew the programmed distance and began a dive to impact from which pilot Sperry recovered control. Following a safe landing, Wilkinson prepared a report listing the advantages and liabilities of such a guided missile, which may be used to describe the pros and cons of such weapons produced in the next forty years. Admiring the missile's longer range, the lieutenant wrote, "They are practically indestructible, unless a well-aimed shot disables (the) engine or control devices, and they cannot be driven off." Wilkinson duly noted the expense of the weapon, complicated launching methodology, and dubious strategic value due to the craft's inability to strike a specific point. With such imprecise targeting abilities, guided missiles of the time could only be used against large area targets such as cities.²¹

While European powers, most notably Britain, worked on their own versions of "flying bombs" the U.S. Navy authorized two hundred thousand dollars for Sperry's project two months after America entered World War I in 1917. One hundred flight tests began in September with Sperry automatic controls installed in five Curtiss N-9 seaplanes. Navy pilots aboard the planes were in control of the take off, but then flew "hands off" to monitor the control system until it began its preset dive to the target area. However, unmanned airplanes under automatic control did not fare well. The Navy

²¹ Ibid., 7-8. Both Hewitt and Sperry were prolific inventors. Hewitt is perhaps best known for his invention of the mercury vapor lamp (fluorescent) and Sperry for the gyrocompass used in aircraft.

persevered for five years, but cancelled the program in 1922 after repeated crashes, shrinking funds, and an overall lack of progress.²²

The United States Army, wishing to erase the chagrin of missing their original opportunity with Sperry, invited him to be a part of their own guided missile project in 1918 under the direction of Charles F. Kettering (inventor of the automobile electric starter). Kettering surrounded himself with a stellar development team, including Sperry, Ford Motor Company's chief engineer C.H. Willis, and the surviving Wright brother, Orville (Wilbur had died of typhoid fever in 1912). The "flying bomb" that resulted from this consortium officially debuted as the *Liberty Eagle*, but it became far more commonly known as the "Kettering Bug." Developed to be cheaper and simpler, the pilotless biplane was less than one-fourth the size of the Navy's full-scale aircraft. The designers focused on economy, wishing to avoid destruction of full-size airplanes, and realizing that missiles in good working order are non-renewable resources. Several of the features of the "Bug" became components of the V-1 (and its American copy, the JB-2) twenty-five years later. These elements included the use of a cart and track launching system, the exclusion of ailerons, and an impeller that turned in the wind during flight to advance a counter that measured distance. When the counter on the "Bug" reached the preset number, the spark to the engine was cut and the wings folded to place the aircraft into a dive to the target area. Testing in the summer and fall of 1918 near Dayton, Ohio, ended with mixed results, but inspired Major General George O. Squier, Chief Signal Officer (a position equal to today's Air Force Commanding General), to inform the Chief of Staff that the new weapon, "marks an epoch in the evolution of artillery for war purposes, of

²² Ibid., 8-12.

the first magnitude, and comparable, for instance, with the invention of gunpowder in the Fourteenth Century.”²³

Those witnessing the trials of the Kettering Bug included a young officer named Henry H. “Hap” Arnold, who learned to fly at the Wright brothers’ aviation school at Simms Station, Ohio. The Division of Military Aeronautics sent Arnold to France following the “flying bomb” tests to inform select officers of the Allies about the program’s results. Shortly after his arrival at the Western Front, the Armistice of November 11, 1918, ended the war. Arnold, who would rise to command the United States Army Air Force during World War II, became the strongest American proponent of guided missiles during the next three decades and the driving force behind the rapid development of the JB-2. Testing of the “Bug” continued after the war, with the last flights conducted at Carlstrom Field near Arcadia, Florida, in October 1919. Although the Army remained enthusiastic about the potential of the “flying bomb” there were far more failed launches than successes, leaving the concept unproven.²⁴

Development of guided missiles continued in both Britain and the United States through the 1920s, with the most significant technological advance coming through the development of radio-controlled flight. The Royal Air Force (RAF) tested several aircraft with radio control in the 1920s, and developed an unmanned “flying bomb” called the *Larynx* in both mechanical and radio controlled versions. The *Larynx* tests proved relatively successful, with improvements in both range and accuracy, but perhaps the most promising realization for the future of guided missiles appeared in its ability to outrun contemporary fighter aircraft. The high cost of program development coupled with

²³ Ibid., 13-15.

²⁴ Ibid., 15-17.

slow improvement led to the cancellation of the *Larynx* in 1936. However, the RAF found success in developing reliable radio-controlled missiles used as aerial targets for gunnery practice, and continued their production from the 1930s well into World War II. Stateside, both the Army and Navy experimented with radio-controlled aircraft from 1920 to 1925 for both guided missile and aerial target missions. Mixed results and military budget cuts (most significantly during the worst years of the Great Depression) led to a freeze on further development until the mid-1930s.²⁵

Concerned about the extensive military expansions in Germany and Italy, as well as the Japanese invasion of China, Hap Arnold, now a brigadier general and assistant chief of the United States Army Air Corps, revived the army missile program in 1936. However, due to funding delays, Arnold was unable to get new test aircraft produced and flown until November 1941. Manufactured by General Motors and designated GM A-1, the new missile could fly at 200 miles per hour for up to 400 miles carrying a 500-pound bomb load. Available in both mechanical and radio-controlled versions, the unit launched from a cart and rail system. Technicians modified the last of these devices with altitude control and a powered catapult launching system, tested in March and April 1942 at Eglin Field, Florida. Though aerodynamically sound, the small payload and poor directional control evidenced in these tests halted further development following final testing at Lake Muroc, California, the next year. Two additional guided missile programs between 1943 and 1945 also ended in failure. The XBQ series of twin engine radio-controlled missiles ended quickly after repeated crashes and exorbitant costs during the testing phase, and a program using radio-controlled war-weary bombers filled with explosives (Project

²⁵ Ibid., 17-23.

Aphrodite) closed following poor target accuracy and the vulnerability of large, slow-moving solo bombers to anti-aircraft and enemy fighter planes.²⁶

The U.S. Navy, equally motivated by developing fascist militarism, re-started its missile initiative in 1935 with approval to develop a high-speed radio controlled target aircraft that began flight tests in 1937. The flying targets began appearing in the sights of naval gunners the following year. Discussion of radio-controlled aircraft for combat use began anew, with the term “assault drone” employed as a term for “flying bomb” or “guided missile.” In November of 1941 the Navy ordered one hundred new missiles specifically designed as assault drones, along with one hundred obsolete torpedo bombers converted to the same purpose. The attack on Pearl Harbor caused the withdrawal of the torpedo bombers from the drone program for piloted deployment in the Pacific. Successful tests of these drones in April of 1942, which employed the cutting-edge technology of television to extend the operator’s vision, ultimately resulted in an order of 338 drones armed with television cameras and torpedoes designated TDNs or TDRs depending on their source of manufacture. TDRs were combat tested in the Pacific in September and October of 1944. Launched from the Sterling and Green Islands, twenty-nine of forty-six TDRs reached their Japanese targets. Ironically the TDR development program had been officially cancelled September 8 due to resistance from naval aviators, its arrival late in the war when the U.S. had achieved complete air superiority, and the high expense in labor and materials with insignificant results. The Navy offered the entire program to the Army on October 25. General Arnold declined the offer, fully committed to the new JB-2 program which had just begun test launches two weeks earlier at Eglin

²⁶ Ibid., 26-35.

Field. Thus, the United States ultimately relied on German technology (in the form of an American copy of the V-1) for its first successful cruise missile.²⁷

Vengeance is Mein: The Development and Deployment of the V-1

The development of a reliable jet engine served as the catalyst for the creation of a successful cruise missile, and Germany led the world in this technology through the interwar period while missile development efforts in the United States and Great Britain struggled. The 1919 Treaty of Versailles forbade Germany to have an air force, but clandestine development of aircraft under the auspices of a secret air force progressed rapidly in the 1920s and 30s. In 1928 Paul Schmidt, an engineer from Munich, began experimenting with the concept of the pulse-jet engine developed by Georges Marconnet of France in 1909. Schmidt's experiments led to a 1931 patent, and modest government support for development in 1933. The following year Schmidt proposed a "flying bomb" powered by a pulse-jet, and in 1935 Schmidt received a contract to produce one. That year Hitler publicly renounced the disarmament provisions of the Versailles Treaty, and revealed to the world that Germany had an air force of eighteen thousand men with a budget larger than those of Britain and France combined. Four years later Germany produced and tested the first jet powered aircraft, the Heinkel He-178-V1, which utilized a gas turbine jet (turbo-jet) unlike the pulse-jet. Schmidt's pulse-jet powered pilotless bomber prototype also debuted in 1939 (not the later V-1 design), but the Luftwaffe denied further development citing the same problems all embryonic guided missiles faced at the time, cost, accuracy and range. However, the Argus Company had been working

²⁷ Ibid., 23-26.

independently to develop a pulse-jet engine, and in 1940 the German Air Ministry teamed Schmidt with Argus.²⁸

The engine resulting from this union emerged from the workshops ingeniously simple and reliable with a good power-to-weight ratio, and less expensive to produce than turbo-jet engine designs. A pulse-jet consists of a long tube used as a combustion chamber into which a fuel and air mixture is forced in pulses and ignited. Such combustion is self-sustaining, as the shock waves from the initial combustion ignite subsequent pulses of the mixture. The explosion resulting from each pulse forces exhaust out of the chamber, but there must be a means of guiding the exhaust in the proper direction for controlled propulsion. To properly route the exhaust power, Schmidt created small spring steel shutters forced open by the intake of air, allowing the fuel mixture into the chamber, then forced closed by the combustion. The low pressure in the chamber following the explosion (combustion) in combination with the pressure of the incoming air forced the shutters open again to repeat the cycle and provide directed propulsion. Argus combined this shutter system with a stable fuel injection method. Though not fuel efficient, it ran on regular gasoline rather than more expensive high octane aviation fuel. The primary drawback of the engine appeared as vibration, caused by the combustion detonations which occurred forty-seven times per second. Such vibration would damage both the engine and airframe over time, but as each “flying bomb” launched would complete only a single flight of one half hour, such deficiencies remained acceptable. The

²⁸ Sebastian Cox and Peter Gray, *Air Power History: Turning Points from Kitty Hawk to Kosovo* (London: Routledge, 2002), 68; Werrell, *Evolution of the Cruise Missile*, 41. A pulse-jet engine releases fuel into a combustion chamber at regular intervals and does not employ a fan-like compressor nor a turbine, whereas a turbo-jet engine (a more complex design) increases the pressure of intake air using a compressor, releases fuel into a combustion chamber in a continual flow, and funnels the hot exhaust gases through a turbine, which, in turn, provides continual power to the intake compressor.

Argus Company, as an engine manufacturer, had no experience designing airframes. Accordingly, Luftwaffe leadership initiated a cooperative effort with the Fiesler Company in February 1942 that led to Fiesler engineer Robert Lusser creating a preliminary airframe design in April.²⁹

The German war effort faced an epiphany in early 1942 resulting from a number of developments that ultimately led to the creation of the V-1. With the conquest of France in 1940, the range necessary for a guided missile attack on London significantly decreased. Luftwaffe losses in the failed attempt to defeat England with air power alone during the Battle of Britain and the continuing air war on the Russian front shocked the German Air Ministry, greatly increasing the value of a “flying bomb.” Hitler, infuriated by British bombing attacks on German cities, demanded suitable retaliation. In June Argus and Fiesler, working with the Askania Company to provide a guidance system, were given official approval by the German Air Force to move forward with the development of the Fiesler Fi-103, later known as the V-1. Like Great Britain and the United States, Germany tested radio control technology for guided missiles, but these signals could be easily jammed. Therefore, the Fi-103 was fitted with a mechanical inertial guidance system based on gyroscopes; a derivative of the same system developed by Sperry in 1915.³⁰

²⁹ Zaloga, *V-1 Flying Bomb*, 5-6.

³⁰ Werrell, *Evolution of the Cruise Missile*, 41-42; Michael S. Sherry, *The Rise of American Air Power: The Creation of Armageddon* (New Haven, CT: Yale University Press, 1987), 163; Zaloga, *V-1 Flying Bomb*, 5-6.



V-1 Missile (Fi-103/FZG-76)³¹

Upon the completion of the first Fi-103 on August 30, 1942, testing commenced in September. The Luftwaffe gave the new missile the code name *Kirschkeim* (Cherry Stone) and later provided another cover name, FZG-76 (Flakzielgerät 76). The Air Ministry created the latter moniker to disguise the weapon as a target drone for use in anti-aircraft gunnery practice. Flight tests took place at the Luftwaffe Test Establishment at Peenemünde on the Baltic Coast near the test site for the A-4 ballistic missile (later to be better known as the V-2). A four-engine Fw-200 *Condor* bomber dropped the first Fi-103 in an unpowered flight on October 28, and the first powered flight from an aerial launch was on December 10. The Argus-Schmidt pulse-jet engine did not have enough power to launch the Fi-103 alone from the ground. The first surface launch occurred at Peenemünde on December 24 using a rocket-powered cart on a rail track. A catapult powered by hydrogen peroxide and sodium permanganate soon replaced the less efficient rocket/cart method, and remained the sole ground launch system throughout the V-1 program. Testing continued into 1943, with eighty-four total launches by the end of July.

³¹ “V-1 Flying Bomb,” accessed September 25, 2013, http://www.bisbos.com/air_missiles_v1.html.

While the aerial launches proved reliable, only twenty-eight of the sixty-eight ground launches achieved success by this point.³²

The British began conducting reconnaissance flights over Peenemünde in January 1943, and the program to identify and destroy the German secret missile program known as Operation *Crossbow* commenced the following August. The first RAF bomber attack on Peenemünde on the night of August 17-18 set back the V-2 ballistic missile program several weeks, but left the V-1 program virtually unscathed. A successful Fi-103 aerial launch on August 22 resulted in a major detriment to the program when the missile crash landed on Bornholm Island. The Danish Resistance took photographs of the wreckage and quickly forwarded them to British Intelligence. Further aerial reconnaissance and reports from the French Underground confirmed the construction of V-1 launch ramps aimed toward London in Normandy and the Pas de Calais. Bombing raids on these sites and Peenemünde at night from the RAF and by day from the USAAF continued for one year. Constructed of heavily reinforced concrete, with walls as thick as twenty feet in some areas, the German missile sites presented a tough target for allied air crews to destroy.³³

Following dubious results from the first six months of *Crossbow* missions, the armament division at Eglin Field, Florida, received orders to find the best method to attack V-1 launch sites, in one of the most notable logistical feats of the war stateside. Commanding General of the USAAF Proving Ground at Eglin, Grandison Gardner, received a phone call from Chief of Staff General “Hap” Arnold on January 25, 1944:

³² Zaloga, *V-1 Flying Bomb*, 6-8.

³³ Werrell, *Evolution of the Cruise Missile*, 43-44; Zaloga, *V-1 Flying Bomb*, 13-14.

Gran, I can't tell you over the telephone what I'm talking about, but I hope you will know. ...I want you to build one, study it and decide what is the best way to destroy it. I want it done in days and not weeks. Did you hear? Days and not weeks, and it will take a helluva lot of concrete.³⁴

Details from the French Underground, aerial reconnaissance photos, and sketches by British Intelligence provided construction specifications. Gardner directed the purchase of all available brick, lumber, concrete and steel within hundreds of miles of Eglin to build the mock-up V-1 launch sites, completed after twelve days of around-the-clock construction during February and March. As soon as the concrete dried fighters and bombers flying at different altitudes attacked the sites employing various tactics. On February 19 British Air Marshals Norman Bottomley and Frank Inglis along with General Arnold watched one of the demonstrations at Eglin. The March 1 final report from Gardner showed that low level attacks by fighter-bombers equaled the effectiveness of medium or high level bombers with less risk of loss and at a lower expense. Much to the surprise of the USAAF, the British refused to accept the results and continued to insist on using heavy bombers at high altitudes. After acrimonious debate between U.S. and British air chiefs, General Dwight Eisenhower chose to acquiesce to RAF demands. The *Crossbow* bombing campaign resulted in 122,133 tons of explosives dropped during 68,913 sorties flown by the RAF and USAAF between August of 1943 and March of 1945. Most of the larger, permanent V-1 launch sites were ruined by the bombardment,

³⁴ Melvin Kessler, *Chronological Syllabus of the Armament Division, Part Two, The War Years: 1942-1945* (Eglin Air Force Base, Florida: Office of History, Armament Division, 1982), 31-32. This resource provides a summary of the more historically important missions carried out on Eglin Field during World War II, and includes copies of original documents, photographs, and select, edited transcripts of notable telephone conversations involving General Grandison Gardner, the commander of Eglin during this time.

but smaller sites escaped destruction. During the height of *Crossbow* operations from December 1943 to June 1944 the Allies lost 771 crewmen in 154 aircraft.³⁵

The Germans reacted to the bombardment of the V-1 sites by building more mobile facilities that could be easily constructed and concealed, while continuing to improve the missile in test flights until May 1944, the month before scheduled launches against England. On May 16 Hitler ordered Operation *Eisbar*, the missile attack on London, to begin by mid June. Approximately half of the 150 launch sites achieved readiness for action by the D-Day invasion on June 6, 1944. Hitler pushed for the start of the V-1 campaign as a reprisal, with plans to launch up to 500 missiles. However, due to the disruption of supply lines from allied bombing, only nineteen V-1s headed for England on the overnight of June 12/13. Fifteen of these devices failed before reaching England, with four hitting the greater London area killing six civilians. Lord Cherwell (Frederick Lindemann), Winston Churchill's trusted personal scientific advisor, remarked, "The lion hath groaned and given forth a mouse."³⁶

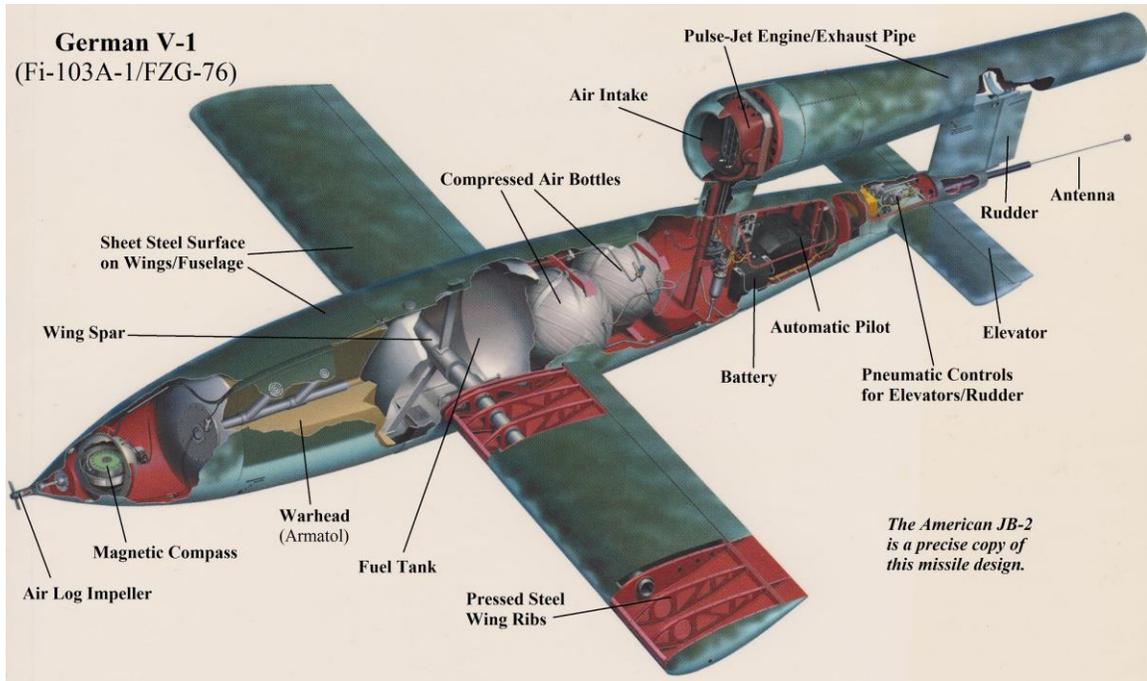
The "flying bomb" about to rain death and destruction along the Thames, for all its heinous intent, consisted of a simple, inexpensive, and ingenious technological advance. Once placed on the launch ramp, crewmen primed the pulse-jet motor by opening the fuel and air valves, and connecting an air compressor to the intake. The

³⁵ Joseph W. Angell, *History of the Army Air Forces Proving Ground Command, Part One: Background of Eglin Field 1933-1940* (Eglin Air Force Base, Florida: Office of History, Munitions Systems Division, Reprinted 1989 from 1944 publication), 41-46; Grandison Gardner, "Personal Narrative, Brig. Gen. Grandison Gardner, Commanding Officer Eglin Field, 1 April 1942 to 31 May 1945," in "A History of Air Proving Ground Command; Personal Narratives of Key Personnel to 31 March 1946," Historical Branch AC/S-2, Air Proving Ground Command, 1946, 12-13, Office of History, Eglin Air Force Base, Florida. Hereafter cited as EAFB; Adam L. Gruen, *The U.S. Army Air Forces in World War II—Preemptive Defense, Allied Air Power Versus Hitler's V-Weapons, 1943-1945* (Washington, D.C.: United States Air Force History and Museums Program, 1998), 21-25; Zaloga, *V-1 Flying Bomb*, 15; Werrell, *Evolution of the Cruise Missile*, 44.

³⁶ Werrell, *Evolution of the Cruise Missile*, 44-45; Zaloga, *V-1 Flying Bomb*, 18.

mixture ignited when the single Bosch spark plug in the top of the combustion chamber received electrical current. With the engine running, the catapult accelerated the missile to at least two hundred miles per hour to establish enough lift and forward inertia for the pulse-jet to thrust itself forward from there. Two spherical compressed air bottles behind the fuel tank (which the main wing spar passed through) powered both the gyroscopic autopilot controlling the rudder and elevator (holding a course determined by a magnetic compass in the nose) and pressurized the fuel lines to inject an atomized mixture to the engine. At the tip of the nose a small propeller (known as an impeller), attached to a threaded rod running back through the missile, armed the warhead in flight and (after the preset number of turns) fired detonators that severed the pneumatic hoses leading to the rudder and elevator. Simultaneously the impeller rod created an electrical impulse that detonated two explosive charges at the rear of the aircraft which deployed two spoilers (small metal flaps) underneath the horizontal stabilizer just forward of the elevator. The spoilers put the V-1 into a dive over the target, and the warhead (nearly one ton of amatol) exploded upon impact.³⁷

³⁷ Werrell, *Evolution of the Cruise Missile*, 43; Peter G. Cooksley, *Flying Bomb* (London: Robert Hale, 1979), 33-37. The missile's designers intended the V-1 to power dive to the target, but the downward attitude of the aircraft usually interrupted the fuel flow. The sudden stop of the engine warned those beneath of impending doom. Amatol is a mixture of TNT and ammonium nitrate.



V-1 Cutaway View³⁸

Table 1. Specifications for the V-1 (Fi-103A-1/FZG-76)

Overall Length:	25 feet, 4 inches.
Fuselage Length:	21 feet, 10 inches (engine extends past the rear of the fuselage).
Fuselage Diameter:	2 feet, 8 inches.
Wingspan:	17 feet, 6 inches.
Launch Weight:	4,858 pounds.
Fuel:	160 U.S. gallons.
Warhead:	1,870 pounds Amatol high explosive with redundant impact fuses.
Guidance:	Askania pre-set autopilot with gyro inertial platform/magnetic compass.
Engine:	Argus-Schmidt 109-014 pulse-jet.
Maximum Cruise:	415 miles per hour at 4,500 feet.
Maximum Range:	130 miles.
Accuracy:	Circular error probability of 8 miles.

³⁸ Zaloga, *V-1 Flying Bomb*, 29. Both the cutaway view and table of specifications are from Zaloga.

The unforgettable sound of the V-1 resonated from the Argus-Schmidt pulse-jet engine, and the new terror weapon caused a rising panic in London as the attacks increased. Londoners ascribed a number of names to the menacing missile, including Doodlebug, Hellhound, Junebug, robot bomb, flying bomb, and a host of unmentionables. Yet, the term “buzz bomb” became most prevalent when describing the V-1, derived from its distinct engine rumble. The second attack on June 15/16 began as 244 missiles launched with 144 reaching the English coast, resulting in 73 falling on London and 53 on the Port of Southampton. Germany launched over five thousand V-1s by July 22, 1944, causing an exodus from London both officially and unofficially. A government program provided for the relocation of 360,000 women, children, elderly, and disabled that summer. Hitler rejoiced at the press accounts of the V-1’s physical and psychological impact on the city, and ordered the Luftwaffe to expand the effort. Attacks peaked on August 3 with 316 missiles launched, 220 of which hit London.³⁹

The continuing Allied air attacks on V-1 sites and the British and American ground forces advancing through France slowed the missile launch rate, and forced a German withdrawal to the East and to the air. The last V-1 launched from France flew toward England on September 1, and all program personnel relocated to new launch sites in Belgium and The Netherlands where ground operations continued. V-1s also launched in the air from Heinkel He-111 bombers. The air launches began on July 9, 1944, and ended January 14, 1945, accounting for 1,776 missiles fired at London, Southampton, Gloucester and Manchester in England as well as Paris. The air launch campaign proved

³⁹ Zaloga, *V-1 Flying Bomb*, 19-21, 28.

particularly costly for the Luftwaffe. For the 388 V-1s that impacted England from He-111s, RAF fighter aircraft shot down 77 bombers.⁴⁰

Not all V-1s carried deadly explosives alone. A few were also fitted with a hole near the wing that ejected propaganda leaflets when the target dive began. Some had a tube extending out beneath the tail that spewed such papers upon impact. Various kinds of leaflets included disturbing photos of German civilians killed in Allied bombing attacks, fabricated letters from P.O.W.s expressing the humanity of their German captors, newsletters proclaiming to tell the “real story” of Allied losses withheld from the British and American press by London and Washington, and warnings of new secret weapons to come. Some leaflets simply displayed the message, “V1” in bold red letters. The German propaganda ministry believed simply the name of the flying bomb would be enough to traumatize its intended victims.⁴¹

During the first weeks of the V-1 “Robot Blitz” in June 1944, the Allies temporarily believed at least some of the guided missiles had the capability to find precise targets, and the barrage grew so intense that sweeping defensive measures were taken. A V-1 struck Eisenhower’s headquarters, and one of the most dramatic attacks hit the Guard’s Chapel at Wellington Barracks near Buckingham Palace. The explosion at the chapel occurred at 11:20 a.m. on Sunday morning June 18, and killed 121 worshippers. On that very Sunday, Eisenhower (deep in the throes of directing the Normandy invasion) made countermeasures to the V-1 attacks priority over all other military needs except those urgently required by the ground war. Numerous fighter plane

⁴⁰ Ibid., 21-23.

