AIR POWER History

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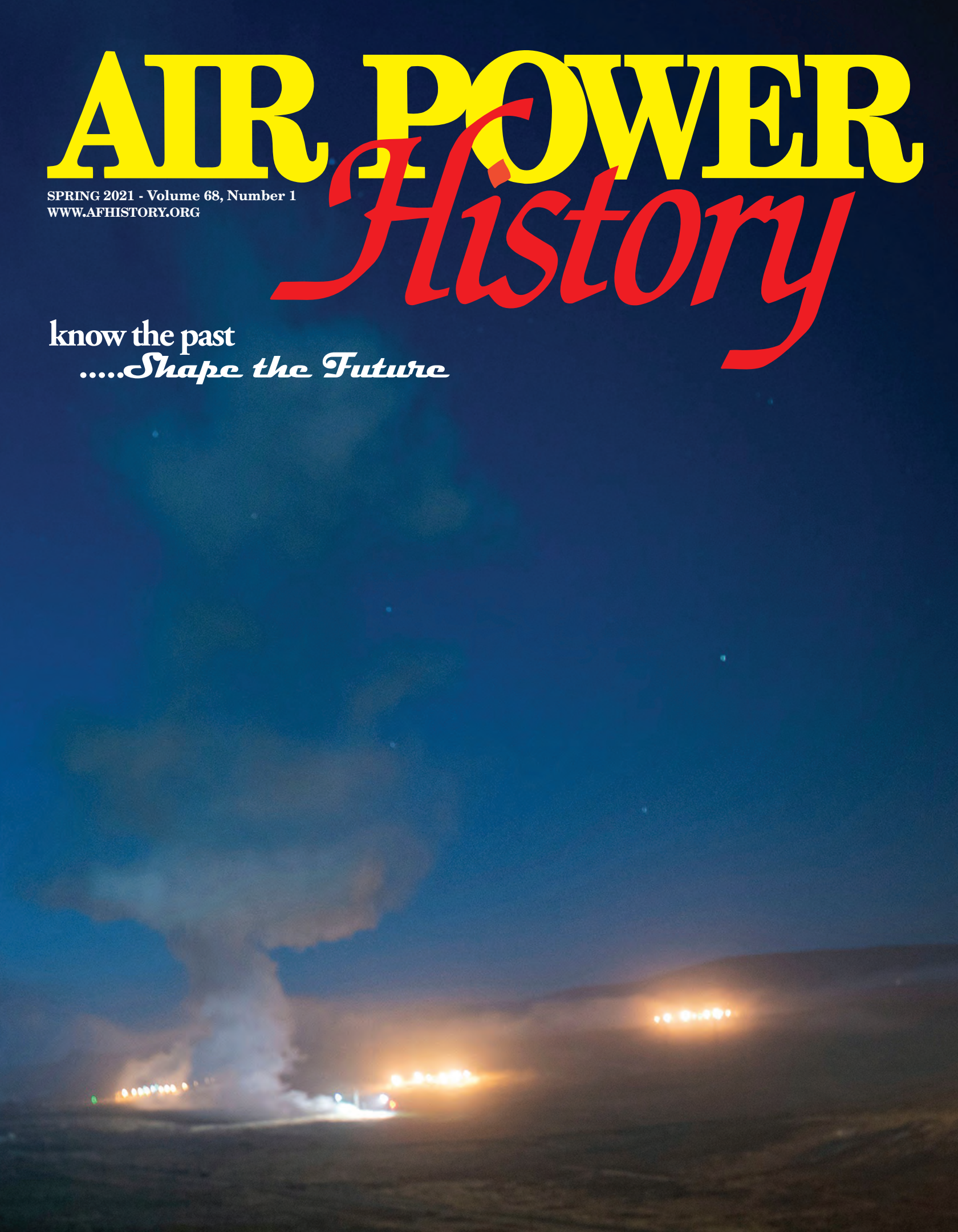

Center: McConnell. Clockwise from Top Right: Doolittle and LeMay, Chapman, Leavitt, Phillips, James and Olds, Pitsenbarger.

Can you name 75 Great Airmen?

Help AFHF Choose

The Air Force Historical Foundation is preparing a book featuring **75 Great Airmen** who served between 1947 and today. Look for the book in 2022 to celebrate the Air Force's 75th Anniversary. Send your nominations to 75Great@afhistory.org

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Features

Book Reviews

Departments

COVER: A Minuteman III ICBM launches during a test at Vandenberg AFB, Calif. *(USAF photo.)*

The Air Force Historical Foundation

Air Force Historical Foundation
P.O. Box 790
Clinton, MD 20735-0790
(301) 736-1959

E-mail: angelabear@afhistory.org
On the Web at http://www.afhistory.org

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Editor
Richard I. Wolf

Editor Emeritus
Jacob Neufeld

Book Review Editor
Scott A. Willey

Advertising
Jim Vertenten

Circulation
Angela J. Bear

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Address **LETTERS** and **manuscripts** to:

Air Power History
3043 Sunny Ridge Drive
Odenton, MD 21113
e-mail: airpowerhistory@yahoo.com

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Air Power History
P.O. Box 790
Clinton, MD 20735-0790
(301) 736-1959
e-mail: angelabear@afhistory.org

ADVERTISING

Jim Vertenten
P.O. Box 790
Clinton, MD 20735-0790
(301) 736-1959
e-mail: ed@afhistory.org

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From the President

Dear Members,

As always, *Air Power History* editor Richard Wolf has assembled a very thoughtful retrospective this quarter. He is able to do this because of authors who faithfully contribute thoughtful, disciplined accounts of success and failure, innovation and operations, people and weapon systems. Your membership helps sustain this work.

Normal operations for the Foundation are on the horizon. While our Annual Membership meeting is nearly certain to be virtual in the May-June timeframe, it seems likely we will be able to conduct our 2020-2021 Awards and Banquet in person sometime in the Fall. We are certainly planning for it.

Many members of the Board are working hard on the Foundation's book "75 Great Airmen," to be released in early 2022 to help mark the 75th anniversary of the Department of the Air Force. Member suggestions for names to include have been thoughtful and much appreciated, and your inputs remain welcome (via email to 75Great@afhistory.org) before 30 April.

We will also soon decide on a revised publishing proposal for updating the Foundation's "U.S. Air Force – A Complete History," which would encompass the earliest days of air and space power all the way to the three-quarter century mark.

Many thanks to the Foundation's Life Members, who were recently recognized with a small token in the form of attractive Life Member cards. Their continued generous donations to the Foundation are deeply appreciated, especially during this past year of disruption. Should you have other ideas for ways to recognize members' support, please pass them on.

Incremental growth continues in outreach through our website, Facebook, Twitter, Instagram, Linked-In, our daily e-mail, and archived journal issues. It is crystal-clear, however, that the Foundation's value and its future existence depend on us successfully charting and pursuing even wider and more engaging ways to involve new generations of Airmen, Guardians, and historians. This is not an exercise.

Passing one year from the onset of the pandemic's impact on all aspects of life, it is worth reflecting on challenges ahead. At home, achieving "a more perfect union" remains a cacophonous, centuries-old work in progress, but as both CSAF C.Q. Brown and CSO Jay Raymond have stressed, we face rising threats from geopolitical competitors that will demand successful innovation, purposeful change, and hard work to overcome.

In partnership with others, AFHF aids that cause by recording and sharing accurate and complete air and space power history. We must also help members of the Air Force and Space Force know and celebrate both their history and their heritage, and strive to provide insights on the ways air and space technologies have defended America and improved lives across the globe. Our charter, signed by Carl Spaatz and others on 20 February 1953, applied to today's challenges, committed us to these things. It was a serious commitment then; it remains one today. Your support matters.

With Best Regards,

Christopher D. Miller,
Lieutenant General, USAF (Ret)
President and Chairman of the Board

From the Editor

Our issue this time seems to be focused on mid-Twentieth Century events from World War II to ICBMs.

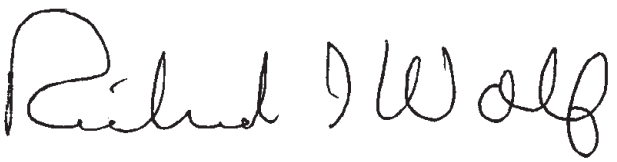
Our first article is by first-time contributor Troy Halsell, who writes about the embedding of Minuteman ICBMs into the Montana landscape. I don't remember reading much on it previously, but it wasn't completely welcome, although it was ultimately rewarding.

Our second article is from the winner of the Two Air Forces Award, a joint award between our foundation and the Royal Air Force Historical Society. Bryan Hunt's article won the award in 2019, and it's about the V–2, the events around its utilization in World War II, and information on some of the scientists involved.

Our third article is also an award-winner. Air Force Academy Cadet Cole Resnik's student paper won the AFHF Award for best historical student paper. It's all about the important contribution that gliders made to resupply efforts in the days immediately after D-Day. The cargo hauled by the gliders proved essential to the invasion's development from beachhead to breakout.

The final article in this issue is more 1950s civil defense-oriented, as it talks about the Civil Air Patrol's contributions to monitoring air samples for evidence of nuclear attack. Jayson Altieri is a professor at Air University and a forty-year CAP veteran, which provides a unique perspective. Don't skip over it to get to the reviews of which there are 19 this time..

The President's Message begins on page 3. Don't miss Upcoming Events on page 62, although I fear you must take all dates in that section as still uncertain at this point. If you see something scheduled, be sure to check with the organization sponsoring the event to ensure it will take place. It's a most uncertain world today. And the closing story is this issue's Mystery. Enjoy!



Building Malmstrom's Minuteman Missile Fields in Central Montana, 1960-1963

President John F. Kennedy (right) accepts a model of PT Boat 109 from Luke Flaherty as he greets the crowd gathered at Great Falls High School Memorial Stadium, Great Falls, Montana, September 26, 1963. *(Image courtesy of the John F. Kennedy Presidential Library and Museum).*

Troy A. Hallsell

In September of 1960, the Air Force Association held its 14th annual convention at the San Francisco Civic Auditorium in San Francisco, California. This grand event demonstrated to the American public (and the world) the best aerial hardware the Air Force had to offer. On display was a Bell X–1B rocket plane, North American Aviation's Hound Dog air-launched standoff missile, a Titan intercontinental ballistic missile (ICBM), and the Thor-Able missile that promised to reach the moon. While this display of weaponry sought to allay Americans' fears about a supposed missile gap in favor of the Soviet Union (USSR), the Air Force's unveiling of the Minuteman ICBM was the main attraction.[1] On September 22, at 7:00 PM Gen Thomas D. White, the Chief of Staff of the Air Force, San Francisco mayor George Christopher, and NBC producer Roy Neal took to the podium to introduce the United States' newest weapon system. As General White pushed a button, the "gleaming dummy missile rose to a vertical static display, where it would remain through the weekend."[2] Never underestimating the power of an image, White understood that the Air Force had to convince the American public to embrace the Minuteman as the "ultimate deterrent force." The future of missiles depended on their good graces.[3]

This study explores why the Air Force deployed the Minuteman to Malmstrom AFB in central Montana, how the United States Army Corps of Engineers (USACE) and Air Force built the weapon system's infrastructure, and their experience bringing the first flight of missiles to alert during the Cuban Missile Crisis. The Cold War was an international political contest that pitted the west, led by the United States, against the east as represented by the USSR.[4] The ICBM emerged as an integral weapon system in waging the Cold War. While the Air Force trotted out the Atlas and Titan ICBMs, the Minuteman became the weapon system of the future.[5] The Air Force selected Malmstrom AFB in central Montana as home for the first Minuteman strategic missile wing. Shortly after construction began in 1962, the U.S. and USSR engaged in the Cuban Missile Crisis following the Soviet Union's installation of intermediate-range ballistic missiles in Cuba. During this confrontation Strategic Air Command (SAC) ordered the 341st Strategic Missile Wing (341 SMW) to bring its first flight of Minuteman ICBMs to alert and entered into an unprecedented state of readiness. In the nuclear posturing that followed, the USSR agreed to remove its missiles from Cuba as long as the U.S. made some concessions of its own.[6]

The Cuban Missile Crisis brought long-term effects to Montana and the ICBM mission. The Minuteman program was a large scale defense infrastructure project that established a permanent military presence in central Montana. During this process, the Department of Defense (DoD) exacerbated tensions between property owners and the federal government while at the same time injecting millions of dollars into the state's economy. This economic relationship made Montana dependent on defense dollars in the decades that followed.[7] Following the Cuban Missile Crisis, the U.S. and

An Atlas ICBM at a launch facility. ***(Image courtesy of the Air Force Global Strike Command History Office.)***

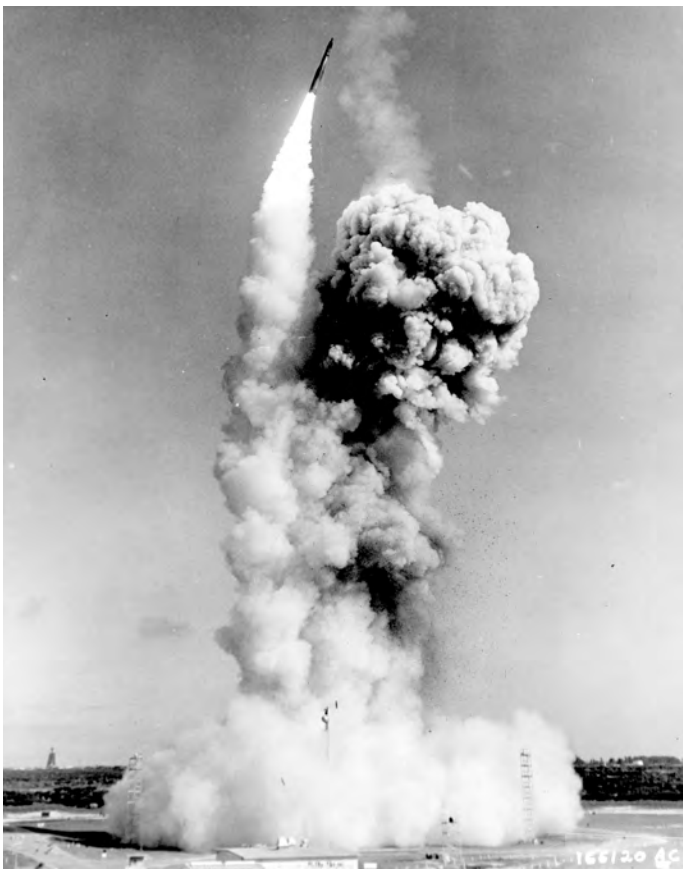
A Titan I ICBM in its silo. ***(Image courtesy of the Air Force Global Strike Command History Office.)***

Soviet Union realized that nuclear weapons posed a threat to each other together instead of one another separately. As a result, the DoD shifted from a counterforce strategy to mutually assured destruction and pared back resources for the ICBM mission. The first real world test of the Minuteman provided the foundation for the mission's institutional problems during the post-Cold War era.

Building Malmstrom's Missile Fields

First constructed as the Great Falls Army Air Base in May 1942, and later renamed Malmstrom AFB (MAFB) in 1955, MAFB has a storied history supporting World War II and the Cold War's broader strategic missions.[8] For example, during World War II Malmstrom was an integral piece of President Franklin D. Roosevelt's Lend-Lease program that provided material resources to U.S. allies—in this case the Soviet Union. Between 1942 and 1945, workers at both MAFB and Gore Hill processed 7,983 aircraft before airmen with the 7th Ferrying Group flew them from central Montana to Fairbanks, Alaska and turned them over to Soviet pilots for use on the eastern front against Germany.[9] As the Cold War emerged following World War II, the 7101st Air Transport Wing at Malmstrom AFB helped win the first big conflict against the Soviet Union, the Berlin Airlift (Operation Vittles). After the Soviets cut off ground transport and rail access to West Berlin in June 1948, the U.S. and its allies rallied to deliver much-needed supplies. The Air Force chose MAFB to train the airlift's replacement pilots since its weather, terrain, and magnetic course was similar to Germany. Pilots and flight engineers attended a grueling three-week program that churned out 100 flight crews a month, replacing sixteen percent of the operation's Airmen every 30 days. Malmstrom's training mission was integral to the Airlift's success: allied forces demonstrated their air superiority by delivering 2.3 million tons of supplies into West Berlin and winning people's hearts and minds. The installation also hosted fighter interceptor and bomber escort missions and bomber refueling throughout the 1950s, 1960s, and beyond. Despite not being on the front lines, Malmstrom AFB's training and support missions were integral to winning World War II and the Cold War's early conflicts.[10]

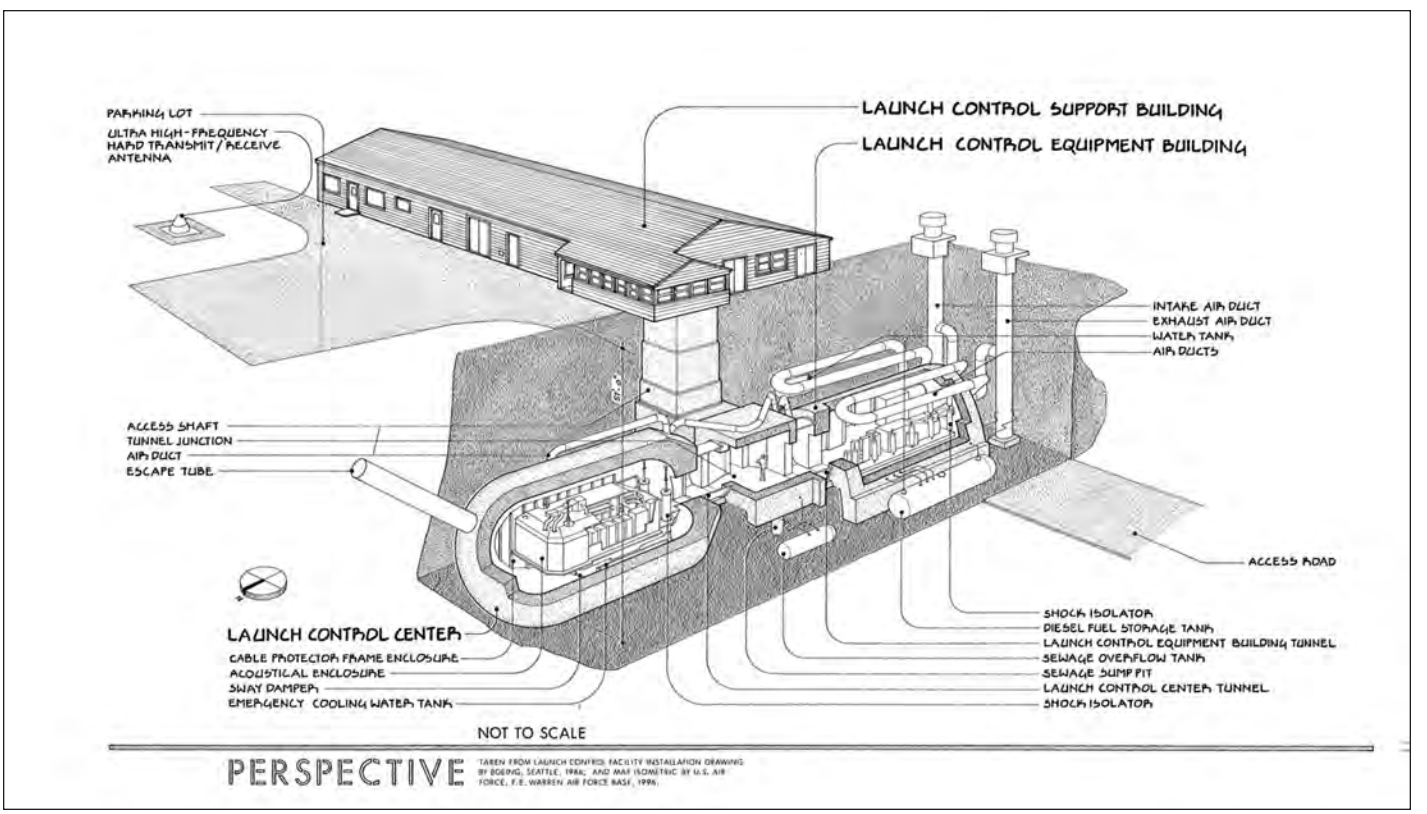
Troy A. Hallsell, Ph.D. is the 341st Missile Wing Historian at Malmstrom AFB, Montana. Before coming to the Air Force as a government service civilian, he served in the United States Army from 2005-2010 as an all-source intelligence analyst. After a stint at the National Ground Intelligence Center in Charlottesville, Virginia he entered graduate school in 2011 and earned a Ph.D. in history from the University of Memphis in 2018. He is an assistant editor at The Metropole*, the official blog of the Urban History Association and is currently revising his book manuscript titled* The Overton Park Freeway Revolt: Place, Politics, and Preservation in Memphis, TN, 1955-2017 *for publication.*



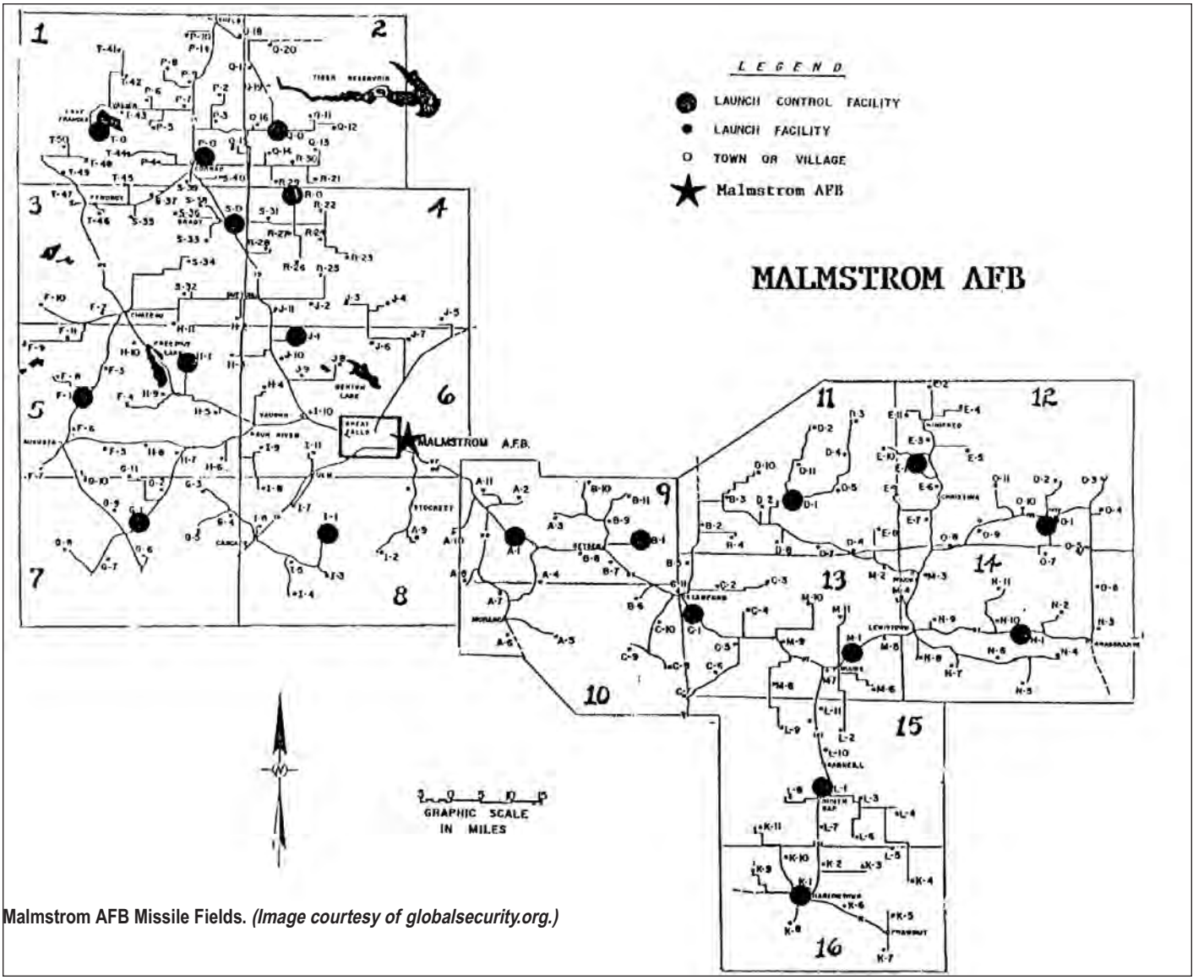
This successful launch took place at Cape Canaveral, Fla., on Nov. 17, 1961. The Minuteman became operational less than a year later. ***(Image courtesy of the National Museum of the Air Force.)***

The Air Force chose MAFB as home of the first Minuteman ICBM missile wing for two interconnected reasons. First, the Minuteman IA's technical limitations forced the Air Force to move the first Minuteman squadron from Vandenberg AFB, California to Malmstrom AFB. The Minuteman's engineers discovered a flaw in its first stage booster that reduced its range from 6,300 to 4,300 miles. This proved a major setback for any Minutemen stationed at Vandenberg—4,300 miles was simply insufficient to carry them over the North Pole to their targets in the Soviet Union. Since MAFB was 600 miles north of Vandenberg, this move placed the missiles that much closer to their targets. Also, Great Falls' 3,500 foot elevation made it easier to launch the Minuteman into space. Instead of delaying deployment for six months to a year while the engineering team redesigned the missiles, the Air Force moved the first wing to Malmstrom.[11]

The Air Force also selected Montana (and the Great Plains states) because the USACE needed wide swaths of sparsely populated land to build 341 SMW's launch control centers (LCC) and launch facilities (LF).[12] The wing consisted of three 50-missile squadrons—the 10th Strategic Missile Squadron (10 SMS), 12th Strategic Missile Squadron (12 SMS), and the 490th Strategic Missile Squadron (490 SMS)—divided into five flights of 10 missiles each. Each flight consisted of one underground LCC, a 59 foot long by 29 foot in diameter command center staffed by a two-person missile crew that monitored 10 LFs. LFs were hardened launch tubes that were 12 feet in diameter and 62 feet long. The Minuteman ICBMs rested in these facilities until missileers in the LCCs received or-



The Launch Control Facility, (above) also called a Missile Alert Facility, is the main Minuteman working space. Each one controls a flight of 10 widely-dispersed missiles, contained in a Launch Facility. ***(Image courtesy of the National Museum of the Air Force.)***



Malmstrom AFB Missile Fields. ***(Image courtesy of globalsecurity.org.)***

ders to launch them towards their targets somewhere in the Soviet Union. To ensure the weapon system survived a nuclear attack, the USACE spaced each LF 3.5 to 17.5 miles away from its LCC and each LF 3.5 to 8.5 miles apart from one another. While this footprint ensured a 10-megaton blast from a Soviet warhead would not destroy the neighboring facilities thus negating the United States' retaliatory response, it also guaranteed a long-term military presence across 13,800 square miles in central Montana.[13]

Before the Minuteman became a reality, Malmstrom AFB butted heads with Great Falls, Montana's city government over city services and housing. Throughout the mid-to-late 1950s, elected officials lobbied the Air Force to get Malmstrom to renegotiate its water agreement with the city. Simply put, the base tapped into the city's water lines and strained the city's system. Mayor J.B. Austin requested that SAC invest approximately $80,000 to help the city improve its water capacity. The Air Force stood firm, stating it had no funds to improve a municipal water system and forced Great Falls to abide by the agreement.[14] Other residents sparred with the USAF over new housing construction on base. Despite a post-WWII housing construction boom, during the 1950s the military faced a housing shortage across the nation. As a result, bases like Malmstrom did not have enough units to house their personnel, forcing many to do battle with an expensive housing market in Great Falls. For those that could get housing on base, they often dealt with horrid living conditions.[15] Enter the Capehart housing program.[16] Malmstrom stood to gain upwards of 400 of these new units to remedy the installation's housing needs.[17] However, several landlords and property managers in town took issue with this approach. They believed Great Falls could handle the Airmen's housing requirements: they had the stock, needed tenants, and believed a partnership between the base and landlords would be mutually beneficial by injecting much needed money into the local economy.[18] With the base population set to increase during and after Minuteman construction, one resident griped that "the base has been instrumental in helping to raise our taxes, for example the need for more water, policemen, firemen, etc." but "the base personnel does not contribute their share to these increased costs."[19] Simply put, if the base was good for Montana, why did it hurt so many residents' bottom line?