⁴¹ Reginald George Auckland, *V.1 Propaganda Leaflets, 1944-45* (Leeds, UK: Psywar Society, 1990), 1-3, 32, 67-69.

squadrons intercepted the flying bombs, using the fastest types available (The USAAF *Mustang* and RAF *Spitfire*, *Tempest* and the Allies' first jet fighter the *Meteor*) to catch up to the little buzz bombs that could reach four hundred miles per hour. Established fighter tactics did not work well against a V-1, as approaching at close range from behind the missile and firing would result in an explosion taking out the attacking fighter plane as well. One successful, though hazardous, tactic against the V-1 required a pilot to fly alongside it and slip one of the fighter's wings under a missile wing and flip it over. This disruption tumbled the gyroscope guidance system in the missile, causing it to crash. In a matter of days the British Army's Anti-Aircraft Command completed a massive redeployment of anti-aircraft guns from just south of London to the channel coastline in hopes of destroying the missiles well before they reached urban centers. The final line of defense was two thousand barrage balloons outside London, but some of the V-1s contained blades just inside the leading edge of their wings designed to cut balloon cables. These defenses downed just over half of all V-1s that reached England.⁴²

The German Air Ministry produced 30,257 V-1s (many by slave labor), and the Luftwaffe launched approximately 20,000 between June 12, 1944, and March 29, 1945. Despite a twenty percent launch failure rate from ramp explosions, premature crashes or wandering off course, over ten thousand civilians died in buzz bomb attacks on England, France and Belgium with three times as many wounded. Impacting in large cities, the missile's target circumference allowed it to kill indiscriminately. The V-1 exemplified the "fire and forget" weapon, an aerial torpedo that could not be turned back. Once launched it flew until it crashed prematurely, exploded on target, or was destroyed by defenses.

⁴² Werrell, *Evolution of the Cruise Missile*, 46-60.

With its high speed, low altitude approach (usually between 2,000 to 4,000 feet), no pilot to be injured or killed, and few vulnerable parts, it presented a difficult target. The buzz bomb could be launched at any time of day in any weather condition. It could easily be deployed in massive numbers because it was built of cheap, low carbon sheet steel instead of aircraft aluminum (some had wooden wings) and thus did not make use of precious wartime production materials. Yet this first generation cruise missile had a number of disadvantages. Poor accuracy limited its targets to large cities, thus it succeeded predominantly as a psychological terror weapon used against civilians rather than as a threat to military targets. Though fast and difficult to bring down, it flew a constant course and speed without the ability to evade threats. The V-1 required a catapult system on a long ramp to launch. These ramps were not mobile, and therefore vulnerable to attack. Further, the V-1 had a small warhead relative to the amount of explosives a bomber could employ. Despite its limitations, the Fi-103 guided missile represented a remarkable economic, technical achievement that would soon re-energize a sluggish U.S. missile program. American missileers soon faced the same advantages and limitations with the buzz bomb in their efforts to test and improve the new weapon.⁴³

Every Available Resource: Design, Development and Production of the JB-2

As much as the Allies publicly cursed the V-1 as an unconscionable terror weapon employed by a madman, ironically, they privately praised its performance and deeply desired one of their own. Rather than waste development time fabricating a new missile design, the United States created “Chinese copies,” in the popular slang of the

⁴³ Sherry, *Rise of American Air Power*, 163; Zaloga, *V-1 Flying Bomb*, 3, 19, 37; Werrell, *Evolution of the Cruise Missile*, 42, 60-62. Both Zaloga and Werrell meticulously document Germany’s use of the V-1 as a planned psychological terror weapon, demanded by Hitler and causing the widespread panic in London the Fürher expected.

era, of the V-1. Fortunately for the Allies, some of the V-1 missiles launched at England landed harmlessly, and by July a few unexploded V-1s went stateside to be duplicated. America's first successful cruise missile, the JB-2, arose simply as a direct copy of a Nazi terror weapon. Great Britain and the United States viewed a V-1 launched in support of fascism and racism as deplorable, and, paradoxically, a JB-2 propelled in the cause of freedom and democracy as admirable. Terror, however, would remain consistent in those underneath the flying bomb, regardless of their cultural beliefs or politics.⁴⁴

Just over one ton of V-1 parts, salvaged from largely intact missiles that failed to dive and detonate as calibrated, arrived at Wright Field in Dayton, Ohio, on the evening of July 13, 1944, aboard a C-47 *Skytrain* piloted by Lieutenant Tom Wigglesworth. Dr. Stanley P. Franckel, a technical advisor to General Eisenhower in London (and another member of the Manhattan Project), escorted the precious cargo and carried with him construction plans to reverse engineer a duplicate copy of the V-1. The Air Technical Service Command at Wright Field began building thirteen copies of the flying bomb, which they called the JB-2 (Jet Bomb model number 2); the JB-1 designation having been assigned to a missile under development by Northrop Corporation that was later re-designed as the JB-10. Three weeks later engineers completed a replica of the pulse-jet engine, using both German and American components, and successfully test fired it on August 1 before placing it in the twenty-foot diameter wind tunnel for aerodynamic

⁴⁴ Werrell, *Evolution of the Cruise Missile*, 62-63, 75. Werrell explains, and documents, the War Department's use of the term "terror" weapon, a discussion of plans to launch JB-2s against Berlin, and the value placed upon development of the new missile by the Pentagon. "Chinese copy," accessed September 25, 2013, <http://www.merriam-webster.com/dictionary/chinese%20copy>. According to Merriam-Webster, the term "Chinese copy" entered the American lexicon c.1920, and refers to "an exact imitation or duplicate." This phrase, now considered taboo for its implied cultural slur, is common throughout the archival materials related to the construction of the JB-2.

evaluation during the remainder of the month. Meanwhile the USAAF contracted with Ford Motor Company (pulse-jet engines), Republic Aircraft (airframes), Jack & Heintz (autopilot control systems), and Alloy Products (air tanks) to produce one thousand JB-2s. A V-1 site had not yet been captured, so the Army Air Force was uncertain as to what launch system to require. Soon program officials settled on a rocket-propelled launch cart on a ramp to accelerate the JB-2s to speeds above one hundred fifty miles per hour. This system allowed the pulse-jet engine (too weak to power take off alone) to sustain an airspeed sufficient for lift and forward thrust. Northrop Aviation won the contract for the carts and Monsanto for the rockets, known as RATOs for Rocket Assisted Take Off (in later decades more commonly referred to as JATOs for Jet Assisted Take Off, even though none of the secondary power sources used to launch the JB-2s, or similar craft, consisted of jet engines).⁴⁵

It is important to note the expediency, efficiency, and economy with which the United States developed its first successful cruise missile, copying German technology, in comparison to the immense effort expended under the ultra-secret Manhattan Project, in order to create the world's first atomic bomb. Begun in 1939, America's quest for a nuclear weapon required six years of toilsome effort, 125,000 workers (including the country's leading scientists) at multiple sites, and over two billion dollars. In three months, Project MX-544 (the JB-2) arose from a collection of dysfunctional V-1 missiles to dozens of operational JB-2s ready for test launch, involving less than a thousand

⁴⁵ Werrell, *Evolution of the Cruise Missile*, 62-63; Hanle, *Near Miss*, 253, 262; "Personal Narrative, Brig. Gen. Grandison Gardner, Commanding Officer Eglin Field, 1 April 1942 to 31 May 1945," 12-13, Office of History, EAFB. I maintain the use of the acronym RATO throughout this essay to refer to the small rockets attached to the launching cart of JB-2 missiles, as this is the term found in the original Air Force documents of the 1940s and 1950s. RATO, in my opinion, is a more accurate moniker, as it describes a rocket used to assist the "take-off" of an aircraft from the surface. Since the 1960s, the acronym JATO has replaced RATO in military jargon and civilian vernacular.

workers and military personnel combined, for less than \$10,000 per missile. There is little comparison between the daunting task of creating the original nuclear bomb and copying the latest missile technology. Quite simply, missiles existed as known, and predictable, vehicles in 1944-45; atomic explosions did not and, therefore, remained unknown and unpredictable. The Manhattan Project resulted in a new invention that ushered the world into the nuclear age. Whereas the battle-proven engineering within the initial version of the JB-2 had existed for two years, and, though the innovation it embodied was indeed significant, the missile relied on much of the basic mechanical methodology developed twenty-five years before in the “Kettering Bug.” Still, both weapons would change the very nature of modern warfare wherein enemies destroyed one another from great distances. Nuclear weapons have existed predominantly, thus far, as a proven threat for mass, if not global, destruction, while the cruise missile, though capable of carrying a nuclear warhead, and its progeny (the modern assault drone) became the oft-employed “surgical strike” alternative using conventional explosives.⁴⁶

Eglin Field near Fort Walton Beach, Florida, served as the initial site for JB-2 trials. Eglin, as the Army Air Force’s weapons testing ground since 1941, had carried out the most recent U.S. missile trials in 1942. With test ranges over a large uninhabited land area and within the adjacent Gulf of Mexico, Eglin provided an ideal proving ground for

⁴⁶ Cynthia C. Kelly, *The Manhattan Project: The Birth of the Atomic Bomb in the Words of Its Creators, Eyewitnesses, and Historians* (New York: Black Dog & Leventhal Publishers, 2009), 11-15; “Progress Report – AAF Guided Missiles Development Status and Availability,” Assistant Chief of Air Staff, Materiel and Services, Materiel Division, December 18, 1944, RG 218, Entry 343A, Box 4, File “JB-2 1944,” NARA II. Despite the precision indicated in the term “surgical strike” the phrase is somewhat inflated. Explosions are rarely as accurate as a well-handled scalpel, and collateral damage is expected.

fledgling air weapon technology. The JB-2, with its jet speed, less than perfect guidance system, large target radius and volatility, needed lots of room for things to go wrong.⁴⁷

During the late summer and early fall of 1944 personnel at Eglin Field procured private land near the western edge of Walton County and quickly began construction of Range 64, the JB-2's first test facility. Proving Ground Command chose the land for its remote location, large sand dunes for earthen launch ramps, level areas for operational facilities, and its uninhabited gulf shoreline. The War Department leased the property from owners John and Dorothy Coffeen for the duration of hostilities. Range 64 became America's first dedicated guided missile installation, and as such remained a work in progress throughout its use. A self-sufficient base of operations, the area included missile launching, storage and maintenance facilities as well as housing quarters and a fully provisioned mess hall. In addition to Proving Ground Command officers and enlisted men, liaison officers from the Engineering Corps and U.S. Navy, as well as civilian manufacturer representatives, pushed the total population of the little base up to 200. Range 64 grew so overcrowded that an additional 300 men assigned to JB-2 Training Unit, Squadron "P" had to be located one and one half miles east of Range 64, "where equipment was adapted to field conditions and assembly and launching operations were practiced in preparation for an overseas assignment."⁴⁸

⁴⁷ "Report on Study of Possible Locations for a Suitable Proving Ground for Aircraft Armament," War Department, Office, Chief of the Air Corps, Washington, D.C., April 19, 1939, Item 19, Proving Ground Command, Box 1, File "Development," Aerospace Research Studies Institute, United States Air Force Historical Division, Archives Branch, Maxwell Air Force Base, Alabama. Hereafter cited as PGC, ARSI, Archives, MAFB; Werrell, *Evolution of the Cruise Missile*, 28.

⁴⁸ "War Department Summary Sheet, Subject: Buzz Bomb (JB-2)," Col. Carter/72442, Office of Preparation, January 20, 1945, RG 218, Entry 343A, Box 4, File "JB-2 1945," NARA II; Robert R. Hastings, "Coffeen Nature Preserve: A Sierra Club Treasure," *Alabama Sierran*, March 2007, 1. Some archival sources list the Eglin JB-2 World War II test area as "Range C-64," but most use simply "Range 64" to identify the area. I have chosen to use "Range 64" exclusively, for simplicity, in this essay.

Located between Fort Walton and Destin, Range 64 extended two and one-half miles by one mile in area. Over the course of testing operations between October of 1944 and November of 1945, the Army Air Force constructed nine launch ramps, but no more than four could be operated at the same time due to space limitations.⁴⁹

The cost of construction for housing, supporting structures, and launch sites totaled \$157,800. In addition to the mess hall, post office, and housing units, these physical facilities included: shops for the assembly and adjustment of JB-1, JB-2 and JB-10 missiles, an instrument shop, a machine shop, a welding shop, a carpenter shop, three observation towers, two concrete bunkers for personnel protection during launches, two Shoran ground radar sites (for plotting impact points), and one SC-584 radar site (for plotting course, altitude, speed and range of missiles), as well as four radio sites (for directional finding plotting of each missile course). Additional recording equipment included photographic cameras, a ballistic camera, 16mm and 35mm motion picture cameras, a recording theodolite, a telemetry system, aerial cameras aboard chase planes and a U.S. Navy blimp, and a transit. In addition to the water range stretching outward from the beach 150 miles to the south, JB-2 tests also utilized a 4-square-mile land range wherein wingless missiles would be dropped from a B-17 bomber.⁵⁰

⁴⁹ "Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island," War Department, U.S. Engineer Office, Mobile, Alabama, Engineering Division, October 19, 1945, RG 218, Entry 343A, Box 4, File "JB-2 1945," NARA II; The nine launch ramps built and tested on Range 64 included a 500 foot, 6 degree inclined earthen ramp topped with steel-reinforced concrete built into the side of a sand dune, a 500 foot level earthen ramp covered with steel-reinforced concrete built on top of the same dune, a 400 foot steel portable ramp, a 400 foot ramp constructed using wooden railroad ties, a 390 foot steel portable ramp, a 165 foot steel portable ramp used for steam-powered (flash boiler) catapult launches, a 165 foot portable ramp used for multiple explosive cartridge-powered launches, a 40 foot steel portable ramp on a trailer, and a 40 foot steel fixed ramp.

⁵⁰ Ibid.

The first launch of a JB-2 occurred on October 12, 1944, at Range 64. Arriving partially dismantled in customized wooden shipping crates, a test missile received final assembly in the maintenance shops where technicians attached the engine and wings. Shortly before launching, the ground crew towed the missile to one of two special concrete semi-circular compass swing bases in designated areas designed with no ferrous metal, where the magnetic compass and gyro guidance mechanism could be preset without any magnetic interference. With the range and bearing set, personnel towed the missile to the ramp base where a crane lifted the two-ton flying bomb onto the launch cart. The Ford PJ31 pulse-jet engine roared to life when atomized gasoline injected by an air compressor ignited from the single spark plug in the top of the engine casing. Launch personnel took cover in the nearby concrete bunker or behind temporary sand bag revetments. The operator at the control panel fired the missile electronically engaging a switch in the bunker that sent current to ignite the four RATO boosters at the rear of the launch cart. During the first launch on October 12 the JB-2 rapidly accelerated down the launch ramp and climbed away as the launch cart fell to the sand beneath it. Soon the missile began a shallow descent that lasted for two miles before it ended in the Gulf waters. Proving Ground Command considered the forty-second flight a successful first effort, as the missile launched properly, separated safely from the launch cart, and flew

on course briefly, but understood much work was ahead to improve range, accuracy and reliability.⁵¹



JB-2 on 500-foot, six-degree inclined ramp at Range 64, c.1944.⁵²

As tests continued with four additional JB-2 launches in October and six during November, Range 64 personnel saw more failures than successes. Only three of the first eight missiles became airborne. Shadowing each missile, a chase plane, charged with aerial photography, could, if necessary, destroy the buzz bomb if it strayed too far off course. The pilot of the P-63 *Kingcobra* assigned to chase the JB-2 launched on November 11 had the best view of the program's earliest triumph. This missile accelerated to over four hundred miles per hour, pulling away from the P-63. The pilot lost visual contact as it headed south over the Gulf of Mexico. Though the only test to

⁵¹ *Assembly, Preparation and Launching of Pilotless Aircraft Type JB-2*, Technical Order No. 11-75BA-3, Commanding General, Army Air Forces, June 1, 1945 (Fostoria, OH: Gray Printing Co., 1945), 22-28, 43-51, Office of Scientific Research and Development, Item 2525, Division 3, Rocket Ordnance, Box 3, File "MX-544, 1945," Library of Congress, Washington, D.C. Hereafter cited as OSRD, LC; Hanle, *Near Miss*, 264. The vast majority of primary and secondary sources cite October 12, 1944, as the date of the first JB-2 launch, but the officer in charge, Captain Frank Kabase, listed October 10 as the first launch, and the Associated Press reported it as October 11.

⁵² Photograph #164173 USAAF, Photograph Collection, Office of History, EAFB.

attain such results among these early attempts, it provided USAAF Commanding General Arnold justification to increase JB-2 production priority to AA-1 (the highest status) two months later.⁵³

Designated project MX-544 (missile experimental) by the USAAF upon its inception, Proving Ground Command referred to the JB-2 program at Range 64 as Jet Propulsion Bomb, Service Test 4-44-44. Captain Frank Kabase, as Service Test Officer, oversaw the preparation of accurate monthly reports, among a myriad of other duties. In the Remarks section of the November 1944 report, dated December 1, the following explanation appears, “Test carried on I status major part of month due to lack of rockets for launching bomb.” The “I” referred to “inactive.” The officers and men of the test squadrons, the missiles, and the chase planes stood ready, but without booster rockets the entire program stood down. Frustrations with the RATO boosters went beyond the logistics of supply.⁵⁴

Ten of the first seventeen JB-2 launches ended in crashes due to launch problems, and most of these issues directly related to the rocket assisted take-off system. Until the Allies captured the first V-1 site in September 1944, they did not know what powered the German launch ramps. Early in the program engineers decided to use multiple RATO boosters to accelerate the JB-2 up to flying speed, as the missile’s engine lacked the power to self-launch the craft. By the time allied ground forces discovered that the German V-1 ramps used a combination of hydrogen peroxide and potassium

⁵³ *Assembly, Preparation and Launching of Pilotless Aircraft Type JB-2*, 22-28, 43-51, OSRD, Item 2525, Division 3, Box 3, File “MX-544,” LC; Hanle, *Near Miss*, 264.

⁵⁴ “Service Test Data for Monthly Historical Report, Service Test no. 4-44-44, title ‘Jet Propulsion Bomb,’” Medium and Light Bombardment Department, Proof Testing Section, 611th AAF Base Unit A, December 1, 1944, Item 101, PGC, Box 5, File “JB-2, 1944,” ARSI, Archives, MAFB.

permanganate to create a compressed gas that accelerated the missile to take off speed, the USAAF had already committed to a contract with Monsanto for RATOs. The JB-2 development team soon discovered that facilities to produce sufficient quantities of the chemicals used in the German launchers did not exist in the U.S. anyway. Sources of the era also express the dangerous nature of the hydrogen peroxide-potassium permanganate mixture, but subsequent documentation proves it more stable than the solid rocket fuel (ammonium picrate and potassium nitrate with a resin binder) used in the American Monsanto RATO boosters.⁵⁵

The high hopes built from the successful flight of test number eight on November 11 fell deeply with number nine on November 17. On the six-degree four-hundred-foot inclined ramp two of the five RATO boosters exploded during the take off roll, and an attachment lug connecting the missile to its launch cart failed. The lug failure allowed the cart to shoot out from under the flying bomb. With no way to achieve flying speed, the missile crashed just off the ramp. (This particular failure deflated Army pride, due to on site observers from the Navy's Bureau of Ordnance in the process of acquiring their own JB-2s for use at sea). The cart, which secured the booster rockets and supported the JB-2, had to separate from the missile immediately after launch or the extra weight would stall the aircraft. A number of missiles crashed from being struck by their own launch carts after, or during, the release of the launch cart. Test number ten on November 21 went wrong early when an attachment lug failed to release the jet bomb from its sled. As the

⁵⁵ Hanle, *Near Miss*, 264-265; V. D. Russillo and R. B. Kershner, "Status Report on Scale Model of JB-2 Launcher," March 19, 1945, OSRD, Item 2525, Division 3, Box 3, File "MX-544, 1945," LC; Joseph Adams Shortal, *A New Dimension: Wallops Island Test Range: The First Fifteen Years* (Hanover, MD: NASA Science and Technical Information Office, 1978), 9.

JB-2 dragged its cart into the air, the missile was hit time and time again by the flailing launch cart until the sled knocked the tail off the fuselage.⁵⁶

In the midst of these disappointments the Pentagon decided to go public with the JB-2 program as a part of the continuing efforts of the Office of War Information (OWI) to promote patriotism, boost war bond sales, and support morale on the Home Front by releasing news of the launches in a press conference at Wright Field, Ohio, on November 22. The *New York Herald Tribune* had the story in its November 23, 1944, issue. The USAAF had confirmed the missile's existence publicly in September, seeing no reason to deny it since Nazi V-1 missiles were regularly featured in the war news in the press and news reels. However, the army kept details on JB-2 construction and testing shrouded until the OWI completed a publicity plan. Under the headline, "Army Develops 'A Good Robot'—Just in Case!" the writer explained the rush to reproduce the German V-1, and provided a decent explanation of how the missile worked. The article included a photograph showing the JB-2 at "an undisclosed proving ground" and the caption cheered the improved launching ramp, which allegedly could be built ten days faster than the German design. Major General Bennet E. Myers, Deputy Director of the Air Force Technical Service Command, opined, "We may never need the robot bomb, for the Army Air Forces do not go in for indiscriminate bombing attacks. But if we do need it, we've got a good one." Perhaps Myers believed his own spin, but the devastating fire-bombing of Dresden and Tokyo (not to mention the nuclear fission above Hiroshima and Nagasaki) in the coming months would juxtapose the USAAF's strategic bombing policy upon "indiscriminate bombing attacks" in a way that historians continue to debate. The

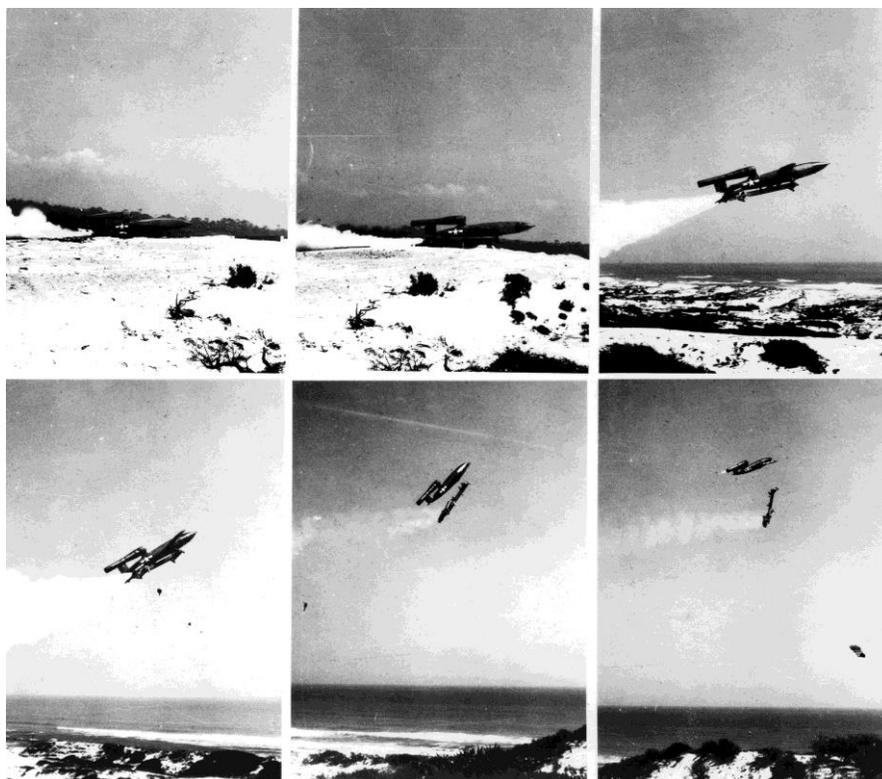
⁵⁶ "Progress Report – AAF Guided Missiles Development Status and Availability," RG 218, Entry 343A, Box 4, File "JB-2 1944," NARA II; Hanle, *Near Miss*, 265.

United States had a terror weapon in the JB-2, no different than the V-1 from which it came, and would not hesitate to use it if necessary.⁵⁷

The disappointing test launches of November 17 and 21 faded under the success of test numbers eleven and twelve on December 6 and 9. Each of these launches gave validity to new techniques. The test on December 6 proved that successful launches could be made from the 500 foot level track ramp. This missile achieved a take off speed of 300 miles per hour, climbed into the overcast at 1,500 feet and flew 22.5 miles, tracked by radar. The launch on December 9 was significant in that it proved four RATO boosters could be used successfully rather than five. On the 400-foot, 6-degree inclined ramp the JB-2 reached a speed of 225 mph. Upon leaving the ramp the aircraft lost altitude briefly before it recovered and climbed to its preset altitude of 2,000 feet on course. At its preset range termination of 50 miles, the robot bomb dived to the water.⁵⁸

⁵⁷ “Army Develops A Good Robot—Just In Case!” *New York Herald Tribune*, November 23, 1944, File “JB-2/Loon,” Archives, National Air and Space Museum, Washington, D.C. Hereafter cited as NASM. This public announcement of using the JB-2 “if we do need it” is consistent with documentary evidence of the War Department’s plan to use the missile against Berlin (if necessary) and its labelling of the JB-2 as a “terror weapon” documented by Werrell in *Evolution of the Cruise Missile*, 62-63, 75.

⁵⁸ “Progress Report – AAF Guided Missiles Development Status and Availability,” RG 218, Entry 343A, Box 4, File “JB-2 1944,” NARA II.



RATO discharge and launch cart separation from JB-2, Range 64, 1944.⁵⁹

The same date, December 9, Willys-Overland distributed a press release heralding the company's triumphant production of America's robot bomb. Wishing to capitalize on the recent media attention given the JB-2 by the USAAF press conference, the maker of the ubiquitous and now-famous Jeep wanted the nation to know its role in creating a winged cousin to its indispensable military four-wheel-drive vehicle. The prestigious Carl Byoir & Associates public relations firm in New York sang the praises of the Toledo company in a press release titled, "Willys-Overland Now Turning Out U.S. 'Buzz Bomb'." Though Republic Aviation received the contract for JB-2 airframe production, they quickly found themselves unable to meet the demand given their other contracts such as supplying P-47 *Thunderbolt* fighter planes. Republic subcontracted the job to

⁵⁹ Unnumbered Photograph USAAF, Photograph Collection, Office of History, EAFB.

Willys-Overland, which made 1,292 of the 1,382 JB-2s produced, fabricating all but the engines, control system and boosters. Company President Charles E. Sorensen revealed that, “Mass production facilities were installed and production operations on the aerial bombs were underway 60 days after receipt of the contract.” Cleared by the U.S. Army Bureau of Public Relations, the release goes into surprising detail on the missile’s components.⁶⁰

JB-2 tests numbered 13, 14, and 15 exemplified the continuing ups and downs of the roller coaster ride experienced by the Army Air Force’s guided missile development program. Both the flying bomb and the launching cart (fitted with four RATO boosters) disintegrated above the level ramp during the December 12 test (number 13) when technicians piled sand off the end of the track to prevent damage to the launching cart (from rolling off the end of the rails), in hopes that carts might be re-used for subsequent tests. After missile separation the cart hit the sand launching itself into the JB-2, ending cart conservation efforts. Two days later (December 14, test number 14), again on the 500-foot level ramp using four rockets, “The bomb attained an altitude of 3,800 feet and a speed of approximately 350 miles per hour, before diving in due to air log action at a range of 55 miles.” Encouragement from this achievement receded on December 17 when the last JB-2 test launch of 1944 (number 15), also on the level track with four rockets, crashed shortly after take-off, “due to failure of the motor metering units.”⁶¹

⁶⁰ “Willys-Overland Now Turning Out U.S. ‘Buzz Bomb’,” Carl Byoir & Associates, New York City, December 8, 1944, File, “JB-2/Loon,” Archives, NASM; “Willys-Overland Motors, Inc.—World War II Production Record 1941 through 1945,” File “JB-2,” Archives, Wright-Patterson Air Force Base, Ohio. Hereafter cited as WPAFB; “Progress Report of AAF Pilotless Aircraft as Guided Missiles Development Status and Availability,” Assistant Chief of Air Staff, Material and Services, Material Division, June 1, 1946, RG 218, Entry 343A, Box 4, File “JB-2 1946,” NARA II.

⁶¹ “Progress Report – AAF Guided Missiles Development Status and Availability,” RG 218, Entry 343A, Box 4, File “JB-2 1944,” NARA II.

The successful launch on December 14 occurred on the same day the American public got its first glimpse of the JB-2. Headlined, “Crowd Gets First View of Robot Bomb” a *New York Sun* story explained,

New Yorkers had a close-up of a buzz bomb today when a duplicate of the German robot, built by Republic Aviation Corporation of Farmingdale, L. I., was trundled into Father Duffy Square at 47th Street and Broadway, aboard a forty foot trailer and placed on exhibition at the Winged Victory display there. The robot was brought across the Queensboro Bridge from Long Island, causing considerable excitement along the way, and will remain on display until December 20.⁶²

The OWI created this JB-2 display as part of a media event promoting the film *Winged Victory*, a propaganda piece written by Moss Hart (*You Can't Take It With You* and *The Man Who Came to Dinner*) to be released December 22 across the country to raise money for Army charities. *Winged Victory* and its supporting JB-2 exhibit as one of hundreds of innovative propaganda efforts OWI initiated to remind the public to fully support the war effort. Hollywood, with its weekly film audience of eighty million Americans, acted as a crucial part of the U.S. war machine⁶³

As 1944 drew to a close, Proving Ground Command placed the JB-2 program in full development mode. The Army Air Forces “Guided Missile Development Status and Availability” progress report listed ongoing activities in addition to launch tests. The most immediate questions to be answered from missile tests addressed the minimum length of ramp required to launch with four RATO units and gauging the responsiveness of the preset guidance system. The Aircraft Radio Laboratory at Wright Field initiated the fabrication of a remote radio/radar control system for the JB-2 to improve the missile’s

⁶² “Crowd Gets First View of Robot Bomb,” *New York Sun*, December 14, 1944, File “JB-2/Loon,” Archives, NASM.

⁶³ “Crowd Gets First View”; Walter L. Hixson, *Parting the Curtain: Propaganda, Culture, and the Cold War, 1945-1961* (New York: St. Martin’s Griffin, 1998), 2.

accuracy. A captured German V-1 launching ramp arrived at Range 64, slated for use beginning in January. To that end Eglin technicians ordered 4,000 pounds of hydrogen peroxide and 400 pounds of calcium permanganate to recreate the German launching method. Project engineers investigated several mechanical launching mechanisms, including an air turbine, a large flywheel and cable system, windlass and cable system, and a flash steam boiler system. Technical Service Command drafted preliminary design systems for launching two JB-2s from a B-17 *Flying Fortress* bomber in flight. The latest missile progress report listed seventy-five JB-2s completed on the assembly line, and confirmed authority received from the War Production Board (WPB) for the procurement of an additional 1,000 missiles and 10,000 additional RATO units. The WPB revised cost estimates to \$7,925 per complete JB-2 and \$1,888 for each launching cart with rockets for a total of \$9,813 taxpayer dollars per launch.⁶⁴

A final word from the press in 1944, concluding the OWI publicity blitz that began with the November press conference at Wright Field, came from a newspaper article on December 30 that hints at potential JB-2 usage in the coming year. A headline touting, “U.S. Rockets Mean Trouble for Foes” over the two-column report is followed by a sub-header stating, “Yankee Doodle Robomb; Undergoing Tests, Assures Precision

⁶⁴ “Progress Report – AAF Guided Missiles Development Status and Availability,” RG 218, Entry 343A, Box 4, File “JB-2 1944,” NARA II; “JB-2 Installation on B-17 Airplane,” Army Air Forces, Air Technical Service Command, December 2, 1944, Item 101, PGC, Box 9, File “JB-2, 1944,” ARSI, Archives, MAFB. I use the terms “radio control” and “radio/radar control” interchangeably when discussing USAAF/USAF remote guidance for the JB-2 in this essay (as well as US Navy remote guidance prior to 1950), and employ the term “radar control” specifically to reference the Navy guidance system developed for the *Loon* in 1950. The remote control systems used by the Air Force utilized radio signals to make guidance corrections during the flight of a JB-2, based on a radar signal from the missile received and tracked by a ground-based radar station. The radar signal from the JB-2 transmitted its range, altitude and bearing (direction), and controllers transmitted radio guidance signals back to the missile based on its radar tracking. In 1950 the Navy developed the first true “radar control” by utilizing the same radar signal to both track the missile and send guidance control corrections, thereby eliminating the need for transmissions from a separate radio unit. This Navy achievement is discussed below in Chapter II: *Sailing to Sunset*.

Attacks on Tokyo, Nazis.” Citing unnamed “officials” the story argues the JB-2 is a, “great improvement over anything that Nazi scientists have been able to produce.”

Readers are told how the U.S. took the design of the V-1 and, “molded it into the Yankee Doodle robomb which may be used next year for precision bombing attacks on Tokyo and German cities.” As a propaganda piece the article clearly shines in patriotic duty toward the psychological war effort, but given the unsteady status of JB-2 testing at the time, any semblance of the truth is dubious, though, arguably, irrelevant to the intent.

Explaining the motive of journalists of the era, historian Michael Sherry explains, “They saw themselves as enlisted in the war effort, their task that of establishing confidence in Allied virtue and victory and commanders. . . .Americans still needed to view the war as a positive experience.” The headline of this story also serves as a reminder that neither the media nor the public yet understood the difference between a rocket and a jet in 1944.⁶⁵

As the JB-2 emerged as a media darling, the USAAF Technical Service Command continued work on nine other jet bomb (JB) missiles. Sequentially numbered based on the initiation date of each project, only the JB-2 reached the production line. In spite of mixed results in early testing, Proving Ground Command recognized the clear superiority of the JB-2 in comparison to the other JB designs. As the American “buzz-bomb” proved itself as the most successful, and ultimately most important, missile in the

⁶⁵ “U.S. Rockets Mean Trouble for Foes,” *Science News-Letter*, December 30, 1944, File “JB-2/Loon,” Archives, NASM; Sherry, *Rise of American Air Power*, 132-133. Under no circumstances was the JB-2 capable of “precision bombing attacks.” *Science News-Letter* was a publication of Science Service, a news service for reporters founded in 1921 by renowned journalist Edward W. Scripps and California zoologist William Emerson Ritter. The goal of this service was to keep the public informed of scientific achievements. In 2008, Science Service became the Society for Science and the Public.

Air Force arsenal, concurrent JB designs faced irrelevance. However, one JB project predated the JB-2, and its prototype soon appeared on Range 64.⁶⁶

The designation JB-1 belonged to a jet bomb designed by Northrop Aviation, which began development prior to the JB-2 as project MX-543. Convinced that maximum aerodynamic efficiency could best be achieved with a wing design that provided stability and control without the drag induced by an additional horizontal stabilizer, elevator, vertical tail plane, or rudder, company founder Jack Northrop created a “flying wing” for the JB-1 (although Northrop eliminated the rudder, stability concerns resulted in the JB-1 retaining a vertical tail plane). This wing concept achieved varying success in aircraft until it was ultimately proven successful in the present-day B-2 bomber, which does not employ a vertical stabilizer or rudder. A manned-glider version of the JB-1 tested successfully prior to the first powered launch attempt.⁶⁷

⁶⁶ “Summary Handbook of Guided Missiles,” RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II; “War Department Summary Sheet,” RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II; Andreas Parsch, “Directory of U.S. Military Rockets and Missiles, Appendix 1: Early Missiles and Drones, JB Series, accessed January 26, 2012, <http://www.designation-systems.net/dusrm/appl/jb.html>.

⁶⁷ “JB-1, Jet Propelled Bomb,” Army Air Forces, Air Technical Service Command, Engineering Division, December 21, 1944, File “JB-2,” Archives, WPAFB; D. M. Carpenter and P. V. D’Allesandro, *JB-1A Thunderbug WWII Flying Wing Bomb* (Bedford, MA: Jet Pioneers of America, 1997), 4-5, 13-19, 48; Hanle, *Near Miss*, 262-263.



JB-1 prototype (foreground) and JB-2s at missile barn, Range 64, December 1944.⁶⁸

Technological concerns plagued the initial JB-1 test from the start of operations at Eglin Proving Ground (Range 64) in early December 1944. Army Air Force requirements called for four hundred pounds of thrust from each of the two jet engines, but the completed General Electric Type BI turbo supercharger power plants could only muster half the requested power. With just two hundred pounds of thrust from each engine, the JB-1 had to be launched in a lightweight condition. Difficulties encountered with the ignition system, and a series of fuel leaks, delayed the test 24 hours. The next day, December 7, 1944, technicians placed the JB-1 on the five-hundred-foot, level launch ramp, attached to a modified JB-2 launch cart with two RATO units, at a nine-degree nose-up attitude with its two elevons (movable surfaces at the trailing edge of the wing providing both pitch and roll control) also adjusted to nine degrees. The launch team

⁶⁸ Photograph #164199 USAAF, Photograph Collection, Office of History, EAFB.

started the engines with compressed air and spark from a high voltage transformer. Just thirty seconds before launch time, with the engines at full speed, considerable sparking began coming out of the right tailpipe. Nonetheless, the countdown continued and the JB-1 roared down the track at two hundred thirty feet per second. The jet bomb departed the launch cart and nosed up to a forty-five degree angle, climbing rapidly until the wing stalled and the missile crashed into the surf after a five-second, four-hundred-yard dash from the ramp. Salvage revealed the source of the engine sparks during the launch sequence to be the shearing off of half of the turbo blades. Engineers determined the elevons being set at too great a positive angle caused the steep climb and stall. By December 21, after extensive review, Northrop decided to drop the General Electric turbo jets in favor of the more reliable and proven pulse-jet engine of the JB-2. This design change resulted in the close of the JB-1 designation with only one unit produced and tested, and led to the production of the JB-10 which incorporated a single pulse-jet engine in the center of the missile's fuselage surrounded by a special cooling shroud. Testing of the JB-10 would follow in 1945, but also ended in failure.⁶⁹

The ten jet bomb projects included a broad range of designs. However, the Technical Service Command cancelled four of the JB missiles (JB-5, JB-6, JB-7 and JB-9) in the concept or design phase. Hughes Aircraft developed the JB-3 (MX-570) *Tiamat* subsonic air-to-air missile. Test launched from the ground and from an A-26 aircraft, this design featured three large fins at the tail with active control surfaces. The JB-4 (MX-607), essentially a modification of the existing GB-4 guided glide bomb, featured a Ford PJ31 pulse-jet engine. The JB-5 (MX-595) designers envisioned an unguided, wingless

⁶⁹ "Progress Report – AAF Guided Missiles Development Status and Availability," RG 218, Entry 343A, Box 4, File "JB-2 1944," NARA II; "JB-1, Jet Propelled Bomb," File "JB-2," Archives, WPAFB.

air-to-surface rocket that had a six-mile range. The JB-6 (MX-600), also an air-to-surface guided missile, would have been spin-stabilized and supersonic. Design details of the JB-7 (MX-605) show a high-speed, jet-powered research craft. Boeing developed the JB-8 (MX-606) as a surface-to-air guided missile. Plans for the JB-9 (possibly known as project MX-626) called for a short-range, surface to surface missile design.⁷⁰

As 1944 drew to a close Technical Service Command evaluated whether continuing multiple JB initiatives made sense, given the operational capability of the JB-2 along with its ongoing factory production run, and the failure of the JB-1. Ultimately, the Air Force chose to focus solely on the JB-2, trusting test results would improve over time.

After a three week hiatus, JB-2 testing at Range 64 resumed on January 10 and again on January 12, 1945, but both missiles burned on the launch ramp when RATO rockets exploded, causing the fuel to combust. A week later the crash percentage of JB-2 tests rose to 62.5% with 15 of the first 24 test launches ending in failure either during the launch sequence or shortly thereafter.⁷¹

Unaffected by the troubled test program, General Arnold, in a clear departure from USAAF precision bombing doctrine, increased the order for 1,000 JB-2s to a staggering 75,000 missiles on January 14. The following day Arnold gave the JB-2 project the highest priority (AA-1), equal to the production priority of the B-29 *Superfortress* bomber. Arnold based his support of the project on the same advantages the German high command saw in the missile. The weapon put no pilot or crew at risk

⁷⁰ “Summary Handbook of Guided Missiles,” RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II; “War Department Summary Sheet” RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II; Parsch, “Directory of U.S. Military Rockets and Missiles,” <http://www.designation-systems.net/dusrm/appl/jb.html>.

⁷¹ Hanle, *Near Miss*, 265; Werrell, *Evolution of the Cruise Missile*, 64.

delivering its ordnance, its small size, high speed, and low altitude approach made it difficult to destroy, and it could be launched at any time in any weather conditions. The design consisted almost entirely of sheet steel; it did not expend critical war production materials such as aircraft aluminum. Cheap to produce, the flying bomb could readily be deployed and consumed in mass quantities without depleting precious human and materiel resources. Arnold's decision to multiply the JB-2 production order by seventy-five occurred immediately following the Battle of the Bulge, a major German offensive that caught Allied forces completely by surprise and resulted in massive casualties, materiel loss, and the delay of the end of the war in Europe. Eisenhower, himself a proponent of the JB-2, could not allow such a large scale attack to occur again. Pushed by his superiors to deliver as many missiles to the European Theater as possible, and faced with the possibility of losing control of the JB-2 program to the Army Ground Forces if he failed, Arnold persevered.⁷²

Yet the JB-2 had the same disadvantages as the V-1. Once launched, the missile could not be terminated, nor its course altered. Ground launched JB-2s required booster rockets and a ramp, which not only revealed the missile's predictable and unchangeable flight path to the enemy, but also made an attractive, identifiable target despite camouflage efforts. A predictable flight path gave notice to the intended target, allowing the enemy to focus defenses efficiently. The poor accuracy of the JB-2, a probability of impacting within a radius of 8 miles, required that only large areas (cities) could be focused upon. The relatively small size of the missile limited the payload of its explosive warhead to just below one ton, and thus its ability to inflict damage. This inability to aim

⁷² Sherry, *Rise of American Air Power*, 49-52; Werrell, *Evolution of the Cruise Missile*, 62-64; Hanle, *Near Miss*, 257, 271-272.

at a precise target, and a comparatively low destructive force, relegated the JB-2 (and its predecessor, the V-1) to a psychological terror weapon. Both Germany and the United States proved equally willing to employ it as such.⁷³

Critics of the JB-2 expressed concerns that resources dedicated to its production would affect the production and availability of bombs and artillery shells. Within two weeks of General Arnold's 75,000 missile order, budget projections determined that the new program would consume up to twenty-five percent of shipping bound for the European Theater of Operations and cost over one billion dollars. Unwilling to dedicate so much support to an unproven weapon, the War Department, upon consultation with the Air Materiel Command, reduced the total order to 10,000 units.⁷⁴

Evaluating launch methodology presented a continual challenge to JB-2 testing throughout the missile's service life. The most prevalent problem in the first five months of testing centered on the reliability and stability of RATO rockets used to propel the missile up to flight speed on the ramps at Range 64. As JB-2 testing continued through the first months of 1945, the initiative to air-launch the missiles from B-17 bombers in flight (designed in part to resolve the continuing problems with RATO ground launches) entered the trial phase. Inspired by the V-1s fired in flight from the Luftwaffe's Heinkel

⁷³ Werrell, *Evolution of the Cruise Missile*, 62-63, 75; Roger A. Freeman, *The Mighty Eighth* (London: Cassell & Co., 2000), 153, 168. A target radius is not the same as a kill radius or "kill zone." The JB-2 target radius of eight miles refers to accuracy, not destructive capability. An eight mile target radius means that a properly operating JB-2 missile had the circular probability of impacting within an eight mile radius of the target area. With a warhead of just under one ton, the JB-2 had a kill radius or "kill zone" of 200 to 300 feet, with the minimum safe distance from the blast at 1,000 feet. Comparing the payload of a JB-2 (warhead weight of 1,870 pounds carried less than 100 miles) with the most common U.S. heavy bombers of the Eighth Air Force during World War II, B-17 variants usually carried 4,000-5,000 pounds of bombs on missions extending over 1,000 miles, and B-24 variants usually carried 5,000 pounds of bombs on missions extending over 1,400 miles. USAAF bombers normally carried 500 or 1,000 pound bombs, but occasional missions were flown with 2,000 pound bombs.

⁷⁴ "Minutes of Meeting held at Aberdeen Proving Ground, Aberdeen, Maryland," Joint Committee on New Weapons and Equipment, Guided Missiles Committee, June 22, 1945, RG 218, Entry 343A, Box 3, File "Guided Missiles," NARA II; Werrell, *Evolution of the Cruise Missile*, 64.

He-111 bomber, airmen modified one USAAF B-17 bomber at Eglin Field to carry two JB-2 missiles (one under each wing). The first successful air launch of JB-2s from the B-17 occurred on March 2, 1945. Bomber crews launched a total of ten JB-2s during March and April. Launching in flight eliminated the need for RATO units to accelerate the buzz bombs to a speed that allowed the missile to attain lift, as the B-17 simply had to maintain an indicated airspeed between 180 miles per hour and 220 miles per hour prior to missile release. The airspeed also eliminated the need for an air compressor, required during ground launches to provide forced air into the pulse-jet engine to allow ignition. However, five of the missiles launched from the bomber experienced engine starting malfunctions, resulting in unsuccessful flights. Of the remaining air launches, four proved successful and one experienced a control malfunction causing it to nose-dive into the Gulf of Mexico. The test report concluded that JB-2s may be launched successfully from a B-17, and that the engine failures could be eliminated by the installation of a motorized fuel valve. Adding air-launch capability to the JB-2 increased its limited one-hundred-mile range to over one thousand miles, but other problems remained to be solved with the American buzz bomb.⁷⁵

⁷⁵ "Launching of the JB-2 from B-17G Type Aircraft," Army Air Forces, Air Technical Service Command, Engineering Division, May 16, 1945, File "JB-2," Archives, WPAFB; Hanle, *Near Miss*, 266.



First launch of JB-2 missiles from B-17 bomber, March 2, 1945.⁷⁶

The USAAF took delivery of 437 JB-2s by the first week of April 1945 and 47 successful test launches had occurred after 71 attempts, raising the overall success rate to 66 percent. Testing confirmed the most successful method for ground launch utilized four RATO units. Much enthusiasm grew from the tests with the so-called “Zero launch ramp,” that required only forty feet of ramp length to attain missile flight speed with the RATO nozzles turned downward and to the side. This RATO configuration allowed for a vertical thrust component strong enough to maintain a positive rate of climb for the JB-2 using only one-tenth the length of the longer ramps. The “Zero” method provided significant mobility, defense and stealth advantages, particularly with truck and trailer launch units. Test missiles flew between 350 miles per hour and 430 miles per hour, usually at altitudes between 1,500 feet and 2,500 feet, but one JB-2 performed successfully at an altitude of 10,500 feet. Maximum range increased to approximately 130 miles, but accuracy did not improve. All JB-2s launched to date applied mechanical

⁷⁶ Photograph #169997 USAAF, Photograph Collection, Office of History, EAFB.

guidance through a clock and compass within the pilotless bomb setting range and course (like the V-1). The dive command to the target area utilized the German impeller timing system that locked the control linkage to the elevator into full rapid descent position at the correct moment in flight. The large target area this system provided (an eight-mile or more radius) limited the use of the missile to terrorizing large urban areas. Because of its imprecise targeting ability and less than fool-proof guidance systems, none of the JB-2s test launched at Eglin carried the 1,870 pounds of Tritanol explosive designed for its warhead; instead the missiles carried a sand and aggregate concrete ballast to maintain a proper aerodynamic weight and balance.⁷⁷

As successful launches increased, JB-2 technological teams concentrated on guidance and accuracy as the pressing concerns with the new missile. In April, engineers at the Aircraft Radio Laboratory at Wright Field completed development of a radio/radar control system utilizing the highly accurate and battlefield proven SCR-584 microwave radar unit to track an AN/APW-1 radar transceiver installed in the JB-2; allowing the missile to transmit a locator beacon and receive multiple radio control signals from the ground. Technicians installed the AN/APW-1 in a C-45 *Expeditor* transport aircraft for initial trials. Proving Ground Command employed a similar control system, previously

⁷⁷ “Progress Report—AAF Guided Missiles Status and Availability,” RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II; R. B. Kershner and V. D. Russillo, “Status Report on Multiple Cartridge Launcher for JB-2,” June 25, 1945, OSRD, Item 2525, Division 3, Box 3, File “MX-544, 1945,” LC; Werrell, *Evolution of the Cruise Missile*, 62-63, 75; Quigg, “Assessment of Significance,” 1-29. Among several launches gone wrong, three JB-2s went rogue in June 1945. On the 13th a missile buzzed Panama City, landing eventually near DeFuniak Springs forty miles northeast of Range 64. On the 15th a missile turned completely around over the Gulf of Mexico and was shot down by a chase plane four miles short of Ft. Walton Beach. A wayward JB-2 launched on June 21 headed eastward and landed on Dog Island, one hundred miles from the range. After a meticulous search in JB-2 technical and operations manuals, the author could not locate documentation directing the use of sand and aggregate ballast to replace the empty warheads of the JB-2. Proof of this “field modification” was revealed in the fieldwork on Santa Rosa Island, where decades of exposure to the elements rotted away the top half of warheads on several JB-2 wrecks. Inside these warheads lie one example of value in the “ground truth” of archaeology, in the form of sand and aggregate gathered nearby prior to launches of the late 1940s.

tested at Eglin, in what the Army Air Force called “Willie Orphans,” war-weary B-17 and B-24 bombers (without pilots or crew) packed with explosives flown by remote ground radio/radar control to a given target. Concurrently, the Technical Service Command created an electronic system to ignite small explosive charges that would separate the wings from a JB-2 missile in flight. The hypothesis for wing separation presumed that a missile rendered wingless at a precisely timed moment would have a more predictable, controlled, and therefore more accurate, trajectory toward a target.⁷⁸

The development of reliable radio guidance, radar tracking, and wing separation in JB-2 systems design marked a pivotal moment of transition from the mechanical to the electronic age in cruise missile technology. No longer an exact American copy of a German design, the JB-2 began to transcend its origins, taking the next steps in cruise missile evolution toward new generations more complex, adaptable to changing strategies and tactics, with perhaps unlimited growth potential.