A Launch Control Facility under construction near Malmstrom AFB, Mont. Cold War requirements to build up U.S. nuclear defenses speeded up Minuteman site construction. Builders often labored year-round in three shifts, seven days a week. The Army Corps of Engineers Ballistic Missile Construction Office and its contractors built 1,000 silos between 1961 and 1966. ***(Image courtesy of the National Museum of the Air Force.)***

Widely dispersed missile silos were nearly featureless in the open landscape, and most equipment was deep underground. This silo is near Malmstrom Air Force Base, Great Falls, Mont. ***(Image courtesy of the National Museum of the Air Force)***

To encourage Montanans to let the federal government install nuclear weapons within the state, officials at all levels undertook a public information campaign to sell the Minuteman ICBM to a skeptical public.[20] First and foremost, Air Force officials emphasized how the program would inject money into the state's economy. While they estimated the construction contract would cost around $50 million, boosters believed the project would spark $330 million of overall spending within the state across the project's 2.5 year lifespan. For example, the program improved rural roads within the missile fields; the DoD scheduled 120 miles of improvements in Cascade County alone.[21] This meant that local governments would not spend money improving these sections of roads and could spend this money elsewhere. As a result of this infusion of cash, workers could spend the millions of dollars in anticipated salaries on goods and services around the state. It's perhaps no surprise that journalist Martin P. Moler called the ICBM program "the darnedest thing to hit Montana since they found copper in Butte Hill."[22] Given the project's estimated 3,600 new skilled and semi-skilled jobs, the Minuteman's economic effect would seemingly touch almost everyone living in Montana.[23]

Second, boosters noted how the program would improve infrastructure throughout the state. Not only would Montanans see road improvements, but towns like Lewistown witnessed new housing development. For example, Boeing constructed 200 housing units in town. It purchased 10 acres from George Machler to build 100 mobile home family housing and five acres from the city for bachelor style dwellings. While this served an immediate need (housing for an influx of workers), Boeing also installed sewer and water lines to these units and constructed roads and sidewalks in accordance with city code. Once the USACE and Boeing finished constructing and installing the Minuteman missiles, it could sub-lease the land to a private housing company thus increasing Lewistown's housing stock.[24] Finally, the Air Force tried to convince Montanans that the Minuteman would not interfere in their lives in a meaningful way. Capt Donald B. Smith, Malmstrom's public information officer, took to the pages of the *Great Falls Tribune* to make the wing's case. He explained that the USACE would place the missile sites in remote, sparsely populated areas. Given Montana's natural beauty, Captain Smith declared "they will not be unsightly or detract from the…landscape," thus protecting the state's sylvan allure.[25] The only evidence that they existed would be the small fenced in area with a few security guards. Perhaps most importantly, these were retaliatory weapons; no practice launches would occur in the state. And to hammer the point home, the *Tribune* made sure to tell its readers that a Montanan led the project.[26] While no evidence exists these efforts persuaded residents to accept the Minuteman ICBM, they do demonstrate that the DoD did its best to convince them this program was in their best interest.

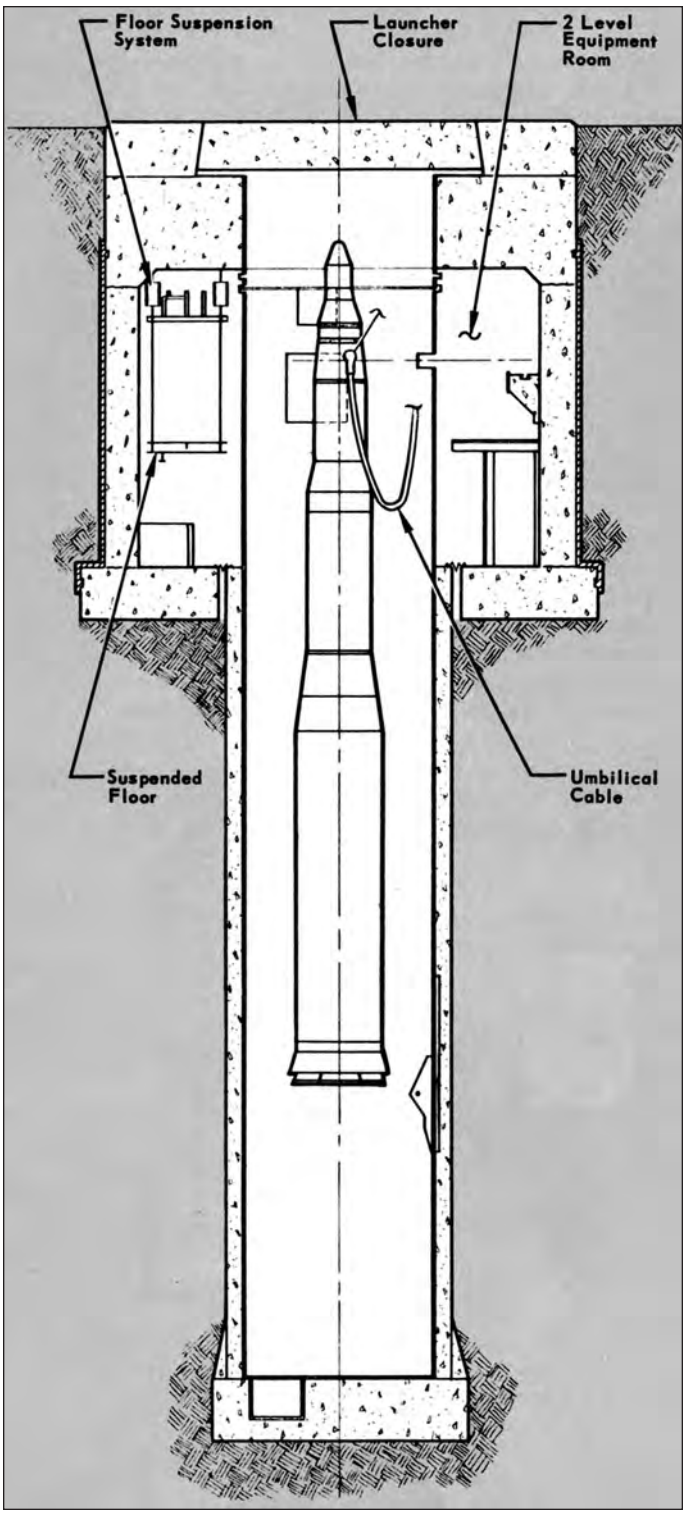
Following the Air Force's announcement that Malmstrom would become SAC's first Minuteman ICBM base, the USACE began acquiring land, easements, and rights of ways to build the infrastructure necessary to operate this new weapon system.[27] From its perspective, this was a straightforward process; it had to acquire 5,200 tracts of land totaling 20,000 square miles. During the early survey work, workers approached land owners and requested a right of entry so they could conduct detailed core drilling and soil samples to determine if the terrain was suitable for an ICBM. Next, it purchased approximately two acres for each LCC and LF and acquired permanent easements for access roads to the sites, communication cable lines, and azimuth markers. The DoD would pay "just compensation" for individuals' property based on "fair market value." Once agreed upon, the USACE received title to the property and the property owner received their money in a timely fashion. However, if a property owner refused the USACE's

offer, then it would turn to the federal courts to make a determination though a condemnation proceeding. The USACE would acquire this land one way or another, and as one can imagine, this could be a contentious process.[28]

While the Minuteman land acquisition process went relatively smoothly, some property owners dug in their heels to protect their land from federal government.[29] In the spring of 1960, DoD representatives approached Vernon Taylor, owner of a 25,000 acre ranch in Fergus County, Montana, with a proposal to install an ICBM site on his property. While he did not want to "interfere with the proper defense of my country," he argued that having an ICBM on his ranch would prevent him from using it as intended.[30] After refusing the USAF's initial attempt to survey the land, and later acquiescing in court following a condemnation proceeding, Taylor asked Montana Senator Mike Mansfield to work with the Air Force to get them to relocate the site. Mansfield did, but the DoD would not budge. Instead it explained the rationale behind its decision and attempted to put Taylor's concerns to rest. The USACE could not relocate the ICBM site since it would be too close to other missile facilities and a nearby mining operation. Also, the land north of the proposed site contained a geological fault that rendered the area unstable for ICBM use. Additionally, the Air Force claimed the ranch would "still be subject to virtually full use, with only a minor diminution in value." It explained the ICBM would be enclosed underground with a seven foot fence around the 300ft by 300ft site; odorless and without noise except for infrequent maintenance by 341 SMW personnel; and no hazard to life or property (it did not mention it could be a target for incoming Soviet ICBMs).[31] This rationale did not cut it for Taylor.

In response to the Air Force's stonewalling, Taylor took his fight directly to Washington D.C. While he exerted some of his effort lobbying members of the Senate and House Appropriation Committees, since, in his mind this was "just another example of the terrific waste that shows op [*sic*] daily in the Armed Services," he personally met with Secretary of the Air Force Dudley C. Sharp to make his case for moving the ICBM site off his land.[32] Unfortunately, Taylor did not appear to get anywhere with the Secretary. In a response to Taylor's June 1st visit, Sharp provided the same worn out response the Air Force gave him previously: that the site would not interfere with his ranch. The whole experience left Taylor discouraged.[33] After this futile back and forth with the Air Force he decided to pull up stakes and leave Montana forever. In the November 7, 1960 issue of the *Wall Street Journal* he offered his 25,000 acre ranch for sale. He hoped "to be out before the Minutemen comes in."[34] While Taylor's experience dealing with the Air Force was not typical, it did demonstrate the lengths some people would take to get out from under the thumb of the federal government.

As the DoD acquired land for the Minuteman missile, it also hired a general contractor to build the weapon system's infrastructure. On September 2, 1960, the Army Corps of Engineers Ballistic Missile Construction Office (CEBMCO), headquartered in Los Angeles, California,



Thick concrete and steel protected the Minuteman from nuclear attack, and the missile could be stored unattended and with minimum maintenance for long periods. ***(Image courtesy of the National Museum of the Air Force)***

announced its call for bids from a general contractor to construct Malmstrom's missile fields.[35] Unfortunately, CEBMCO rejected the first round of bids; the lowest one came in at almost $79m whereas the USACE anticipated the project costing between $50m-$55m. Eventually the contract went to Fuller-Webb, a joint venture between the George A. Fuller Company and the Del E. Webb Corporation. The company signed a fixed price incentive contract

A typical two-man Minuteman IA launch crew. These crewmen served with the 10th Strategic Missile Squadron, 341st Strategic Missile Wing, Malmstrom Air Force Base, Mont. The 341st was one of six Minuteman wings. ***(Image courtesy of the National Museum of the Air Force.)***

initially valued $61,773,644 with a March 6, 1961 proceed date.[36] On March 16, 1961, dignitaries from local and state governments, the Fuller-Webb Company, local labor leaders, Boeing, the USACE, Air Force, and the Site Activation Task Force (SATAF) attended a groundbreaking ceremony at Malmstrom's base theater. To honor the occasion, Montana Governor Donald G. Nutter detonated an excavation blast in Alpha flight marking the beginning of construction.[37] In many ways this was a standard ceremony, but it marked a notable moment in Montana and the nation's past: it ushered in a key component of the US's nuclear triad, flooding the state of Montana with cash and jobs.

Despite being an economic boon to Montana, labor controversies hampered the Minuteman project from the start. Montana workers and construction companies accused Fuller-Webb of hiring too many out-of-state firms and laborers. This ruffled more than a few feathers. Tim Babcock, Montana's Lieutenant Governor had earlier declared that this project would be "a tremendous boost for Montana's economy if Montana's firms and labor are used." He continued, "It was essential that employment, equipment, and supplies went to Montana workers in every possible instance."[38] Montanans of all stripes advocated on the state's behalf. Senator Lee Metcalf lobbied Frank McGarvey, Fuller-Webb's project manager, to meet with tribal delegations to discuss hiring Native Americans to work on the project. Another worker wrote Senator Mansfield demanding that he "look into this matter at once."[39] Governor Nutter met with military and contracting officials to get to the bottom of this, and after his initial meeting he was not pleased. "What I want to guard

Minuteman missiles are transported overland in a special vehicle called a transporter erector. ***(Image courtesy of the National Museum of the Air Force)***

against is that at the end of the project, we might find that Montanans have not benefited appreciably and that we will be left with many additional people on our relief rolls," he bemoaned.[40] However, construction officials allayed Nutter's concerns following a public Q & A session; a 1962 study showed that approximately 41 percent of workers on the project hailed from Montana. Prosperity, if even short lived, had arrived.[41]

The Minuteman project had many different construction jobs spread across several phases, but an examination of cable ditching and emplacement work reveals what the experience was like for workers. The Etz-Hokin and Galvin Co., headquartered in San Francisco, California, was responsible for installing approximately 2,100 miles of communication cable that spanned 34 underwater crossings, 107 highway crossings, and 74 railroad crossings and connected the 150 LFs, 15 MAFs, and Malmstrom AFB. During the project's two year lifespan, the company would hire between 180 and 200 workers from Montana to ditch and lay this vast network of cables.[42] Workers like Jack A. Gannon, a Great Falls resident, leapt at the opportunity to work on the Minuteman project; he left his job in a tire shop after Etz-Hokin offered him a 400% hourly wage increase to be a Quality Assurance inspector. Working out of Lewistown, him and his crew of 10 (five teams of two; one splicer and one splicer's assistant) would meet at the airfield before sunrise, load up their trucks, and drive to the day's work location. Upon arrival, the splicers set up their station and got to work.[43] Unfortunately, since the project began in the winter, they would often have to dig snow and ice out of the trenches before they could splice the communication lines. In one instance Gannon remembered "Everything was frozen but it was full of water. And they dug that out and it was still freezing…This water came down through the cable line and we had to put a pump on there and pump for 24 hours for a couple days to dry that thing out enough."[44] Once complete, his team spliced the cables, set them in a capsule, and tested the connection. After Gannon determined the splice was up to standard, another contractor came through and injected it with silicone to waterproof it. As the USACE and Fuller-Webb got Malmstrom's missile field construction underway, the first nuclear standoff of the Cold War took shape and forced SAC to bring its nuclear arsenal to an unprecedented state of readiness.

Senator Mike Mansfield at Malmstrom AFB, Great Falls, Montana, October 30, 1962. ***(Image courtesy of Archives and Special Collections, Mansfield Library, University of Montana.)***

The 341st Strategic Missile Wing during the Cuban Missile Crisis

The Cuban Missile Crisis began on October 14, 1962 after an American U–2 surveillance plane photographed Soviet military personnel emplacing medium and intermediate range ballistic missiles throughout Cuba. Soviet Premier Nikita Khrushchev's planned deployment of 36 R-12 medium range ballistic missile had a 1,292 mile range with 1-2 megaton warheads that could hold the eastern half of the U.S. hostage.[45] He sought to spread Communism through Latin America, ensure Fidel Castro's Communist revolution endured, and project Soviet military strength in the United States' backyard. In response to this aggression, on October 22, 1962, President Kennedy called for an immediate meeting of the Organization of American States to organize a regional security arrangement and asked the United Nations Security Council to resolve that the USSR dismantle and remove its offensive weapons from Cuba. As Commander-in-Chief Kennedy directed the military to take action: the navy initiated a strict quarantine on all Soviet military equipment shipped to Cuba; he reinforced Guantanamo naval base and evacuated all dependents; and increased aerial reconnaissance of the island. Perhaps most damning, Kennedy stated "It shall be the policy of this Nation to regard any nuclear missile launched from Cuba against any nation in the Western Hemisphere as an attack by the Soviet Union on the United States, requiring a full retaliatory response upon the Soviet Union."[46]

Kennedy's address forced military personnel in Montana into an unprecedented state of activity. The governor activated the Montana National Guard since almost half the state's counties did not make adequate civil defense preparations; Butte, Custer, and Miles City were the only towns that had a plan in place. Given the state's shortcomings, the Guard established a shelter plan, communication network, warning systems, and a radiological program for forecasting and detecting radioactive fallout.[47] The Air Force also moved fighter planes from Malmstrom AFB to a civilian airfield in Billings. Officials claimed "the dispersal is in accordance with a predetermined dispersal plan. The idea is to get all of our eggs out of one basket and provide much better combat capability."[48] Dwight A. Spencer, a Nuclear Weapons Arming and Fusing Systems Specialist in the 341st Missile Maintenance Squadron, worked at a frenetic pace over the next month: "Typically, 16-hour days were normal, weekends included. The payoff was the Missile Squadrons [*sic*] and Wing [*sic*] reaching operational readiness well ahead of schedule."[49] The unfolding events even took the construction crews by surprise. Jack Gannon heard about the crisis while driving to Lewistown from Eddie's Corner. Upon arrival he told his co-workers they "Better get them wrapped up, we're going to be using them in about 20 minutes."[50] The speed at which the Cuban Missile Crisis occurred made everyone associated with the ICBMs in Montana work to get them operational as soon as possible.

Two days later on October 24, while Kennedy coordinated the U.S. response with his administration, Air Force Systems Command (AFSC) and Strategic Air Command entered into an agreement where SAC assumed operational control of all AFSC ballistic missile launch complexes in Emergency Combat Capability (ECC). Upon declaration of Defense Condition two or higher SAC would assume operational control of all ECC ICBMs and bring them on alert. Fortunately, the USACE and Boeing had already completed construction on 341 SMW's LCC and 10 LFs in Alpha flight and finished installing all the Minuteman's equipment. Unfortunately, the wing accepted the Air Force's first flight of Minuteman IA ICBMs before contractors finished their tests and demonstrations. SAC requested the Ballistic Systems Division "conduct an immediate technical evaluation of the flight in order to ascertain the possibility of accidental launch."[51] While the system passed inspection, it ordered the heavy steel LF lids closed, disconnected, and manually locked with the safety control switch in the safe position—in the event of an accidental launch the Minuteman would explode in the LF. However, if crewmembers received an emergency war order, maintenance crews would have to reconnect the explosive charges that blew the lid open before liftoff. According to historian Michael Dobbs, "they had to plug the cable back in, jump into a waiting pickup truck, and 'run like hell.'"[52] This "suicide squad" had a dangerous job; if they were lucky enough to survive an outgoing Minuteman launch, there was a good chance they would be killed by an incoming Soviet missile.