With the surrender of Germany in May 1945, the opportunity to deploy an operational American cruise missile focused on targets within the Japanese home islands. Possibilities for using the JB-2 in the Pacific moved from plausible to probable in War Department discussions during the summer. The Navy wanted their own JB-2s, wishing to execute a plan, under development since the previous September, to launch the missiles from an aircraft carrier. The Navy’s Bureau of Aeronautics procured fifty-one JB-2s, with an additional one hundred to be delivered. Ground testing of the Navy missiles would take place at Point Mugu, California. A joint Army/Navy program to

⁷⁸ Ibid.; Hanle, *Near Miss*, 255, 267; SCR-584 was the abbreviation for Signal Corps Radio model 584. AN/APW-1 was the designation for Army-Navy/Aircraft Automatic transmitting and receiving submarine sonar.

launch JB-2s from LST (Landing Ship Tank) vessels benefitted from unusually amicable inter-service cooperation. As plans progressed for the invasion of Japan, Army planners counted JB-2s as a part of the ground forces arsenal available once beachheads were established.⁷⁹



JB-2 on “zero launch” mobile ramp at Range 64, 1945.⁸⁰

Pressure to improve the accuracy of the JB-2 increased with its planned deployment against Japan. With all missiles at Range 64 on Eglin Field fired out to sea, Proving Ground Command was limited in its ability to assess and improve accuracy. Precise measurements could not be obtained on the water, with the impact point of the flying bomb quickly erased by the waves. Further, a pilotless aircraft resting at the bottom of the Gulf of Mexico prohibited examination of any malfunctioning components. On June 22 the Army Air Force selected the expansive and desolate Wendover Army Air

⁷⁹ “Minutes of Meeting held at Aberdeen Proving Ground, Aberdeen, Maryland,” RG 218, Entry 343A, Box 3, File “Guided Missiles,” NARA II; Hanle, *Near Miss*, 269.

⁸⁰ Unnumbered Photograph USAAF, Photograph Collection, Office of History, EAFB.

Field Range in Utah as the next JB-2 testing site, to conduct launches concurrent with those ongoing at Eglin. Testing on the Wendover range also allowed the use of live warheads on JB-2s for the first time.⁸¹

Retired USAF Major Phil Mack, who served as Operations Officer at Wendover in 1945, provided a chase pilot's perspective on JB-2 testing. Launch teams in Utah utilized an eighty-foot inclined ramp with the same RATO-powered launch cart used at Eglin. Wendover benefitted from an added fail safe at the far end of the target area. In addition to a fighter plane giving chase and, if necessary, shooting down a rogue missile, a mountain range stopped any errant JB-2s that failed to dive when they were pre-set, or radio-controlled, to do so. JB-2s often outpaced their chase planes.

On the occasion of the first launch, I flew the P-51 in a pattern and approaching the launch ramp, I gave the signal by radio to the ground crew. On schedule, the four rockets on the launching sled went off giving a large cloud of smoke. I flew through the cloud on instruments, and upon passing out of the smoke, looked for the missile and found it right in front of me. From that point I could fly formation with the bomb, observe its flight characteristics, shoot it down if needed, and take pictures with a GSAP camera of the flight. Once the bomb reached its cruise altitude, which wasn't very high, the bomb flew faster than I could in the P-51 at max continuous power. As I recall, the length of the range was about 80 miles. It had been planned that the bomb, if it failed to dump, and if it was impossible for me to shoot it down, would fly harmlessly into the uninhabited mountain range. This is exactly what happened on the first launch.⁸²

Atomic bombs dropped from B-29 bombers destroyed Hiroshima and Nagasaki six weeks later; the resulting new paradigm for warfare called into question the need for conventional weaponry, including the JB-2. Yet the testing continued at Eglin and

⁸¹ "Minutes of Meeting held at Aberdeen Proving Ground, Aberdeen, Maryland," RG 218, Entry 343A, Box 3, File "Guided Missiles," NARA II.

⁸² Phil Mack, "JB-2," e-mail to Gary F. Quigg, September 10, 2008 (3:47p.m. ET). A GSAP camera is a Gun Sight Aim Point camera that employed 16 mm motion picture film, during World War II, to record targets observed or engaged by a fighter aircraft.

Wendover, through the Japanese surrender of September 2, the cancellation of contracts with all manufacturers of JB-2 components on September 15, and beyond. Both the Army and Navy remained committed to the missile in the midst of the massive military demobilization, facing an uncertain future. Having lost the opportunity for combat trials, America's armed forces began to recognize the value of the JB-2 in a world where large scale attacks may be initiated remotely, by the push of a button. The transition from weapon to research vehicle had begun for the buzz bomb.⁸³

Eglin built a new test facility for the JB-2, and the Wendover accuracy tests rolled forward through 1946. Range 64, in accordance with the lease agreement, had to be returned to its civilian owner upon the cessation of hostilities. Of the 1,382 JB-2s received by the Army Air Force, Range 64 personnel launched 233 between October 1944 and October 1945. Proving Ground Command cancelled the test launches in November, and ordered the facilities at Range 64 to be deconstructed, removed or abandoned by December 12. Planning for a new 4,700 acre ground missile launching site at Eglin, to be located twenty-two miles west along the Gulf coast on Santa Rosa Island, began prior to V-J Day. Construction of this new range commenced in January.⁸⁴

⁸³ Hanle, *Near Miss*, 277. Within two years, in 1947, the military recognized the potential of the JB-2/*Loon* to carry an atomic warhead, although this was never tested. From this realization onward through the present day, all succeeding cruise missiles have been designed to carry both conventional and nuclear payloads. *Matador* and *Regulus*, the cruise missiles that replaced the JB-2/*Loon*, were commonly armed with nuclear warheads targeted for Soviet cities beginning in 1954. These developments are chronicled below in Chapter II: *A Rising Red Tide*, and Conclusion.

⁸⁴ "Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island," RG 218, Entry 343A, Box 4, File "JB-2 1945," NARA II; Hanle, *Near Miss*, 277; "American Copy of German Robot Bomb V-1, Army Air Forces Type JB-2," Army Air Forces, Air Technical Services Command, Engineering Division, November 30, 1945, Archives, File "JB-2/*Loon*," Archives, WPAFB; John F. Whitely, "Personal Narrative, Col. John F. Whitely, Commanding Officer Eglin Field, 1 June 1945 to 31 March 1946," in "A History of Air Proving Ground Command: Personal Narratives of Key Personnel to 31 March 1946," 91-93, Office of History, EAFB.

The Air Technical Service Command detachment at Wendover conducted tests to determine the accuracy, reliability and limitations of JB-2s guided by remote radar/radio ground control from September 1945 through January 1946. These radar-controlled tests resulted in much improved accuracy, with the missiles impacting within one-half to one and one-half miles of the target marker with a maximum range of eighty-five miles.⁸⁵

In a memo dated March 1, 1946, designed to summarize the development of the JB-2, Proving Ground Command presented the following conclusions, somewhat inflated: the preset mechanically controlled version of the JB-2 could carry an armed warhead up to 150 miles at 400 miles per hour with a 50 percent accuracy rate within a 5 mile radius of target center which rendered it, “suitable for area bombing of cities or other large areas;” and, “The remotely controlled version of the JB-2 is limited to distances of 100 miles. Consistent hits are possible within an area ½ mile square.” The memo asserted that the initial development phase of the JB-2 had been completed as provided for under the original expenditure order.⁸⁶

A Cultural Resource Perspective: A Place of War, Peace, and Mistaken Identity

The former area of Range 64, where the JB-2 test program began, is now Coffeen Nature Preserve in Four-Mile-Village; the roar of rockets and jet engines has given way to the calls of osprey and mockingbirds. John and Dorothy Coffeen moved back to their property in 1946, and made the former military mess hall their home for the next thirty years. The Coffeens turned the abandoned barracks, missile barns and machine shop into

⁸⁵ “Remote Control of JB-2 Pilotless Aircraft with a Modified SCR-584 Radar Set and AN/APW-1 Radio Unit,” Army Air Forces, Air Technical Service Command, Engineering Division, February 28, 1946, File “JB-2,” Archives, NASM.

⁸⁶ “JB-2 Pilotless Aircraft,” Army Air Forces, Air Technical Service Command, March 1, 1946, File “JB-2/Loon,” Archives, NASM.

storage facilities and garages. They enjoyed the convenience of a multitude of paved roads the Army had left behind, but had no use for the concrete structures: four launch bunkers, two 400-foot launch ramps, a magnetic compass calibration swing base, and assorted piers and foundations that remain on the property to this day. In the dunes near the beach, sheltered by scrub brush, lies a rusty JB-2, the sole survivor of hundreds of test missiles launched toward the Gulf here. Shortly after John's death, in 1976 Dorothy donated 197 acres of her property to the Sierra Club to create a nature preserve that she hoped would be, "A place of peace, a place of quiet, and a refuge for all God's creatures." When Dorothy passed two years later, she bequeathed the remaining property (28 acres) to the preserve.⁸⁷

In 1996, the Keeper of the National Register of Historic Places approved a nomination to add two JB-2 launch areas, archaeological sites 80k246 and 80k248 on Santa Rosa Island, to the Register. The nomination stated the USAAF constructed these two sites, approximately one-half mile apart, in 1944 and maintained operations thereon from 1944 to 1946. Unfortunately, this is incorrect. The sites on Santa Rosa Island (80k246 and 80k248), are twenty-two miles west of Coffeen Nature Preserve (formerly Range 64) where World War II JB-2 testing occurred. Santa Rosa Island did not transfer to the War Department until August 13, 1945, and missile launch facility construction did

⁸⁷ Hastings, "Coffeen Nature Preserve," 1; Fieldwork by the author conducted in March 2008.

not begin there until 1946. Thus, neither archaeological site (8Ok246 or 8Ok248) has significance related to World War II, as the nomination states.⁸⁸

Despite the error in the nomination, all three locations, Range 64 (Coffeen Nature Preserve), and the JB-2 launch areas on Santa Rosa Island (archaeological sites 8Ok246 and 8Ok248), are historically significant and deserve placement on the National Register, as evidenced in this chapter as well as Chapter II and Appendix. With regard to World War II, the Coffeen Nature Preserve (Range 64) embodies a high level of significance.⁸⁹

The material culture remaining on Range 64 qualifies under Criterion D of the National Register as, “archaeological remains that have yielded, and are likely to continue to yield, information important in history.” Criterion D requires such sites to demonstrate the information contained at the location within an appropriate historic/archaeological context, the connection between the information and the specific property, and the presence of adequate data on site. The important information on the site of Range 64 includes the design features, construction materials, and evidence of operational use conveyed through two earthen launch ramps, two concrete bunkers, a concrete compass calibration swing base, missile barn, machine shop, mess hall and barracks remaining as symbols of the historical context discussed above (World War II,

⁸⁸ Prentice M. Thomas Jr., James H. Matthews, Joseph P. Meyer, Aubra Lee, and L. Janice Campbell, “Investigations at the JB-2 Sites,” in *Various Archaeological Investigations at Eglin Air Force Base, Okaloosa, Santa Rosa and Walton Counties Florida* (Mary Esther, FL: Prentice Thomas & Associates, 1993), 202; “Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island,” RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II.

⁸⁹ “The National Historic Preservation Act,” accessed September 26, 2013, <http://www.achp.gov/book/sectionII.html>. As the location of the World War II Range 64 is on private land, it is not subject to the National Historic Preservation Act of 1966 (NHPA). Sections 106 and 110 of the NHPA require all agencies of the U.S. government to take responsibility for the identification, evaluation and protection of cultural resources on lands they control, and for undertakings that may affect historic properties within an area of potential effect. As Coffeen Nature Preserve is private property, the owner must provide permission for any formal nomination to the National Register of Historic Places to occur.

military aviation, and Florida aviation). The connection between the information at the location is self-evident, as the material culture remains in situ, and the presence of adequate data on site is amply demonstrated through the multiple structures extant.⁹⁰

Whereas a case for National Register eligibility of Coffeen Nature Preserve (Range 64) may be established from World War II testing and its implications, the JB-2 sites on Santa Rosa Island are significant because they represent a transition from research and development related to World War II to that of the early Cold War. The Army and Navy, facing an uncertain future as the military forces of a new world superpower in the nuclear age, continued to push for new technologies that would provide any advantage over threats unknown. The relief from the end of world war was short-lived, as the Soviet Union, unwilling to leave the eastern European countries it pushed through to defeat Germany, began the transition from ally to enemy. The JB-2 became less important as a weapon of readiness, and more important as a technological step on the steep learning curve of guided missile warfare.

Both Range 64 and the JB-2 installations on Santa Rosa Island are cultural landscapes. The sites are best understood as geographical areas created by an American military motivated by the societal values of ending conflict (World War II), prevention of, or preparedness for, future conflict (Cold War), the need for self-preservation common to all cultures, and the belief that advancing technology helps make each of

⁹⁰ U.S. Department of the Interior, National Park Service, National Register of Historic Places, *National Register Bulletin: Guidelines for Evaluating and Documenting Historic Aviation Properties*, Anne Milbrooke, Patrick Andrus, Jody Cook, and David B. Whipple (Washington, D.C.: U.S. Government Printing Office, 1998), 30; Fieldwork by the author conducted March 2008.

these possible. The abandoned missile launch facilities are evocative of these values, conveying cultural meaning through their remains.⁹¹

The placement of JB-2 sites in secluded, secure areas, like most military facilities, also bears cultural meaning. This spatial relationship to public and private land indicates Americans were (and are) generally comfortable with their armed forces operating largely in secret toward the perceived protection of United States lifeways.

⁹¹ U.S. Department of the Interior, “Guidelines for the Treatment of Cultural Landscapes: Defining Landscape Terminology,” accessed March 29, 2014, <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/terminology.htm>. This National Park Service website defines cultural landscape as, “a geographic area . . . associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.”

CHAPTER TWO: TESTS AND GLOBAL STRESS (1946-1953)

Malaise, Moscow, and Mission

When JB-2 testing came to an end at Eglin in October 1945 and at Wendover in January 1946, program personnel pondered the plight of a conventional missile in an atomic age where allies became enemies. After the nuclear attacks on Hiroshima and Nagasaki the JB-2, and many other weapons dwarfed by the power of fission, seemed obsolete and irrelevant for a time. The global shockwave of realization reached far beyond those generated by the A-bombs dropped from B-29 bombers *Enola Gay* and *Bock's Car*, as the world's population struggled to comprehend the terrible technology now solely in the hands of the United States. America stood, "at the pinnacle of world power" according to Winston Churchill, addressing an international broadcast audience from Westminster College in Fulton, Missouri, on March 5, 1946. Although the former British Prime Minister titled this speech "The Sinews of Peace" it was his use of the term "iron curtain" that resonated; used to describe the Soviet Union's continuing occupation of Eastern Europe (almost a year after German forces surrendered) that fired imagination, distrust, and fear on both sides of this metaphorical tapestry. Cold War historians Randall B. Woods and Howard Jones explain that Americans, "wanted to enjoy the fruits of victory, but events would not let them. The United States had learned the folly of appeasement and unpreparedness, but it wanted nothing so much as to be left alone to

pursue the American dream of self-sufficient prosperity. The bomb made confrontation with the Soviets a terrifying prospect.”⁹²

Less than two weeks prior to Churchill’s address, on February 22, a junior diplomat at the American Embassy in Moscow sent a prophetic cable that became famously known as the “Long Telegram” scholars consider the progenitor of the “policy of containment” adopted by the administration of Harry S. Truman and sustained throughout the entire Cold War. George F. Kennan used his reply to a U.S. Treasury query about the Soviet economy to expound broadly on his recommendations for American foreign policy toward the Kremlin. Arguing that the Kremlin respected only strength, a point Churchill emphasized later at Fulton College, Kennan wrote that Soviet power was, “impervious to the logic of reason” and “highly sensitive to the logic of force.” Kennan suggested the United States should abandon any hope for a long-term resolution with Moscow and embrace that there will be two “spheres of influence” supported, if not controlled, by each side. President Truman and his cabinet read Kennan’s telegram, and Secretary of the Navy James Forrestal championed it as required reading for the U.S. officer corps at the command level. In a later report to Forrestal, Kennan defined containment stating, “In these circumstances it is clear that the main element of any United States policy toward the Soviet Union must be that of long-term, patient but firm and vigilant containment of Russian expansive tendencies.” Thwarting the spread of Communism, maintaining peace through strength, the president first

⁹² Sherry, *Rise of American Air Power*, ix; Randall B. Woods and Howard Jones, *Dawning of the Cold War: The United States’ Quest for Order* (Athens, GA: The University of Georgia Press, 1991), 67, 101, 113-114. Woods and Jones present an insightful synopsis of Churchill’s speech, including an examination of critical reactions voiced immediately after its presentation, and the impact of the address on the American socio-political milieu.

articulated the new policy, officially, on March 12, 1947, when he addressed a joint session of Congress asking for military and economic aid to Greece and Turkey in their struggle against communist subversion. Historians consider this executive pronouncement of containment as U.S. policy monumental, as its adoption marked the first time America became involved in European affairs during a time of peace. Truman's speech made it clear that although he requested aid only for two Mediterranean nations, the broad threat to democracy existed in the form of Communism wherever it may appear; and a precedent now existed which soon became known as the Truman Doctrine.⁹³

While the American policy of containment arose, and most of the U.S. military focused on rapid and rampant demobilization following World War II, the JB-2 program found renewed relevance. Stalin's decision to retain Eastern European nations as Soviet satellites in late 1945 convinced the American military that weaponry such as the JB-2 might find an application should the new Cold War turn hot. Contingency planners at the Pentagon surmised if the effort to prevent the expansion of Communism required force of

⁹³ Woods and Jones, *Dawning of the Cold War*, 105-106, 145; John Lewis Gaddis, *The Cold War: A New History* (New York: Penguin Press, 2005), 29-31. Woods and Jones, along with Gaddis, provide discerning overviews of Kennan's "Long Telegram." Kennan also wrote, under the pseudonym "X," an article for the July 1947 issue of *Foreign Affairs* titled, "The Sources of Soviet Conduct," that expanded upon his assertions in the "Long Telegram" and presented an unofficial outline for the Cold War to the American public; "The Sources of Soviet Conduct," *Foreign Affairs*, June, 1947, accessed November 20, 2013, <http://www.foreignaffairs.com/articles/23331/x/the-sources-of-soviet-conduct>. The "Truman Doctrine," which developed from Kennan's assessments, according to the U.S. Department of State, "established that the United States would provide political, military and economic assistance to all democratic nations under threat from external or internal authoritarian forces. The Truman Doctrine effectively reoriented U.S. foreign policy, away from its usual stance of withdrawal from regional conflicts not directly involving the United States, to one of possible intervention in far-away conflicts." See "Milestones: 1945-1952," accessed November 20, 2013, <http://history.state.gov/milestones/1945-1952/truman-doctrine>. Kennan argued that the U.S. should contain the Soviets inside their 1947 borders by the application of "counter force." Because Kennan believed the main Soviet threats were political and economic, he argued for political and economic counter force. Truman and his advisors embraced Kennan's assertions, but also concluded that the threat posed by the USSR included a military element which supported being prepared to apply military counter force as necessary.

arms, or simply a threat to deploy them, the JB-2 represented new technology essential to containment. The existence of this flying bomb, the world's first practical and operational cruise missile, and, more importantly, the future generations of missiles it would spawn, provided a means by which deterrence might be achieved in the weapon, its development potential, and the training of "missileers" who would ultimately hold the keys (figuratively and literally) to the prospect of mutual destruction; a new class of warriors for a remote-controlled war. Commanders of the United States Army Air Force (USAAF) especially marketed the JB-2 for this role, as they prepared to divorce themselves from the Army to become the leaders of the United States Air Force (USAF), a separate military branch equal to the Army and Navy. Seeking equilibrium in power to their Army and Navy counterparts, USAF general staff wanted to stake a clear claim to the new cruise missile technology, also coveted by Army ground forces. Officially created as a part of the National Security Act in September, 1947, the USAF won its case for the JB-2 and future cruise missiles, though the technology would continue to be a shared development with the Navy. As the USA and USSR emerged as global superpowers, each employed captured German technology to attain an arms advantage for deterrence of direct conflict. America's JB-2, (essentially born of the Third Reich) had a new mission. The German Air Ministry of World War II could not have foreseen their terror weapon used against the Soviet Union by the United States.⁹⁴

⁹⁴ Gaddis, *Cold War*, 29-31; Sherry, *Rise of American Air Power*, 313; Werrell, *Evolution of the Cruise Missile*, 60-63, 75.

Island Renewal, Cold Weather, and White Sands

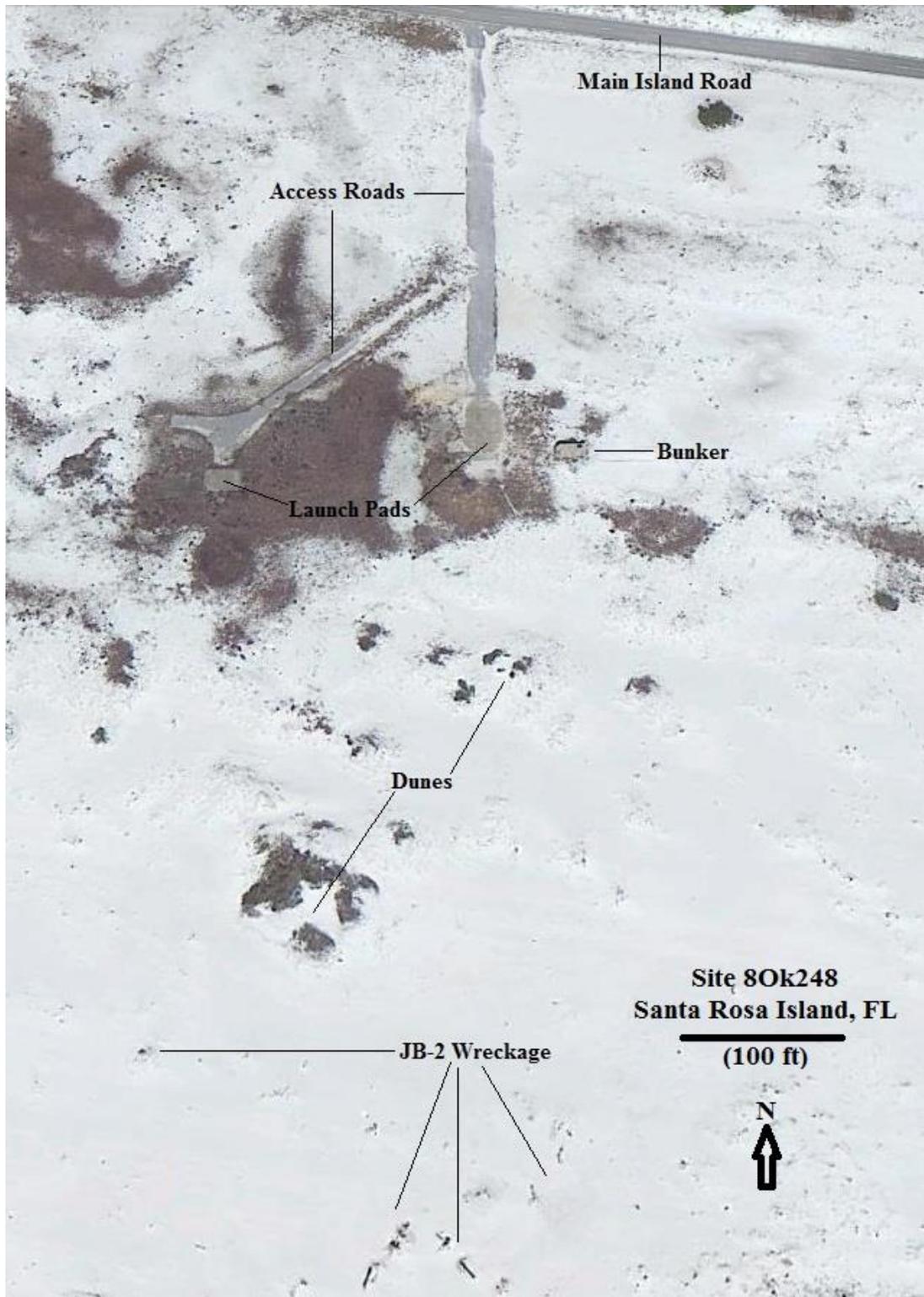
As the Air Force conducted the last JB-2 tests on Eglin in 1945 and on Wendover in 1946, they began construction of two new missile launch sites for the continuation of the program. JB-2 testing would start anew twenty-two miles west of the first JB-2 test site on an island south of Eglin Auxiliary Field #9 (Hurlburt Field). Santa Rosa Island offered a well-suited location for secret military operations such as JB-2 testing. With no bridge to the forty-five-mile-long barrier island off the Florida panhandle coast, it remained accessible only by watercraft, and it featured a Gulf shoreline bordering a virtually unlimited test range consisting entirely of seawater. In 1939 President Franklin D. Roosevelt approved the creation of the Santa Rosa Island National Monument, with the intent of preserving the area in its natural condition. However, during the week following the atomic bombing of Japan in August 1945, President Truman signed a proclamation that transferred the eastern half of the island from the Department of the Interior to the War Department. The Air Force completed the two JB-2 launch sites in 1947, along with a number of support buildings and roads. The Army Corps of Engineers dredged the sound between the mainland and Santa Rosa, allowing barges to transport the missiles and support materiel to the launch complex, and set concrete receiving docks on the leeward shore.⁹⁵

The USAAF activated the First Experimental Guided Missiles Group on February 6, 1946, and assigned personnel to the JB-2 program testing two launch methods. A historic first for the Air Force, the mission of this new command unit focused solely on

⁹⁵ "Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island," RG 218, Entry 343A, Box 4, File "JB-2 1945," NARA II; "National Park System Birthdays," National Park Service, accessed July 9, 2013, <http://www.nps.gov/history/history/hisnps/NPSHistory/birthdays.htm>.