Following Kennedy's address SAC Commander-in-Chief Gen Thomas Power instructed Col Burton C. Andrus, Jr., the 341 SMW commander, to determine if the wing could posture all 10 Minuteman ICBMs in its Alpha flight and find a way to launch them. Engineers designed the weapon system to require launch commands from two different LCCs—the problem was that 341 SMW only had one constructed. In order to bypass the weapon system's safety procedures, Colonel Andrus had to "kluge the system."[53] His airmen did so by introducing "the critical part of a second launch control unit into the circuitry in Alpha's Launch Control Center so that a double crew could turn four keys simultaneously and thus launch the birds."[54]

President Kennedy addresses a capacity crowd at Great Falls High School Memorial Stadium, Great Falls, Montana, September 26, 1963. ***(Image courtesy of the Cascade County Historical Society.)***

SAC's first Minuteman went on alert at 3:07 PM on October 27, 1962. Colonel Andrus reported to SAC that its new weapon system had entered the war plan. Five days later all of Alpha Flight was on alert. The gravity of bringing the first flight of Minuteman ICBMs on alert was not lost on Colonel Andrus. Reflecting on the Cuban Missile Crisis, he said "If we seemed nervous it was only because we were—being not only 99% sure that you can't have an inadvertent launch is not good enough when you are looking at the possibility of starting WW III."[55] Luckily for 341 SMW and the world, Khrushchev agreed to dismantle and remove the USSR's missiles from Cuba on October 29, 1962. In exchange for Soviet withdrawal, President Kennedy agreed to make no further attempts to invade the island and dismantle the Jupiter intermediate range ballistic missiles stationed in Turkey. He then lifted the naval blockade on November 20.[56]

The Cuban Missile Crisis was the first real world test of the Minuteman ICBM. The 341 SMW's successful effort to bring a brand new weapon system to alert was unprecedented, especially given Alpha Flight's status—constructed, installed, but not tested. Couple this with a maintenance crew that had yet to see a live nuclear warhead and one can comprehend the challenge that lay before them. Luckily, Colonel Andrus had "been in SAC long enough to become convinced that the weapon system had not yet been invented that professional airmen could not outsmart."[57] On December 11th the wing placed its second flight on alert and by July 1963, all 150 Minutemen ICBMs at Malmstrom were ready to receive their emergency war orders. The crisis also provided SAC an opportunity to bring its forces to an unprecedented state of readiness: by November 3, 1962, it achieved 186 missiles on alert. The Minuteman's success, along with technical improvements to the emerging Minuteman II ICBM, prompted Secretary of Defense Robert McNamara to authorize a 1,000 Minuteman ICBM force.[58]

The Minuteman ICBM program in Montana had long-standing effects on the state and ICBM community. The following September, while on an 11-state "conservation" tour of the western United States, President Kennedy addressed a crowd of approximately 20,000 people at Great Falls High School's Memorial Stadium. In his remarks on September 26, 1963, he placed Great Falls on the front-lines of the Cold War. Unlike World War I, World War II, or the Korean War, the Cold War was fought in Montana on American soil—no longer was war something that happened "over there." Pointing to the "100 Minuteman missiles which ring this city" Kennedy called on "the 180 million people of the United States throw their weight into the balance in every struggle…on side of freedom." As if he contracted both time and space he pointed to a grave reality, "We are many thousands of miles from the Soviet Union, but this State [*sic*], in a very real sense, is only 30 minutes away."[59] Montanans might not have realized it but the Cuban Missile Crisis, and the Cold War in general, shifted the United States to a permanent war footing.[60] With 150 Minuteman ICBMs standing watch in their backyard against the Soviet Union, wartime was always right now. Montanans eventually came to accept this reality, especially since the Minuteman was a weapon system never "used" in the Cold War. Yes, the threat of a nuclear strike, its deterrent power, became its primary function. But no airman ever launched an ICBM from central Montana. Combined with the money Malmstrom AFB and the Minuteman pumped into the state's economy, even those that were wary of the weapon system came to depend on it.[61]

The Cuban Missile Crisis also had a damaging effect on the ICBM mission itself. While many historians claim the end of the Cold War led to the ICBM mission's decline within the USAF, historian and former missileer David W. Bath roots its post-Cold War problems in the era immediately following the Cuban Missile Crisis.[62] Just a few years

earlier, President Kennedy argued the Minuteman could help fill the missile gap between the U.S. and Soviet Union, but following the crisis his administration questioned its utility as a weapon. Both the Kennedy and Khrushchev administrations realized that "fighting a limited nuclear war within defined boundaries…was impossible."[63] It persuaded the U.S. and Soviet Union that nuclear weapons presented a threat to both sides equally rather than to one another separately. The Cuban Missile Crisis was the closest the world came to World War III and "provided a glimpse of a future no one wanted: of a conflict projected beyond restraint, reason, and the likelihood of survival."[64] The Kennedy administration moved quickly to remove the Atlas and Titan I missiles from the Air Force inventory. This rush led to both enlisted personnel and officers leaving the career field. Additionally, as the Vietnam War accelerated, in March 1964 the Air Force ordered 1,700 qualified pilots in non-rated assignments back to flying duty, depriving the missile field of almost all of its senior members. Seemingly overnight the ICBM field went from a group of mostly rated midlevel officers with years of experience to a group composed of nonrated personnel with less than four years of experience. These events, combined with an increasingly automated "push button" weapon system that left few opportunities for innovation, the stress of continuous evaluations, remote duty assignments like Montana, and the lack of upward mobility for missileers within Air Force leadership, prompted morale among ICBM operators to decline.[65]

According to Bath, Air Force leaders never fully accepted the ICBM mission. Once McNamara and other political leaders stopped advocating for the new weapon system Air Force leaders like LeMay, and later General Merrill A. McPeak, "placed the bulk of their money, personnel, and emphasis back in the areas they preferred—flying and support for flying operations."[66] "This remarkable change in attitude toward nuclear conflict among influential American leaders and politicians had significant and long-term influence on U.S. defense posture and allocations for military forces after 1963, particularly on the Air Force missiles and missileers," Bath concluded.[67] Combined, these factors from the 1960s, left largely unattended by leaders in the Air Force, provided the foundation for the mission's post-Cold War problems.[68]

As the Air Force begins the research and development process on its next ICBM weapon system, the Ground Based Strategic Deterrent, the DoD, Air Force, and 341st Missile Wing must be cognizant of the longstanding tensions that landowners adjacent to missile alert facilities, LFs, and access roads still have towards the Air Force.[69] Some have long-simmering distrust against the Air Force and might resist efforts to outfit the Minuteman sites with the next generation ICBM. As for the missileers themselves, with the U.S. and Russia pulling out of Cold War-era nuclear arms treaties, the ICBM may well return as an integral tool of international diplomacy.[70] Whether this is a positive development for Malmstrom AFB, Montana, and the US, only time will tell. ■

NOTES

1. On the missile gap see William I. Hitchcock, *The Age of Eisenhower: America and the World in the 1950s* (New York: Simon and Schuster, 2018), pp. 377-78; and Julian E. Zelizer, *Arsenal of Democracy: The Politics of National Security from World War II to the War on Terror* (New York: Basic Books, 2010), pp. 134-43.

2. Gretchen Heefner, *The Missile Next Door: The Minuteman in the American Heartland* (Cambridge: Harvard University Press, 2012), p. 16.

3. *Ibid*, pp. 15-20.

4. The literature on the Cold War is vast. See for example John Lewis Gaddis, *The Cold War: A New History* (New York: Penguin Press, 2005); Hitchcock, *The Age of Eisenhower*; and Odd Arne Westad, *The Cold War: A World History* (New York: Basic Books, 2017). For the Cold War's effect on American society see Mary L. Dudziak, *War Time: An Idea, Its History, Its Consequences* (New York: Oxford University Press, 2012), pp. 63-94; Heefner, *The Missile Next Door*; Brian McAllister Linn, *Elvis's Army: Cold War GIs and the Atomic Battlefield* (Cambridge: Harvard University Press, 2016); David W. Mills, *Cold War in a Cold Land: Fighting Communism on the Northern Plains* (Norman: The University of Oklahoma Press, 2015); and Catherine McNicol Stock, "Nuclear Country: The Militarization of the U.S. Northern Plains, 1954-1975," in *Local Consequences of the Global Cold War*, Jeffery A. Engel, ed., (Stanford: Stanford University Press, 2008), pp. 238-72.

5. The literature on the Air Force's ICBM program is slowly growing. See David W. Bath, *Assured Destruction: Building the Ballistic Missile Culture of the U.S. Air Force* (Annapolis: Naval Institute Press, 2020); Heefner, *The Missile Next Door*; John C. Lonnquest and David F. Winkler, *To Defend and Deter: The Legacy of the United States Cold War Missile Program* (Rock Island, IL: Defense Publishing Services, 1996); Jacob Neufeld, *Development of Ballistic Missiles in the United States Air Force, 1945-1960* (Washington, DC: Office of Air Force History, 1990); Neufeld, *Bernard Schriever: Challenging the Unknown* (Washington, D.C.: Office of Air Force History, 2005); Steven A. Pomeroy, "Highball! Missiles and Trains," *Air Power History* Vol. 57, No. 23 (Fall 2010), pp. 22-33; Pomeroy, *An Untaken Road: Strategy, Technology, and the Hidden History of America's Mobile ICBMs* (Annapolis: Naval Institute Press, 2016); Neil Sheehan, *A Fiery Peace in a Cold War: Bernard Schriever and the Ultimate Weapon* (New York: Random House, 2009); Christina Slattery, et al., *The Missile Plains: Frontline in America's Cold War: Historic Resource Study* (Minuteman Missile National Historic Site, South Dakota, 2003); and David Stumpf, *Titan II: A History of a Cold War Missile Program* (Fayetteville: University of Arkansas Press, 2002).

6. David W. Bath, ed., *Air Force Missileers and the Cuban Missile Crisis* (Breckenridge, CO: The Association of Air Force Missileers, 2012); Bath, *Assured Destruction*, pp. 93-122; Michael Dobbs, *One Minute to Midnight: Kennedy, Khrushchev, and Castro on the Brink of Nuclear War* (New York: Vintage Books, 2008); Jerome H. Kahan and Anne K. Long, "The Cuban Missile Crisis: A Study of Its Strategic Context," *Political Science Quarterly* Vol. 87, No. 4 (Dec., 1972), pp. 564-90; Robert F. Kennedy, *Thirteen Days: A Memoir of the Cuban Missile Crisis* (New York: W.W. Norton & Company, Inc., 1969); Mills, *Cold War in a Cold Land*, pp. 153-69; Sheldon M. Stern, *The Cuban Missile Crisis in American Memory: Myths versus Reality* (Palo Alto: Stanford University

Press, 2012); Curtis A. Utz, *Cordon of Steel: The U.S. Navy and the Cuban Missile Crisis* (Washington, DC: Naval Historical Center, 1993); and Zelizer, *Arsenal of Democracy*, pp. 148-77. For the Cuban Missile Crisis from the Soviet perspective see Sergo A. Mikoyan, *The Soviet Missile Crisis: Castro, Mikoyan, Kennedy, Khrushchev, and the Missiles of November*, ed. Svetlana Savranskaya (Palo Alto: Stanford University Press, 2014).

7. See Roger Lotchin, *Fortress California, 1910-1961: From Warfare to Welfare* (Lincoln: University of Nebraska Press, 1992).

8. "History, Air Base Headquarters, Army Air Base, Great Falls, Montana, 9th May to 31st December 1942," August 13, 1943, p. 1, *341st Missile Wing History Office* (341 MW/HO), Malmstrom AFB, Montana. For clarity I will refer to Great Falls Army Air Base, Great Falls Army Air Field, and Great Falls Air Base as Malmstrom AFB throughout this essay.

9. James C. Bard, Sara A. Scott, and David C. Schwab, *Base and Missile Cold War Survey: A Baseline Inventory of Cold War Material Culture at Malmstrom Air Force Base, Montana* (CH2MHill, 1997), pp. 15-16; and Glenda Lesondak, ed., "ALISB Lend-Lease and the Air Support Command," in *The World War II Heritage of Ladd Field, Fairbanks, Alaska* (Ft. Collins, 2004), pp. 35-49.

10. Bard, Scott, and Schwab, *Base and Missile Cold War Survey*, pp. 21-28; and Roger G. Miller, *To Save a City: The Berlin Airlift, 1948-1949* (Washington D.C.: Air Force History and Museums Program, 1998), pp. 79-80.

11. By deploying the Minuteman to the central United States, they were also out of range of the USSR's submarine launched ballistic missiles. See Lonnquest and Winkler, *To Defend and Deter*, pp. 77-78, 249-50.

12. The Air Force reorganized and re-designated the 341st Bomb Wing as 341 SMW on July 15, 1961. See "341st Strategic Missile Wing Chronology," May 17, 1962, *341 MW/HO*.

13. Lonnquest and Winkler, *To Defend and Deter*, pp. 249-55.

14. J.B. Austin to Strategic Air Command, July 26, 1954, S17, B55, F2, *Mike Mansfield Papers (*MMP*),* Archives and Special Collections, Maureen and Mike Mansfield Library, The University of Montana-Missoula; John Obstarczyk to Mike Mansfield, April 5, 1957, S19, B558, F3, *MMP*; and Maj Gen Joe W. Kelley to Mike Mansfield, May 10, 1957, S19, B558, F3, *MMP*.

15. Mike Mansfield to Gordon Nease, August 26, 1959, S19, B558, F2, *MMP*; and Mary R. Patee to Mike Mansfield, September 10, 1959, S17, B151, F11, *MMP.*

16. The brainchild of Indiana Senator Homer Capehart, the Capehart housing program provided thousands of new homes to military installations across the country. Private contractors designed, planned, and constructed these new homes and then turned them over to the military for management and maintenance. This agreement ensured high occupancy (service members were assigned to these homes as opposed to voluntarily living in them) and since the military owned them, and therefore did not pay taxes, rental rates would not rise ensuring a soldier or airmen's housing allowance would always be enough. Most were single family homes laid out in what would now be considered a traditional suburban neighborhood, but the DoD also constructed numerous duplexes and apartments for single personnel or couples without children. See United States Army Environmental Center, *"For Want of A Home": A Historic Context for Wherry and Capehart Military Family Housing* (Aberdeen Proving Ground, MD, 1998), pp. 57-74.

17. Col Jay P. Thomas to Mike Mansfield, September 12,1958, S17, B151, F11, *MMP*; and Brig Gen Cecil P. Lessig to Mike Mansfield, March 2,1960, S17, B150, F1, *MMP*.

18. S.M. Swanberg to James E. Murray, August 16, 1957, S17, B151, F10, *MMP*; R.F. Kitchingman to Mike Mansfield, January 2, 1958, S17, B151, F10, *MMP*; and Leo Graybill, Jr. to Mike Mansfield, March 6, 1959, S17, B151, F11, *MMP*.

19. Jim Brown to William Swanberg, February 11, 1960, S17, B150, F1, *MMP*.

20. Heefner, *The Missile Next Door*, pp. 30-48.

21. "24-Foot Missile Site Roads Asked," *Great Falls Tribune*, May 11, 1961; "18-Foot Missile Road Accepted by County," *Great Falls Tribune*, May 24, 1961; and William S. Dunbar, interview by Troy A. Hallsell, February 13, 2020, Helena, Montana. On the Defense Access Roads program see Darcel M. Collins and Darryl M. Hampton, "Defense Access Roads," *Public Roads* Vol. 75, No. 6 (May/June 2012), 1-10, https://www.fhwa.dot.gov/publications/publicroads/12mayjune/02.cfm, accessed on June 17, 2020.

22. Murray M. Moler, "Minuteman is Greatest In Magnitude Ever in Montana," *Great Falls Tribune*, September 22, 1960.

23. "Cost of Minuteman Complex In State Estimated $330 Million," *Great Falls Tribune*, January 26, 1961; and "Boeing Gets Lewistown Housing Sites," *Great Falls Tribune*, January 26, 1961.

24. "Boeing Gets Lewistown Housing Sites," *Great Falls Tribune*, January 26, 1961.

25. Capt Donald R. Smith, "Solid-Fuel Minuteman Missiles to be Based in State Can Blast off in Seconds; Won't Clutter up Scenery," *Great Falls Tribune*, March 27, 1960.

26. Frank Norberg, "Former Montana Resident Guides Minuteman Launch Complex Work," *Great Falls Tribune*, May 7, 1961.

27. DoD, Press Release, "Air Force Selects First Minuteman Site," March 23, 1960, S19, B55, F20, *MMP*.

28. USACE, "Montana Minuteman Land Acquisition: Here Are the Facts!," October 1, 1960, S17, B155, F "Minuteman ICBM Base," *MMP*; Heefner, *The Missile Next Door*, p. 60; and Mills, *Cold War in a Cold Land*, p. 203.

29. Citizen resistance to large scale federal infrastructure projects was widespread in the postwar period. See for example Troy A. Hallsell, "The Overton Park Freeway Revolt: Urban Environmentalism, Historic Preservation, and Neighborhood Protection in Memphis, Tennessee, 1956-2016," (PhD Diss., University of Memphis, 2018); Mark W.T. Harvey, *A Symbol of Wilderness: Echo Park and the American Conservation Movement* (Albuquerque: The University of New Mexico Press, 1994); and Samuel Zipp, *Manhattan Projects: The Rise and Fall of Urban Renewal in Cold War New York* (New York: Oxford University Press, 2010).

30. Vernon F. Taylor to Mike Mansfield, May 9, 1960, S17, B154, F "re Vernon Taylor," *MMP*.

31. Woodrow Herge to Mike Mansfield, June 10, 1960, S17, B154, F "re Vernon Taylor," *MMP*; and Col Harold B. Sparks to Mike Mansfield, June 17, 1960, S17, B154, F "re Vernon Taylor," *MMP*.

32. Vernon Taylor to Mike Mansfield, June 23, 1960, S17, B154, F "re Vernon Taylor," *MMP*; and Vernon Taylor to Mike Mansfield, June 28, 1960, S17, B154, F "re Vernon Taylor," *MMP*.

33. Edward L. Fike to Mike Mansfield, June 20, 1960, S17, B154, F "re Vernon Taylor," *MMP*; and Secretary Dudley C. Sharp to Vernon Taylor, July 26, 1960, S17, B154, F "re Vernon Taylor," MMP.

34. Vernon Taylor to Mike Mansfield, August 8, 1960, S17, B154, F "re Vernon Taylor," *MMP*; and Vernon Taylor to Mike Mansfield, September 3, 1960, S17, B154, F "re Vernon Taylor," *MMP*.

35. USACE, letter, "Advance Information: Minuteman Construction, Central Montana," September 2, 1960, S17, B154, F "re contract awards," *MMP*; USACE, Bid Announcement, "Notice to Interested Parties in Minuteman Construction-Central Montana," September 2, 1960, S17, B154, F "re contract awards," *MMP*; and United States Army Corps of Engineers Ballistic Missile Construction Office, "WS133A Minuteman Technical Facilities, Malmstrom Air Force Base, Great Falls, Montana," undated, chapter 3.

36. "Bids Rejected…Start Delayed On Minuteman," *Great Falls Tribune*, December 24, 1960; and United States Army Corps of Engineers Ballistic Missile Construction Office, "WS133A Minuteman Technical Facilities, Malmstrom Air Force Base, Great Falls, Montana," undated, chapter 11.

37. "Minuteman Formal Groundbreaking Will Be Conducted at Base Theater Thursday," *Great Falls Tribune*, March 15, 1961; $61.7M…Minuteman Project Starts Today With Dynamite Explosion," *Great Falls Tribun*e, March 16, 1961; and United States Army Corps of Engineers Ballistic Missile Construction Office, "WS133A Minuteman Technical Facilities, Malmstrom Air Force

Base, Great Falls, Montana," chapter 19.
38. Quoted in Mills, *Cold War in a Cold Land*, p. 204.
39. Basil Emry to Mike Mansfield, June 15, 1961, S17, B154, F "re jobs," *MMP*. See also Ingvald Kjera to Mike Mansfield, March 11, 1961, S17, B155, F "Minuteman ICBM Base," *MMP*; and Lee Metcalf to Frank McGarvey, Telegram, June 9, 1961, S17, B154, F "re jobs," *MMP*.
40. Quoted in Mills, *Cold War in a Cold Land*, p. 204.
41. *Ibid*, pp. 203-5.
42. "Easements Sought for Missile Lines," *Great Falls Tribune*, June 2, 1961; "Missile Cable Ditching Will Start This Month," *Great Falls Tribune*, June 6, 1961; and "Local Labor Will Work on Missile Cable Laying," *Great Falls Tribune*, June 14, 1961.
43. Jack A. Gannon, interview by Troy A. Hallsell, November 20, 2020, Great Falls, Montana.
44. *Ibid*.
45. Dobbs, *One Minute to Midnight*; Gaddis, *The Cold War*, pp. 75-78; and Sheehan, *A Fiery Peace*, pp. 437-51.
46. John F. Kennedy, "Radio and Television Report to the American People on the Soviet Arms Buildup in Cuba," October 22, 1962, https://www.presidency.ucsb.edu/documents/radio-and-television-report-the-american-people-the-soviet-arms-buildup-cuba, accessed on June 17, 2020.
47. Mills, *Cold War in a Cold Land*, pp. 157-59, 164-6.
48. Quoted in *Ibid*, p. 165.
49. Dwight A. Spencer, "Recollection of the early days of 341st MMS & 341st SMW as it formed and became operational from June 1962 through August 1964," undated, *341 MW/HO*.
50. Jack A. Gannon, interview by Troy A. Hallsell, November 20, 2020, Great Falls, Montana.
51. Robert Kipp, Lynn Peake, and Herman Wolk, *Strategic Air Command Operations in the Cuban Missile Crisis of 1962* Historical Study No. 90, Vol. 1 (Decl. 20 Aug 92), p. 72, https://nsarchive2.gwu.edu/nsa/cuba_mis_cri/dobbs/SAC_history.pdf, accessed on June 17, 2020.
52. Dobbs, *One Minute to Midnight*, p. 279.
53. Quoted in *Ibid*, p. 277.
54. Burton C. Andrus, Jr., "The Cuban Missile Crisis and the 341st's Reaction," undated, *341 MW/HO*.
55. *Ibid*. See also Dobbs, *One Minute to Midnight*, pp. 276-9; and Frederick J. Shaw, Jr. and Timothy Warnock, *The Cold War and Beyond: Chronology of the United States Air Force, 1947-1997* (Washington DC: Air Force History and Museums Program, 1997), p. 32.
56. Dobbs, *One Minute to Midnight*; pp. 276-9; Gaddis, *The Cold War*, p. 78; and Kipp, Peake, and Wolk, *Strategic Air Command Operations*, pp. 64-5, 72-4.
57. Andrus, Jr., "The Cuban Missile Crisis."
58. Bernard C. Nalty, *USAF Ballistic Missile Programs, 1962-1964* (USAF Historical Division Liaison Office, 1966), pp. 7, 21-8, https://nsarchive2.gwu.edu/nukevault/ebb249/doc03.pdf, accessed on June 17, 2020; and Kipp, Peake, and Wolk, *Strategic Air Command Operations*, pp. 66, 72-4.
59. John F. Kennedy, "Remarks at the High School Memorial Stadium, Great Falls, Montana," September 23, 1963, https://www.presidency.ucsb.edu/documents/remarks-the-high-school-memorial-stadium-great-falls-montana, accessed on June 17, 2020. See also "President Arrives Today Amid Growing Excitement," *Great Falls Tribune*, September 26, 1963; and "20,000 Pay Tribute At Stadium," *Great Falls Tribune*, September 27, 1963.
60. See Dudziak, *War Time*.
61. Walter Herman Harris, "Economic impact of Malmstrom Air Force Base on Great Falls Montana: A model," (MA Thesis, University of Montana, 1978), https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=6172&context=etd, accessed on June 17, 2020; *Malmstrom AFB and Central Montana: Partners in One Community* (September 2015), https://greatfallsmt.net/sites/default/files/fileattachments/community/page/40351/malmstromafbcentralmtpartnerscommunityflyer.pdf, accessed on June 17, 2020; and Heefner, *The Missile Next Door*, pp. 188-99.
62. Kyle J. Brislan, "The Evolution of ICBM Alert Shifts, 1959-2019," (unpublished manuscript, March 2019), typescript; Donald L. Koser, "Morale and the Force Improvement Program Part I – ICBM," (unpublished manuscript, 2018), typescript; William McLaughlin and Yancy Mailes, "ICBM Normalization," (unpublished manuscript, 2018), typescript; and Jeremy P. Prichard, "Safety in Minuteman Launch Control Centers: A History," (unpublished manuscript, November 2019), typescript.
63. Bath, *Assured Destruction*, p. 120.
64. Gaddis, *The Cold War*, p. 78.
65. Morale among ICBM operators was a recurring theme with missileers in professional military education courses. See Lt Col Paul A. Hughes, "Management of Monotony: A Study of ICBM Crew Duty," (Thesis, Air War College, 1964); Maj Carl Lindahl, "A Look at the Missile Combat Crew Status and Prestige," (Thesis, Air Command and Staff College, 1971); Maj David L. Driscoll, "Missile Combat Crew Morale: Its Impact on Officer Retention," (Thesis, Air Command and Staff College, 1972); Maj Robert S. Luckett, "People Problems in the SAC Missile Force and What is Being Done to Correct These Problems," (Thesis, Air Command and Staff College, 1972); Capt William Thomas McDaniel and Capt John R. Dodd, "Minuteman Combat Crew Integrity: Its Effect on Job Satisfaction and Performance," (Thesis, Air Force Institute of Technology, 1972); Rodgers W. Bickerstaff, "A Review of Literature on Missile Combat Crew Attitudes and Motivations," (Thesis, University of North Dakota, 1973); Capt Michael Patrick Weitzel, "Career Development: Missile Officers' Perceptions and Opportunities," (Thesis, Wichita State University, 1975); Capt Dennis M. Ashbaugh and Capt Larry J. Godfrey, "The Impact of SAC Missile Management Working Group on Combat Crewmember Attitudes," (Thesis, Air Force Institute of Technology, 1976); Capt Rodney L. Boatwright and Capt Robert D. McCaskey, "A Study of the Relationship Between Member Attitudes and Organizational Effectiveness in a Strategic Missile Wing Operations Directorate," (Thesis, Air Force Institute of Technology, 1978); Maj Rayford D. Nichols, "Keeping the ICBM Relevant in the Post-Cold War Environment," (Thesis, Air Command and Staff College, 2006); Maj Niki J. Kissar, "Reinvigorating the Nuclear Enterprise: Is it Time For a Separate ICBM Career Field?," (Thesis, Air Command and Staff College, 2009); Maj Jack Felici, "Modernizing the ICBM Force," (Thesis, Air Command and Staff College, 2009); Col Angela G. Stout, "Organizational and Cultural Erosion of the ICBM Enterprise," (Thesis, Air War College, 2010); and Maj Laurel P. Gammon, "Culture Change: Is the United States Air Force Taking the Right Steps to Change the Culture of the Air Force Nuclear Enterprise?," (Thesis, Air Force Fellows, 2011).
66. Bath, *Assured Destruction*, p. 140.
67. *Ibid*, p. 122.
68. Bath, *Assured Destruction*, pp. 123-49; and Koser, "Morale and the Force Improvement Program," pp. 1-17.
69. Valerie Insinna, "Air Force's next-gen ICBM program takes another step forward," *Defense News*, July 17, 2019, https://www.defensenews.com/2019/07/17/air-forces-next-gen-icbm-program-takes-another-step-foward/, accessed on Jun 17, 2020; Mark Guzinger, Carl Rehberg, and Gillian Evans, *Sustaining the U.S. Nuclear Deterrent: The LRSO and GBSD* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2018); and Don Snyder, et al., *Managing Nuclear Modernization Challenges for the U.S. Air Force: A Mission Centric Approach* (Santa Barbara, CA: RAND Corporation, 2019).
70. "INF nuclear treaty: US pulls out of Cold War-era pact with Russia," *BBC*, August 2, 2019, https://www.bbc.com/news/world-us-canada-49198565, accessed on June 17, 2020; and Richard Pérez-Peña, Ivan Nechepurenko and David E. Sanger, "Last Major Nuclear Arms Pact Could Expire With No Replacement, Russia Says," *New York Times*, November 1, 2019, https://www.nytimes.com/2019/11/01/world/europe/nuclear-arms-pact-expire-russia.html, accessed on June 17, 2020.