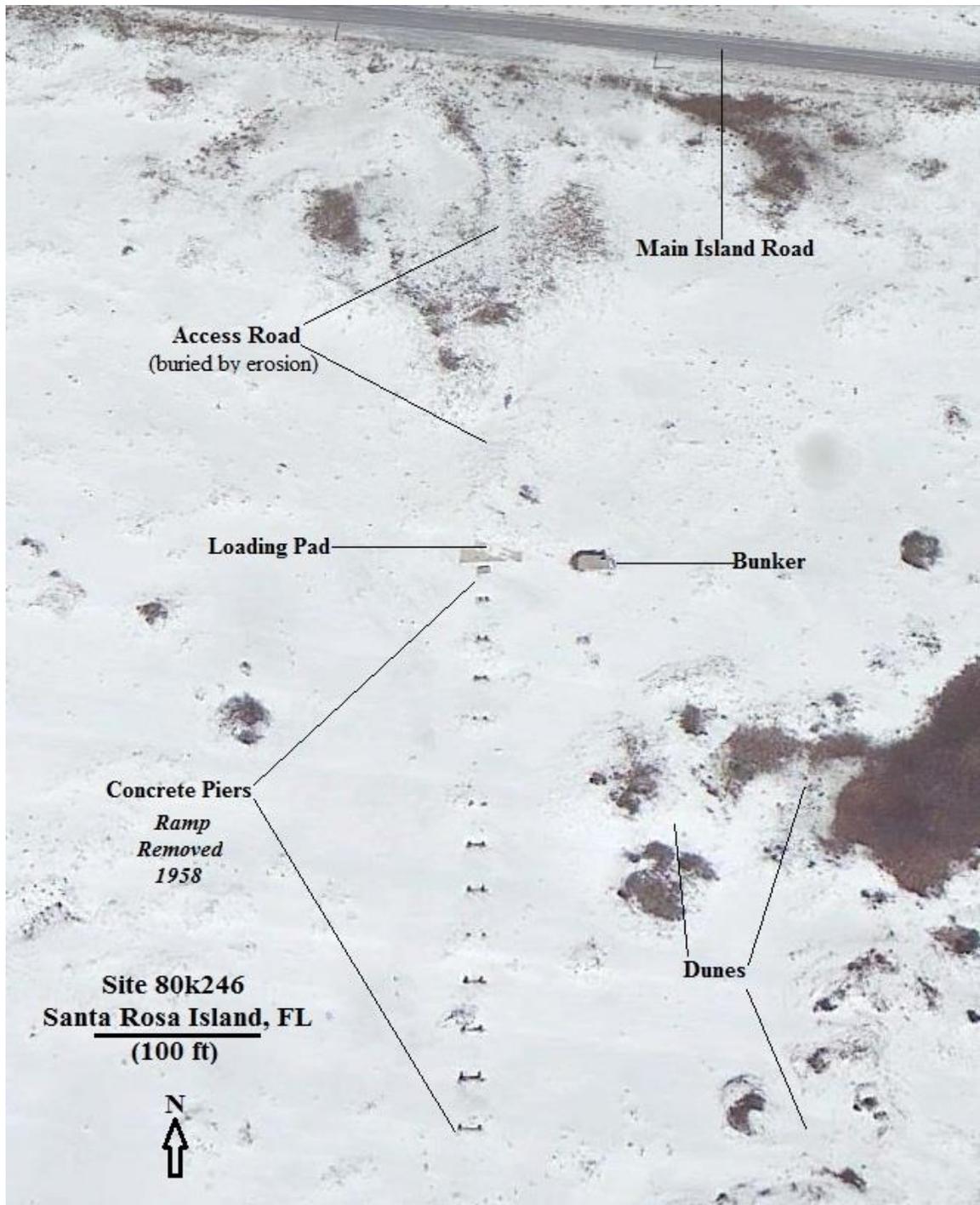
the operation of guided missiles. The two launching areas (under construction on Santa Rosa Island at the time of the group's creation) featured two concrete pads for fifty-foot-long mobile ramps (mounted on flat-bed trailers) and a 400-foot-long inclined steel ramp on concrete piers. Located one half mile apart, each missile site housed launch controls in a concrete bunker, and exclusively used Rocket Assisted Take Off (RATO) propellant cylinders to accelerate the JB2s to flight speed. Previous testing at Range 64 during 1944 and 1945, where experimentation with nine different ramp configurations occurred, resulted in more efficient methodology for Santa Rosa. The following present-day satellite photograph maps show the remains of both the mobile ramp launch facility (archaeological site 8Ok248) and the 400-foot steel ramp location (archaeological site 8Ok246). These images are not only helpful as a visual aid in understanding the operational logistics of launching JB-2 missiles on Santa Rosa Island in the late 1940s, but also as illustrative examples of how cultural landscapes, particularly military landscapes, are created, convey meaning, and retain integrity through time. Research conducted by the author failed to yield historic aerial photographs of either site.⁹⁶

⁹⁶ "Constitution and Activation of the 1st Experimental Guided Missiles Group," in "Air Proving Ground Historical Data, 2 September 1945 to 30 June 1949," Vol. 2, 13, Office of History, EAFB; "An Overview of the Organizational History of the Air Proving Ground, September 1945 to June 1949," 114, Office of History, EAFB; "Security Information," in "Air Proving Ground Historical Data, 2 September 1945 to 30 June 1949," Vol. 3, 44, Office of History, EAFB. See Appendix for a more detailed description of archaeological (JB-2) sites 8Ok248 and 8Ok246.



Satellite Photograph Map of JB-2 Mobile Ramp Site (8Ok248)⁹⁷

⁹⁷ "Google Earth," accessed February 25, 2014, <http://www.google.com/earth/>, map text/graphics by Gary F. Quigg.



Satellite Photograph Map of JB-2 400 Foot Ramp Site (80k246)⁹⁸

⁹⁸ "Google Earth," accessed February 25, 2014, <http://www.google.com/earth/>, map text/graphics by Gary F. Quigg.

JB-2 testing on Santa Rosa Island began in March 1947; one year after the program, and its supporting facilities, closed at Range 64. Staffing requirements, supply chain logistics, and the completion of construction at the new location caused the year-long delay from the time the First Experimental Guided Missile Group formed to the first missile launch. While the missile men waited, Proving Ground Command sent the unit and its weapons to Ladd Field, Alaska for cold weather testing, where, “It was concluded that the JB-2 is capable of satisfactory operation in extreme low temperatures if internal operating and control systems are heated in flight.” Equally significant, Project Frigid determined, “Successful launchings of the JB-2 may be accomplished under combat conditions by the construction of a six-degree wooden ramp of simple design and a minimum length of thirty (30) feet.” No doubt the growing tensions between the US and USSR led to the extreme weather testing “under combat conditions” in proximity to Russia.⁹⁹

Arriving back on Santa Rosa, the missileers conducted testing from March through the remainder of 1947 and beyond. After a dozen successful launches in April, the airmen were plagued again, in May, by the failure of several booster rockets (RATOs). On June 10, unfolding world events prompted the Pentagon to order the First Experimental Guided Missiles Group to fire 179 JB-2s by rail ramps and 107 from aircraft in a program designed to compare the accuracy of missiles with the pre-set, mechanical guidance system against those under radio/radar control. As engineers created new radar guidance systems to improve range and accuracy for the next generation of

⁹⁹ “History of the 1st Experimental Guided Missiles Group: January 1947 Thru June 1947,” July, 1947, 426, Office of History, EAFB; “Functional Test (Cold Weather) of JB-2 (Jet Propelled) Bomb,” in “Report of the Air Proving Ground Command,” March 24, 1947, 1-3, Office of History, EAFB.

missiles, the JB-2, as the only operational cruise missile in the US arsenal, served as the sole test platform for these emerging technologies. Air Proving Ground Commanding General Grandison Gardner considered the JB-2 test program, “invaluable to its application to future projects of similar scope now in the research and development stage.”¹⁰⁰

The renewed emphasis on JB-2 testing prompted upgrades in launch protocol on Santa Rosa, and the re-start of a JB-2 ground test program in the American Southwest. Eglin’s Proving Ground Command added the use of motion picture cameras to record each launch, more precise radar tracking, Lockheed P-80 *Shooting Star* jet fighters as chase planes, and crash boats stationed in the Gulf along the projected missile flight path (for both observation and air-sea rescue of chase pilots if necessary), to the list of standard operating procedures for each launch. In 1947 the JB-2 test program at Wendover Army Airfield, Utah, dormant since January 1946, moved to Alamogordo Army Airfield (re-named Holloman AFB in January 1948), New Mexico, and the adjacent White Sands Proving Ground (re-named White Sands Missile Range in 1958). Personnel at these installations, site of America’s first atomic bomb tests, concurrently tested captured German V-2 ballistic missiles. A brief eight-month evaluation began at Holloman/White Sands on April 23, 1948, wherein eleven radio-controlled JB-2s were launched until testing concluded on January 10, 1949. During the summer of 2012, a

¹⁰⁰ “History of the 1st Experimental Guided Missiles Group: January 1947 Thru June 1947,” 426-29, 435, Office of History, EAFB; “Group History: 1st Experimental Guided Missiles Group 1 July 47 Thru 31 Dec 47,” 1313, Office of History, EAFB.

writer for the *Alamo Pulse* photographed the remaining 400-foot, three-degree inclined launch track, along with its associated loading pit, blockhouse and blast wall.¹⁰¹

During the first few months of tests on Santa Rosa in 1947, missile crews used only the mobile, trailer-borne, fifty-foot “zero launch” ramp recently provided the designation “L-1” (used on what is now archaeological site 8OK248), as construction workers did not begin assembly of the 400-foot, six-degree fixed ramp (8OK246) until the middle of July. Tests using the L-1 ramp continued, uneventfully, through August and September, but during a launch on October 1 a JB-2 was destroyed when the RATO booster rockets exploded just after the missile left the ramp.¹⁰²

Success in the air compensated for the October 1 failure on Santa Rosa a week later when the First Experimental Guided Missile Group launched its first two JB-2s from a B-17 bomber in flight above the island. Both air-launched missiles flew successfully on course until shot down by P-80 fighters ten miles off shore. Unlike ground-launched JB-2s, those dropped from bombers did not require the problematic RATO booster rockets to achieve sufficient airspeed for flight. The “Flying Fortress” simply initiated a shallow dive to reach a speed of 200 miles per hour, and the pulse-jet engine on the missile received ignition spark remotely from controls inside the bomber just prior to its release from the mount beneath the wing of the B-17.¹⁰³

¹⁰¹ “History of the 1st Experimental Guided Missiles Group: January 1947 Thru June 1947,” 619, 621-22, Office of History, EAFB; George Mindling and Robert Bolton, *U.S. Air Force Tactical Missiles 1949-1969: The Pioneers* (Morrisville, NC: Lulu.com, 2008), 33; Joe Page, “Holloman’s First Test Track,” *Alamo Pulse*, September 17, 2012, accessed July 9, 2013, <http://www.alamopulse.com/2262/hollomans-first-test-track/>.

¹⁰² “Group History: 1st Experimental Guided Missiles Group 1 July 47 Thru 31 Dec 47,” 799, 800, 810, 937-40, 1311, 1370, Office of History, EAFB.

¹⁰³ *Ibid.*, 809, 941-46.

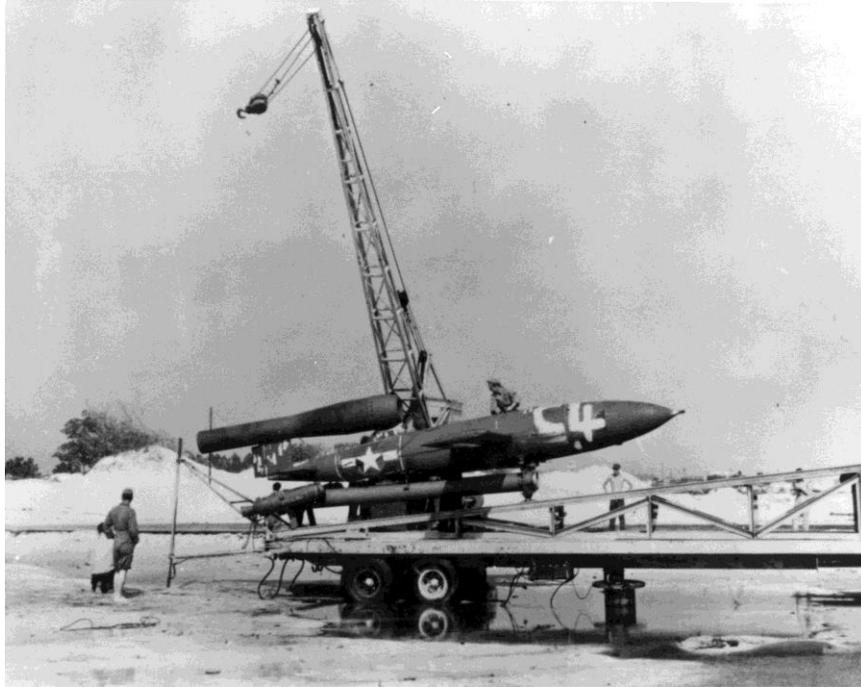
The firsthand experiences of a veteran from the First Experimental Guided Missiles Group allow unique insight into each area of JB-2 operations at Eglin AFB during 1947. Oral history, despite its flaws from the frailties of human memory, often provides historical detail unavailable from original documentary and photographic sources. The personal experiences of a young airman on Santa Rosa Island are particularly helpful, offering a more complete view of the daily operations of America's first cruise missile program.

Immediately upon graduation from Air Force technical school in Denver early in 1946, Private First Class Reece Bowen reported directly to Eglin. Assigned to the new engine shop crew on Santa Rosa Island, the eighteen-year-old technician found himself on the cutting edge of American cruise missile technology. Bowen initially assembled pulse-jet engines and missile airframes shipped from the storage facility at the 829th Specialized Sub-Depot in Gadsden, Alabama, where the remaining 700 JB-2s awaited assignment. Surprised at the simplicity of the airframe and engine housing, Bowen recalled, "Those things was shipped to us in a crate, the missiles were. So we'd just take and match bolts and stuff and put them back together. See, there wasn't much to the doggone things." The crates arrived on the island by barge from the mainland, and crewmen assembled the missiles on the docks for transport to storage buildings or one of the two launching areas. When test launches began only the "zero launch" fifty-foot mobile ramp stood ready, as the 400-foot fixed ramp was not yet complete.¹⁰⁴

Accompanying each JB-2 as it rolled on a trailer from the assembly area to the launch site, Bowen remained nearby as the crane operator slung the JB-2 onto the launch

¹⁰⁴ Reece Bowen, telephone interview by Gary F. Quigg, March 20, 2008.

cart (sitting on the ramp with four RATO boosters attached), completing any mechanical adjustments necessary as the engine and airframe were tested and prepared for launch. A reinforced concrete bunker twenty-five yards east of the “zero launch” pad sheltered airmen directly involved in firing the missile, but Bowen remembers hiding behind a sand dune with the rest of the airmen on site.¹⁰⁵



JB-2 on L-1 “zero launch” ramp, (at 80K248) after crane placement, c.1947.¹⁰⁶

In the hundreds of JB-2 launches Bowen participated in, the most common problem encountered involved the RATO booster rockets attached to the launch cart, “It had four boosters back there, and if one didn’t help get it up to speed it would just die there between the launch pad and the ocean out there.” Documented during

¹⁰⁵ Ibid.

¹⁰⁶ Unnumbered Photograph USAAF, Photograph Collection, Office of History, EAFB.

archaeological work in June 2012, the rusting remains of these missile failures still lie in the shifting sands on 8Ok248, and are discussed in further detail in the Appendix.¹⁰⁷

As Reece Bowen progressed in rank from Private First Class to Sergeant on Santa Rosa Island, his duties within the JB-2 program evolved. During his two years on station (1946-1948), Bowen participated in tests designed to determine how many JB-2s could be launched during a single day. Timing began at the docks as technicians removed the missiles from crates, and ended with the last JB-2 launched from the ramp. Up to thirty missiles per day were launched during these trials. Eventually, officers ordered Bowen inside the concrete bunker during launches to “push the button.” Despite being directly responsible for energizing the solenoid that released the missile, Sergeant Bowen remained unimpressed, “I didn’t particularly care. I’d rather have been outside watching it take off. You can’t see too much out of that block house. Everybody would rather be out there watching than inside.” Bowen enjoyed his next assignment much more, when he left the island briefly for temporary duty with a crew launching the JB-2 from B-17 and B-29 bombers on Eglin Auxiliary Field #1. The sergeant attached a missile onto a specially designed rack on the underside of each wing of the bombers, before entering the plane as part of the flight crew. Bowen’s job aboard the aircraft included igniting the pulse-jet engine and releasing the missile remotely via a small control panel at his station. As the bombers could reach over 200 miles per hour at launch altitude, no RATO rockets were necessary. Although both the JB-2 tests on Santa Rosa Island and thousands of feet

¹⁰⁷ Bowen interview; Quigg, “Assessment of Significance,” 1-29.

above it supplied valuable data to America's fledgling cruise missile program, Bowen, ever pragmatic, explains, "I liked the deal because we got flight pay out of it."¹⁰⁸

The blockhouse and launch pad where Reece Bowen served as a young missileer on Santa Rosa Island remain, along with deteriorating material remains of JB-2s he watched fall short of the Gulf of Mexico onto the white sands in failed launch attempts. All of these are part of Florida archaeological site 8Ok248, where the First Experimental Guided Missiles Group utilized an L-1 "zero launch" fifty-foot mobile ramp during the JB-2 test program. The remnants of this facility, and its sister site one half mile east (8Ok246) where the 400-foot fixed ramp once stood, acted as a catalyst for the author's work in these pages, and the archaeological research conducted on Santa Rosa Island thus far provides the base from which a cultural resource perspective is examined in the Appendix of this essay. Some structures and numerous artifacts remain at these two JB-2 launch areas on the island.¹⁰⁹

Archaeological research, conducted in June 2012, consisted of surface documentation only, as unexploded ordnance (UXO) material lies on site. Using the Global Positioning System (GPS) the author and field technicians from Prentice Thomas & Associates (PTA) first established site boundaries, then recorded location coordinates on debris concentrations and identifiable components lying outside concentrations (solitary discoveries), as well as on the camera position of each photograph taken. The author closely examined each identifiable artifact on both sites, noting that few objects remained intact due to the predominantly ferrous (sheet steel) composition of JB-2 missiles and the extremely dynamic seaside environment (sun, salt, high winds, severe

¹⁰⁸ Ibid.

¹⁰⁹ Quigg, "Assessment of Significance," 1-29.

storms) that has accelerated the deterioration of material culture on site. As a part of this on-site analysis, the author recorded detailed text notes on each debris concentration with particular attention given to identifiable components, assemblies, and structures of airframes and engines while PTA staff photographed and sketched these artifacts and features. While a PTA remote sensing team performed non-invasive sub-surface research (completing an electromagnetic survey of both sites with inconclusive results), the author videotaped the sites from multiple perspectives, focusing on each debris concentration, with narration as an additional source of both visual and verbal documentation. The author identified fifteen debris concentrations consisting of the deteriorating and/or damaged remains of JB-2 missiles left on the sites from failed test launches conducted between 1947 and 1950, and utilized historic photographs taken at these locations for an on-site comparative analysis with the material remains.¹¹⁰

At the conclusion of fieldwork, the author selected twelve artifacts to be recovered from the sites for conservation due to the significance of these objects as diagnostic design elements of JB-2 construction. The eligibility potential of both 8Ok248 and 8Ok246 for the National Register, assessed through the archaeological evidence obtained through the fieldwork and conveyed by the material culture remaining there, is presented in detail in the Appendix.¹¹¹

¹¹⁰ Quigg, "Assessment of Significance," 2-3. My field observations, conducted from June 11 through June 15, 2012, and detailed in the report cited, are the source of the site descriptions and eligibility assessments in the Appendix of this work. Prentice Thomas & Associates (PTA) is a cultural resource management firm located in Mary Esther, Florida, providing archaeological services throughout the southeastern United States. PTA has been the primary contractor to Eglin AFB for archaeological services since 1982.

¹¹¹ Quigg, "Assessment of Significance," 3. The removal of artifacts from sites 8OK248 and 8OK246 is discussed further in the Conclusion.

Swift Wings Against A Rising Red Tide

Sergeant Bowen and his crew launched their test missiles into the Gulf of Mexico wary of world events foretelling an uneasy future. The upgraded, radio/radar-controlled JB-2s showed improvements in range, control precision, and accuracy compared to the pre-set, “fire and forget” mechanical missiles as they transformed from relative mechanical simplicity to electronic complexity. Designers, under contract for new missiles still in the research and development stage, learned from the data being generated on Santa Rosa Island and made engineering changes accordingly. Yet, the JB-2 tests capturing the imagination of both the American public, and the Soviet politburo, occurred at sea.

A *Loon* (Navy JB-2) fired from a fixed ramp atop the hull of the USS *Cusk* on February 12, 1947, created headlines as the first cruise missile launched from a submarine. This pivotal event in the evolution of naval warfare brought sweeping changes in both strategy and tactics. The *Loon* increased the effective heavy bombardment range of the Navy, previously limited to twenty-five miles with traditional ordnance, to over one hundred miles. If force was necessary as a last resort of containment, the U.S. Navy *Loon*, as the world’s only submarine-launched cruise missile, presented a swift, stealthy, and viable option. Even China, where communist forces under Mao Zedong would soon defeat the nationalist regime of Chiang Kai-shek, became vulnerable to submarines armed with *Loons*. With radio/radar control, *Loon* missiles had not only greater accuracy, but also the ability to change course in flight if necessary. Submarines could now engage the enemy far beyond sea-going vessels and shoreline targets. As a portable, submerged missile launch site, such vessels could be brought

undetected to within a few miles of a hostile shoreline to engage land targets anywhere within the *Loon's* one-hundred-mile range. To emphasize this element of surprise, the Navy conducted the February 12 launch within full view of hundreds of unsuspecting Californians going about their daily routines near Point Mugu. An enthusiastic press exclaimed the Navy “has the greatest guided missile in the history of warfare.” Wishing to temper exaggerated claims for the *Loon* while maintaining public zeal for the future of submarine-launched cruise missiles, Navy officials explained, “the *Loon* is admittedly outmoded and obsolescent as a missile and serves only as a vehicle for testing missile components, radio guidance mechanisms and new theories.” The tactical advantage of submarine-launched missiles presented an historic moment the Navy wanted to publicize and capitalize upon, an achievement made possible through a reliable, adaptable test vehicle.¹¹²

¹¹² “V-1 Fired From Submarine,” *New York Herald Tribune*, February 27, 1947, File “JB-2/Loon,” Archives, NASM; “Missile Warships Loom In New Test,” *New York Times*, June 14, 1947, File “JB-2/Loon,” Archives, NASM; “Navy’s Loon is Three Tons of Flying Destruction,” *Washington Daily News*, April 21, 1947, File “JB-2/Loon,” Archives, NASM. It is notable that the Navy, for the first time publicly, describes the *Loon* as “outmoded and obsolescent” here. The JB-2/*Loon* existed as the only operational cruise missile in the United States arsenal. Certainly, improved generations of missiles continued under development in 1947, incorporating systems proven on the JB-2/*Loon*, but these would not be deployed until 1954 and 1955. Perhaps the Navy, not yet considering the *Loon* for a nuclear warhead, felt any conventionally armed missile was behind the times in the new atomic age. Or, knowing that the Soviets read American press accounts, Navy officials deliberately described the *Loon* as obsolete in part of a disinformation campaign to create uneasy speculation within the Kremlin about other unannounced U.S. missiles. Whatever the orders to, or motives of, the Navy’s press officers, the JB2/*Loon* effectively transitioned from ready weapon to essential test vehicle with the end of World War II until later world events developed.



Loon missile launch from USS *Cusk*, February 12, 1947.¹¹³

To an audience concerned about communist expansion, the national media re-told the story of the submarine *Loon* launch through June 1947. The story had staying power, fed by Navy public relations officers eager to keep their missile milestone fresh in the minds of Pentagon planners as the budget for fiscal year 1948 was finalized. The well-publicized submarine launch exemplified how the U.S. Navy continued its watch with a new waterborne weapon to keep the Russian bear at bay. Fleet Admiral Chester Nimitz, in an obvious prediction printed in the *Chicago Tribune*, suggested submarines might be armed with cruise missiles carrying atomic weapons. Scientists at the Naval Air Missile Test Center, in step with the Admiral's remarks and motivated by disturbing events in Europe and Asia, explored fitting nuclear warheads to *Loon* missiles. Historian Elaine Tyler May describes how a sense of security in such an insecure world came to the American family through protection, “against impending doom by the wonders of

¹¹³ “Cusk Makes National News!” accessed October 3, 2013, <http://www.usscusk.com/>.

modern technology.” The JB-2/*Loon* stood as one of those “wonders” helping American families feel safer in a nuclear world.¹¹⁴

The United States Navy, as the front line of the new American defense policy of containment, had taken a keen interest in the JB-2 since the beginning of the program in 1944. Naval observers remained billeted at the original Range 64 on Eglin Field throughout the initial JB-2 test period. Pacific Fleet headquarters developed plans to launch the missiles from an American aircraft carrier against Japanese forces in 1945, but the initiative ultimately became unnecessary. Eventually obtaining almost four hundred JB-2s, the Navy officially re-named the missile the KGW-1 in 1945, changed this designation to KUW-1 in 1946, before finally settling on LTV-N-2. The confusing nomenclature protocol prompted the much more common use of the informal term “Loon” to identify the Navy’s JB-2. The successful February 1947 submarine initiative originated from an onshore test program in 1946 at the newly established Naval Air Missile Test Center at Point Mugu, California. The same project developed the Navy’s experimental guided missile surface vessel, the USS *Norton Sound*, which launched its first missile (a *Loon*) on January 26, 1948. A second submarine, the USS *Carbonero*, was fitted for cruise missile testing with the *Loon*, conducting test firings from 1949 to 1950.