Lost in Space: The Defeat of the V–2 and Post-War British Exploitation of German Long-Range Rocket Technology

A V–2 being prepared for refuelling prior to launch in post-war British 'Backfire' trials in 1945. The missiles were mobile and apart from a level concrete pad, no other fixed infrastructure was needed to launch them.

Bryan Hunt

Battle of London is over … sort of

On the evening of September 7, 1944, Duncan Sandys MP (1908-1987), chair of the government rocket and flying bomb countermeasures 'CROSSBOW' committee, confidently announced that the Battle of London, comprising the V–1 flying bomb attacks, was now over and that the public could now relax, and because of Allied advances through northern France, discounted the apocalyptic predictions of 'rocket' (ballistic missile) attacks. The fear of these attacks had caused the Home Secretary, Herbert Morrison (1888-1965), grave concern because of alarmist intelligence assessments of the size of warheads and predicted scale of attacks.[1] Starting in August 1943, Bomber Command and the U.S. Eighth Air Force had bombed research sites in Poland and dropped 120,000 tons of bombs on the monumentally large reinforced-concrete 'large sites' and 'rocket projector' sites on the Cherbourg Peninsula in northern France and in Belgium that were believed to be crucial to the operational deployment of long-range rockets.[2] Allied forces had now overrun the distinctive, curved assembly and launch 'ski site' buildings where V–1 flying bombs had been launched at Britain. The Chiefs of Staff Committee also believed that all potential rocket launch sites were now in Allied hands.

However, a scant 24 hours later on September 8, 1944, a mysterious explosion occurred in Chiswick, west London, killing three people and injuring a further 20. A second similar explosion occurred a few seconds later in Epping, though with no casualties. Described officially as 'gas leaks', these explosions heralded the first ballistic missile attack on the United Kingdom. The weapon was the A4, a 46 ft/14 m high single-stage liquid-fuelled rocket carrying a one ton high-explosive warhead. The A4 – *Aggregat* (experimental) Bombardment Rocket and later renamed by the Nazi Propaganda Ministry and universally known as the V–2 (*Vergeltungswaffen* - vengeance or retaliatory weapon) - had been launched from a mobile position in The Hague, in the occupied Netherlands.[3] It took just under five minutes to travel the 200-odd nautical miles to southern England. Although the British Government maintained the story of gas leaks for two months

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Editor's Note: *In 1996, the Royal Air Force Historical Society established, in collaboration with its American sister organisation, the Air Force Historical Foundation, the Two Air Forces Award, to be presented annually on each side of the Atlantic in recognition of outstanding academic work by a serving officer or airman. This article, the 2019 award winner, was previously published in the RAF's Air and Space Power Review volume 22, number 2 Summer 2019.*

on security grounds,[4] it was recognised across Whitehall that this was the commencement of a ballistic missile (code word:'BIGBEN') bombardment that had been expected – and feared - from late 1943.[5]

Origins of the V–2

The A4 had been developed in great secrecy at purpose-built research facilities at the German Army Rocket Research Centre on the Baltic peninsula of Peenemünde, near the Polish town of Świnoujście.[6] The origins of the A4 can be directly linked to Germany's defeat in the First World War. The Versailles Treaty of 1919, which formally ended the Great War, imposed severe limitations on the rearmament of Germany, including retaining and developing large calibre/long-range artillery. To avoid these restrictions, covert research and rearmament commenced in the early 1920s, and contrary to popular belief, a decade before Hitler came to power. However, under the National Socialists, defence research and development 'was accentuated' and disinformation was used to disguise the true purpose of military matériel and technical developments.[7] Encouraged by Hermann Oberth (1894-1990), an astrophysicist and space-flight visionary, who had established links with the National Socialists in Munich in the 1920s, amateur rocketry clubs were formed with state sponsorship.[8] By the 1930s, German scientists and engineers led in the field of ballistic rocketry to circumvent the ban on heavy artillery. One of Oberth's students was a talented engineer, Wernher von Braun (1912-1977). On completion of his doctorate on liquid-fuel rockets in 1933 (and through Oberth's influence), von Braun was recruited by Colonel Walter Dornberger (1895-1980), the German Army's Director of Artillery, and put to work developing long-range artillery rockets. The pinnacle of these developments was the liquid-fuel propelled *Aggregat* 4 and first successfully launched—after many setbacks—on October 3, 1942. Whilst Dornberger organised the development programme and marshalled military support and resources, von Braun used his charm, his technical knowledge and political astuteness to secure advancement and funding, and ultimately the endorsement from a doubtful Adolf Hitler, to turn an expensive and esoteric research programme into a new weapon of war.

Wing Commander Bryan Hunt was born in New Zealand. He read hydrology at Auckland University and International Relations and Law at Cambridge University. Following service in the RNZAF he transferred to the RAF and was employed in a number of joint and NATO roles. He then moved into defense engagement, working in Italy and Germany before serving as the Naval and Air Attaché in the British Embassy Ankara, Turkey. He attended Staff College in the UK, Rome and Istanbul and served operationally in the Balkans, Middle East and Afghanistan. He has previously written articles on counter-insurgency intelligence, air power and psychological warfare, and on the failed Gallipoli campaign of 1915.

The British Joint Intelligence Committee (JIC) was aware of a nascent rocket programme from 1942 (although intelligence pointing to a rocket weapons programme had been around since 1939) but understanding the extent of the programme and defeating it proved to be challenging. This lack of understanding was down to tensions across the scientific intelligence community, but through a combination of a dedicated intelligence-led investigation, involving photographic reconnaissance and signals intelligence, coupled with heroic espionage by the Polish Resistance movement, 'torpedo like objects 38 feet [12m] long' were discovered, confirming British suspicions of German development of 'remotely controlled pilotless aircraft', even though the items that were seen were probably long-range rockets.[9] This led to the Royal Air Force (RAF) conducting a devastating 600-strong bomber raid on Peenemünde on night of August 17/18, 1943 (Operation HYDRA), with a loss of forty-one aircraft. Unknown to the RAF, Peenemünde consisted of two separate (and rival) research institutions. The V–1 was being developed by the *Luftwaffe* at Peenemünde West, along with rocket powered aircraft such as the Me-163 *Komet*, whereas long-range rocketry at an adjacent and larger site was being carried out by the German Army. Although research laboratories were largely undamaged, the destruction of production workshops and logistics facilities and the loss of several key propulsion staff, along with much of the housing, resulted in the near-immediate relocation of A4 production and some test facilities to underground centres.[10]

After the raid, which RAF Bomber Command thought had delayed the programme by four to six months, research continued at Peenemünde and at sites in Blizna, Poland, about 550 miles/900 km south east of Peenemünde. Although the damage was extensive, Dornberger (by now a Major General) believed that the delay in research and development was only four to six weeks, and elaborate camouflage techniques were applied to make the site appear abandoned.[11] Production moved to a former gypsum mine near Nordhausen in central Germany. A state-owned company was established for production of the V–2, with staff brought in from the engineering companies of Siemens and AEG, under the dynamic, yet deranged leadership of Gerhard Degenkolb (1892-1954).[12] Other major sites included the Zeppelin Works, near Friedrichshafen, on Bodensee (Lake Constance), with sub-components built across Germany. The Nordhausen mine, which ultimately expanding to include several forced-labour camps, including the notorious '*Dora*' camp, was known as '*Mittelbau*' (also known as '*Mittelwerk*'). Here A4 designs were put into industrial-scale production and testing, prior to the completed V–2 missiles being moved to launch sites. Reports vary, but it is thought that between 15,000 and 25,000 slave workers died at *Mittelbau-Dora* due to appalling living conditions and brutal treatment.

After the July 1944 assassination attempt against Hitler, on August 8, Heinrich Himmler ordered that the V–2 programme was to be taken from German Army control[13] and moved across to the *SS*, under *SS–Obergruppenführer* Hans Kammler.[14] Kammler then directed production and

V–2 operations after September 1944, whilst issuing up to 100 'ignorant, contradictory, irreconcilable' telegrams a day, and in doing so arguably damaging development, production and deployment of the weapon system.[15] In early 1945, Kammler also took over from the German Air Ministry and the *Luftwaffe*, direction of the V–1 programme, in addition to oversight of all jet aircraft production.

Rocket in a Bottle?

Debate amongst intelligence and scientific circles raged for eighteen months, from early 1943 until autumn 1944, as to the size, range and potency of the rockets. This was only partially resolved when the first rocket landed to the west of London. The arguments were fierce and obtuse. Churchill's friend and scientific advisor, with the sinecure of Paymaster-General, was the German-born and irascible Professor Frederick Lindemann (1886-1957, later 1st Viscount Cherwell).[16] He was convinced that no single-staged liquid-fuelled rocket could reach out 150-200 miles and assumed (and contrary to the scientific intelligence and Allied research and development) that such a device would be launched from a projector—akin to launching a sky-rocket from a milk bottle. His protégé, Dr Reginald Jones (1911-1997, known universally as 'RV Jones'), who had been appointed to the Air Ministry in 1939 as a scientific advisor and in February 1941 became Assistant Director of Intelligence (Scientific Intelligence), challenged this and interpolated from scant intelligence and scientific input, that a liquid-fuel rocket could deliver up to a ten-ton warhead on London. He was later to revise this in 1944 to a twelve-meter long body with a one-ton warhead. Although Jones reported to Assistant Chief of the Air Staff (Intelligence), he combined this role with a more covert position as a scientific adviser to the Secret Intelligence Service (SIS/MI6), giving him immediate and privileged access to intelligence reports from agents[17] and ULTRA decrypts – intercepts of sensitive Nazi radio communications that had been encrypted using the Enigma machine encryption system.

Duncan Sandys MP, a former artillery officer and Financial Secretary to the War Office (appointed by his father-in-law, Winston Churchill) who led the BODYLINE committee established to counter the rocket threat, used his political acumen to persuade the government and the Chiefs of Staff of the threat. But Lindemann was bullish and to prove his theories on the method of launching long range rockets were right, he convinced the Chiefs of Staff, and in particular, the Chief of the Air Staff, Air Chief Marshal Sir Charles Portal (1893-1971), probably with the intervention of Churchill, to search for these mythical projectors on the Cherbourg peninsula and around Calais. Many sites were incorrectly identified as rocket projector sites and received the attention of Bomber Command and the USAAF from August 1943 to early 1944. Post-war analysis showed that the heavy bomber campaign had almost no impact on the eventual operational deployment of the V–2, because of the rapid advance of Allied forces through France, coupled with delays in producing an operational variant, the missiles were not to ready to deploy in large numbers – from mobile convoys – until September 1944, and that the vast concrete structures, such as 'La Coupole' and nearby 'Blockhaus d'Eperlecques' in Pas de Calais were unlikely to have been used.[18]

Lindemann also remained unconvinced that the German war machine would invest so heavily in what he saw as a grossly inefficient and inaccurate weapon, given competing operational requirements and set against a deteriorating war situation.[19] However, from 1939 on, the Nazi leadership—principally through the Propaganda Minister Josef Goebbels—had promised 'secret' weapons that would win the war and destroy 'England'. The V–2 was a manifestation of Nazi technological supremacy and a symbol of raw, unfettered power; as the situation deteriorated Hitler, who had initially been unconvinced by the V–2, saw the missile as a panacea to defeat the British, given that there were no defences against it.[20]

In addition to coping with Lindemann's bullying behaviour and his frequent attempts to undermine the BODYLINE Committee, the team had to contend with a dizzying array of conflicting intelligence. For example, a JIC paper on 'German Long-Range Rocket Development' dated April 21, 1943, variously reported that the rocket had been test-launched in South America, had a 100 (or 200) km range and with a five (or ten) ton warhead, was launched from a metal tube projector or could be fired from a ship. One German prisoner of war (POW), a tank expert who had provided otherwise detailed and reliable information on a variety of other German technological advances, reported to interrogators a rocket of 120 tons with a 60-80 ton warhead (with a 30 km blast radius), propelled by hydrogen and with a range of up to 1,800 km, and guided by a 'direction finding' beam. Although this POW had provided useful information in the past, his credibility was doubted in a most colourful way by the JIC:

[POW] 164 gives the impression of a one track, furiously working brain mounted on a neglected over-grown child's body…it is a case of morbid genius close to insanity by ordinary standards.[21]

A later BODYLINE report of November 4, 1943, outlining targets to interrupt the production and launch of the V–2 established that the 'projectile [would be] fired from a mortar tube of considerable dimensions…made up of multiple sections' and that 'the method of operation may require the incorporation in the design of a high-pressure pump or compressor driven by some form of motor of very high horsepower.' This high-pressure pump or compressor would be used to propel the missile from the projector. The source of these 'facts' is unclear – or may have been German misinformation - but helped to distract the intelligence collection and analysis effort for some months, searching for mythical launch tubes much favoured by Lindemann.[22]

Defeating the Unknown

Defeating the V–2 operational deployment proved to be very difficult for the British. The destruction by bombing

of the huge assembly, storage and launch facilities in the Pas-de-Calais region of France, led to a wider belief that the threat from rockets had been eliminated, even though the Allies had little information to distinguish between the V–1 and V–2 programmes, having never encountered weapons of either type.

Air Chief Marshal Sir Roderic Hill, Air Officer Commanding-in-Chief Air Defence of Great Britain (ADGB) noted that by summer 1943, Ministry of Supply (MOS) scientists, working against a theoretical model of a rocket (as supplied by the BODYLINE Committee), determined that a rocket could be identified by modified early-warning radar during the boost phase and both points of launch and impact could be identified by use of both electronic and mechanical predictors, although the rockets could not be tracked in flight. Hill took over as the Air Defence Commander on November 15, 1943; coincidentally the role of devising counter-measures was moved from the Ministry of Supply to the Air Ministry on the same day. By that time, five radar stations between Ventnor (Isle of Wight) and Dover on the South Coast had been modified to detect rockets fired from northern France, and 'operators had been trained to identify the characteristic trace which a rocket was expected to produce.'[23] Alongside the radar, the Royal Artillery anti-aircraft units employed sound-ranging and flash-spotting teams to observe for launches, as they were to do in Belgium from September 1944, when the V–2 campaign commenced. From early 1944, however, the rocket threat was assessed by the BODYLINE Committee as reduced, so the radar watch was dropped. Hill, concerned that such relaxation was premature, insisted that the radar operators should remain in place and train others; a further two radar stations were included in the chain after June 1944, as the V–1 flying bomb campaign commenced, in what Hill described in his-post war report as 'an intermittent drizzle of malignant robots [*that*] seemed harder to bear than the storm and thunder of the Blitz.'[24] Collier notes that ground-based electronic counter measures were established to jam 'control beams' that had been postulated, but were never employed.[25]

In the meantime, arguments still raged in London over the possible size of the warhead and, in July 1944, the Home Secretary Herbert Morrison urged the War Cabinet to commence the evacuation of one million people from London and the provision of over 100,000 'Morrison' table shelters. His Ministry estimated over 100,000 fatalities a month and, in August 1944, evacuations from London commenced.[26] Fortunately, a stream of intelligence derived from documents and prisoners captured in France independently confirmed that the warhead was about one ton, and not ten tons as was previously assumed.[27] Advancing Allied troops in northern France had discovered a number of sites, and as Hill noted, these did not resemble the 'large sites' but were merely rough concrete slabs.[28] But by August 1944, Jones had refined the rocket model and through intelligence—principally photographic intelligence and by examining the remains of two A4s: one crashed in Sweden and recovered by the British Air Attaché, and another that had been launched from Blizna and fell in Poland and heroically smuggled back to Britain by the Polish Home Army.[29] Jones and his team determined the size of the warhead and deduced that no special launch facilities were needed apart from a small concrete launch pad to hold the launch table and missile upright and the distinctive 'lemon squeezer' blast deflector, which sat underneath it; the latter two items had been identified on test stands in Peenemünde by photographic reconnaissance.

Contrary to intelligence reports reiterating the extant threat, but rather based on the assurance from the Chiefs of Staff that the tactical situation meant that there were no suitable launching sites left from where missiles could reach London, on September 7, 1944 Duncan Sandys felt comfortable enough to dismiss a large-scale attack. Five weeks before the JIC had outlined the continuing threat of attack in a Top Secret report:

'We have no physical reasons preventing the launching of BIGBEN in the immediate future. It may well be that about a thousand of these rockets exist.'[30]

The report detailed the training of personnel, launch procedures, the availability of liquid oxygen, anti-aircraft protection for storage and launch sites, and citing a 'senior source' (probably an ULTRA decrypt), that launches against Britain would start in 'mid-September [1944]'. Dornberger, separately, reported that a bombardment campaign would not start until September. Just two weeks before the V–2 campaign was launched, and Duncan Sandys' premature declaration of victory, the Security Service's (MI5) Deputy Director General, Guy Liddell (1892-1958) expressed his grave concern about the imminent V–2 campaign and suggested to the Chief of SIS (MI6) 'C', (Sir Stuart Menzies) that:

'the uranium [atomic] bomb…be used as a threat of retaliation to the Germans if they used the V.2. 'C' said that he had no reason to think the V.2 was imminent although it was possible to think that it might start in the near future.'

Menzies agreed to put the suggestion to the Prime Minister, Sir Winston Churchill, but his reply is not recorded.[31] At any rate, the British TUBE ALLOYS project (which, by now, had combined resources with the U.S. Project MANHATTAN) to develop nuclear weapons was still eight years away from delivering a working British device and the decision to construct a viable warhead was not made until 1947.

Coupled with the worsening operational situation and with little faith in the invulnerability of monumental static launch sites so favoured by Hitler, by August 1944, von Braun and General Dornberger developed mobile Transporter-Erector-Launcher (TEL) convoys (*Miellerwagen*) which were easily camouflaged and practically impossible to locate. Now V–2s could be launched from any piece of open ground, although the movement and storage of the rockets proved to be difficult under the chaotic wartime conditions.[32] As observed fourteen years later by Constance Babbington-Smith, a senior RAF Photographic Interpreter

who first identified the V–2 on its launch stand at Peenemünde, 'General Dornberger's almost ridiculously simple concept of how the V–2s should be launched defeated Allied photographic reconnaissance.'[33]

There was fierce debate in secret over whether to warn the public about V–2 attacks. However, the inaccuracy of the rockets, coupled with the limited warning time raised concerns that the public would soon lose confidence in false alarms. The Home Secretary believed that this would erode public confidence in the system; conversely, given the little warning time, public panic could result in chaos and injuries as people rushed to enter deep shelters. A missile attack warning system was developed with clusters of maroons (signal rockets) positioned across London and the south east of England that would be fired to alert of an impending attack. This, in turn, was the resurrection of an air raid alarm system that was belatedly introduced in London in July 1917, in response to Zeppelin and Gotha bombing raids on the capital.[34] However, the performance of the V–2 was so erratic (operational analysis showed that 50% fell within a 200 square mile/16 x13 mile box) that alerts would be vague and, furthermore, by the time the semi-automated system was activated, the public would have little time to react and public and private shelters offered scant protection in the event of a direct hit.[35] Morrison's other major concern was the event of a missile breaching the underground rail network, leading to extensive flooding and inevitable loss of life, as thousands of people were continuing to spend their nights in the deep tunnels because of the V–1 bombardment. Transport planners anticipated that up to fifty-seven miles of tunnels of the Underground rail network would be inundated at a speed of 15 mph/24 km/h if the tunnels at Charing Cross or London Bridge were breached.[36] On receipt of a radar report of a V–2 launch, ADGB Headquarters at RAF Bentley Priory in Stanmore (NW London) would alert the London Passenger Transport Board of an impending attack and the Board would remotely close water-tight doors on the underground network.[37]

General Sir Frederick Pile, commanding Anti-Aircraft Command and serving under Hill, proposed on a number of occasions a 'wall of lead' to disrupt the warheads during the terminal phase of flight. Scientific estimates of the number the number of shells, and therefore the number of AA guns, needed to fill the radar-predicted airspace varied widely and the proposal was eventually dropped as the V–2 campaign ended, but it should be remembered as the first attempt to develop an anti-ballistic missile system.[38]

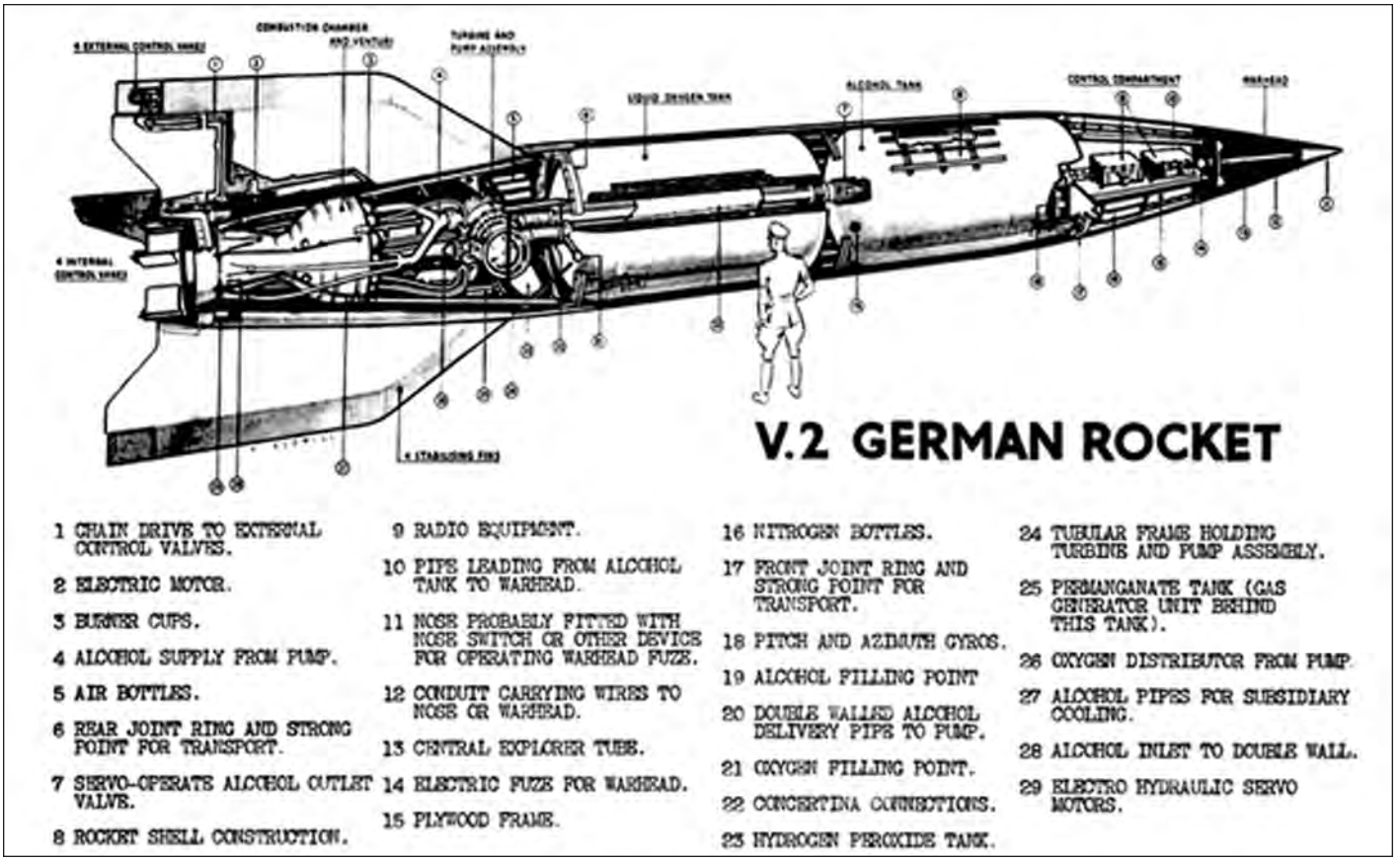
The Deceptive Role of Intelligence

Intelligence was not only essential to understanding the V–2 and the influence it might have, it was also key to defeating it. MI6 and MI5 devised a complex and highly sensitive deception plan under the jointly-run Twenty or 'XX' Committee.[39] In this plan, 'turned' Nazi agents broadcasted false reports on the impact points and exaggerated the accuracy of the attacks, resulting in the mean point of impact being shifted away from central London, as had been done during the V–1 campaign. The plan also relied on the British press not publishing the rocket attacks in any detail, hence the need for initial official silence about the attacks.

The Ministry of Home Security assessed that a further 1,300 people would have died and a further 10,000 injured if the mean point of impact had not been moved from central London through an elaborate deception plan.[40] In a 1951 interview in the *New Yorker* magazine, von Braun described his unexpectedly pleasant treatment by the British during his visit to London in September 1945.[41] Demonstrating the on-going secrecy of the deception plan, when confronted by the damage caused in parts of London by the V–2, his only concern was the fate of the German agents who radioed damage reports back to the *Abwehr* (German military intelligence) who passed it on battery commanders and to von Braun. The range of the missiles were then adjusted by altering the burn rate and fuel cut-off of the engines, as well as setting the gyros used to tip the missiles, directly under the guidance of von Braun and his team. Even in 1951, he was unaware that all Nazi agents in Britain had been 'turned' or captured, imprisoned, tried and executed. This deception plan remained secret until the 1970s.