¹¹⁴ “V-1 Rocket From Navy Submarine,” *Chicago Tribune*, February 27, 1947, File “JB-2/Loon,” Archives, NASM; “Rocket Tests Made On A Pacific Beach,” *New York Times*, April 21, 1947, File “JB-2/Loon,” Archives, NASM; “Navy’s Loon,” *Washington Daily News*, April 21, 1947, File “JB-2/Loon,” Archives, NASM; Elaine Tyler May, *Homeward Bound: American Families in the Cold War Era* (New York: Basic Books, 1999), ix. Tactical nuclear warheads were not developed in time for testing on JB-2/Loon missiles. First deployed by the United States in 1952, they were initially designed to be carried by piloted aircraft. See Gaddis, *The Cold War*, 63 for Eisenhower’s interest in tactical nuclear weapons.

Loon launches ashore at Point Mugu continued concurrently with the submarine and surface ship program.¹¹⁵

While the Air Force and Navy enhanced the *JB-2/Loon*, tensions rose in the continuing quid pro quo between the United States and the Soviet Union. The Marshall Plan (1948-1952), officially the European Recovery Program initiated by Secretary of State George C. Marshall, brought thirteen billion dollars in aid to re-build Europe in a direct application of the Truman Doctrine to contain the spread of Communism. Stalin responded by tightening his hold on Eastern Europe, most notably with the Berlin Blockade (1948-1949), ordering the Red Army to close all routes to non-Soviet areas. America, Great Britain, and France countered with a round-the-clock airlift that earned, “the respect of most Germans, and a global public relations triumph that made Stalin look brutal and incompetent.” The crisis in Berlin fueled the formation of the North Atlantic Treaty Organization (NATO) in 1949, wherein member nations of North America and Europe agreed to defend one another if attacked. As the US committed itself to the peacetime defense of Europe, the USSR exploded its first atomic bomb on August 29 and Mao Zedong announced the formation of the People’s Republic of China on October 1. Shocked the Soviets obtained “the bomb” so quickly, and shaken by the rise of a communist China, Americans also feared “enemies within” as former State Department official Alger Hiss, accused as a Soviet spy, faced sentencing for perjury from investigations of the House Un-American Activities Committee. Using this “Red Scare”

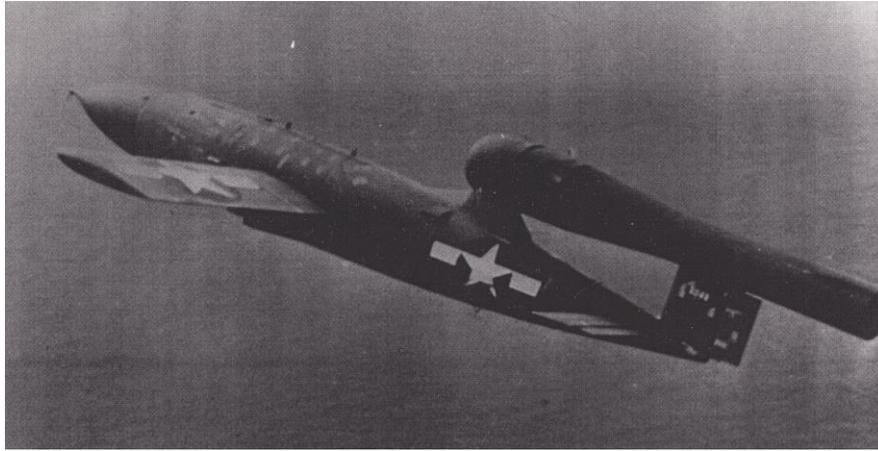
¹¹⁵ “Oscillation Tests and Analysis of the LTV-2 *Loon* Automatic Control System,” February 10, 1948, U.S. Naval Air Missile Test Center, Point Mugu, California, File “*JB-2/Loon*,” Archives, NASM; Jesse Russell and Ronald Cohn, *USS Norton Sound (AVM-1)* (Key Biscayne, FL: Bookvika, 2012), 37; Norman Polmar and Kenneth J. Moore, *Cold War Submarines: The Design and Construction of U.S. and Soviet Submarines* (Washington, D.C.: Potomac Books, 2003), 87.

to advance his career, Senator Joseph McCarthy attained national fame on February 9, 1950 claiming to have a long list of communist party members working in the Department of State. In April, top secret report NSC-68 from the Department of Defense described US military strength as “dangerously inadequate” and the USSR “developing the military capacity to support its design of world domination.” The rapid succession of the above events legitimized the need to expand America’s arsenal of democracy, now including an operational cruise missile, against the communist threat.¹¹⁶

The USN navigated the troubled waters of this unpredictable world current as the Cold War gathered steam from 1948 through 1950, making certain the *Loon* missile, now defined as a test vehicle, stood ready for deployment if needed, while the USAF worked concurrently to upgrade its JB-2s. Improvements in accuracy, reliability and control responses of the JB-2/*Loon* progressed steadily, and the capability to air-launch the missiles from the B-17 *Flying Fortress*, B-29 *Superfortress*, and B-36 *Peacemaker* (in 1949) Air Force bombers extended the range of the weapon by thousands of miles. The new Strategic Air Command stationed B-29 bombers, capable of launching JB-2s, in England throughout the test program (1947-1950). Seeking publicity for the tests on Santa Rosa Island, the USAF invited reporters to ride in the nose of a B-29 to observe JB-

¹¹⁶ Woods and Jones, *Dawning of the Cold War*, 31, 68-71, 169-175, 243, 248-251; Gaddis, *Cold War*, 22, 31-40; David Reynolds, *The Origins of the Cold War in Europe: International Perspectives* (New Haven: Yale University Press, 1994), 13. Nations participating in the Marshall Plan saw their economies rise above pre-war growth levels by 1952. Mao Zedong defeated Chinese Nationalist forces under Chiang Kai-shek after twenty-two years of civil war. Joseph McCarthy further charged communists had infiltrated the Truman Administration and the United States Army in a series of subcommittee hearings lasting four years. The Senate found only trivial evidence supported McCarthy’s claims and censured him for deception, fraud and ethics violations in 1954. See Woods and Jones, *Dawning of the Cold War* and Gaddis, *The Cold War* for excellent, readable overviews of the early Cold War era in which the JB-2/*Loon* flew.

2 air launch operations, and hosted President Truman, Secretary of State Dean Acheson, and Secretary of Defense Louis Johnson at a JB-2 ground launch on April 22, 1950.¹¹⁷



JB-2 launched from B-29 bomber over Gulf of Mexico, March 17, 1949.¹¹⁸

Recall to Duty

Two months later, the invasion of South Korea by North Korean troops on June 25, 1950, proved Moscow's expansionist intentions to Truman, as the Cold War turned hot. Two days after the conflict began, and immediately following the United Nations recommendation for member nations to provide military aid to South Korea, President Truman announced that, "Communism has passed beyond the use of subversion to conquer independent nations and will now use armed invasion and war." Remaining true to his policy of containment, Truman immediately mobilized United States military forces occupying Japan to repel North Korean forces. The JB-2/*Loon* missile, though considered obsolete and valuable only as a test vehicle a few weeks earlier, transferred

¹¹⁷ "Group 3200 Proof Test," June 30, 1949, accessed July 10, 2013, <http://airforcehistoryindex.org/data/000/103/281.xml>; "Group History: 1st Experimental Guided Missiles Group 1 July 47 Thru 31 Dec 47," 819-821, Office of History, EAFB; "Chronology: Air Proving Ground Command 1 June 1945 – 1 December 1957," 17, Office of History, EAFB. No JB-2 missiles were sent to England. It is not known which site (8Ok246 or 8Ok248) Truman and his cabinet members viewed the JB-2 launch from on Santa Rosa, but, given their proximity, importance to America's embryonic missile program, and their relevance to NSC-68, it is likely the presidential entourage inspected both sites.

¹¹⁸ Photograph #42242 AC, File, "JB-2/*Loon*," Archives, NASM.

back to active duty. The Chief of Naval Operations soon ordered twenty-five *Loon* missiles to be armed with fuses and warheads for possible operational use.¹¹⁹

By Land or By Sea

By the summer of 1950, the Pentagon began to consider the submarine, with its stealth advantage over land ramps (fixed or mobile) and bomber aircraft, as the ultimate cruise missile launch platform. A November 1949 Navy exercise, off Hawaii, provided convincing evidence. *Loon* missiles fired from the submarines USS *Cusk* and USS *Carbonero* managed to escape unharmed through a gauntlet of anti-aircraft fire from thirty-five surface vessels, and elude the machine guns of fighter aircraft from carriers USS *Valley Forge* and USS *Boxer*. The USAF continued its JB-2 tests both from 8Ok246 and 8Ok248 on Santa Rosa Island, and above it from B-29 and B-36 aircraft through the end of June when the war in Korea re-directed Air Force efforts and effectively ended the program six weeks later. The new war had the opposite effect on the Navy's *Loon* program. Along with the directive to arm twenty-five *Loon* missiles for tactical readiness

¹¹⁹ Gaddis, *Cold War*, 41-43; Harry S. Truman, "Statement by the President on the Situation in Korea," June 27, 1950, online by Gerhard Peters and John T. Woolley, *The American Presidency Project*, accessed February 23, 2012, <http://www.presidency.ucsb.edu/ws/?pid=13538>; Dennis D. Wainstock, *Truman, MacArthur and the Korean War* (New York: Enigma Books, 2011), 11; Nevin J. Stevenson, "Interim Report on LTV-N-2 (Loon) program from 1 March 1949 to 1 September 1951," Point Mugu, California, U.S. Naval Air Missile Test Center, September 5, 1952, 4, Technical Reports Unit, "AD841188," LC. After repeated requests from North Korean leader Kim Il-sung for an armed initiative to unify the Korean peninsula, Stalin gave his approval. The Soviet premiere believed that a "second front" (to counter the Kremlin's setbacks in Europe) could be initiated in East Asia by proxy, without direct risk to the USSR, as the US had done nothing to prevent the fall of China to communist forces. America had stated officially, and publicly, in a speech delivered by Secretary of State Dean Acheson, that the "defensive perimeter" of the United States did not include Korea. Thus, Stalin was convinced there would be no opposition to the invasion of South Korea, and shortly after endorsing it, encouraged Ho Chi Minh (leader of the Viet Minh communist forces in Indochina [Vietnam]), to intensify attacks to drive the French out of that country. The Korean War, intensified and extended when the People's Volunteer Army of China joined North Korean forces in November 1950, continued until a July 1953 armistice ended the conflict essentially where it began, along the 38th Parallel.

in August 1950, funding for research and development initiatives of the JB-2/*Loon* went to the Navy for the duration of the Korean conflict.¹²⁰

Just before the Navy became sole proprietor of America's first cruise missile, the Army considered deploying its own JB-2s in July 1950. Informed by the Air Force of the successful testing of the fifty-foot mobile "zero launch" ramp, the Army obtained sixty JB-2s as a "suitable interim guided missile for an emergency war or a suitable training vehicle." When Korea provided an emergency war, the Army test program became priority for the Army's 1st Guided Missiles Group at Fort Bliss, an extensive military reserve stretching across the Texas-New Mexico state line north of El Paso. Almost as quickly as it began, the Army program yielded to the Pentagon's new direction, leaving JB-2/*Loon* efforts to the Naval Air Missile Test Center.¹²¹

In addition to the ground and air launch tests to improve radar tracking and radio guidance originating on and above Santa Rosa, fourteen JB-2s became aerial targets during the last months of the USAF program. Testing of the new A-10 infrared gunsight for fighter aircraft, underway on Eglin, utilized JB-2s launched from B-29 bombers. Shortly after the bomber released the missiles, fighter aircraft equipped with the new infrared gunsight shot down the JB-2s over the Gulf of Mexico. The last documented JB-

¹²⁰ "Carriers Will Try to Knock Down Rockets," *New York Times*, November 6, 1949, File "JB-2/*Loon*," Archives, NASM; "Sub-Fired Buzz Bomb Eludes Shells of Navy Ships and Planes," *New York Times*, November 8, 1949, File "JB-2/*Loon*," NASM; "History 1st Guided Missiles Squadron, Eglin Air Force Base, Florida for the Period 1 January 1950 Through 30 June 1950," 7-8, 18, Office of History, EAFB; Stevenson, "Interim Report on LTV-N-2 (*Loon*) program from 1 March 1949 to 1 September 1951," 4, Technical Reports Unit, "AD841188," LC.

¹²¹ Major General Ray T. Maddocks, "Memorandum For Commanding General, Army Field Forces, Fort Monroe, VA," March 23, 1949, RG 218, Entry 343A, Box 9, File "JB2," NARA II; Brigadier General S.R. Mickelsen, "Memorandum for Admiral Hall," July 11, 1950, RG 218, Entry 343A, Box 9, File "JB2," NARA II.

2 launch at Eglin AFB occurred on August 11, 1950, as an air-launch from a B-29 bomber participating in the A-10 gunsight project.¹²²

Sailing to Sunset

The US Navy brought the JB-2/*Loon* to its full potential in the last years of its use as America's first cruise missile. By 1950, the Pentagon considered the Navy version superior to the Air Force model. Technicians at the Naval Air Missile Test Center modified the 399 JB-2s received from the USAF with a succession of upgrades, including a more reliable radio guidance system, improved radar tracking methods, and better target acquisition through the installation of a wing separation device that expended both wings from the missile via a small explosive charge initiated by radio control.¹²³

In the most successful transfer of radio guidance control of a missile from ship to shore on March 22, 1950, the USS *Cusk* launched a *Loon* just off Point Mugu. The *Cusk* guided the missile for twenty-five miles before surrendering radio control to a station on San Nicolas Island. Navy technicians on the island guided the missile another twenty-five miles to a splashdown in the Pacific just over a thousand feet from the center of the target. On May 3, the *Cusk* set a new distance record for the *Loon*. Diving to periscope depth immediately after the launch, the submarine controlled the missile and tracked its position for 105 nautical miles. *Loon* launches from the *Cusk* were featured in an episode

¹²² "History 1st Guided Missiles Squadron, 1 January 1950 Through 30 June 1950," 7-8, 18, Office of History, EAFB.

¹²³ "Memorandum for Admiral Hall," RG 218, Entry 343A, Box 9, File "JB2," NARA II; "Semi-Annual Progress Report of the Guided Missiles Program," Department of the Navy, Office of the Chief of Naval Operations, October 31, 1949, Record Group 219, U.S. Navy, Entry 201A, Navy Missiles, Box 3, File "Loon," NARA II. The wing separation system was tested by the Air Force at Wendover Army Air Field in 1945, but not adapted for operational use until the Navy installed it on *Loon* missiles.

of *Time for Defense* (a radio program broadcast nationally on the ABC network), and in the May 1950 issue of *Popular Science*.¹²⁴

The US Navy pioneered the use of both radar and computer control of guided missiles with the *Loon* between 1950 and 1953. Under Project Trounce, engineers from the Naval Electronics Laboratory created a control system designed to replace radio guidance by using the radar signal tracking each *Loon* to transmit control commands to the missile. Test launches from Point Mugu under radar control successfully guided *Loons* for up to 93 nautical miles, during which operators transferred control of the missiles from the Naval Air Missile Test Center shore station to the *USS Cusk*, and subsequently to the *USS Carbonero*. Scientists at the test center produced a pivotal achievement in modern warfare with the creation of the Marine Guidance Computer (MGC), which used the *Loon* in the first successful missile flights controlled by a computer. With position, course, and speed information provided by tracking radar, the computer analyzed this data and transmitted course correction commands by radio transmission, guiding the missile to the target. As each *Loon* neared the target area, the MGC computed the position where the dive to the target should be initiated and transmitted the “dump” command when the missile reached that point.¹²⁵

The last *Loon* missile launch occurred on September 11, 1953, putting an end to a nine-year span of JB-2/*Loon* test programs that advanced cruise missile development

¹²⁴ Stevenson, “Interim Report on LTV-N-2 (Loon) program from 1 March 1949 to 1 September 1951,” 34, Technical Reports Unit, “AD841188,” LC; “Time for Defense to Broadcast Description of Guided Missile Launched from Submarine,” Department of Defense, Office of Public Information, February 13, 1950, File “JB-2/Loon,” Archives, NASM; “Sub Fires Guided Missile,” *Popular Science*, May 1950, 134-135, File “JB-2/Loon,” Archives, NASM.

¹²⁵ Stevenson, “Interim Report on LTV-N-2 (Loon) program from 1 March 1949 to 1 September 1951,” 18-19, 34, Technical Reports Unit, “AD841188,” LC.

from the mechanical era into the computer age, provided essential training to America's first missileers, and brought sweeping changes to both military strategy and battlefield tactics. The Navy's Bureau of Aeronautics, believing that testing of the *Loon* missile had reached the practical limit, summarized its important contributions to United States defense initiatives in a report to the Committee on Guided Missiles of the Research and Development Board of the National Military Establishment. The narrative reiterates that the JB2/*Loon* provided the only test vehicle available between 1944 and 1953 for the successful development of command guidance techniques (including radio, radar, and computer control), launching methods, personnel training, and the improvement of individual components and entire systems for succeeding missile designs. Emphasizing the seminal achievement of a submarine-launched cruise missile, the Navy detailed the, "opportunity provided for evaluation of submarine missile launching, handling and guidance gear," and the, "information provided on problems of submarine and shipboard missile operations" furnished to the *Regulus* and *Rigel* missile programs under development. As a cogent reminder of geo-political realities of the time, and the dual role of the JB2/*Loon* as both teacher and, if need be, terminator, the Navy mentioned the *Loon* missiles, "held in readiness for possible operational use as an interim weapon."¹²⁶

¹²⁶ David K. Stumpf, *Regulus: America's First Nuclear Submarine Missile* (Paducah, KY: Turner Publishing Company, 1996), 17, 161; H. E. Oppenheim, "Navy Presentation on Loon Missile (LTV-N-2)," March 12, 1951, 1-4, Record Group 330, U.S. Navy, Entry 341, Navy Missiles, Box 194, File "Loon," NARA II. Chance-Vought Corporation designed and manufactured the US Navy *Regulus* as the first turbo-jet powered cruise missile deployed by a ship or submarine designed specifically to carry a nuclear warhead, utilizing the same launch and guidance systems tested on the *Loon*. The Navy deployed *Regulus* missiles from 1955 through 1964 (see photo on page 102). Grumman Corporation developed the US Navy *Rigel* as a submarine-launched, ram-jet powered super-sonic cruise missile, also utilizing launch and guidance systems proven during the *Loon* program. The Bureau of Aeronautics cancelled the *Rigel* program in 1953 before the missile reached production.

Ironically, seven months earlier in February 1953, the USSR cancelled its first cruise missile test program, centered upon Soviet copies of the German V-1. Completely unknown to the Americans, the Red Army also captured V-1s near the end of World War II. In typical Stalin-era secrecy, the Soviet Air Forces produced hundreds of V-1 clones (known as the 10Kh), and began a test launch program in March 1945 that paralleled the JB-2/*Loon* program until early 1953. Crews launched 10Kh missiles from ground ramps and aircraft, but the USSR made no effort to launch the missiles from ships or submarines. The Kremlin reaped the same benefits from the 10Kh that the Pentagon harvested from the JB-2, employing the invaluable technological lessons learned from these test vehicles on next generation cruise missiles.¹²⁷

When the JB-2/*Loon* retired from military service following the end of the Korean War in 1953, the two men ultimately responsible for the missile's continuing development had recently departed the world stage. Harry Truman left office on January 20, 1953, upon the presidential inauguration of Dwight D. Eisenhower, and Soviet premier Joseph Stalin died six weeks later on March 5. Both men had begun, privately, to sense the futility of a nuclear war, but subsequent leadership in the US and USSR failed to reach this conclusion.¹²⁸

President Eisenhower asked his advisors to find ways to use strategic, and the newly-developed "tactical" nuclear weapons, in Korea to end the conflict. Understanding

¹²⁷ Zaloga, *V-1 Flying Bomb*, 41-42; "The CT-10 Guided Target," *Flight*, May 25, 1956, 637. The French also produced copies of the German V-1 after World War II. Designated the CT-10, this aircraft was not developed as a cruise missile, but rather as a target drone for anti-aircraft guns and air to air missiles. The first CT-10 flights occurred in April 1949 and it remained in service with the French armed forces, and the Royal Navy, through the 1950s.

¹²⁸ Gaddis, *The Cold War*, 63. Other notable Cold War events of 1953 included the execution of New York residents Julius and Ethel Rosenberg, convicted of conspiracy to commit espionage for providing secret information on the atomic bomb to the Soviet Union, and the first hydrogen bomb test by the Soviet Union. The United States tested its first "H-Bomb" in 1952.

the many objections to this initiative, Eisenhower stated firmly, “somehow or other the tabu which surrounds the use of atomic weapons would have to be destroyed.” Tactical nuclear weapons consisted of smaller atomic warheads for use on the battlefield that could be delivered via aircraft, artillery, or missile. First developed by the United States and deployed in 1952 in gravity bomb form with both Air Force and Navy aircraft, tactical nuclear weapons designed for cruise missiles arrived too late for the JB-2/*Loon*, but its successors, the *Matador* and *Regulus*, carried them throughout their service life. All subsequent cruise missile designs have retained tactical nuclear capability.¹²⁹

The Cold War continued another forty years, during which, according to historian John Lewis Gaddis, “the world spent the last half of the 20th century having its deepest anxieties not confirmed.” One of the many legacies of the Cold War, the present-day cruise missile, conceived in Nazi vengeance as the V-1 and matured by American fears as the JB2/*Loon*, retains the ability to terrorize, or avenge, in missions unimaginable to its creators.¹³⁰

¹²⁹ Gaddis, *The Cold War*, 63-64; Mindling and Bolton, *U.S. Air Force Tactical Missiles*, 95-97, 112. Gaddis details Eisenhower’s strong wish to use nuclear weapons in Korea, and his statement on eliminating the taboo surrounding their use.

¹³⁰ Gaddis, *The Cold War*, 63, 266.

CONCLUSION

Korea, along with the cruise missile and its progeny, continue to make headlines well into the twenty-first century. On February 14, 2013, in response to North Korea's continuing development of long-range ballistic missiles, the South Korean Defense Ministry announced the deployment of a cruise missile launched from a ship or submarine described as, "a precision-guided weapon that can identify and strike the window of the office of North Korea's leadership." Three months later on May 22, United States Attorney General Eric Holder revealed to Congressional leaders that counterterrorism assault drone strikes had killed four Americans overseas. Through the fall of 2013, the Obama administration debated whether or not to launch cruise missiles against Syria for its use of chemical weapons on its own populace. Neither cruise missiles nor assault drones would exist without the technological innovations tested and proven in the JB-2/*Loon*, serving as a "catalyst in rejuvenating a dormant US missile program."¹³¹

The USAF *Matador* and USN *Regulus* cruise missiles, immediate successors to the JB-2/*Loon*, both deployed in 1954, became obsolescent with the development of the Navy's *Polaris* ballistic missile by 1961. The *Polaris*, a direct descendant of the German V-2, just as the *Matador* and *Regulus* were children of the V-1/JB-2/*Loon*, employed solid rocket fuel to power its sub-orbital trajectory. Both the *Matador* and *Regulus* suffered from the same deficiencies as the JB-2/*Loon*, a target radius of one mile at best

¹³¹ "South Korea unveils missile capable of striking North," February 14, 2013, accessed June 4, 2013, <http://news.msn.com/world/s/>; "Holder says drone strikes since 2009 have killed four U.S. citizens," May 23, 2013, accessed June 4, 2013, <http://nbcpolitics.nbcnews.com/news/2013/05/22/18427162/>; Gordon Marino, "If Cruise Missiles Fly, Peace Must Be the Target," accessed October 8, 2013, http://www.huffingtonpost.com/gordon-marino/syria-if-the-tomahawk-mis_b_3846936.html; Huisken, *Origin of the Cruise Missile*, 15; Neufeld, *Ballistic Missiles*, 24; Werrell, *Evolution of the Cruise Missile*, 62.