The RAF takes the Battle to the V–2

V–2 convoys were elusive yet vulnerable if caught in the open but attacking them presented Air Chief Marshal Hill organisational challenges. As part of the restructuring of Allied commands ahead of the invasion of Europe ('OVERLORD'), Fighter Command had reverted to the pre-war title of ADGB in late 1943 and was under the aegis of the Allied Expeditionary Air Force, commanded by Air Chief Marshal Sir Trafford Leigh-Mallory, who reported directly to the Supreme Allied Commander, General Eisenhower. ADGB, in addition to defending Britain's airspace against conventional attack, was tasked to provide air defence over Allied forces when they landed in France, as well as preparing for the expected V–1 attacks. Hill had at his disposal Anti-Aircraft and Balloon Commands, as well as fighter/ground attack aircraft from Nos 11, 12 and 13 Groups. As the V–1 campaign began in June 1944 (just as OVERLORD landings commenced in Normandy), despite many requests, Hill was unable to draw fully on either the additional resources of Bomber Command or the Second Tactical Air Force to attack possible V–2 launch locations, as both formations had their own target priorities supporting OVERLORD, such as providing close air support to allied forces, paralysing the French rail network as well continuing the strategic bombing offensive. Hill also described his relationship with Air Chief Marshal Sir Arthur Harris, Air Officer Commanding-in-Chief Bomber Command, as being 'less than to be desired', which may have influenced the outcome of ADGB's request for heavy bombers. Hill, instead, relied on several groups of fighter-bombers assigned to ADGB, (Spitfires, Tempests and Typhoons) engaged in armed reconnaissance which could be tasked to reconnoitre possible V–1 and V–2 launching sites



Cutaway drawing of a German V-2 rocket. ***Air Ministry Collection, courtesy of Imperial War Museum. © IWM (C 4832)***

and attack targets of opportunity. However, the ongoing strategic bombing offensive across Germany would have had a major disrupting effect on missile production and distribution, as well as a second order effect on fuel and liquid oxygen production.

By mid-September 1944, it was clear that the V–2s were being launched from built-up areas in The Hague, so to minimise civilian casualties (and after consultation with the Dutch Government in Exile), his fighter-bombers practised accurate dive bombing in order to attack convoys and complexes believed to house missiles, equipment and personnel. They would be vectored on to possible locations based on radar plotting from a Royal Artillery Mobile Air Reporting Unit, and more frequently, by reports from Dutch operatives. But these attacks only had a limited, short-term effect; targeting was switched to the local rail network and possible storage areas which had a greater, long-term impact. Collier noted that on March 7, 1945 the 'German Rocket Organisation in Holland reported its casualties since air attacks began as 51 dead, 117 wounded, and 58 lorries and cars, 11 oxygen-trucks and 48 missiles damaged.'[42] Hill also sought assistance from 100 Group RAF, who flew electronic intelligence gathering missions up and down the Channel, with Hill's fighters escorting, in a vain effort to detect both 'control beams' and radio guidance to the rockets.[43] Post-war analysis showed that no such methods of guidance existed, although Dornberger acknowledged that unsuccessful attempts had been made to incorporate such control systems and that a remote guidance system had been installed in an A4 that fell in Sweden and was subsequently recovered to England.[44] This led investigators, including Jones, to conclude that remote guidance would be used.

Allied advances in the Low Countries in March 1945 forced Kammler to withdraw the V–2 batteries eastwards into Germany, where they were then broken up and personnel dispersed. From March 1945 the threat rapidly diminished. A JIC report of April 23, 1945 examining the continued threat posed by V-weapons, pointed out that as 'V-weapons were produced in widely dispersed areas, many of which we have overrun…we do not believe that the enemy will be able to continue production on any considerable scale. Moreover, the provision of fuel would be extremely difficult.'[45]

The Campaign – and the Costs

'There is no siren warning now. No time to take shelter, for this is the most indiscriminate weapon of this or any other war. It is a sinister, eerie form of war.'

Daily Herald, London, January 1945.

The A4 was a 46 feet (14 m) high, vertically launched, single-stage, liquid-fuelled rocket, with the production variant weighing 12.65 tons (12.85 tonnes), with a one ton/tonne (nominal) warhead, although this was later reduced to 1,650 lbs (750 kg). Maximum range of its ballistic trajectory was about 220 miles (350 km). Monthly production was 300 in May 1944 rising to 616 between September 1944 and March 1945, with a total of circa 6,000 launch

Ruined flats in Limehouse, East London. Hughes Mansions, Vallence Road, following the explosion of the last German V–2 rocket to fall on Greater London, March 27, 1945. ***Courtesy of the Imperial War Museum. © IWM (HU 88803)***

bodies produced. Apogee (top of trajectory) was 38 to 60 miles (60-96 km) and achieved a maximum speed of up to 3,600 mph (1,600 m/s; 5,800 km/h) and, due to atmospheric friction, dropping to between 2,200-2,500 mph on impact. The missiles used an early two-dimensional gyroscopic stabilised inertial navigation system, that also fed the stability system. Fuel cut-off, and therefore trajectory and range, was pre-programmed although later (but unsuccessful) attempts of radio control were made. The rocket incorporated most of the design features that are seen in ballistic missiles of today.

German records show that up until April 7, 1945, 1,190 V–2s were launched against Britain (with a further 169 failures) with 501 of those falling on Greater London. However, the first operational launch was against Paris, on the morning of September 7, 1944, but batteries then withdrew as Allied troops advanced. Antwerp was the target for 1,610 V–2s.[46] Casualty figures vary slightly, but according to British Ministry of Home Security reports, 2,754 civilians were killed in Britain by V–2 attacks with another 6,523 injured. The single largest loss of life in the UK was on November 25, 1944 and saw 160 killed, with a further 108 seriously injured when a Woolworth's department store on New Cross Road in south London was hit. In greater Antwerp, missile attacks between October 1944 and March 1945 left 1,736 dead and 4,500 injured, including 682 Allied service personnel. Thousands of buildings were damaged or destroyed as Antwerp was struck by 590 direct hits. The largest loss of life occurred on December 16, 1944, when the roof of a crowded cinema was struck, leaving 567 dead and 291 injured. The German offensive came to an end at 1645 hours on the March 27, 1945, when the last rocket fell to earth at Orpington, in Kent, killing 34-year-old Ivy Millichamp, the last British civilian casualty from enemy action in World War II. The campaign had lasted seven months.[47]

Although the V–2 was a technical triumph over Allied developments and despite the terror imparted and the casualties inflicted, the V–2 had no demonstrable impact on the outcome of the war. Indeed, the expense and scope of the programme diverted resources from conventional weapons production, such as fighter aircraft and surface-to-air missile systems. Furthermore, the synthetic fuel for the rocket required 30 tons of potatoes to distil one ton of alcohol, at a time of chronic food shortages in Germany. The relatively small warhead and a lack of a proximity fuse (which would have permitted a more effective 'air burst') compared unfavourably with the mass effect of conventional bombing. The V–2, delivering a one tonne/ton warhead per missile, was set against the Combined Bomber Offensive that could deliver thousands of tons of bombs every day – with considerably greater accuracy and effect. Even during the London Blitz (October 1940-May 1941), the *Luftwaffe* dropped over 35,000 tons of bombs in 70 separate attacks, equating to some 35,000 V–2 attacks. Churchill eloquently pointed out that the de Havilland Mosquito bomber, with similar construction costs to the V–2, delivered on average 125 tons of bombs within a mile

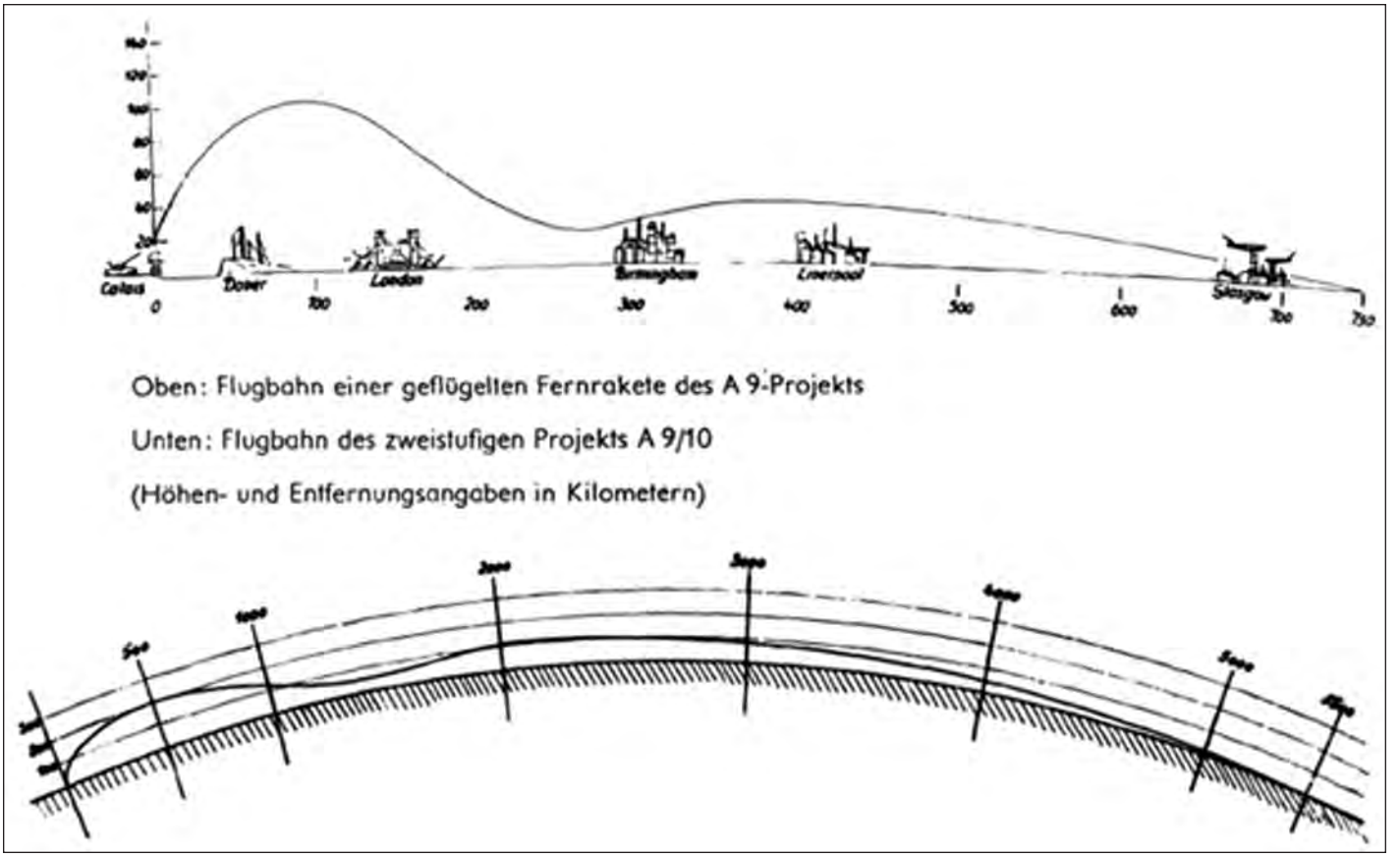
Chinatown (Limehouse, East London) V–2 combustion chamber and venturi which separated from missile on impact. March 1945.
http://www.wikiwand.com/en/Limehouse_Causeway

during its operational life, compared with the missile delivering just one ton with an error radius of 15 miles.[48] However, contemporary accounts of the V–2 'Blitz' in London graphically illustrate the fear, horror and destruction these weapons engendered. There was no public warning of their approach thus many casualties were civilians in the open who were unable to seek shelter, and a one ton warhead, travelling at between 2-3,000 mph created massive destruction, albeit localised (because of the deep crater), with the attendant shockwaves creating widespread structural and shock wave damage.[49]

Long-Range Rocket Development

Greater Mobility. Towards the end of the war, even more radical – some might say desperate – weapons were considered by Dornberger, von Braun and their staff, reflecting the changing fortunes of war and Allied air superiority. One proposal – code-named Test Stand XII – envisaged V–2s being launched against New York City and Washington DC from U-boat-towed submersible canisters. In 1943, the *Kriegsmarine* conducted experiments towing up to three 100 ft/30 m long cigar-shaped submersible containers. Dornberger claimed that Bodo Lafferenz (1897-1974), Head of the Institute for Physical Research, visited Peenemünde in autumn 1943 and urged that they examine the possibility of launching the A4 from these floats, with the obvious strategic impact that this development would have.[50] Experiments had been conducted from the decks of submerged submarines (at a depth of between 30-50 feet/10-15 m) firing short-range *Nebelwerfer* solid-fuel rockets.[51] These tests in 1942 had been successful, though never deployed operationally because of the adverse effect on submarine performance and increased acoustic signature caused by the on-deck structures. Further research at Peenemünde determined that a submarine could tow three V–2 missiles in floats – at a total weight of 500 tons – for 30 days at 12 knots. On arrival at the launch area, the canisters would be partially flooded to a vertical position, the gyro-stabilised missiles fuelled (the fuel was apparently to be carried in these cannisters) and then launched. Dornberger anticipated no major problems and he thought the work was promising; however, missile reliability in general (principally premature bursting of warheads)[52] delayed further work on this concept. There are no references to how liquid oxygen would be carried or produced for the missiles, given that LOX evaporates from storage very rapidly; perhaps Dornberger did not include this in his account given that both the U.S. and USSR were attempting to develop submarine-launched missiles, and this would have been a key technical advantage.[53] Research recommenced in November 1944, but the progressive evacuation of personnel, equipment and records from Peenemünde to Upper Bavaria from February 1945, ahead of the Russian advance, stopped further development.[54]

At about the same time, German agents captured in the U.S. revealed under interrogation a supposed plan to deploy V–1 flying bombs from submarines against U.S. East



Captured diagram of potential range of the A9 and A10 rockets. ***Courtesy of NASA Historical Office. Source:Schulz H.A (1965) 'Technical data on the Development of the A4 V-2' NASA Historical Office, George C Marshall Space Flight centre.***

Coast targets; in early 1945, the U.S. Navy launched Operation TEARDROP to counter this technically ambitious yet mythical threat, which had previously been discounted by the JIC in London.[55]

Work had been underway until 1942 to launch the V–2 from special railway wagons, envisaging missiles being prepared for launch in tunnels and then being wheeled out and erected on firing tables clamped on to the tracks. Greater cross-country mobility of the *Meillerwagen* Transporter-Erector-Launcher convoys and the inherent vulnerability of the rail network stopped development, but in late 1944 Kammler resurrected it. Dornberger claimed that he went about the work half-heartedly and the programme was abandoned in January 1945, but not before dry-firing trials from special trains took place.[56]

Greater Range. Despite the many setbacks developing a working A4/V–2 missile, von Braun's team had two research strands to increase the range of the A4. One test launch of an A4 reached an apogee of 118 miles/190 km, according to Dornberger, with a scaled increase of range anticipated. Documents and photographs held by U.S. National Aeronautics and Space Administration (NASA), show wings were fitted to the A4, creating the A9 (sometimes designated the A4b) which had an extended range of 500 miles/800 km, with the same one ton warhead. Work had commenced 1940 but ceased in 1943 because of ongoing problems with the A4, but demand for greater range from rockets caused by the deteriorating war situation saw work recommence in January 1945. After one unsuccessful launch, Dornberger reported that on January 24, 1945 a swept-wing A4b (A9) with a wing area of 145 square feet/13.3 m2 reached an apogee of 50 miles/80 km at 2,700 mph/4,350 km/h. The missile levelled out on the upper edge of the stratosphere at 12-16 miles/19-26 km and flew in a controlled glide, until a wing failed. A captured diagram shows the missile trajectory over London and then gliding past Birmingham and Liverpool and landing just beyond Glasgow.

The final wartime research programme that got underway was the A10, a winged two-stage rocket that could have had trans-Atlantic reach of 3,500 miles/5,600 km, taking about 40 minutes to cross the Atlantic. The theoretical design consisted of an A9 carried by a booster with a projected all up weight of 100 tons/tonnes, with an engine delivering 200 tons/tonnes thrust (compared with a mere 25 tons/tonnes of the A4/V–2). The overall height was to be almost twice as high as the V–2 at over 80 feet/26 m but with only a one ton/tonne warhead.[57] As with the A9, there was insufficient time or resources to develop the concept further. Dornberger commented in 1952 on these developments, noting that 'we had taken a long stride forward in developing the first intermediate stage preceding the space ship.' He also tantalisingly referred to discussions in 1943 with the leading nuclear physicist Professor Werner Heisenberg (1901-1974) on the use of 'atomic energy for rocket propulsion' but Heisenberg was uncertain.[58] Another proposal – which has captured the imagination of fantasists - was preliminary research commenced under

the orders of Hitler on a 'ten ton' warhead rocket, nicknamed '*Amerika-raket*' – an order of magnitude bigger that those missiles in service. This theoretical work was carried out in Oberammergau just prior to American forces overrunning the area.[59]

End of the War

As Russian forces swept into Germany in early 1945, von Braun and Dornberger gathered up 400-500 of their key technicians and engineers, and with their families, and with an SS escort made their way in stages to barracks in the picturesque Upper Bavarian town of Oberammergau by April 1, 1945, under the direction of Kammler.[60] Once established at the 'Upper Bavarian Research Centre', run by the Messerschmitt Aircraft Company with an attendant forced-labour camp (and now the site of the NATO School Oberammergau)[61], his team were engaged on 'make work' tasks and conceptual development – such as the A10 multistage rocket - to keep them occupied. Von Braun's team also evacuated a reported 16 tons of A4 reports, designs and other documentation from Peenemünde, hiding this archive in another disused mine north of Nordhausen before they moved to Oberammergau. Key research equipment, such as the Peenemünde supersonic wind tunnel, had been moved to a small lake resort town 20 km east of Oberammergau, where there was a hydroelectric plant that could have powered it.[62]

Von Braun was well-known in the nascent rocketry circles in the U.S. and the UK, and secret British Air Ministry Technical Intelligence Summaries from 1943 onwards frequently referred to 'Herr von Braun's' work on ballistic missiles, including references to the hitherto unknown launch of V–2s in late 1943 against Russian targets (although this probably referred to test launches from Blizna, in Poland).[63] Von Braun was detained near the Austrian border on May 2, 1945 by U.S. Counter-Intelligence Command (CIC) personnel and taken to Garmisch Partenkirchen via Oberammergau in what was probably a pre-arranged event.[64] He was treated as a celebrity; in return, he later claimed to have hosted a champagne-fuelled party for his captors at his mountain retreat.[65]

Exploiting the Technology

Allied Tensions. As the V-weapon threat developed, one of the dilemmas facing BODYLINE was what information Britain should share with the Americans about the Nazi long-range rocket programme. In a JIC report of October 26, 1943, the opening paragraph made an appeal:

'We feel that it is becoming necessary for a ruling to be given as to what information regarding our knowledge of German long-range rockets should be disclosed to the Americans, and by whom.'[66]

The report pointed out that U.S. scientists had been consulted by BODYLINE scientists (such as the potential of liquid-fuelled rockets) and that there had been inadvertent leakage from British personnel working alongside U.S. staff; moreover, the U.S. Army Air Forces had carried out attacks against 'heavy sites' in France. It was agreed that each Service intelligence chief would brief orally their opposite number, and the respective service attachés in London would be informed by the permanent chairman of BODYLINE, Commander Ian Fleming RNVR, later the creator of the James Bond novel series. At the same time, although allied military cooperation was increasing, there was the concern of what to tell the Soviet Union. The advances on the Eastern Front meant that Soviet forces would soon encounter A4 test ranges and facilities. RV Jones minuted the Chief of the Air Staff, Air Chief Marshal Sir Charles Portal, recommending that Air Intelligence Officers should be sent to the range at Blizna, and as it was of such importance, Churchill should make a personal approach to Stalin. Stalin agreed in a letter of July 25, 1944, but at that point numerous bureaucratic obstacles were put in the way of the team by the Soviets. Blizna (also referred to as Dębica) was taken by Soviet forces on August 6, 1944, and their scientific teams scoured the site for material of intelligence value. The British team travelled via Teheran but, with visa delays and illness, they were unable to arrive at Blizna until about September 20. Although the site was well-picked over, the team found and identified a number of components and impressed the Russians who accompanied them with their knowledge on guided missiles. However, crates of salvaged equipment were delayed en-route; when the cases were opened at Farnborough, the contents had been substituted with old aircraft parts.[67]

A curious report of the JIC sub-committee dated February 6, 1945 revealed a personal offer from a Soviet colonel to arrange for an Allied team to investigate the main research site at Peenemünde, once Soviet troops overran it. The colonel had assisted the 'Anglo-American team working on the experimental rocket site in Poland [Blizna] last summer [*and*] had been very impressed by the ability of some of the team members. The colonel had offered to facilitate a similar event in the future if he was approached direct.' The sub-committee agreed that Assistant Chief of the Air Staff (Intelligence) would write the Head of the British Mission in Moscow, Admiral Ernest Archer, who in turn would write to the colonel and accept this offer.[68] As an aside, present at the meeting and representing MI5 was Major Anthony Blunt (1907-1983). Blunt was an officer in the Intelligence Corps but had been recruited as a Soviet agent in 1937 and was one of the five members of the infamous Cambridge Spy Ring. Given his duplicity, it is highly likely that Blunt would have passed this information to his Soviet handlers.[69] In any event, the Russians did not allow access to the Americans or the British when Peenemünde fell to the Russians in May 1945.

The Race for Space Scientists. From 1944, British and American planners sought to exploit after the war German technological advances across all fields resulting in the Combined Intelligence Objectives Sub-Committee (CIOS) set up between the U.S. and the British Chiefs of Staff Committees. CIOS also prepared lists of what scientific and industrial intelligence would be shared with the Soviet

Union. The British Intelligence Objectives Sub-Committee (BIOS) identified a bewildering range of industrial and scientific intelligence objectives for exploitation on a national basis. To collect this military-industrial technology, an ad-hoc organisation of regular army units was established to escort civilian experts, known as 'Investigators', to seize archives, equipment and personnel on a 'Black List' of prioritised targets. Commander Fleming had been the driving force behind the Royal Navy's 30 Assault Unit (30AU) technical intelligence and exploitation team which had operated successfully in the Mediterranean and during the early stages of Operation OVERLORD. Fleming's team was the inspiration for T-Force, which was subsequently developed and directed by BIOS, and commenced work in early 1945. T-Force consisted of several infantry battalions, with Royal Engineer bomb disposal experts and extensive transport support, together escorting teams of civilian 'Investigators' and searched for equipment, archives and personnel. T-Force moved with the front-line and gathered material as they went; on some occasions, T-Force personnel engaged in combat as they got ahead of friendly troops, most notably accepting the surrender of the *Wehrmacht* and *Kriegsmarine* garrisons in Hamburg![70]

What were the British Prizes? In the British Zone, there were two great technical prizes. One was the *Walterwerk* complex near Hamburg. Here, under the mercurial engineer Dr Hellmuth Walter (1900-1980), air-independent propulsion systems were developed, principally for the *Kriegsmarine*, such as hydrogen peroxide-powered torpedoes and submarines, but also the turbo-pumps needed to deliver 50 gallons/225 litres of fuel per second into the V–2 combustion chamber. He also developed the turbine pump for the Me–163 'Komet' rocket-powered fighter, also developed at Peenemünde. The second great capture was the *Luftfarhtforschungsanstalt Hermann Göring* (Hermann Göring Aeronautical Research Institute), four miles west of Brunswick. Ben Lockspeiser (1891 -1990), Director-General of Scientific Research at the UK's Ministry of Aircraft Production, after visiting the institute (which was a collection of semi-autonomous research establishments), described what he found:

Aerodynamic, supersonic and high-speed equipment is far ahead of anything in this country…it is probably true to say that in several directions the technical equipment … is unsurpassed anywhere.[71]

Lockspeiser immediately requested a team be sent to Völkenrode to secure the site, equipment and personnel. He and his team realised the vital importance of swept-back wings for supersonic flight. This led him to cancel the UK's first supersonic experimental aircraft project, the straight-wing Miles M.52. According to his 1993 obituary, he was much criticized for this decision as he had been earlier castigated for placing the contract with the Miles Aircraft Company in 1943.[72] Scientists at Völkenrode, and indeed on other research and development sites, were immediately re-engaged in completing their research work and writing up their results in scientific monographs. Most, it seems, were happy to do this as it temporarily guaranteed food and safety for themselves and their families.

Meanwhile, after his capture von Braun was questioned at length at Garmisch about the rocket programme and his National Socialist beliefs by U.S. officers, as well as personnel from the CIOS. On May 15, 1945, von Braun wrote a futuristic report for British investigators, led by Dr William Cook, outlining his aspiration for larger, multi-stage, longer-range, crewed and reusable rockets that could orbit the Earth.[73] Dr Cook (1905-1987), who was appointed in 1940 as Deputy Controller of the British Rocket Projectile Establishment under Sir Alwyn Crow (1894-1965), had agreed with Professor Lindemann in 1943 that a liquid-fuelled missile as proposed by RV Jones was impractical and a solid-propellant rocket would be unfeasibly large. Perhaps still influenced by this prejudice, Dr Cook seems to have reported little of what von Braun had said under interrogation. On June 17, 1945, von Braun was taken back to Nordhausen to locate other members of his team and to recover what equipment they could from the site before it was due to be handed over to Soviet forces. In addition to the archives, over 6,500 tons of equipment, including components to assemble 75 V–2 rockets, were to be shipped to the U.S.[74]

Von Braun and several of his colleagues were also taken to London for two weeks in September 1945 for further questioning by Ministry of Supply and JIC officials. Sir Alwyn Crow, who also doubted the viability and future of ballistic missiles, interviewed von Braun and reportedly made a half-hearted attempt to recruit him, which von Braun did not accept.[75] Unfortunately, no detailed records of his interviews in London have been found. When he was taken to an impact site in south London, for the first time von Braun was confronted with the damage that V–2s had caused. His observations were of a technical nature and he expressed frustration that debris had been cleared from one site and thus he could not get an accurate impression of the damage the warhead had caused. He seemed to demonstrate little remorse or emotion; this lack of emotion was also noted by von Braun's interrogators in Garmisch.[76] Although not mentioned in biographies of von Braun, during this period it appears that he was also taken to the Hermann Göring Aeronautical Research Institute at Völkenrode, and possibly to Cuxhaven, south of Hamburg. He demonstrated the potency of the A4 turbo pump steam generation components (potassium permanganate and hydrogen peroxide), which had been developed at *Walterwerk*, to British T-Force staff, who subsequently reported on this meeting.[77]

At the end of July 1945, approval was given by the U.S. War Department under Operation OVERCAST (later renamed Operation PAPERCLIP) for von Braun and 350 other scientists, engineers and technicians to be moved to the U.S. and re-commence the development of V weapons for use against Japan. It appears that about 125 of his team in Oberammergau were selected, probably on von Braun's advice, to travel to the U.S.[78]

Von Braun was to enjoy celebrity status in the United States as a rising star in the National Advisory Committee

for Aeronautics (NACA), culminating on leading the Apollo programme, which landed men on the moon in 1969. The U.S. Authorities, although aware of his Nazi party and SS membership (he had been promoted to SS-*Sturmbannfuhrer* (Major) in June 1943), quietly ignored his background, and accepted his explanation of membership of both organisations 'as a political necessity' and he was granted U.S. citizenship in 1955. He was last investigated about his Nazi links by the Federal Bureau of Investigation in 1971 and in recent years evidence has emerged of his complicity in the thousands of deaths of slave labourers by starvation, execution and ill-treatment at *Mittelbau-Dora*, forever damaging his reputation as the twentieth century's preeminent space scientist.[79]

Operation BACKFIRE

BACKFIRE was a British plan but authorised in June 1945 by General Eisenhower as Supreme Allied Commander, to test-launch captured V–2s. Under the War Office's Special Projectiles Operations Group, between July and October 1945, 30 unarmed launches were planned to take place at the Ministry of Supply (MOS) Establishment, Cuxhaven (MOSEC), south west of Hamburg. The War Office commented in the official account of the launches:

[Backfire] might save years of development work, and…it was agreed that the launching and control of rockets was a complicated operation which it was necessary for the German technicians to demonstrate in the near future before they lost their skill.[80]

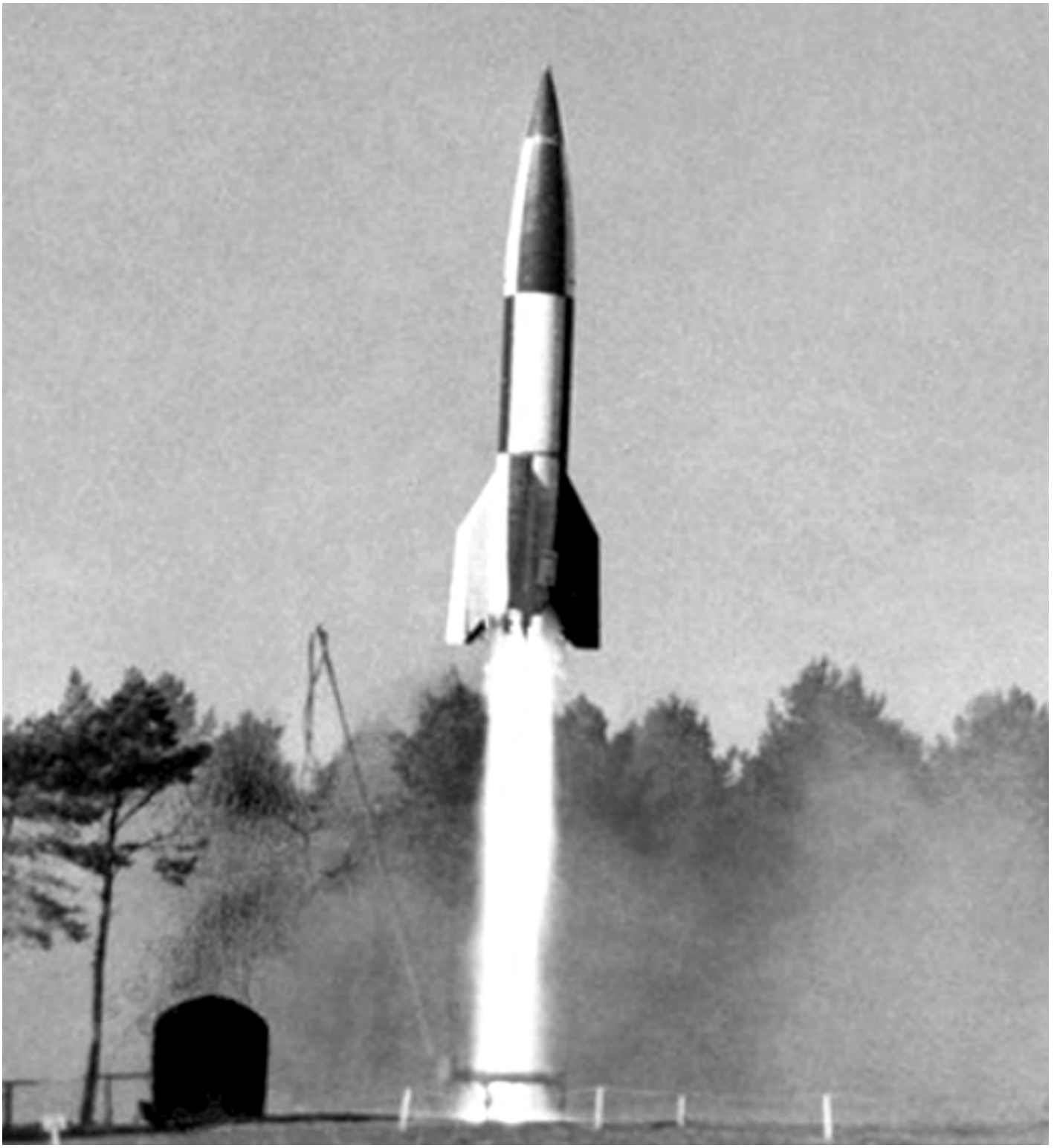
T-Force were tasked to locate V–2 components, documentation, support vehicles, equipment and technical personnel across the British and U.S. sectors. This took longer than expected and many of the rocket components had been hidden, suffered from poor assembly, looting and corrosion from many months of open storage.[81] U.S. authorities, who had earlier stripped *Mittelwerk* in Nordhausen of most of its useful equipment, delivered the British 640 tons of components by rail. The volatile hydrogen peroxide, used to produce steam for the turbine that drove the fuel pumps, was conveyed from the *Walterwerk* site near Hamburg.

Around 570 German personnel were employed to prepare and launch the rockets. However, competition with U.S. authorities had made assembling the group more difficult. About 130 of the staff had practical experience of launching rockets and another 85 were scientists or engineers who had worked at Peenemünde.[82] The first launch took place on October 1, 1945, but was regarded as a failure, but on October 2, a successful launch over the North Sea was made. A final launch, captured on film by the British Army Directorate of Kinematography, took place on October 15, in front of a large audience of senior Allied officers. The film covers the whole process from receiving the rocket from the factory by rail, through its transportation to the technical storage site, preparation and transfer to the *Meillerwagon* TEL, erection on the launch pad, fuelling and the launch. The work was done by German personnel, often still in uniform, but under the watchful eyes of the British soldiers, generally standing at a discreet distance.[83] Adverse weather and deteriorating components saw the operation draw to a premature close. The BACKFIRE project was summarised in a five-volume secret technical report and, after the test launches, the remaining equipment and five assembled rockets were shipped to the UK. The BACKFIRE reports noted that the V–2 heralded a new type of warfare, but only if the rocket was able to deliver an 'atomic' warhead to mitigate errors in accuracy.

Most of the German workers returned to a U.S. internment camp in Garmisch, with a number of them then recruited to work in the U.S. or France. Fifty Germans were retained on site after the launches, but the MOS made it clear that no UK-based employment contracts would be offered. MOSEC wound up on May 1, 1946; in a reversal six days later, the MOS offered 15 contracts, but in most cases the team had dispersed: six joined the French programme, two refused the offer, two couldn't be found, one went to the USSR and only two readily went to the UK, joined by another two who had initially agreed to join the French. General Dornberger also assisted in the test launches, but instead of being welcomed to the UK, he was still held as a POW. He was transferred from the Artillery Kaserne in Garmisch and detained at Farm Hall and Wilton Park detention centres in England, both special camps for senior German officers and scientists thought to be associated with the German nuclear programme. He was interrogated by the British War Crimes Investigation Unit and then held in a POW camp in Bridgend, Wales and not, it seems, offered employment. British and U.S. investigators were particularly concerned that the Nazi regime had hidden nuclear material and had developed nuclear warheads for the V–2 and went to great lengths to find out whether this was the case, under Operation EPSILON.[84] Coincidentally, cubes of uranium isotopes – part of a nascent Nazi nuclear weapons programme - were recovered by U.S. forces in the river adjacent to the barracks in Garmisch, where both Dornberger and von Braun were initially held by U.S. forces.[85] In 1947 Dornberger travelled to the U.S., ultimately ending up working for the Boeing Aircraft Corporation, and died in Germany in relative obscurity in 1980.

Another Ministry of Supply establishment was set up at Trauen, on the site of the former *Sänger Raketentechnische Forschungsinstitut* (Sänger Rocket Technology Institute) German scientists from *Walterwerk*, Peenemünde and Trauen were assembled there and conducted research into oxidising rocket fuels, producing reports that were subsequently published by the Royal Aircraft Establishment (RAE) at Farnborough.

By the time T-Force was wound up in 1947, it had seized huge quantities of documentation and equipment, which was shipped back to the UK. By the end of the removal phase, over 14,000 tons of equipment was removed to Britain, along with 4,600 volumes of aerospace research from Völkerode and 3,300 reports from the Focke-Wulf library. Anecdotally, it seems much of it was never exploited and was progressively destroyed in the 1950s. Amongst this equipment was a large number of high-speed, high-al-



BACKFIRE: A German V–2 rocket at the moment of launch during British tests in Germany, October 10, 1945. ***Courtesy of Imperial War Museum © IWM (BU 11149)***

titude test facilities which eclipsed anything available in Britain or the U.S. Most of these were delivered to the new RAE research centre at Bedford.

The Russian Dilemma

By early 1945, there was considerable hand-wringing in bureaucratic circles about the exploitation of German technologies and its proponents. BIOS noted the technological advantages that German industry and science offered, but there were equal concerns about the 'remunerated employment of ex-enemy aliens' and security aspects of employing former adversaries. The Deputy Chiefs of Staff Committee (DCOS) established in April 1945 Operation SURGEON, under which hundreds of scientists and engineers were held by the British and inter-

rogated about their technical knowledge and their Nazi party affiliations. Yet, those who encountered the Germans – both British and American – noted a willingness to continue their research and work for the West. As the European war ended, the actions of U.S. and British authorities were increasingly concerned with denying scientific knowledge and novel military technologies to the Russians, although this did not appear to become official British policy until December 1946.[86] However, a decision to actively employ 'alien scientists' in the UK was not made by DCOS until August 31, 1945, thus almost four months were lost after VE Day, during which many personnel were recruited by the U.S., USSR or France. Contrary to popular belief, although millions of German nationals streamed West, justifiably fearing occupation by the Red Army, many scientists willingly accepted very lucrative offers made by the Soviets, who were prepared to overlook previous Nazi affiliations.[87] This caused concern in Whitehall, as revealed by the JIC minutes of early 1946, regarding the disposal of German scientists, based on the British interrogation of three naval scientists at 'DUSTBIN', the British interrogation and processing centre for senior Nazi officials and scientists detained under SURGEON. Three scientists were questioned by staff from the Directorate of Naval Intelligence attached to the British Naval Gunnery Mission. They were asked about scientists being transferred to the Soviet Union and they claimed that the Russians wanted all German scientists and technicians to work for them:

'[The Soviets] Employed the Germans regardless of their political creed or antecedents and have placed them in positions of high authority with the right to issue orders to their Russian subordinates. Russians offer enormous monetary attractions in addition to houses and food on the most luxurious scale to the Germans who they need.'
'Experts in V weapons are among those whose services the Russians are anxious to acquire…The common belief in England that Russia will have its hands full with reconstruction is incorrect…the low standard of life for Germans in the American Zone and the absence of any unified Anglo-American policy will prove an inducement for the German scientists to seek service under the Russians.'

The paper acknowledged that the U.S. had first pick on scientists, and the UK second, but that the Russians were targeting scientists in the UK and U.S. sectors of occupied Germany, as were the French. An 'atomic physicist', Dr Albert Joos, also held at DUSTBIN, stated that he was ready to return to the Russian Zone, and that a Soviet mission, led by a General, to recover a small number of Russian 'displaced persons' within the British sector was actively recruiting scientists.[88] In response to this, in January 1946, the JIC suggested policy options for the retention of key German scientists to the Chiefs of Staff:

1. To return to the United Kingdom for employment there.
2. To keep them under permanent detention in the British Zone.
3. To offer the conditions at least as attractive as those of the Russians and hope they will remain in our Zone.

The JIC noted, not surprisingly, that scientists preferred the third option.[89] A report six months later confirmed further Russian recruitment in the British sector.[90]

Progressively, observers both in Germany and London became concerned about the predations of the Soviet Union. The vast majority of experts in the British and American sectors were not well-treated; most were unemployed or misemployed as labourers and on near-starvation rations. A May 1946 letter from the Royal Navy's Flag Officer Schleswig Holstein, concerning the loss of great technical knowledge, summed up the problem:

Nine or even six months ago the idea of working for the Russians or going to the Russian Zone was completely abhorrent to virtually every German of any mental capacity in the British of American Zones…Many of the ablest scientists and technicians from the Western Zones have already entered the services of the Russians and many more are clearly contemplating doing so in the near future unless future prospects in the British or U.S. spheres improve considerably for them at a very early date. The food situation on the British Zone will undoubtedly accelerate this Russia-ward trend, but it is doubtful whether the prospects of physical starvation weigh heavily with these men as the virtual certainty of mental starvation if they remain in Western Germany.

From December 1946, coinciding with the changing role of British technological exploitation to denying it to the USSR, contracting of German experts began in earnest, but was a mere shadow of the American and Russian programmes. Numbers were low in comparison. By the end of SURGEON, 87 scientists had been contracted to work in the UK, of which 38 were in rocket-related technology areas.

Security Concerns. There was a clear shift in feelings and policy in the immediate aftermath of the War. Whereas there had been an unbridled desire to exploit Nazi technology long before the War finished through CIOS (for the U.S. to potentially use V–1s against Japan), the morality and the security of employing former Nazis was questioned. Within JIC meetings, MI5 expressed obvious concerns about the loyalty of these individuals and the risk that they could return to Germany – or elsewhere – and share their knowledge of sensitive British programmes, and potentially help in covert German rearmament. Moreover, offering 'aliens' (as they became increasingly referred to from 1946) work was problematic. Most scientists in Britain were employed in the public sector across a plethora of civilian-run government research establishments or at universities. Civil Service employment rules specifically forbade 'aliens' from being employed on government work and there was considerable bureaucratic lethargy in having short-term contracts awarded to those scientists who wanted to come to Britain. The contracts were by no-means generous in an austere post-war Britain that was functionally bankrupt, and aliens were paid less than British

equivalents and given particularly austere ration books. Those who came to Britain were deliberately separated from their previous colleagues and worked on highly compartmentalised projects. Living conditions could also grim: the Guided Projectile Establishment in Westcott, Buckinghamshire, was typical. Scientists were housed in damp, unheated wooden former-RAF dispersal hutments within a barbed wire enclosure, initially with little freedom of movement. They occasionally met hostility amongst the local populace (as recorded against naval scientists in Barrow, Cumbria)[91] yet in work they appeared to integrate well with fellow scientists and engineers.

There was a cultural bias as well, as demonstrated in a report bemoaning the lack of a suitable policy on the employment of aliens on defence work, reiterated in a 1948 report:

'The view of the JIC is that in principle no aliens should be employed on secret defence work unless it is essential to achieve a particular result and no British Subject of comparable ability is available. Aliens are…[an] undoubted security risk.'[92]

Referring to an earlier 1947 study on the same subject, the JIC suggested that aliens engaged on defence work could move to less sensitive research-related projects or to 'universities in the Dominions', rather than continuing to increase their knowledge of British defence secrets and technical skills that 'they could take back to their native country.' The report further noted:

Even if not disloyal most aliens are temperamentally less discreet than British Subjects, while in the UK they tend to mix with and talk freely with their compatriots.

In the same paper, Polish workers were given special attention:

The employment of Poles on defence work merits special treatment. It is not unfair to say of Poles generally, and particularly of those who are now in the UK that they are temperamentally unstable.

Heads of research establishments had voiced their collective concerns about removing key personnel and the damage that this would do to projects but were advised by the JIC to remove them from sensitive posts as soon as practicable. Nonetheless, a January 1947 report noted that of a group of Germans at the Völkenrode research facility who were offered contracts 'most had been members of the Nazi Party, but denazification was passed as a mere formality'.[93]

The MI5 warnings mainly came from Lieutenant Colonel Martin Furnival-Jones (1912-1997), later to become Director-General of the Security Service from 1965 to 1972. He may have been echoing concerns less about Nazi sympathies but more of Soviet penetration of the British establishment. Though not well-publicised at the time, MI5 had been active in breaking up Communist 'entryist' cells in pre-war Britain and remained concerned about Communists in senior government and academic positions.[94] Since the early 1940s, there had been an extremely sensitive Anglo-American programme to decrypt Soviet diplomatic traffic – VENONA – and, through this, by around 1947, a very small group of senior personnel within the FBI and MI5 learned of Soviet attempts to penetrate sensitive Western establishments. As an example, Klaus Fuchs (1911-1988) was a German émigré to Britain in 1933 and was recruited as a Soviet agent in 1941. He worked on the British TUBE ALLOYS and the American MANHATTAN nuclear weapons projects and felt a moral duty to share the research with the Soviets. Fuchs was unmasked in 1950, although his espionage had been identified several years earlier in VENONA decrypts.[95]

There was particular sensitivity around the pioneering technology of the V–2 and its accuracy. In a 1946 Top Secret report, a JIC sub-committee recommended that the time, date and location of particular V–2 impacts remained secret:

'It is known that experiments in V–1 and V–2 weapons are being carried out by a certain Power [USSR] using captured equipment, and possibly, German personnel. It is, therefore, important that no information which might assist these experiments should be released.'

In referring to the elaborate deception 'XX' plan run jointly by MI5 and MI6:

'Certain measures were taken during the V–2 attacks to deceive the enemy as to the results of his firings. To conceal the fact that a cover plan was used, it would be necessary to avoid any publication of details which might be a link to a particular shot fired with a particular fall of shot marked [on an unclassified map].'[96]

Contribution to Astronautics

About 38 rocket scientists travelled to Britain between the end of 1945 and 1948.[97] Most were offered either a six- or twelve-month initial contracts to work in supernumerary appointments in government research establishments. They were split up between four main sites: the former *Walterwerk* staff went to Admiralty Department Establishment Barrow (ADEB), via Vickers-Armstrong, to work on underwater air-independent propulsion systems; five went to Waltham Abbey to the Explosives Research and Development Establishment (ERDE) established on the site of the former Royal Gunpowder Mills; 12 went to RAE at Farnborough; but the majority went to the newly-established Guided Projectile Establishment (GPE) at Westcott, Buckinghamshire. Others may have been directly recruited into industry, but details are scant. By 1950 about 23 were still in the UK. Those on longer contracts were permitted to bring their families to the UK, which led to an improvement in housing.

In 1945, Sir Alwyn Crow, as Controller of Projectile Development, produced a report on the future organisation of 'Guided Projectiles' within the Ministry of Supply. This re-

port outlined areas of research, where it would be conducted and how many staff would be allocated. Liquid fuel rocket research was focussed on hydrogen peroxide systems and 'monofuels' that did not require an external oxidiser. Most of the projects were looking at short-range missiles for the Admiralty, but the General Staff had submitted two requirements: the first was for a long-range rocket with a 100 mile/160 km range with a three ton warhead (and high degree of accuracy); and the second requirement was for a 'rocket for use as a strategical weapon' with a range of up to 300 miles/480 km also with a high degree of accuracy and a high rate of fire. A margin comment notes that the Army requirements were under review and that weapons with considerably longer ranges would be specified.[98]

GPE at Westcott was the hub of most British post-war rocket research and exploitation, and was responsible, under Dr William Cook, for guided missile development for the British Army and Royal Navy. The leading engineer was Dr Johannes Schmidt, who had been responsible for development of the 'Walter' rocket engine for the Me–163 Komet fighter, which first flew at the *Luftwaffe* Peenemünde East research centre. Unfortunately, there was to be a major setback. In November 1947, a German-designed Rocket Assisted Take-Off unit exploded during a test run, killing two British technicians and decapitating Dr Schmidt.[99] Perhaps the most significant recruit was Walter 'Papa' Riedel (1902-1968) who was employed by the MOS at Cuxhaven and Trauen, emigrated to England in 1947 to work initially for the RAE at, Farnborough and later at the MOS establishment at Westcott, until his untimely (and slightly suspicious) death in a hit and run accident in East Berlin in 1968, shortly after his retirement. From 1937, Riedel had headed the Technical Design Office as Chief Designer of the A4 at Peenemünde and was probably the most senior scientist on the programme after von Braun.

In contrast with Westcott, RAE Farnborough was primarily interested in exploiting German aeronautical and trans-sonic technology, and in 1946, 26 Germans were offered contracts of varying lengths to work at RAE. Accommodation was reportedly better than at Westcott, but the staff were still dispersed and few of their names appear on research papers until the 1950s. However, their immediate impact, following on the cancellation of the M52 straight wing supersonic aircraft, was to design a 55º swept-wing transonic aircraft in 1948. Dietrich Kuchemann (1911-1976) became more prominent by contributing to supersonic research (in particular, the Concorde) and others behind the 'swing wing' variable geometry which resulted in the Tornado combat aircraft design. But few at RAE were involved in rocketry and the RAF (RAE's major customer) had little interest apart from missiles used in various anti-aircraft and air-to-ground roles. One proposal for a long-range Ballistic Missile – Menace – which may have been the oblique reference to the General Staff requirement of 1945, was abandoned as being patently unaffordable.[100] An indication of the pervading atmosphere of austerity was measuring manpower down to just ½ person labour units in Alwyn Crow's paper on the guided projectile organisation. In contrast, and hidden from Parliamentary estimates until the 1950s, in 1947 the Labour Government committed £100 million to independently developing viable and indigenous nuclear warheads.[101]

Perhaps the greatest rocket engineering technology transfer was the extensive use of hydrogen peroxide as an oxidiser in the Black Knight test vehicle rocket and the Black Arrow two-stage satellite launch body, which were developed in the mid-1950s. From 1958, 22 successful test launches were conducted in Australia until the programme was cancelled in 1965. The Gamma power-plants for both launch bodies were derived from an earlier design produced by the German staff at Westcott, under Walter Riedel. The Black Knight was also considered as a launch body for the 'Blue Streak' indigenous Intermediate Range Ballistic Missile, carrying a British-designed thermo-nuclear device. The Blue Streak was derived from Air Staff Operational Requirement OR 1,139 of 1953 from a nuclear-armed ballistic missile with a 2,300 mile (3,700 km) range, with design work commencing at RAE Farnborough in 1954. At Westcott, the vulnerability of missiles on the ground was studied, with launch options including V–2 styled trailers, floating or submerged platforms, and massive underground silos considered. In 1958 work started on designing 60 silos dispersed at 6 mile (10 km) intervals, ensuring survival of most missiles if there was 20 megaton strike within 800 yards/metres, and at Westcott, a one-sixth mock-up of a silo was constructed.[102] Partial construction of a full-sized silo is thought to have taken place at RAF Spadeadam in Cumbria, where rocket engines were also tested. However, inter-service rivalry, and spiralling costs saw Blue Streak cancelled in April 1960. Smaller, shorter range missiles using a bi-propellant system including Red Duster, a forerunner of the Bloodhound surface-to-air missile (SAM), and the naval Sea Slug missile, were also developed at Westcott. [103]

Conclusions

The post-war exploitation of German technologies and scientists by Britain is often regarded as a signal failure compared with the achievements of German teams in the Soviet Union and America. Greater attention was given to the German presence in the US; indeed, von Braun's capture in 1945 was widely publicised in a positive light by the U.S. Army. Similarly, the achievement of the Soviet Union's Sputnik satellite launch in 1957 was ascribed in the West to the contributions of German scientists and engineers; in reality almost all has been expelled in a fit of Stalinist paranoia in 1952. The reasons for the apparent lack of exploitation by Britain are many-fold.