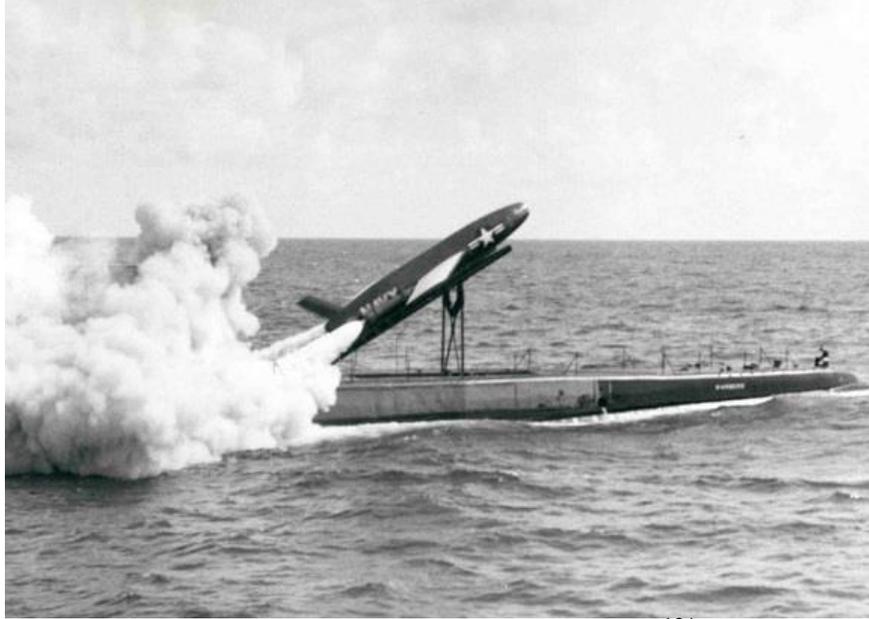
with a limited range (100 miles) and payload. Though targeting accuracy and payload did not significantly improve with this first sub-launched ballistic missile (SLBM), *Polaris* offered a much longer range (1,000 miles), and, most importantly for the Navy, the ability to launch from a submerged submarine. Both the *Loon* and *Regulus* cruise missiles required a surface launch, thereby making the submarine vulnerable to attack during missile firing operations. Submerged cruise missile launches began in the 1980s.¹³²



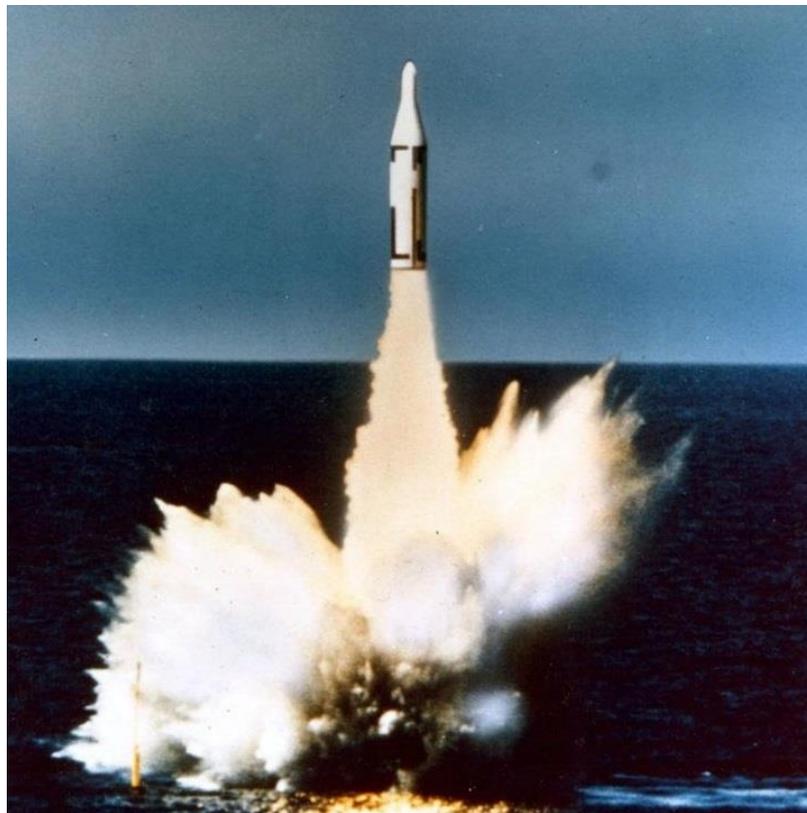
USAF *Matador* cruise missile, c.1954.¹³³

¹³² Mindling and Bolton, *U.S. Air Force Tactical Missiles*, x, 25, 47-48, 62, 73; Stumpf, *Regulus*, 8, 17, 51, 75, 161; Graham Spinardi, *From Polaris to Trident: The Development of US Fleet Ballistic Missile Technology* (Cambridge, UK: Cambridge University Press, 1994), 33, 37, 57, 65. Glenn L. Martin Company designed and manufactured the USAF *Matador* as the first turbo-jet powered cruise missile launched on land designed specifically to carry a tactical nuclear warhead, utilizing the same launch and guidance systems tested on the JB-2. The Air Force deployed *Matador* missiles from 1954 through 1962.

¹³³ "Matador Cruise Missile," accessed October 7, 2013, <http://www.brookings.edu/about/projects/archive/nucweapons/matador>.



USN *Regulus* cruise missile, c.1954.¹³⁴



USN *Polaris* ballistic missile, c.1961.¹³⁵

¹³⁴ “*Regulus I* Missile Fired From USS *Barbero*,” accessed October 7, 2013, http://www.postalmuseum.si.edu/museum/1d_RegulusMail.html.

¹³⁵ “*Polaris*,” accessed October 7, 2013, <http://theleansubmariner.com/tag/41-for-freedom/>.

The success of the *Polaris* effectively shelved further cruise missile development in the US Navy for twenty years, but the Air Force persisted in its own programs for both cruise and ballistic missiles. The *Matador*, and its later variant the *Mace*, remained active duty cruise missiles along the Iron Curtain (armed with tactical nuclear warheads) until 1962 and 1969 respectively, as the Air Force's first Intercontinental Ballistic Missiles (ICBMs), the *Atlas*, *Titan*, and *Minuteman* became operational. Still, the need for short and intermediate range missiles remained in contingency Cold War plans. Cruise missiles including the *Snark*, *Navajo*, *Hound Dog* and others, launched by ground ramp or bomber, built upon the strengths of each preceding design through the 1970s. Although these weapons contained revolutionary map-matching and inertial guidance systems within the missiles' interiors, eliminating the need for a ground, sea, or airborne control station, targeting accuracy did not improve significantly over the radio/radar and external computer control systems of the JB-2/*Loon* programs.¹³⁶

¹³⁶ Spinardi, *From Polaris to Trident*, 33, 57, 59, 62; Mindling and Bolton, *U.S. Air Force Tactical Missiles*, ix, 142, 181; Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force 1945-1960* (Washington, D.C.: United States Air Force Office of History, 1989), 212-214; Kenneth P. Werrell, "The Cruise Missile: Precursors and Problems," *Air University Review*, January-February, 1981, 3-5, accessed July 28, 2013, <http://airpower.au.af.mil/airchronicles/aureview/1981/jan-feb/werrell.htm>.



USAF *Atlas* ballistic missile, c.1962.¹³⁷

The increase in acts of terrorism against the United States beginning in the 1970s, and the fall of the Soviet Union in 1991, led to a change of mission for the American military; and, along with concurrent technological progress, sparked a cruise missile revival. Washington now faced smaller, elusive enemies not always recognizable by uniformed forces, masses of weaponry, or official association with nation-states. The fear of potential nuclear war from communist expansionism faded, replaced by the horrifying reality of attacks by individual extremists, often motivated by religious zeal or cultural exasperation, on American civilians abroad and at home. Unable to prevent all acts of terror, the United States targeted countries sponsoring terrorist actions or terrorist groups, attacking Libya (1986, 2011), Iraq (1991, 2003-2013), and Afghanistan (2001-?). With the perfection of terrain contour map-matching technology, high-speed microcomputers,

¹³⁷ “Atlas,” accessed October 7, 2013, <http://atlasbases.homestead.com/>.

and miniaturized radar circuitry in the late 1970s, and the advent of the global positioning system [GPS] in the 1990s, the accuracy problem of cruise missile targeting dissolved, replaced by “surgical strike” capability. The USAF AGM-86 (1980-present) and the USN *Tomahawk* (1983-present) represent the latest generation of cruise missiles (first used in battle during the 1991 Gulf War) which have become the weapon of choice to neutralize hostile military installations without risk to far more expensive assault drones and American military personnel, and reducing danger to non-combatants. Yet the cruise missile of the early twenty-first century, for all its technological wonder, lacks the psychological consolation its patriarch possessed. The existence of America’s first cruise missile, the JB-2/*Loon*, may have offered some relief to American anxiety rising from the “Red Scare” of the early Cold War, but today’s cruise missiles, though effective against substantial structural targets, cannot quell the fear of a lone extremist with an improvised explosive device (IED) in a crowd of spectators.¹³⁸

In 2014, the use of drones by the United States military is a subject of profound controversy. The most widely known craft among twenty-first century drones (also known as unmanned assault vehicles UAV), another line of descendant from the JB-2, is the *Predator*. Initially developed as a remote reconnaissance platform transmitting live video by satellite in the 1990s (controlled by a computer whose operator may be half a world away), the USAF added an interchangeable weapons system to the *Predator* in

¹³⁸ Charles Townshend, *Terrorism: A Very Short Introduction* (Oxford, UK: Oxford University Press, 2012), 1-15; Mark Juergensmeyer, *Terror in the Mind of God: The Global Rise of Religious Violence* (Berkeley, CA: University of California Press, 2003), 1-14; Werrell, “The Cruise Missile: Precursors and Problems,” <http://airpwer.au.af.mil/airchronicles/aureview/1981/jan-feb/werrell.htm>; Reuben E. Brigety II, *Ethics, Technology and the American Way of War: Cruise Missiles and US Security Policy* (New York: Routledge, 2007), 56-69; “MQ-1B Predator,” *The Official Site of the US Air Force*, accessed July 28, 2013, <http://www.af.mil/information/factsheets/factsheet.asp?fsID=122>. Drones have a significantly lower range, speed and payload in comparison to cruise missiles, in addition to being far more expensive (\$5 million dollars per *Predator* compared to \$2 million dollars per AGM-86D).

2001, transforming it into an assault drone. The Central Intelligence Agency (CIA) is estimated to have killed over 3,000 people with assault drones from 2004 to 2013 in Pakistan alone, judged by the Obama administration to be, “people who are on a list of active terrorists trying to go in and harm Americans.” The morality and legality of the U.S. drone campaign is currently the focus of acrimonious debate.¹³⁹



Predator assault drone firing AGM-114 Hellfire ground attack missile.¹⁴⁰

The drone descendants of the JB-2 are not limited to military service, as police forces, firefighters, scientists, filmmakers, farmers, real estate agents and numerous other operators employ non-lethal designs in an ever-growing list of applications. Private sector drone usage is not without controversy, with questions arising over the legal limits of surveillance and the rights of personal privacy. The Orwellian presence of “Big Brother” evolves with each technological advance.¹⁴¹

¹³⁹ “MQ-1B Predator,” <http://www.af.mil/information/factsheets/factsheet.asp?fsID=122>; Lev Grossman, “Drone Home,” *Time*, February 11, 2013, 30-33.

¹⁴⁰ “Predator Drone Firing Missile,” accessed October 8, 2013, <http://dronewarsuk.files.wordpress.com/2010/06/predator-firing-missile4.jpg>.

¹⁴¹ Grossman, “Drone Home,” 30-33.

So What?

This thesis presents an analysis employing the methodology of two disciplines, history and historical archaeology, integrated for public presentation. Gathering substantial payloads of evidence from both archival research and archaeological fieldwork, the essay illuminates the history of the JB-2/*Loon* and establishes the significance of associated surviving material culture on Santa Rosa Island, Florida. Fusing the practical applications, and perspectives, of history and archaeology (professions working all too frequently in separate domains), allows greater depth and complexity in this examination, as well as better informed conclusions.

The JB-2 is historically significant as the progenitor of all cruise missile and drone developments since World War II, and for its roles as a seminal test vehicle for the development of cruise missile technology, a weapon ready for use by the United States near the end of combat operations against the Japanese in 1945 and, if necessary, throughout the early Cold War until 1953, and as an added measure of security to an American public fearing a nuclear attack from the Soviet Union. Further significance for the “Good Robot Bomb” is rooted in the astonishing irony that the United States eagerly embraced what it considered a Nazi terror weapon in the V-1, copying its design and technology for planned immediate use on a grand scale. This decision emphasizes how the definition of a weapon of terror depends upon which side of the conflict one stands.¹⁴²

The JB-2/*Loon*, as America’s only operational cruise missile between 1944 and 1953, provided the solitary opportunity for new or improved systems of such weaponry to be evaluated and for personnel to be trained. Test programs utilizing these missiles

¹⁴² Werrell, *Evolution of the Cruise Missile*, 62-63, 75.

included ground, air, sea surface vessel and submarine launches, radio, radar, and computer guidance control, terminal dive execution, operations under simulated combat conditions in extreme weather, tactics for missile destruction by fighter plane and anti-aircraft, radar tracking procedures, as well as numerous studies of re-designed components in the electrical, pneumatic, fuel, armament, and flight control systems. America's first cruise missile operators, technicians, and engineers honed their craft on the JB-2/*Loon*, and applied these skills in the development and deployment of more advanced models.

The JB-2/*Loon* exemplifies the technological transition from the mechanical to the electronic age in missile technology and military aviation. America's first cruise missile represented the end of simplicity in design for such weaponry, where operators with a low technical skill set could affect necessary repairs and field modifications through grease monkey know-how and farm boy intuition, and the beginning of a new paradigm where numerous sub-specialists of complex systems filled the growing missileer ranks. Engineers applying numerous innovations driven by Cold War realities resulted in a submarine-launched, computer-controlled *Loon* of 1953 far removed from the V-1 copies of Range 64 and Sergeant Reece Bowen's "fire and forget" procedures on the sands of Santa Rosa.

Alongside America's demonstrated nuclear capability, the JB-2/*Loon* developed in support of the Truman administration's policy of containment within the "arsenal of democracy" used in the growing East-West arms race to intimidate the Soviet Union from further geo-political expansion, thereby temporarily calming some of the fears for Americans preparing to "duck and cover" or considering a backyard bomb shelter.

Historian Stephen J. Whitfield asserts, “Vigilance against Communism was a national priority during the darkest days of the Cold War, from the late 1940s until the mid-1950s.” However vigilant the Pentagon may have been, the threat of American military technology did not prevent North Korea, upon the blessing of Stalin, from attacking South Korea in an effort to extend Communism throughout the peninsula. The Navy prepared Loon missiles for deployment to Korea in 1950, and President Eisenhower repeatedly pushed for the use of atomic weapons there in 1953, but neither was utilized in the conflict.¹⁴³

Why is this stuff important?

The cultural remains of the two JB-2 launch sites on Santa Rosa Island must be understood within the context of the early Cold War period in which they existed. The JB-2 represented, essentially, German technology employed as an implied threat against Soviet expansion by an American government motivated as much by anxiety as by political philosophy. Archaeological sites 8Ok246 and 8Ok248, described and evaluated in the Appendix, are the physical remnants of one defense initiative the United States used in the effort to deter nefarious communist intentions. Thus, the JB-2 stood ready as a contingency weapon that could be made available for rapid deployment, while it pursued its primary mission as a template for improving cruise missile technology. Each of these

¹⁴³ Gaddis, *Cold War*, 31, 63; Whitfield, *Culture of the Cold War*, vii. The phrase “duck and cover” refers to the iconic social guidance/propaganda film *Duck and Cover* produced by the Federal Civil Defense Administration in 1951. The film suggested school children could find protection from a nuclear explosion by hiding under a desk. See Melvin E. Matthews, Jr., *Duck and Cover: Civil Defense Images in Film and Television from the Cold War to 9/11* (Jefferson, NC: McFarland & Company, 2011). Private home bomb shelters generally did not appear until the late 1950s, and grew in popularity with President John F. Kennedy’s encouragement for their construction in a speech on civil defense issues on October 6, 1961. See “JFK urges Americans to build bomb shelters, October 6, 1961,” accessed October 8, 2013, <http://www.politico.com/news/stories/1009/27936.html>. The reference to Eisenhower’s push to use nuclear weapons in Korea at the end of this paragraph is well-documented in Gaddis, *Cold War*, 63-64.

roles is apparent in the structural remains from the late 1940s test programs on Santa Rosa Island. A four-hundred-foot ramp of concrete and steel, though helpful for test launches, would not be a viable option for immediate hostilities; whereas a fifty-foot launch ramp on a highly mobile trailer system could be ideal for battlefield deployment.

Derelict JB-2 missile sites exist in Utah and New Mexico in addition to Florida. Earthen launch ramps, though incomplete, remain at Wendover AFB (Utah) and Holloman AFB (NM) along with adjacent related structures. Preservation efforts are underway at both sites in the American Southwest. Research for this essay proved unable to determine whether or not there are any structural remains, save for a lone *Loon* on display atop a pedestal, extant from the test program at the former Naval Air Missile Test Center in Point Mugu, California (re-named Naval Base Ventura County in 2000). All sea-going vessels involved in launching *Loon* missiles no longer exist, having been scrapped (USS *Cusk* in 1972 and USS *Norton Sound* in 1988) or sunk as a target (USS *Carbonero*, 1975). In addition to the sites on Santa Rosa Island, Eglin AFB has the remains of a steel JB-2 launch ramp at Auxiliary Field #1 (Wagner Field). Historical and archaeological investigations on Eglin failed to determine precisely how the Wagner Field ramp was used. Far more JB-2 missiles were fired from the ramps on, and bombers above, Santa Rosa Island than those expended at Wendover and Holloman AFBs, or *Loons* launched by the US Navy.¹⁴⁴

¹⁴⁴ Mindling and Bolton, *U.S. Air Force Tactical Missiles*, 33; Page, “Holloman’s First Test Track,” <http://www.alamopulse.com/2262/hollomans-first-test-track/>; “A History of the USS *Cusk*,” accessed July 31, 2013, <http://www.uscusk.com/history.htm>; “USS *Norton Sound* (AV-11)” accessed July 31, 2013, <http://www.navy.mil/navsource.org/archives/09/41/4111.htm>; “USS *Carbonero* (SS-337),” accessed August 1, 2013, <http://www.navy.mil/navsource.org/archives/08/08337.htm>; Thomas, et al., “Investigations at the JB-2 Sites,” 147.

The material culture on archaeological sites 8Ok246 and 8Ok248, consisting of JB-2 missile remnants and related launch facilities, are significant because, according to the National Register *Guidelines for Evaluating and Documenting Historic Aviation Properties*, they, “have yielded, and are likely to continue to yield, information important in history.” These guidelines specifically state that “aviation wrecks and ruins of aviation facilities” may qualify for National Register listing. The historical context of the JB-2 sites on Santa Rosa Island, examined in Chapter II, includes the Cold War and military aviation. Both sites retain “physical characteristics of an aircraft that provide information about the craft’s construction, use or operation” that the National Register requires in determining importance “within an appropriate historic or archaeological context.” Though documentation of the JB-2 has survived, it is incomplete. The cultural landscape composing the two early cruise missile sites on Santa Rosa, reviewed in the Appendix, replace some of the missing pages in the historical record. Lastly, the National Register requires that archaeological sites eligible for listing contain adequate data and demonstrate the connection between the specific property and the information it possesses. Both JB-2 sites include abundant data, held within some structurally complete (and some partially complete) launch facilities, fifteen deteriorating missiles, and hundreds of small associated artifacts scattered upon the sands which, by virtue of their existence in situ, directly connect the properties to the information thereon.¹⁴⁵

Those uninterested in the technical requirements of the National Register will, understandably, ask what possible relevance the rusting remnants of missiles and

¹⁴⁵ U.S. Department of the Interior, *Guidelines for Evaluating and Documenting Historic Aviation Properties*, 27-30; Quigg, “Assessment of Significance,” 1-29; “Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island,” RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II.

launching facilities on a Florida barrier island have to their lives. The answer lies in what these sites represent; a time when a global conflict, very likely involving nuclear weapons, was a tangible possibility. The Cold War affected every American family that lived through it, and the generation that followed. Perhaps an awareness of the Cold War, realized or enhanced through its military remains, may help cultures avoid living through such a tenuous time in the future. Writing about his present-day Yale undergraduate students, historian John Lewis Gaddis adroitly observes, “Some of them---by no means all---understand that if a few decisions had been made differently at a few critical moments during that conflict, they might not even have had a life.”¹⁴⁶

The Santa Rosa Island JB-2 sites are important as cultural landscapes, specifically military landscapes, created from the value Americans place upon societal preservation and new technologies for such protection. These geographic areas represent large examples of material culture, defined by historical archaeologist James Deetz as, “That portion of man’s physical environment purposely transformed by him according to culturally dictated plans.” The American cultural need for national defense motivated the plans and execution of modifications on Santa Rosa Island. 8OK248 and 8OK246 are microcosms of the vast expanses of the United States (military landscapes) removed from public access and dedicated to testing the strategies and tactics of armed forces. Most of these landscapes originated during World War II and the Cold War, as did the JB-2 sites. The cultural meaning of these two missile sites is that they are evocative of an American culture that valued self-preservation through technological advances, and the use of deadly force to achieve it, within a belief system that championed democracy and feared

¹⁴⁶ Gaddis, *Cold War*, ix.

the spread of communism. With the exception of a greatly reduced fear of the spread of communism, recently replaced by a fear of terrorism, those values remain steadfast within American culture.¹⁴⁷

Who cares?

Cultures care about leftover objects from our past because they tell us who we are. The relationship to, and perception of, things depends upon the culture to which we belong. As noted American material culture historian Thomas J. Schlereth reasons, “objects made or modified by humans, consciously or unconsciously, directly or indirectly, reflect the belief patterns of individuals who made, commissioned, purchased, or used them, and, by extension, the belief patterns of the larger society of which they are a part.” The United Nations Educational, Scientific and Cultural Organization (UNESCO) directly expressed the perceived importance of historic material culture by stating, “cultural property is a basic element of people’s identity and ‘being depends on having.’” The material culture of 8Ok246 and 8Ok248 reminds Americans that we, as a society, are often motivated by fear, that we are willing to kill in order to defend ourselves, and our lifeways, and that we receive some consolation in the existence of such weaponry for this purpose like every other human culture since prehistory. Beyond these basic human survivalist needs, the JB-2 sites on Santa Rosa Island exemplify the

¹⁴⁷ U.S. Department of the Interior, “Guidelines for the Treatment of Cultural Landscapes: Defining Landscape Terminology,” accessed March 29, 2014, <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/terminology.htm>; James Deetz’ material culture definition is quoted in Thomas J. Schlereth, “History Museums and Material Culture,” in *History Museums in the United States: A Critical Assessment*, ed. Warren Leon and Roy Rosenzweig (Champaign, IL: University of Illinois Press, 1989), 294.

beliefs, anxieties, technological advances, and socio-political climate of the early Cold War era in the United States.¹⁴⁸

Both 8Ok246 and 8Ok248 became a part of the National Register of Historic Places in 1996 under criteria A (for association with events important to American military history), C (as unique and distinctive structural remains), and D (for the ability to yield information important to American cruise missile development). As discussed in the preceding chapters, the research in the nomination expounded on the sites' significance during World War II, which, unfortunately, is an association not possible. Both 8Ok246 and 8Ok248 are post-war, constructed in 1946-47 and used until 1950. The sites' significance, argued above, and below in the Appendix, is their association with the early Cold War. The individuals preparing the nomination for the JB-2 sites on Santa Rosa Island confused them with the World War II JB-2 site twenty-two miles east at Four Mile Village, Florida, (Coffeen Nature Preserve) in operation from 1944 to 1945. Through this thesis, the author hopes to correct the history provided to the National Register so that these sites may be listed for their proper historical significance and association. Prentice Thomas and Associates (PTA) presented recommendations for both active and passive preservation initiatives for 8Ok246 and 8Ok248, but their existence on Eglin AFB in an active training area utilized by ongoing missile and drone tests, as well as by Special Forces of the United States Army and Navy has presented a number of obstacles to implementation.¹⁴⁹

¹⁴⁸ Thomas J. Schlereth, *Material Culture Studies in America* (Lanham, MD: AltaMira Press, 1999), 3; Michael Rowlands, "Heritage and Cultural Property," in *The Material Culture Reader*, ed. Victor Buchli (Oxford: Berg, 2002), 105.

¹⁴⁹ Thomas, et al., "Investigations at the JB-2 Sites," 203-205.

Although the preservation of these sites, in their entirety, is rife with bureaucratic and environmental challenges, one of PTA's initiatives has been carried out. A small portion of the material culture from both launch locations is in the first stages of conservation. As a part of the author's archaeological consulting work on 8Ok246 and 8Ok248, PTA technicians (working for Eglin AFB), retrieved surface artifacts diagnostic to the JB-2 missile that, due to their condition, presented the best chance for long-term preservation and public interpretation. Working directly with PTA archaeologists in June 2012, the author identified and recovered twelve artifacts from these sites for protection, including a pulse-jet engine grid, elevator, nose cone, and impeller/air log. These artifacts are currently undergoing careful cleaning and conservation efforts in the laboratory facilities of PTA at Fort Walton Beach, Florida for eventual public exhibition.¹⁵⁰

The JB-2, conceived as Hitler's first weapon of vengeance (V-1), reproduced by America's unequalled wartime industry, and arriving too late for use by United States forces in World War II, became the "mother of all cruise missiles" in its Cold War testing role while maintaining implied vigilance in support of communist containment, thereby earning historic significance. Combining traditional historical research, the template for preservation provided by the National Register of Historic Places (applied in the Appendix below), and archaeological fieldwork, this essay explores the operational life and legacy of this first generation unmanned assault vehicle, and the global climate in which it flew. Such multi-disciplinary approaches are essential, particularly for subjects

¹⁵⁰ Thomas, et al., "Investigations at the JB-2 Sites," 205; Quigg, "Assessment of Significance," 1-29. PTA consulted with the Florida State Historic Preservation Officer (SHPO) on the recommended preservation initiatives offered Eglin AFB.

relatively unknown and incompletely documented, to provide a better understanding of our shared cultural experience.

APPENDIX: NATIONAL REGISTER ELIGIBILITY ASSESSMENTS

JB-2 Missile Test Site (8Ok248) Santa Rosa Island, Okaloosa County, Florida

Archaeological site 8Ok248 should be recommended as eligible for the National Register under Criterion D, as it meets the age requirement of being over fifty years old, and its archaeological remains have yielded, and are likely to continue to yield, information important in history. Archaeological sites may qualify under Criterion D, according to the National Register, if they:

- 1) Demonstrate the “importance of the information within an appropriate historic or archaeological context.”¹⁵¹
- 2) Demonstrate “the connection between the important information and the specific property.”¹⁵²
- 3) Contain “the presence of adequate data in the property.”¹⁵³



JB-2 being prepared for launch at 80K248, c.1947.¹⁵⁴

¹⁵¹ U.S. Department of the Interior, *Guidelines for Evaluating and Documenting Historic Aviation Properties*, 30. See page 12 of this essay for a definition of the National Register.

¹⁵² *Ibid.*

¹⁵³ *Ibid.*

¹⁵⁴ Unnumbered Photograph USAAF, Photograph Collection, Office of History, EAFB.