Firstly, agency played a role. Professor Lindemann (now Lord Cherwell), who was hugely influential as Churchill's scientific advisor (and to return in the same role in 1951 in Churchill's first post-war government), doggedly saw little practical future in long-range rockets. Even at the height of the V–2 campaign, Lindemann wrote to Churchill and remained sceptical of the future of missiles, saying, ' Although rockets may play a considerable tactical role as

long-range barrage artillery … I am very doubtful of their strategic value.'[104]

A scant two weeks after the last German V–2 was fired at the UK, Lindemann still remained unconvinced of the value of long-range rockets. Sir Alwyn Crow, Director of Guided Projectiles, like Lindemann, regarded rockets as a very inefficient form of artillery and did little to exploit von Braun and his team. In his defence, Crow focussed on improving accuracy through better guidance mechanisms, though did not exploit German scientists who had expertise in this area. In contrast, RV Jones wrote to the U.S. Army Air Force in late 1944 outlining the potential for two-stage rockets with a uranium bomb (nuclear warhead) that had a range of 3,000 miles – mirroring work that Dornberger and von Braun were undertaking on the A9 and A10 projects.[105]

Additionally, two of the Service ministries showed little interest in the need for a long-range rocket system. The RAF had built a huge strategic bomber force (by this time being replaced by the Lincoln heavy bomber), which by the end of the War could deliver devastating bomb loads with relative accuracy at relatively long range, but the aircraft and crew remained vulnerable. In spite of garnering considerable technical information and assembling a V–2 at Farnborough from smuggled components in August 1944, there seemed to be no attempt to exploit this technology during the war for use against either Germany or Japan, unlike in the US. Perhaps, in Britain, it was seen that there was no need as Germany was all but defeated and the Pacific war was very much dominated by America. The Tizard Report of 1944, whilst urging the development of nuclear weapons, still envisaged that they would be delivered by fast, high altitude jet-powered bombers. Ambitious Air Staff plans, such as Operational Requirement OR 230 of November 1946, led to the V-Force of nuclear armed bombers; ironically the V-Force would soon become obsolete in the strategic role because of surface-to-air missiles developed by the Soviets using technology in part developed from the German developments (such as the *Wasserfal* surface to air missile designed at Peenemünde). Furthermore, by 1946 given it was known that the Soviet Union was experimenting with ballistic missiles and considering the huge aircrew losses during the wartime strategic bombing campaign, it is equally difficult to understand why the RAF did not seek a long-range rocket that would be largely invulnerable to countermeasures – especially as the British TUBE ALLOYS nuclear programme was working towards a fission device that could be conceivably carried by a missile, largely obviating concerns about accuracy. It was not until 1953 that interest was shown by the RAF to develop a long-range missile system. The Royal Navy seemed to show even less interest even though the U.S. Navy successfully test launched a V–2 from the deck of a carrier in September 1947. The only interest at the time in a long-range rocket came, as in Nazi Germany, from the British Army's General Staff. However, this interest was short-lived and the Army requirements for a long-range rocket described by the Director of Guided Projectiles in his 1945 report, did not progress beyond discussion papers.

Secondly, by the end of World War II, Britain's financial, industrial and intellectual resources were exhausted and the cost of debt servicing and of maintaining a huge overseas garrison was crippling. There was also a need to replace most key items of military equipment. This, along with U.S. diplomatic pressure, in part, led to the rapid decolonisation of the British Empire. Additionally, an ambitious long-range rocket programme would have been financially demanding on a post-war Labour government which was more focussed on domestic reconstruction and social reform (such as creating the NHS) – but was also prepared to invest covertly in a domestic nuclear weapons programme, relying on aircraft delivery.

Thirdly, there was the paradox that although the Nazis were acknowledged as having advanced technologies, there was official resistance to harnessing their knowledge. MI5 were clearly concerned that UK defence technology secrets might be stolen but many reports contain a somewhat patronising view of the Germans, leading the few scientists and engineers to be kept at arm's length and not retained in their war-time teams. Furthermore, the financial inducements offered to scientists and engineers were unattractive compared with those offered by the USSR, USA and France, and coupled with a sclerotic bureaucratic lethargy, few Germans found it attractive. Security concerns about a re-emergent and belligerent Germany were unfounded, as were concerns over extensive Communist penetration of defence research and industrial community. There is no evidence to indicate any of those Germans who were brought to the UK posed a security risk, and the establishment of a 'Positive Vetting' system of assurance, introduced by MI5 in 1951, further mitigated the risk.

Authors Professor Matthew Uttley and Dr John Becklake have produced detailed studies of the net contribution to British aerospace research and development of the German infusion and paint a more positive picture. In the astronautic and rocketry fields it was primarily in the area of hydrogen peroxide liquid fuel engines, but the value of the intellectual property that was transferred across to the defence sector, is described as 'incalculable'. Dr Becklake, a former RAE scientist who has extensively researched the German contribution to aerospace technology in Britain, has written that although Britain received several very good general engineers they were too few in number, and as seen above, they were often kept at arm's length, could not collaborate with former colleagues, and were compartmentalised from major defence research programmes. Work at Westcott, where most of the engineers and scientists worked, was focussed on projectiles rather than manned flight. Rockets, including the V–2, were seen merely as projectile bodies and not aerospace vehicles. Furthermore, industry had little contact with these experts, although captured equipment was transferred to many companies and was often destroyed without exploitation. He believes that, overall, the German input saved 'about 18 months R&D [Research and Development], they had little long-term influence on British rocket technology.'[106] In sum, although there were significant contributions by German scientists in trans-sonic aerospace research and de-

velopment and in liquid-fuelled rockets, Britain of the late 1940s had greater concerns. But, in a tired, war-weary and austere post-war Britain, there was no vision; there was simply no perceived need for strategic long-range rockets.

Epilogue

In a retrospectively cruel, and rather late, turn of events, in March 1957 Duncan Sandys, now Minister of Defence, produced the White Paper on Defence, entitled the 'Outline of Future Policy'.[107] This paper recognised the parlous economic conditions at home, the inefficiencies of the domestic aerospace industry, rapidly emerging military technologies deployed by the Soviet Union and changing geo-political landscape with pre-eminence of the U.S. (especially in the wake of the Suez Crisis) and the importance of alliances such as NATO. The report recognised ascendency of long-range ballistic missiles with nuclear warheads and the vulnerability of manned aircraft to surface-to-air missiles. Sandys proposed progressive replacement of manned fighters with surface-to-air missile systems, strategic bombers to be supplemented by nuclear-armed ballistic missiles and to intensify research collaboration with America to develop anti-ballistic missile systems. In addition to swingeing reductions in the Royal Navy and the Army, as well as overseas commitments (which saw still saw 150,000 service personnel deployed overseas outside of Germany), his report forced the amalgamation of much of the British aerospace industry and cancelled most aircraft development programmes. The report concluded with assurances, in somewhat familiar terms:

(a) The Government have adopted this new defence plan in the confident belief that it will not only give relief to the country's sorely strained economy, but will produce compact military forces of the highest quality.
(b) All three Services will be provided with the newest weapons. The reduced Fleet will be composed of the most modern vessels; the Army will be equipped with atomic artillery and given a high degree of strategic mobility; the Air Force will be supplied with a British megaton bomb; a missile system of air defence will be developed; and ballistic rockets will be introduced to supplement the V-bombers.

As an interim measure before Blue Streak was expected to enter service, in February 1958 the UK and U.S. governments agreed to deploy 60 U.S. 'Thor' SM-75 missiles, which meant that U.S. warheads could reach targets in the Soviet Union. Under code-name EMILY, 20 RAF Thor squadrons were established on wartime airfields the east coast of Britain from Yorkshire to Suffolk, and across East Anglia. The RAF provided the infrastructure and workforce, but the warheads remained under U.S. Air Force control, with the launch of missiles controlled under a 'two-key' system.[108] The Thor had a range of 1,500 miles (2,400 km) and was designed by a colleague, and later rival, of von Braun from Peenemünde, Adolph Thiel (1915 – 2001). Like the V–2, the Thor missile was fuelled and launched from a transport-erector launcher system, however in Britain they were launched from fixed locations; the TEL and missile were stored under a shelter that would slide back prior to righting, fuelling and launching the missile. The first missiles – designed to be air-portable - arrived in September 1958 and the last left in August 1963. None were ever launched in the UK. The Blue Streak did not enter service; in its stead the British-designed 'Blue Steel' cruise missile was developed to be launched from the V-bombers. It entered service in 1963 (allowing the Thor to be returned to the US) and finally withdrawn in 1970. Subsequent missile programmes relied on U.S. technology with the Polaris submarine launched ballistic missile, introduced in 1968, finally replacing the V-bomber force in the Deterrent role, albeit with a British designed enhanced re-entry vehicle and warhead system, Chevaline. [109]

The reality was that by 1957 Britain was technologically and industrially at least a decade behind the America and the Soviet Union in missile development. Industrial and scientific resources committed to the UK rocket programme were orders of magnitude smaller that the U.S. and USSR. As a hegemonic actor on the world stage, global leadership had slipped away since the early 1940s and Britain had to contend with being a second-order power, largely reliant on the U.S. for strategic research, development and technologies.

Acknowledgements. I wish to thank Dr John Becklake for his support and detailed knowledge of German scientists employed in the UK after the war. I would also like extend my gratitude to the Mr Kevin Ball of Taylor and Francis Group, who have made National Archives *Secret Files from the Cold War* available on line to assist my research at www.secretintelligencefiles.com. ■

NOTES

1. CROSSBOW was originally the codename for the committee looking at measures to counter the V–1 flying bomb and BODYLINE fulfilled a similar function to defeat rockets. The committees were merged in November 1943 under the name CROSSBOW, although reports relating to BODYLINE continued to be produced until mid-1944. The term 'Operation CROSSBOW' is a post-war expression.

2. Collier, Basil (1964) '*The Battle of the V-Weapons 1944-45*' Hodder and Stoughton, pp. 138-50.

3. In this paper, the experimental models of the long-range rocket are referred to as the A4; operational use by the more recognised name of V–2.

4. An official statement by the Prime Minister, Winston Churchill, wasn't made until November 10, 1944, two days after

the German Propaganda Ministry announced the attacks.

5. The A4/V–2 was code-named 'BIGBEN' by the BODYLINE Committee, but frequently referred to as 'Big Ben', 'long-range rocket or 'simply, 'rocket'. Hill para 148; CAB 176/2 'Most Secret' JIC/1737/43 '*J.I.C. BODYLINE Intelligence Machinery*'. The permanent chair of the BODYLINE Committee was Commander Ian Fleming RNVR.

6. Known at the time by its German name of Swinemünde.

7. CAB/81/132 Confidential JIC(48) 33 report dated Oct 20, 1946.

8. Biddle, Wayne (2009) '*Dark Side of the Moon'* W W Norton NY & London, pp. 39-42. Oberth worked at Peenemünde during World War II. Between 1956-1961, Oberth worked with von Braun at the U.S. Army Ballistic Missile Agency, developing multi-stage rockets.

9. Constance Babington-Smith (1957) *'Evidence in Camera'* Chatto & Windus, London, p. 204-5. Initially Duncan Sandys, Chairman of the War Cabinet Committee for defence against German flying bombs and rockets, led the belief that the V–1 'flying bomb' and V–2 missiles were part of the same programme. Although testing of both took place at Peenemunde, they were separate and uncoordinated projects. On p. 207 the V–1s are also referred to as 'airborne rocket torpedoes' (a direct translation of the German name from signals) revealing—inadvertently—knowledge of the rocket programme through signals interception and codebreaking, which was still 'Top Secret ULTRA' when the book was published in 1957.

10. For technical aspects of the search for the V–2, see Robert V Jones (1978) *Most Secret*, Hamish Hamilton, London, pp. 430-61.

11. Dornberger, Walter (1954): V2, Hurst & Blacket, London, pp. 151-68.

12. *Ibid.*, pp. 79-83.

13. *Ibid.*, p. 222.

14. *SS–Obergruppenführer* Kammler (General) Dr-Engineer Heinz (Hans) Friedrich Karl Franz Kammler (1901-1945) was appointed by Hitler in July 1944 to be responsible for all missile technology, including the V–2 ballistic missile programme, and was additionally assigned the grandiose term of 'General Plenipotentiary of the Fuehrer for Jet Propelled Aircraft'. This gave him full control over the production, distribution and utilisation of jet aircraft and vengeance weapons. Kammler, a civil engineer, was infamous for directing construction of the gas chambers and crematoria at Auschwitz concentration camp. His rank (equivalent to General) was an appointment in the SS—he had no military experience and was known for his cruelty. He is thought to have died, possibly by suicide, near Prague in May 1945 (although irrational pro-Nazi conspiracy theorists have suggested that he survived the war and moved to South America—or Antarctica).

15. Dornberger, p. 224.

16. JIC papers regularly refer to Professor 'Linstead', rather than Lindemann, perhaps avoiding awkwardness of his German origins. Occasionally his name is given the more Anglicised 'Linderman'.

17. Known as 'CX' reports.

18. Collier, p. 147.

19. Lindemann was not alone in this view. According to Churchill, the Nazi Armaments Minister Albert Speer deplored the efforts and the waste of resources to produce the V–2. Winston Churchill (2000) *'The Second World War: Volume VI Triumph and Tragedy'* Folio Society, London, p. 45

20. Collier, pp. 138-40.

21. CAB 176/1 J.I.C./492/43 '*German Long-Range Rocket Development*', April 21, 1943.

22. CAB 176/2 *'BODYLINE Targets in Germany'* November 4, 1943.

23. Hill, para 152.

24. Hill, Sir Roderic (1948): *'Air Operations by Air Defence Great Britain and Fighter Command in connection with the German Flying Bomb and Rocket Offensives, 1944-45.'* The London Gazette Supplement October 19, 1948, para 66. https://www.thegazette.co.uk/London/issue/38437/ data.pdf accessed Mar 7, 2019.

25. Collier, p. 404.

26. Andrew, Christopher (2009) *'The Defence of the Realm: The Authorized History of MI5'* Allen Lane/Penguin, London, p. 313.

27. R.V. Jones (1978): *'Most Secret War'* Hamish Hamilton, London, pp. 447-8.

28. Hill, para 163.

29. Churchill claims that the Swedish rocket was to be remotely controlled in tactical trials, but the operator was not expecting the ballistic trajectory, and tried to correct its flight to that of a glider bomb. Analysis of the wreckage did reveal remote-control equipment. Churchill (2000), p. 43.

30. CAB 81/124 *Imminence of Attack by Bigben*. J.I.C (44) 366 (0) dated July 31, 1945.

31. Guy Liddell Diary, vol 10, August 25, 1944. TNA KV 4/194 in Andrew, p. 313.

32. Dornberger's book shows a V–2 being erected into the launch position from special railway wagons (p. 97). Work began in 1942 but it is thought that no operational launches were made; by late 1944 the railway network was very vulnerable to Allied air interdiction, both in search of V–2 rockets but also as part of the wider Allied offensive against German forces. Dornberger, p. 235.

33. Babington Smith, p. 232.

34. Wright, Jerry (2014) *'Zeppelin Nights: London in the First World War'* Vintage Books, London, p. 250. A fascinating read.

35. This alert system would be resurrected in 1955 and initially operated by the Royal Observer Corps (ROC) and then from 1965 by the UK Warning and Monitoring Organisation, also based at Stanmore (RAF Bentley Priory), and would be activated by ROC posts who would launch three 'maroons' to warn of the local approach of radioactive fallout. The system remained serviceable until about 1991.

36. Longmate, p. 128.

37. Collier, pp. 127-9.

38. Hill, paras 220-221; Collier, p. 150.

39. Perhaps the greatest intelligence coup in WW II after breaking the ENIGMA codes was the complete penetration of the German spy network in Britain by the 'Twenty (XX) Committee'. For accounts of the deception associated with the V–2 programme, see John Masterman's official report released in 1972: *The Double Cross System*, Reed, Wellington, pp. 180-183; Keith Jeffrey's official history (2010) *MI6 – the History of the Secret Intelligence Service*, Bloomsbury, pp. 571-2; Andrew, (2009), pp. 310-16. For technical intelligence on the V–2, see Jones, pp. 430-60.

40. Howard, Michael (1990) *'British Intelligence in the Second World War'* vol 5, pp. 182-3, in Andrew, p. 316.

41. Biddle, pp. 142-3

42. Collier, Basil (1957) *'The Defence of the United Kingdom'* HMSO, London, Chap XXV, pp. 418-419.

43. Hill, paras 201-220.

44. Dornberger, p. 248.

45. CAB 81/128 J.I.C (SHAEF) (45) 18 (Final) *'Ability of Enemy to continue to use V-Weapons'*, April 23, 1945.

46. Jones, p. 459.

47. RAF Fighter Command counted 1,115 missiles falling in the UK or within sight of shore. Hill, para 223.

48. Churchill (2000), p. 49.

49. For harrowing contemporary accounts of the V–2 'blitz' against London, see Maureen Walker (2004): *London 1945*, John Murray Ltd, London, pp. 17-71.

50. Part of the German Labour Front, a central economic planning function of the Nazi Party

51. A short-range mortar-type rocket, normally in a multi-barrel arrangement, initially designed to deploy a smoke barrage. From images available, the tests were conducted using 28/32 cm rockets. http://www.uboataces.com/articles-rocket-uboat.shtml accessed March 7, 2019

52. Collier (1957) p. 399.

53. Submarine Launched Ballistic Missiles typically have solid-fuel engines.

54. Dornberger, pp. 231-2.
55. Lundeberg, Philip K (1994). 'Operation Teardrop Revisited' in Runyan, Timothy J; Copes, Jan M: *'To Die Gallantly: The Battle of the Atlantic.'* Boulder: Westview Press.
56. Dornberger, p. 235; picture p. 97.
57. Schulze, p. 54.
58. Dornberger, pp. 236-7. The Nazi nuclear programme was, at best, in its infancy and never posed a real threat, although considerable Allied resources were committed to dismantling the programmes and seizing both research documents and fissile material. Not only did Nazi Germany lack the resources to develop weapons, Hitler appeared to abhor nuclear physics, which he referred to as 'Jewish Science.'
59. Neufeld, Michael J (2007): *von Braun*, Smithsonian Institute, p. 188-9. Piszkiewicz, Dennis (1998) *Wernher von Braun*, Praeger, Connecticut, p. 39.
60. Neufeld, p. 196.
61. Hunt, Bryan (2013); *'The Most Beautiful Barracks in Germany' A History of the Barracks in Oberammergau 1935 – 1975.* Unpub MSS; NATO School Oberammergau.
62. Biddle (2009), p. 129.
63. A complete set of weekly Air Ministry Technical Intelligence Summaries are held by the MOD Air Historical Branch, RAF Northolt, London.
64. During General Dornberger's internment in Farm Hall, Wilton Park and other POW detention centers in England between 1945 and 1947, he disclosed in a secretly-recorded conversation with another German general that he and von Braun had travelled to Lisbon in October 1944 for secret talks with two officials who claimed to be from the General Electric Corporation, about the surrender of all Germany's top scientists to U.S. forces. Although there may have been some bravado on Dornberger's part, and none of von Braun's biographers refer to any visit to Lisbon during the war (an event he was likely to keep quiet), it is most likely that von Braun's surrender was carefully orchestrated.
65. Biddle, p. 129.
66. CAB 81/118 *'German Long-Range Rocket Report'* JIC.
67. Jones, pp. 440-2.
68. CAB 81/93 JIC(45) *9th Meeting Air Intelligence Targets under Russian Control*. Para 8.
69. Andrew, Christopher (2009): *'Defence of the Realm. The Authorised History of MI5.'* Allen Lane, London, p. 173. Blunt (1907-1983) was unmasked by MI5 in the 1950s and publicly exposed in 1979. In Nigel West & Oleg Tsarev (2009) *'Triplex'* Yale University Press, which draws on Soviet archives regarding what documents Blunt *et al* sent to Moscow, there is no mention of him attending this meeting, which is a matter of record. However, Blunt reveals, in material passed to his Soviet handlers and citing a letter between the Swedish Naval Attaché in London and Swedish Naval HQ in Stockholm, the presence of a 'German secret weapon' that could destroy SE England, that would be deployed from November 1943. West & Tsarev, p. 8.
70. Longden, Sean (2009) 'T-FORCE: The Race for NAZI war secrets, 1945.' Constable, London.
71. AVIA 15/2216 minute by DSR May 11, 1945. In Uttley, Matthew (2002) 'Operation 'Surgeon' and Britain's Post-War Exploitation of Nazi German Aeronautics' in *Intelligence and National Security, v17 No 2 (Summer 2002)* pp. 1-26.
72. https://royalsocietypublishing.org/doi/pdf/10.1098/rsbm.1994.0015 accessed March 20, 2019.
73. Neufeld, p. 205. In Thom Burnett's 2005 work, he is erroneously referred to as 'Colonel William Cook'. British investigators reportedly wore uniforms in the field, however Dr Cook never formally served in the British Army.
74. Longmate, p. 376.
75. Burnett, Thom (2005) *'Who Really Won the Space Race?: Uncovering the Conspiracy That Kept America second to the Russians.'* Collins & Brown, London, p. 154.
76. Biddle, pp. 142-3.
77. Longden, p. 273. Von Braun reportedly spent two days at the former *Luftwaffe* airfield at Völkenrode under British guard.
78. Biddle, p. 142. This group did not include the 'father' of the V–2 programme, General Dornberger, but did include the much less experienced brother of Wernher, Magnus von Braun.
79. Piszkiewicz, Dennis (1998*) Wernher von Braun*, Praeger, Connecticut, pp. 50-4.
80. *'Official Report on Operation Backfire'* v 1-5, War Office, London, January 1946, in Becklake, 2014.
81. Longden, pp. 271-4. The Operation *Backfire* reports noted that the V–2 heralded a new type of warfare, but only if the rocket was able to deliver a nuclear warhead.
82. Becklake, John (2006): '*German Rocket Engineers' i*n Astronautic Acta V 49, updated 2011, 2014.
83. https://www.iwm.org.uk/collections/item/object/1060020906
84. Much of what was said by the POWs and captured nuclear and missile scientists at Wilton Park and Farm Hall camps was secretly recorded under Operation Epsilon, and some of the recordings and transcriptions were declassified in the 1990s.
85. Sayer, Ian & Douglas Botting (1984) *'NAZI Gold'*, Granada, London pp. 239, 240. Now the home of the U.S.-run George Marshall European Center for Security Studies, located on the U.S. Sheridan Garrison and coincidentally, where the author's daughter went to school.
86. Uttley, p. 9.
87. The terms Soviets and Russians are synonymous in the reporting, and this convention is followed in this paper.
88. The Soviet title for their equivalent operation to SURGEON was 'OSOAVIAKHIM', an acronym.
89. CAB 81/132 *'Disposal of German Scientists and Russian Activities in connection therein.'* JIC (46) 8(0) January 18, 1946.
90. CAB 81/133 JIC (46) 51 *'Russian Attempts to Entice German Scientists and Technicians from the BRITISH Zone of Germany.'* July 2, 1946.
91. Barrow News, January 12, 1945, in Becklake, 2002.
92. CAB 158/4 JIC (48) 73 (0) *'Employment of Aliens on Defence Work.'* August 3, 1948.
93. Uttley, p. 9.
94. Sir Ben Lockspeiser, previously Director-General of Scientific Research within the Ministry of Supply, was investigated in the 1950s by MI5 because of pre-war Communist associations, according to his 1993 obituary.
95. https://www.mi5.gov.uk/klaus-fuchs accessed March 7, 2019.
96. CAB 176/11 *'Publication of Details of Fall of Shot of V.1 and V.2 Weapons.'* JIC/953/46 July 10, 1946.
97. Becklake, p. 6; Uttley, p. 9.
98. CCGP (45)2, November 1945. www.peoplescollection.wales/item/381651.
99. The Ministry of Supply assessed Dr Johannes Schmidt, amongst others, as an 'active Nazi' during security screening. Uttley, p. 9.
100. Becklake, p. 10.
101. Andrew, p. 325.
102. Cockrocft, Wayne & Roger Thomas (2003) *'Cold War: Building for Nuclear Confrontation 1946 – 1989'*, English, Heritage, Swindon, p. 46.
103. Uttley, p. 12.
104. Longmate, p. 377.
105. Longmate, p. 378.
106. Becklake, p. 12.
107. CAB/129/86 1957 Statement on Defence, March 1957.
108. Cockroft, pp47-51. The US designation for the Thor missile was PGM-17.
109. The United Kingdom's next generation of nuclear warheads, to be carried on the 'Dreadnought' class of submarines from the mid-2030s, will initially use existing US-supplied Trident II D5 missiles, subject to a mid-life upgrade programme. The Trident launch bodies are maintained in the US and there is no domestic military launch body development programme.