The National Register defines a property with information as, “a geographic location having important historical or archaeological information. The information may be literally buried under ground, submerged under water, or scattered across the surface.”¹⁵⁵

Specific direction regarding the eligibility of aviation properties under Criterion D is provided by the National Register in its Guidelines for Evaluating and Documenting Historic Aviation Properties which states:

An aviation property is significant under Criterion D if that property has yielded, or is likely to yield information important to history, such as the physical characteristics of an aircraft that provide information about the craft’s construction, use or operation. Aviation wrecks and ruins of aviation facilities might qualify for listing in the National Register under Criterion D. Also, rare aircraft for which inadequate or no documentation has survived might also be considered.¹⁵⁶

8Ok248 consists of an area on Santa Rosa Island between the main road and the Gulf shoreline constructed in 1946-1947 dedicated to testing JB-2 cruise missiles. The site continued as a test launch area for the JB-2 until 1950. Material remains on site dating from this era include: a paved access road, reinforced concrete launching pad, reinforced concrete blockhouse/bunker, and numerous fragmented wrecks of JB-2 missiles scattered on the surface between the launch pad and the shoreline. See page 76 above for contemporary satellite imagery maps of 8Ok248.¹⁵⁷

¹⁵⁵ U.S. Department of the Interior, *Guidelines for Evaluating and Documenting Historic Aviation Properties*, 30.

¹⁵⁶ Ibid.

¹⁵⁷ “Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island,” RG 218, Entry 343A, Box 4, File, “JB-2 1945,” NARA II; Quigg, “Assessment of Significance,” 1-29. My fieldwork, conducted from June 11 through June 15, 2012, and detailed in the report cited here, is the source of my site descriptions and eligibility assessments in this essay.



Blockhouse/Bunker on 8Ok248, June 2012.¹⁵⁸

Applying each of the above National Register requirements to 8Ok248, with italics added for emphasis, leads to the following conclusions:

Demonstrating the importance of the information within an appropriate historic or archaeological context.

The historical context of 8Ok248, discussed in detail in Chapter II, includes the Cold War and military aviation.¹⁵⁹ The important information within the material remains includes, “*physical characteristics of an aircraft that provide information about the craft’s construction, use or operation*” conveyed through fifteen deteriorating JB-2 airframes and engines lying on the surface. The decomposing missiles exhibit prominent

¹⁵⁸ Photograph by Gary F. Quigg, June 15, 2012.

¹⁵⁹ U.S. Department of the Interior, National Park Service, National Register of Historic Places, *National Register Bulletin: How to Complete the National Register Multiple Property Nomination Form*, Antoinette J. Lee and Linda F. McClelland (Washington, D.C.: U.S. Government Printing Office, 1991, Revised 1999), 11. This bulletin presents the National Register’s definition of historic context: “Historic contexts are those patterns or trends in history by which a specific occurrence, property, or site is understood and its meaning (and ultimately its significance) within pre-history or history is made clear. ...resources, properties, or happenings in history do not occur in a vacuum but rather are part of larger trends or patterns.”

design features of the JB-2, including wings, fuselages that include fuel tanks, warheads, control housings, and launch cart attach points, empennages that retain elevators and rudders, nose cones, and complete engine assemblies. Each of these characteristics speaks directly to the aircraft's construction and use. The existence of warheads inside some of the airframes, filled with sand and gravel as "dummy" payloads, demonstrates how launch personnel improvised beyond the published JB-2 operations manual to achieve proper weight and balance in each missile when airmen removed the amatol explosive (a mixture of TNT and ammonium nitrate) prior to flight. This field modification illuminates an undocumented process in the aircraft's operation. Further, the JB-2 is a "rare aircraft" as only twelve intact examples remain of the 1,382 manufactured. The surviving complete JB-2s are in environments more conducive to their preservation, but each received alteration from its original appearance and configuration through parts salvage, restoration, or rehabilitation efforts. However, the missiles on 8Ok248, though incomplete with extensive deterioration, appear to have remained untouched by human effort since their date of usage. The existence of these spent missiles in situ enhances understanding the context of the site as a testing ground, whereas unused, intact missiles on exhibition cannot demonstrate this information having been removed from their context. Documentation of the JB-2 survives, but it may be considered "inadequate" without the surviving, unmodified examples 8Ok248 contains.¹⁶⁰

¹⁶⁰ U.S. Department of the Interior, *Guidelines for Evaluating and Documenting Historic Aviation Properties*, 30; Quigg, "Assessment of Significance," 1-29. Among the twelve complete JB-2/Loons existing are examples on exhibition in the National Air and Space Museum's annex, the Stephen F. Udvar-Hazy Center at Washington Dulles International Airport in the vicinity of Chantilly, Virginia, the National Museum of the United States Air Force adjacent to Wright-Patterson AFB near Dayton, Ohio, the United States Air Force Armament Museum adjacent to Eglin AFB near Fort Walton Beach, Florida, and an example on a pedestal mount outside the Putnam County Courthouse in Greencastle, Indiana misidentified as a V-1 within its interpretive signage. The author has studied and photographed each of these.



JB-2 wrecks on 8Ok248, June 2012.¹⁶¹

Demonstrating the connection between the important information and the specific property.

All of the important information remains in situ on 8Ok248 within the missile wreckage scattered on the surface, as well as in the extant launch pad and blockhouse/bunker. Understanding that, “*Aviation wrecks and ruins of aviation facilities might qualify for listing in the National Register,*” this site, containing missile launch facilities and the remains of actual missiles launched, has notable potential for eligibility. With the blockhouse/bunker where each test initiated maintaining its structural integrity, and the launch pad remaining intact, one might argue for eligibility under Criterion A (association with an event that made a significant contribution to the broad patterns of our history) or Criterion C (embodiment of the distinctive characteristics of type, period, or method of construction). However, as all the control panels and furnishings within the interior of the blockhouse/bunker have been removed, and the launch pad itself is barren

¹⁶¹ Quigg, “Assessment of Significance,” 1.

concrete, these structures alone cannot convey their significance without the association of the JB-2 missiles lying nearby. The site must be considered, in its entirety, for eligibility under Criterion D.¹⁶²

Containing the presence of adequate data in the property.

With structurally complete launch facilities (blockhouse/bunker and launch pad), fifteen deteriorating JB-2 airframes and engines, and hundreds of small associated artifacts scattered on the surface throughout the site, 8Ok248 retains more than adequate data. Information from the site is already in use, helping to guide Eglin AFB personnel in the management of this cultural resource.¹⁶³

Site 8Ok248 is significant for its association with the early Cold War period, conveyed through its cultural remains that present information about the JB-2 project (including structural fabrication and operational execution) that cannot be conveyed by a published history or conserved missile on display. The JB-2 existed as a contingency weapon for containment that could be rapidly deployed, while it fulfilled its principal duty as a test aircraft for developing cruise missile technology. These roles are both evident in the material culture on Santa Rosa Island.¹⁶⁴

¹⁶² Quigg, "Assessment of Significance," 1-29; U.S. Department of the Interior, *Guidelines for Evaluating and Documenting Historic Aviation Properties*, 27-28, 30.

¹⁶³ Quigg, "Assessment of Significance," 1-29.

¹⁶⁴ U.S. Department of the Interior, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, 44-49; Quigg, "Assessment of Significance," 1-29. The ability of a property to convey its significance is known as "integrity" according to the National Register, which requires a resource to have retained "several, and usually most," of the following seven aspects to possess integrity: location, design, setting, materials, workmanship, feeling and association (context). As detailed above, 8OK248 has retained each of these seven aspects to a varying degree, most strongly location, design, setting, materials, and association.



JB-2 departing 80K248, note blockhouse/bunker and launch pad.¹⁶⁵

Ironically, 80k248 is already on the register; listed, unfortunately, for significance it does not possess or convey. In a case of mistaken identity all too common within the realm of historic preservation, researchers asserted the Air Force tested JB-2s on the Santa Rosa Island sites during World War II. When, in truth, the airmen of Range 64 at Four Mile Village operated the only JB-2 site active in Florida from 1944-1945. The Air Force constructed the sites on Santa Rosa Island (twenty-two miles away) after the war, in 1946-47, and used them until 1950. On April 19, 1996, the Florida State Historic Preservation Officer (SHPO) and Keeper of the National Register (unaware of the inaccurate history in the nomination forms) approved the nomination of 80k248 and 80k246 for their association with World War II (when they did not exist), rather than for the Cold War association argued in this essay.¹⁶⁶

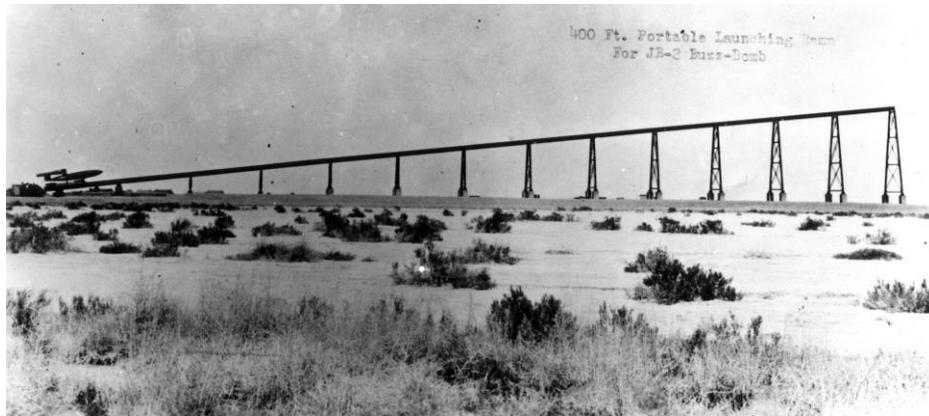
¹⁶⁵ Unnumbered Photograph USAAF, Photograph Collection, Office of History, EAFB.

¹⁶⁶ Thomas, et al., "Investigations at the JB-2 Sites," 202-204; Quigg, Assessment of Significance," 1-29. It is the author's intent to present this thesis, and any additional materials required, to the Florida SHPO and the Keeper of the National Register in hopes this unfortunate situation may be amended. Such a mistake in the research for the nomination is understandable, but also preventable through due diligence.

JB-2 Missile Test Site (8Ok246) Santa Rosa Island, Okaloosa County, Florida

Constructed in 1947, operations at what is now Florida archaeological site 8Ok246 continued until 1950, where JB-2 missiles flew from a 400-foot inclined ramp pointed south to direct the pilotless aircraft over the Gulf of Mexico. At the time the author conducted the 2012 field investigations, remains associated with missile activity included an asphalt access road (completely buried by wind-blown sand) leading south from the singular paved road that bisects the island running east-west, a reinforced concrete bunker where operators controlled missile launches, a reinforced concrete pad where airmen loaded missiles onto the launch ramp, one solid reinforced concrete pier, thirteen H-frame reinforced concrete piers, two sections of steel T-rails (used on the ramp to guide missile launch carts), and numerous small debris scatters along with isolated artifacts. The remains of one JB-2, completely reduced to a mass of ferrous flakes with no structural integrity, lies on the surface at the southernmost pier. All reinforced concrete piers have settled to various depths and angles due to the shifting sands of the last six decades. Only a few steel connector plates remain from the 400-foot steel truss superstructure supported by the piers. A salvage contractor removed the steel in 1958.¹⁶⁷

¹⁶⁷ “Group History: 1st Experimental Guided Missiles Group 1 July 47 Thru 31 Dec 47,” 799-800, 810, 937-940, 1311, 1370, Office of History, EAFB; Quigg, “Assessment of Significance,” 1-29; “Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island,” RG 218, Entry 343A, Box 4, File, “JB-2 1945,” NARA II; Quigg, “Assessment of Significance,” 1-29. My fieldwork, conducted from June 11 through June 15, 2012, and detailed in the report cited here, is the source of my site descriptions and eligibility assessments in this essay.



400-foot launch ramp at 80K246, c.1948¹⁶⁸



Concrete piers from 400-foot launch ramp at 80K246, June 2012.¹⁶⁹

The archaeological research conducted by the author on Santa Rosa Island provides the base from which to present a cultural resource perspective of 80K246 below. Archaeological research consisted of surface documentation due to unexploded ordnance (UXO) remaining on site. A non-invasive, sub-surface electromagnetic survey of both

¹⁶⁸ Unnumbered Photograph USAAF, Photograph Collection, Office of History, EAFB.

¹⁶⁹ Photograph by Gary F. Quigg, June 15, 2012.

sites provided inconclusive results. The following is an assessment of the eligibility potential of 8Ok246.¹⁷⁰

Florida archaeological site 8Ok246 on Santa Rosa Island should be recommended eligible for the National Register under Criterion D, as it meets the age requirement of being over fifty years old, and its archaeological remains have yielded, and are likely to continue to yield, information important in history. Archaeological sites may qualify under Criterion D, according to the National Register, if they:

- 1) Demonstrate the “importance of the information within an appropriate historic or archaeological context.”¹⁷¹
- 2) Demonstrate “the connection between the important information and the specific property.”¹⁷²
- 3) Contain “the presence of adequate data in the property.”¹⁷³

The National Register defines a property with information as, “a geographic location having important historical or archaeological information. The information may be literally buried under ground, submerged under water, or scattered across the surface.”¹⁷⁴

Specific direction regarding the eligibility of aviation properties under Criterion D is provided by the NR in its Guidelines for Evaluating and Documenting Historic Aviation Properties which states:

An aviation property is significant under Criterion D if that property has yielded, or is likely to yield information important to history, such as the physical characteristics of an aircraft that provide information about the craft’s construction, use or operation. Aviation wrecks and ruins of aviation facilities might qualify for listing in the National Register under

¹⁷⁰ Quigg, “Assessment of Significance,” 1-29.

¹⁷¹ U.S. Department of the Interior, *Guidelines for Evaluating and Documenting Historic Aviation Properties*, 30.

¹⁷² Ibid.

¹⁷³ Ibid.

¹⁷⁴ Ibid.

Criterion D. Also, rare aircraft for which inadequate or no documentation has survived might also be considered.¹⁷⁵

8Ok246 consists of an area on Santa Rosa Island between the main road and the Gulf shoreline dedicated to, and constructed for, testing JB-2 cruise missiles in 1947. The site continued as a test launch area for the JB-2 until 1950. Material remains on site dating from this era include: a paved access road, reinforced concrete missile loading pad, reinforced concrete blockhouse/bunker, fourteen concrete piers used as a foundation for the steel-truss launch ramp, sections of steel T-rails (used on the ramp to guide launch carts), and the fragmented wreckage of a single JB-2 missile scattered on the surface at the south end of the ramp area. See page 77 above for contemporary satellite imagery maps of 8Ok246.¹⁷⁶



Crushed nose cone and broken impeller/air log from JB-2 on 8Ok246, June 2012.¹⁷⁷

¹⁷⁵ Ibid.

¹⁷⁶ "Group History: 1st Experimental Guided Missiles Group 1 July 47 Thru 31 Dec 47," 799-800, 810, 937-940, 1311, 1370, Office of History, EAFB; "Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island," RG 218, Entry 343A, Box 4, File "JB-2 1945," NARA II; Quigg, "Assessment of Significance," 1-29.

¹⁷⁷ Photograph by Gary F. Quigg, June 15, 2012.

Applying each of the above NR requirements to 8Ok246, with italics added for emphasis, leads to the following conclusions:

Demonstrating the importance of the information within an appropriate historic or archaeological context.

The historical context of 8Ok246, discussed in detail above, includes the Cold War and military aviation.¹⁷⁸ The important information within the material remains includes, “*Aviation wrecks and ruins of aviation facilities*” conveyed through the structural remains of the 400 foot launch ramp and its related structures. These remnants are one-of-a-kind, as they are the only examples extant from a JB-2 launch ramp constructed with a large concrete pier foundation. Five additional JB-2 ramp structures remain extant, all of which are earthen structures (two at the former site of Range 64 in Florida, and one each at Wendover AFB, Utah, and Holloman AFB, New Mexico) except a small steel ramp at Eglin AFB Auxiliary Field #1. The lone missile wreck on 8Ok246, though without structural integrity, remains evocative of the aircraft’s construction, use and operation. Further, the JB-2 is a “*rare aircraft*” as only twelve intact examples of the 1,382 manufactured remain. The surviving complete JB-2s are in environments more

¹⁷⁸ U.S Department of the Interior, *How to Complete the National Register Multiple Property Nomination Form*, 11. The National Register defines historic context as, “those patterns or trends in history by which a specific occurrence, property, or site is understood and its meaning (and ultimately its significance) within pre-history or history is made clear.”

conducive to their preservation, but each has been modified from its original appearance and configuration through restoration or rehabilitation efforts.¹⁷⁹

Demonstrating the connection between the important information and the specific property.

All of the important information remains in situ on 8Ok246 within the structural remains. Understanding that, “*Aviation wrecks and ruins of aviation facilities might qualify for listing in the National Register,*” this site, containing missile launch facilities and the remains of one of the actual missiles launched, has notable potential for eligibility. As the blockhouse/bunker, concrete loading pad, ramp foundation piers, and access road all maintain structural integrity, one could argue for eligibility under Criterion A (association with an event that made a significant contribution to the broad patterns of our history) or Criterion C (embodiment of the distinctive characteristics of type, period, or method of construction). However, as all the control panels and furnishings within the interior of the blockhouse/bunker have been removed, the loading pad itself is barren concrete, the steel-truss ramp has been removed from its piers, and the road is indistinguishable as a missile site access, these structures, along with the solitary JB-2 missile remains lying nearby, cannot convey the degree of significance required

¹⁷⁹ U.S. Department of the Interior, *Guidelines for Evaluating and Documenting Historic Aviation Properties*, 30; Quigg, “Assessment of Significance,” 1-29; “Estimate of Cost of Proposed Additional Construction Based on Preliminary Layout Plan EGL 3101 Dated 19 October 1945, Project: Santa Rosa Island,” RG 218, Entry 343A, Box 4, File “JB-2 1945,” NARA II; Mindling and Bolton, *U.S. Air Force Tactical Missiles*, 33; Page, “Holloman’s First Test Track,” <http://www.alamopulse.com/2262/hollomans-first-test-track/>; “Willys-Overland Now Turning Out U.S. ‘Buzz Bomb,’” File “JB-2/Loon,” Archives, NASM; “Willys-Overland Motors, Inc.—World War II Production Record 1941 through 1945,” File “JB-2,” Archives, WPAFB.; “Progress Report of AAF Pilotless Aircraft as Guided Missiles Development Status and Availability,” RG 218, Entry 343A, Box 4, File “JB-2 1946,” NARA II.

under Criteria A or C. The site must be considered, in its entirety, for eligibility under Criterion D.¹⁸⁰

Containing the presence of adequate data in the property.

With a number of launch facility structures retaining a high level of structural integrity (blockhouse/bunker, loading pad, ramp piers and access road), one deteriorated JB-2 airframe, and hundreds of small associated artifacts scattered on the surface throughout the site, 8Ok246 retains more than adequate data. Information from the site is already in use, helping to guide Eglin AFB personnel in the management of this cultural resource.¹⁸¹



Blockhouse/Bunker on 8Ok246, June 2012.¹⁸²

Site 8Ok246 is significant for its association with the early Cold War period, and conveys this significance through its cultural remains; offering information on the JB-2

¹⁸⁰ Quigg, "Assessment of Significance," 1-29; U.S. Department of the Interior, *Guidelines for Evaluating and Documenting Historic Aviation Properties*, 27-28, 30.

¹⁸¹ Quigg, "Assessment of Significance," 1-29.

¹⁸² Photograph by Gary F. Quigg, June 15, 2012.

project (including structural fabrication and operational execution) a written history or preserved missile on exhibition cannot. The JB-2 stood ready as a contingency weapon for containment that could be made available for rapid deployment, while it pursued its primary mission as a test vehicle for improving cruise missile technology. Each of these roles is apparent in the material culture on Santa Rosa Island.¹⁸³

¹⁸³ U.S. Department of the Interior, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, 44-49. The ability of a property to convey its significance is known as “integrity” according to the National Register, which requires a resource to have retained “several, and usually most,” of the following seven aspects to possess integrity: location, design, setting, materials, workmanship, feeling and association (context). As detailed above, 8OK246 has retained each of these seven aspects to a varying degree, most strongly location, design, setting, materials, and association.

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CURRICULUM VITAE

Gary Francis Quigg

Education:

Master of Arts in Public History, Indiana University, earned at Indiana University-Purdue University Indianapolis, Indiana (IUPUI), May 2014.

Bachelor of Science in Telecommunications, Magna Cum Laude, earned at Ball State University, Muncie, Indiana, May 1984.

Relevant Professional Experience:

Historian/Archaeologist

Dancing River---Crawfordsville, Indiana (2010-Present) As the sole proprietor of this small cultural resource firm, I am a self-employed historian and archaeologist. My work involves the identification and evaluation of historic properties under Section 106, and determining eligibility for the National Register of Historic Places, as a contractor to the United States Air Force and United States Army.

Research Associate

Weintraut & Associates---Zionsville, Indiana (2007-2010) Conducting architectural and archaeological field surveys, historical research and writing historic property reports as a part of the Section 106 review process, as well as consulting on museum exhibitions, were my primary responsibilities in this public history and archaeology firm.

Associate Director for Historic Resources

Conner Prairie Museum---Fishers, Indiana (2000-2006) My duties focused on the care, conservation and interpretation of all material culture, historic buildings, and period clothing, as well as the administration of the reproduction and restoration programs, all indoor and outdoor exhibitions, and archaeological resources of this 800 acre complex.

Collections & Exhibitions Manager

Conner Prairie Museum---Fishers, Indiana (1998-2000) I was responsible for all collections and an ambitious schedule of temporary exhibitions. Updating long-term exhibitions, as well as expediting development of new permanent historic areas and attractions, were among my additional duties (promoted to position above in 2000).

Selected Archaeological Fieldwork:

Director of Contract Services

TIGHAR---Oxford, Pennsylvania (2011-Present) I secure agreements, perform archival research, and conduct the fieldwork for archaeological evaluation and assessment of significance on historic aircraft sites in the United States and abroad.

Field School Instructor

TIGHAR---Oxford, Pennsylvania (August 2013) Providing both classroom presentations and on-site field supervision, I provided training in archaeological methodology to fourteen non-traditional students. Our objective was the survey of a 1936 crash site of a Lockheed 10A Electra aircraft on the St. Joe National Forest near Kellogg, Idaho.

Deputy Project Archaeologist

TIGHAR---Oxford, Pennsylvania (May/June 2010) I co-supervised archaeological excavations on a possible castaway site suspected to relate to the disappearance of Amelia Earhart in 1937 on the island of Nikumaroro, Republic of Kiribati.

Deputy Project Archaeologist

TIGHAR---Oxford, Pennsylvania (October 2007) I supervised the archaeological field survey of a recently discovered World War II USAAF P-38 fighter plane off the western coast of Wales, UK.

Deputy Project Archaeologist

TIGHAR---Oxford, Pennsylvania (July 2007) I supervised archaeological excavations on sites suspected to contain components of the Lockheed Electra flown by Amelia Earhart at the time of her 1937 disappearance, in the old colonial village area on the island of Nikumaroro, Republic of Kiribati.

Deputy Project Archaeologist

TIGHAR---Oxford, Pennsylvania (June, 2006) Working with the Historic Preservation Office of Yap Island under a grant administered by the United States National Park Service, I led a team of specialists conducting a survey of four World War II Japanese aircraft on Yap Island, Federated States of Micronesia.

Deputy Project Archaeologist

TIGHAR---Oxford, Pennsylvania (August, 2004) Working in cooperation with United States Forest Service personnel, I led the crew that completed the first archaeological survey of the 1943 Harold Gillam Lockheed Electra crash site in the Misty Fjords Wilderness Area near Ketchikan, Alaska.

Selected Reports and Publications:

“Evaluation and Assessment of Significance, Archaeological Sites 8OK2870 and 8OK2871, Eglin AFB”

Prentice Thomas & Associates---Mary Esther, Florida (March 2013)

“Evaluation and Assessment of Significance, Archaeological Sites: 8WL2460, 8OK2583, 8WL1225, 8OK2608, 8WL2176, 8OK2624, Eglin AFB”

Prentice Thomas & Associates---Mary Esther, Florida (January 2013)

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(US Army)”
Logan Simpson Design---Salt Lake City, Utah (August 2011)

“Phase II Test and Evaluation of Archaeological Site 8OK2693, Eglin AFB”
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Chapter 15: “Studying and Managing Aerospace Crash Sites” in *A Companion to
Cultural Resource Management*, Thomas F. King, ed.
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Indiana”
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“Mt. Auburn Cemetery, Mt. Auburn Church, Johnson County, Indiana”
Weintraut & Associates---Zionsville, Indiana (January 2010)

“Adams Center Road Corridor Project, Allen County, Indiana”
Weintraut & Associates---Zionsville, Indiana (November 2009)

“Bass Road Reconstruction, Allen County, Indiana”
Weintraut & Associates---Zionsville, Indiana (November 2009)

Television Documentaries/Series:

Indy in the 60s (2011) Writer, Producer [WFYI Indianapolis, Historical]*

Indiana Expeditions (2010) Writer, Producer [WFYI Indianapolis, Science]

Fly Like the Wind (2006) Writer, Director, Producer [WFYI Indianapolis, Historical]

Adams Mill Valley (2005) Writer, Director, Producer [WFYI Indianapolis, Historical]

Harvesting the Past (2002) Executive Producer [WFYI Indianapolis, Historical]**

Adams Mill Valley (2002) Writer, Photographer, Producer [Site Orientation]**/**

Montgomery County: A Special Place (2001) Writer, Producer [Promotional]

Lew Wallace: Study of An American Hero (2000) Writer, Producer [Site Orientation]**

24 Hours at Indy (1999) Trackside Producer [Nineteenth Star, Worldwide Broadcast]

Blessed Mother Theodore (1999) Writer [Nineteenth Star, Commemorative]**

Sugar Creek (1997) Writer, Photographer, Director, Producer [Environmental/Historical]

The Old Normal (1995) Writer, Producer [Preservation Advocacy/Historical]

*Emmy Award from the National Academy of Television Arts and Sciences

**Telly Award Winner from the National Center for Creativity

***Honorable Mention from the Windsong International Film Festival