SILENT SAVIORS: GLIDERS FOR AMERICAN RESUPPLY OPERATIONS IN NORMANDY, JUNE 1944

Cole A. Resnik

C–47 Skytrain aircraft towing CG–4A glider off an Algerian airstrip, Feb-Jun 1943.

The logistical operations immediately following the invasion of Normandy in 1944 helped Allied forces establish a necessary foothold in France. From those beaches, infantry divisions pushed the Germans to Cherbourg in twenty-four days thanks to supplies dropped by parachute, landed by glider, and sailed ashore by landing craft following D-Day.[1] However, American operations reports gave so much credit to the amphibious resupply missions that they overshadowed the airborne ones.[2] This misconception is common when comparing the volume of equipment delivered by plane versus that delivered by boat from the invasion to the end of the war. Readers of the reports may fail to realize the ineffectiveness of seaborne operations in the week following D-Day. The invasion planners promised to land eight thousand tons of equipment each day on Omaha Beach. Unfortunately, the amphibious resupply missions did not meet expectations until six days after the initial invasion.[3] The need for additional manpower contributed to the slow start. The U.S. Army tasked over five thousand special engineers with clearing obstacles, constructing beach exits, and establishing staging areas necessary for a lodgment.[4] Most engineers landed on the beach under fire, so officers reassigned hundreds of them to infantry roles.[5] In an instant, their objective shifted from building a landing area to fighting the enemy. As a unit historian from the 4143rd Quartermaster Service recalled, "the commander told Lt. Fisher…'It doesn't make any difference what type of organization you may be, there is an urgent need for manpower on this beach,' and [the unit] immediately proceeded shoreward."[6] Consequently, the engineering brigades lacked the personnel needed to clear the beaches by D plus one as planned.

Without a prepared landing area, the Allies delivered only thirteen percent of the planned inventory of vehicles, ammunition, rations, and other supplies during the first four days.[7] At Omaha, infantrymen anticipated fighting with thirty-two thousand tons of equipment; however, only 4,561 tons made it ashore.[8] None of this made it past the front lines, so paratroopers inland acquired equipment elsewhere. Aircraft could not deliver supplies by landing at an airfield, for bombing runs destroyed all within a 150-mile radius.[9] Paratroopers could not wait a week for the completion of a new airfield either.[10] Therefore, the only options remaining were resupply by glider or by airdrop. Historians devote much attention to the glider assault missions on D-Day morning, but resupply missions thereafter contributed more to the success of the airborne divisions and require a closer evaluation.[11] While awaiting the construction of airstrips or the arrival of armored reinforcements following the initial invasion of Normandy, the artillery pieces and ammunition delivered by combat gliders helped outgunned paratroopers of the 82nd Airborne Division hold the surrounding area of Sainte-Mère-Église.[12] Airborne commanders trusted gliders more than airdrops in the aftermath of D-Day because of their ability to deliver heavier equipment behind enemy lines in a precise, cohesive, and timely manner.

Although this project focuses on paratroopers in the 82nd exclusively, it is worth noting that aircraft in three major operations reinforced the 101st Airborne Division around D-Day.[13] However, these missions were much less impactful to them compared to the 82nd. Within hours of jumping, some companies of the 101st linked up with men from the 4th Infantry Division at beach exits. The 82nd, on the other hand, was deeper inland. The need for aerial resupply was much greater for that division, so a better assessment of glider effectiveness lies with them.

The 82nd Airborne Division centered its invasion operations on the French town of Sainte-Mère-Église. The town marked the center of a web of roads that connected other villages in the Cotentin Peninsula. Before reaching Sainte-Mère-Église, an army would need to pass over the Merderet River on bridges at La Fière and Chef-du-Pont. Although the town itself was an important objective, capturing both bridges was crucial. If American paratroopers did so, they could slow German reinforcements coming north from Cherbourg or west from Brittany. This seven-mile buffer zone protected the vulnerable amphibious infantrymen coming ashore. Therefore, in the morning hours of June 6, the 82nd dropped in and around Sainte-Mère-Église.

Despite the element of surprise, a division of soldiers with small arms could not sustain a fight with the battle-hardened German tank and panzer battalions that lurked nearby Sainte-Mère-Église. The average paratrooper landed with an M1 Garand, an M1911 pistol, a knife, extra ammunition, three days of rations, a few explosives, and other personal gear if their leg bag remained attached after the jump.[14] Some dropped with mortar tubes and bazookas, but these soldiers lacked the firepower necessary to compete with an armored enemy on a consistent basis.

The initial lack of firepower proved troublesome for units like the 505th Parachute Infantry Regiment. In order to hold Sainte-Mère-Église, the paratroopers needed command of the surrounding road network that crossed the Merderet River. Of the two bridges, the 82nd tasked the 505th with seizing the one at La Fière. The bridge was incredibly valuable. Designed like a bottleneck, it acted as a natural defensive mechanism by forcing the invader to concentrate its forces. Later, they hoped to meet the 4th Infantry Division there, for its tanks would cross the bridge and reinforce the paratroopers.[15] Unknown to the 505th, reinforcement was days away: the 4th Division spent D plus one on the beachhead where they would gain only two thousand yards.[16] Any confrontation with an armored German battalion without heavy weaponry of their own threatened the success of the 505th. With Allied armored personnel stuck on the beaches, paratroopers required a weapons system that was powerful enough to penetrate tank armor yet light enough for aircraft to deliver behind enemy lines.

Airborne troops admire the graffiti chalked on the side of their glider as they prepare to fly out as part of the second drop on Normandy on the night of June 6, 1944.

In the meantime, paratroopers improvised. They relied heavily on bazookas to counter German tanks early on.[17] Unfortunately, those were not always accessible. In lieu of bazookas, one team used a combination of gammon grenades and Browning machine gun fire to disable an advancing tank.[18] A gammon grenade was a bag filled with plastic explosives, and it required a paratrooper to sneak up close. He would then throw the bag by the strap and pray that it would not detonate prematurely. Risky tactics like that helped the invaders liberate the city that day. Despite the victory, morale dropped as soldiers realized that, without reinforcement, defending the town would cost them their lives.[19]

Fortunately, gliders carrying 57-mm howitzers answered their prayers. Robert Murphy, a paratrooper of the 505th, described these antitank guns as "God-sent gifts [that] were hauled out and put to excellent use against tank battalions."[20] Some paratroopers were so desperate for the guns that they spent hours ripping one out of an orchard after its glider slammed into it.[21] Despite landing thirty-two artillery pieces at dawn of D-Day, only half saw battle. The mangled steel of less fortunate gliders swallowed the rest. By noon of June 6, the 82nd positioned four of these guns at La Fière and two or three on the outskirts of Sainte-Mère-Église.[22] However, as sunlight faded away on D-Day, so did ammunition for the howitzers. Many crews pulled the firing pin from their 57-mm guns and abandoned them

Cole A. Resnik is a Second Class Cadet (or junior) at the United States Air Force Academy. He is pursuing an undergraduate degree in History and Foreign Area Studies with a concentration on the Middle East as well as a minor in Arabic. Apart from his studies, Resnik flies gliders as a certified instructor pilot at the 94th Flying Training Squadron. The squadron is home to the youngest instructor pilots in the Air Force, and it was here that Resnik obtained his inspiration for Silent Saviors. He logged nearly fifty flight hours in the TG–16 since beginning his training in 2019. After graduating from the Academy, Resnik hopes to attend graduate school first for a degree in international relations or history. From there, he wishes to start formal training as a pilot in the Air Force.

CG–4A and Horsa gliders at an English airfield preparing for the Normandy invasion, May 1944; note the application of invasion stripes still in-progress.

as they awaited the arrival of more rounds.[23] Gliders would carry more guns and ammunition to them soon. As crews stuffed the precious cargo into them, the fate of the 82nd now rested on the shoulders of the pilots.

Around 2100 hours on D-Day, nearly two hundred of those pilots anxiously awaited takeoff in an armada of gliders. The mission was crucial, but thankfully, their aircraft could carry the load required. Despite their plywood floor and steel-tube frame, these engineless aircraft could carry thousands of pounds of precious equipment from the sky down to the battlefield. The American-produced Waco CG-4A glider could haul 4,060 pounds of supplies.[24] With that load capacity, pilots crammed the glider with different combinations of men and equipment. Typically, gliders carried fifteen infantrymen with gear or a quarter-ton truck and six-man crew.[25] At times, a one-ton ammunition trailer or a small bulldozer accompanied the pilots on their mission.[26] The Horsa II could carry twice that load. The British glider could fly with 7,380 pounds stuffed in its fuselage.[27] That equaled twenty-five infantrymen with gear, four motorcycles complete with eight troops and equipment, or a one-ton supply trailer attached to a quarter-ton Jeep.[28]

The resupply mission, nicknamed "Elmira," was simple: the 176 gliders hooked to C-47s would depart England, fly to the coast of France, and disconnect from their tow planes near the beaches at Normandy. From there, pilots needed to spot the landing zone in darkness, establish a proper approach to miss the abundant debris, and touch down on speed all while managing enemy fire. If executed properly, the gliders would deliver more of the "the vital 6-pounder anti-tank guns, vehicles (jeeps) and artillery ammunition and bulk supplies that could be obtained in no other way."[29] Two more missions, Galveston and Hackensack, would follow the next morning with landing times at 0700 hours and 0900 hours respectively.

Into the morning, paratroopers watched as 376 gliders from all three missions landed near the village with 57 guns, 81 tons of ammunition, 121 tons of combat equipment, and 161 vehicles.[30] These three deliveries quadrupled the amount of equipment delivered by glider at dawn of D-Day. Most importantly, the influx of more artillery equipment kept the 82nd fighting for days. In fact, in the midst of the landings during the morning of June 7, two tanks from the German 91st Air Landing Division advanced on Sainte-Mère-Église from the north on a road leading to Neuville-au-Plain. Both posed a threat to light airborne infantry units barricaded in buildings across the village. Without hesitation, paratroopers utilized an antitank gun to disable the lead tank. The second one was a sitting duck, and another gun crew made quick work of it.[31] The credit for these kills does not entirely belong to the crews themselves: a portion of it belongs to the brave glider pilots who delivered both guns only hours before the attack.

For the next few days, wave after wave of German counterattacks pounded the town as American supplies dwindled. Thankfully, crashed gliders served as miniature supply depots. If supplies ran thin during battle, Jeeps and tanks would dash away only to return with trailers overflowing with equipment stripped from gliders.[32] The fresh supplies kept the division fighting until their withdrawal on June 11.[33] Ultimately, the glider assault missions of D-Day helped paratroopers survive against an armored enemy whereas the resupply missions helped them win.

Undoubtedly, the preciseness in which pilots landed gliders carrying artillery pieces contributed to the success of the airborne troops behind enemy lines. In comparison to the parachute resupply missions of D plus one, gliders proved more consistent in delivering equipment to the designated area. The airdrop missions attempted to build on the success of the glider assault missions of June 6. Aircraft in Mission Freeport would reinforce the 82nd Division at Sainte-Mère-Église by dropping bundles of ammunition, food, and combat gear. In the morning hours of D plus one, an armada of 208 planes loaded with 234 tons of cargo departed England for Normandy.[34] Poor weather jeopardized the mission from the beginning. Despite favorable reports, the formation encountered ceilings as low as three hundred feet.[35] The weather improved closer to France, and the disorganized formations tightened up. During the chaos, some planes received beacon signals to drop three miles northeast from the designated drop area.[36] The 82nd repositioned the beacon because Germans controlled the proposed drop zone. Half of the aircrews never received the message.[37] Consequently, the 82nd recovered less than one hundred tons on D plus one as many bundles fell into German hands.[38] With forty percent of the promised supplies missing, paratroopers went hungry on D plus two.[39] Fortunately, airdropped equipment followed strict size and weight requirements.[40] Loadmasters could not push quarter-ton Jeeps or one-ton artillery guns out of C-47s, so the paratroopers did not lose equipment of great value.

Gliders in Mission Galveston and Mission Hackensack redeemed the IX Troop Carrier Command by outperforming the airdrops, for their pilots delivered precious antitank guns on target. These daylight glider missions were highly accurate on D plus one thanks to the capabilities of the aircraft and its pilots. First, both the Waco and Horsa models

Troops of 325th Glider Infantry of U.S. 82nd Airborne Division in a Horsa glider, preparing for Normandy, France invasion, in England, May-Jun 1944.

Stripped US Army airborne jeep exiting a Horsa glider, date unknown; note jeep's lack of ends of the front bumper, and some body and fender panels.

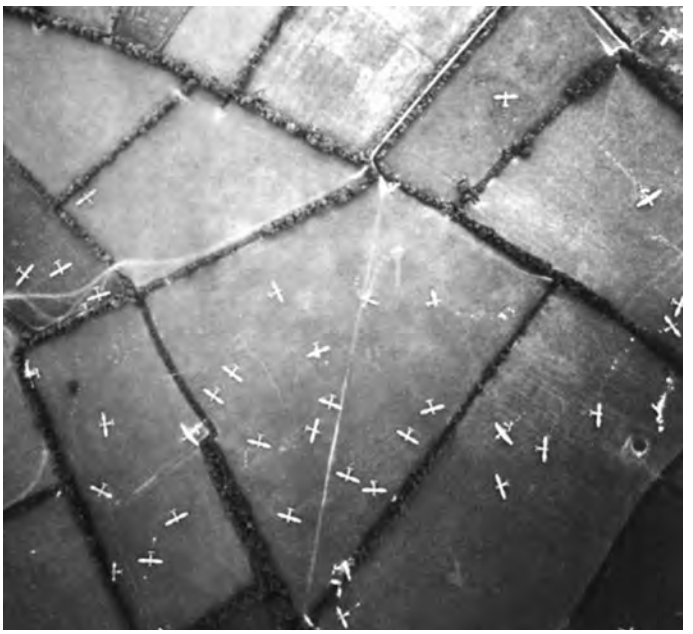
were highly maneuverable. They needed to be, for military strategists wanted gliders to release from tow between two hundred and three hundred feet.[41] At such a low altitude, the aircraft could stay aloft for only thirty seconds, so pilots required a responsive yoke that would allow them to maneuver toward the landing zone quickly.[42] General Henry H. Arnold, Chief of the Army Air Forces, attested to its capabilities. General Arnold recalled watching a Waco land "…about three feet from a man [the pilot] stationed on the runway."[43]

Second, glider pilots were just as capable as their aircraft. Before earning their wings, pilots underwent seventy-two hours of ground instruction and thirty hours of flight training with "…a particular emphasis on spot-landing proficiency."[44] During the resupply missions on D plus one, the conditions tested both the pilot and the glider. After releasing off tow, pilots struggled for control as dense rain and gusty winds slammed against the canvas gliders.[45] The situation was worse on the ground as pools of water, debris, and German infantrymen littered the landing area.[46] This was an unusual case for the pilots of whom many just completed flight school stateside in picture-perfect weather. Despite these complications, over fifty percent of gliders landed within a mile of the designated landing areas near Sainte-Mère-Église.[47] In the last serial to land, "twenty-five…hit the zone, another nineteen were within about a mile of it, and the remaining six were probably not far off."[48] Simply put, the glider missions compensated for the missed airdrops by delivering artillery pieces where paratroopers needed them the most.

The third advantage to gliders is its ability to deliver men and equipment together as a unified force whereas airdrops further displaced the paratroopers. In doing so, the landing party could engage the enemy immediately with the equipment accompanying them. Such tactics were impossible for soldiers dropping by parachute on D-Day. The mistimed jumps displaced almost 80 percent of paratroopers, so many spent the first two days regrouping.[49] This disposition of the airborne divisions curtailed their effectiveness. Additionally, the jump separated operators from their equipment. Some equipment fell into untrained hands. As Murphy remembered, paratroopers raided bundles and would later "…find the rightful owner of the light machine gun, 60mm or 81mm mortar, bazooka or ammunition [they] acquired and make a swap."[50] Until then, the unit was ineffective.

In gliders, operators never lost sight of their equipment. This was devastating to the enemy. As former glider pilot William Knickerboker put it, "We were one hell of an asset when we landed…" together as a unit.[51] The resupply missions near Sainte-Mère-Église proved Knickerboker right. In gliders, the 307th Medical Company landed with medical supplies, the 82nd Signal Company with communications equipment, and the 80th Antiaircraft Battalion with howitzers. As a result, the three units started work immediately: doctors treated the wounded, radiomen reestablished communications with forces on the beach, and gun crews built new batteries.[52] Even isolated, a single glider crew was a formidable force. For instance, upon landing, Technical Sergeant Shimko and his glider team were ready for combat. According to him, within minutes, they "…unloaded the glider and put the equipment and ammunition in hedge rows in the area where we took up a defensive position."[53] Pairing equipment with its trained operator paid dividends for the airborne. While paratroopers attempted to piece together the unit in the hours after landing, glider crews were confronting an armored enemy with artillery immediately.

This cohesion saved valuable time in the field. Unlike airdrops, glider crews could find, unload, and use their artillery pieces within minutes to reinforce outgunned paratroopers. Leading up to the arrival of gliders, paratroopers wasted time searching for airdropped supplies. Upon regrouping, units would send men to recover cargo bundles. As noted earlier, many of these bundles landed miles away from the paratroopers. Additional time spent locating and unpacking them endangered the lives of soldiers on the beach who relied on the airborne to capture certain objectives by specific times. Even acquiring the means of transporting the equipment back was troublesome. Only forty-seven jeeps reached France by glider on D-Day, and most were inoperable after crash landings.[54] Some paratroopers resorted to stealing German vehicles.[55] Driving



CG–4A and Horsa gliders littering Normandy fields amongst the hedgerows, France, Jun 1944.

along the French countryside, they were magnets to friendly fire. After realizing the costs of retrieving air-dropped cargo far outweighed any potential gain from the equipment encased, paratroopers began ignoring them.[56]

Compared to the airdrops, the glider resupply missions did not steal precious time away from the paratroopers. In fact, most glider crews could unload the equipment within minutes. The glider design saved crews valuable time. In the Waco, a pulley system lifted the nose of the aircraft; in the Horsa, explosive charges would remove the tail section when detonated. The quickness in which units disembarked even surprised the Germans. One glider landed under the muzzle of a German 88-mm gun. Before it could fire on the stationary aircraft, "…its crew calmly got out, raised the nose, and unloaded a jeep into which they packed their equipment."[57] Crews could even salvage equipment out of crashed gliders in a quick manner. One managed to unearth a buried jeep in thirty minutes.[58] On D plus one, this expedience was crucial to paratroopers bunkered down around Sainte-Mère-Église. In fact, a single glider immediately reinforced a platoon outnumbered five to one.[59] Thanks to a precise landing, the glider crew unloaded a 57-mm antitank gun and ammunition on the American position. According to reports, this gun neutralized the enemy force.[60] The fast response and unloading times of the glider crews relieved paratroopers in a way that was impossible by airdrops.

During the first week of operations in Normandy, combat gliders pulled the most weight. Unlike airdrops, gliders could deliver a combat-ready unit on time and on target. Additionally, the glider resupply missions of D-Day onward brought essential weaponry and ammunition to help an airborne division capture positions defended by an armored enemy. Such tonnage was impossible to drop by air at the time. Moreover, the advantages to gliders far outweighed the disadvantages to airdrops. First, airdrops

82nd Airborne troops load a 75mm howitzer into a CG–4A Troop Glider during training at Oujda, French Morocco, North Africa a month before the Sicily invasion, Jun 11 1943.

were inaccurate. Parachute resupply missions landed cargo miles away from the designated drop zone, and the enemy recovered several bundles. Gliders experienced far more success. Despite crash landing, over half of glider pilots in a given mission stopped their aircraft within a mile of the appropriate zone. Such accuracy relieved the paratroopers immediately. Second, paratroopers lost equipment on the jump. Operators who received specific training did not have access to the gear they needed for the first hours of the invasion. Meanwhile, the same operators on gliders never lost sight of their equipment. Upon landing, they put it to use. Third, airdrops wasted time. To recover a single bundle, paratroopers stopped operations to locate it, unpack it, and haul it back. The cohesiveness in the glider saved time. On the ground, many crews unloaded their equipment and started fighting within minutes. For historian Roland Ruppenthal, "The efficiency of a logistic system must be measured not only in terms of the certainty and promptness of resupply which it insures, but also by the freedom of action it allows the field forces."[61] Using that logic and the argument presented above, the combat gliders used to reinforce the 82nd Airborne in Normandy did so in the best way imaginable. ■

Reinforcements of men and equipment moving inland at Omaha Beach, Normandy, June 8, 1944.

1. Theater Service Forces, European Theater, "Broad Phases of Organization and Operation for Supply," November 1, 1945, operational study no. 13, box 331, Record Group 407: World War II Operations Reports, 1940-1948, National Archives, Washington, D.C.
2. *Ibid*.
3. Craig L. Symonds, *Neptune: The Allied Invasion of Europe and the D-Day Landings* (New York: Oxford University Press, 2014), p. 317.
4. "Planning Directive for Overlord," February 3, 1944, 5th E.S.B. Overlord Plans (1) folder, box 553, Fifth Engineering Special Brigade, 1943-1945, Papers, U.S. Army: Unit Records, 1940-1950, Dwight D. Eisenhower Presidential Library, Abilene, KS; Gordon A. Harrison, *Cross-Channel Attack: U.S. Army in World War II: The European Theater of Operations* (Washington, D.C.: U.S. Department of the Army, Office of Military History, 1950), p. 336.
5. Walter B. Smith, "Field Force Logistics: 12th Army Group, G-4 Section," box 46, Series IV: Army Operational Unit, Walter Bedell Smith Papers, Dwight D. Eisenhower Presidential Library, Abilene, KS.
6. Commanding Officer, 4143rd Quartermaster Service Company to Commanding Officer, 5th Engineering Special Brigade, September 5, 1944, 5th E.S.B. History, June 1943-October 1944 folder, box 553, Fifth Engineering Special Brigade, 1943-1945, Papers, U.S. Army: Unit Records, 1940-1950, Dwight D. Eisenhower Presidential Library, Abilene, KS.
7. Symonds, *Neptune: The Allied Invasion of Europe and the D-Day Landings*, p. 308.
8. *Ibid*.
9. Samuel T. Moore, *Tactical Employment in the U.S. Army of Transport Aircraft and Gliders in World War II* (Washington, D.C.: Army Air Force Historical Office, 1946), p. 9.
10. David C. Johnson, *U.S. Army Air Force Continental Airfields (ETO) D-Day to V-E Day* (Maxwell AFB, Ala.: U.S. Air Force Historical Research Agency, 1988), p. 5.
11. Cornelius Ryan, *The Longest Day* (New York: Simon & Schuster, 1959); Stephen A. Ambrose, *D-Day: June 6, 1944: The Climactic Battle of World War II* (New York: Simon & Schuster, 1994). Both well-known D-Day historians fail to mention the glider resupply missions in the depth required probably due to its dry subject matter.
12. Moore, *Tactical Employment*, p. 23.
13. Operations include gliders in Mission Chicago and Mission Keokuk on D-Day and airdrops in Mission Memphis on D plus one.
14. Robert M. Murphy, *No Better Place to Die: The Battle for La Fiere Bridge: Ste, Mere-Eglise, June 1944* (Drexel Hill, Penn.: Casemate, 2009), p. 31.
15. *Ibid*., p. 35.
16. Harrison, *Cross-Channel Attack*, p. 341.
17. Marcus Heim, interview by Pat O'Donnell, transcript, accessed April 28, 2020, http://www.thedropzone.org/europe/Normandy/heim.html. Heim and Peterson helped destroy the first three tanks approaching the bridge with bazookas.
18. Murphy, *No Better Place to Die*, p. 69.
19. "Unit Journal 325th Combat Team," June 10, 1944, reel 56, box 10, U.S. Army, 82nd Airborne Division: After Action Reports, 1943-46, Dwight D. Eisenhower Presidential Library, Abilene, KS. This statement is an inference based on a report indicating that artillery presence boosted morale.
20. *Ibid*., p. 46.
21. Milton Dank, *The Glider Gang: An Eyewitness History of World War II Glider Combat* (Philadelphia: J.B. Lippincott Company, 1977), p. 125.
22. *Ibid*.
23. Murphy, *No Better Place to Die*, p. 74.
24. "AAF Glider Model CG-4A," May 16, 1944, folder 1, box 9, William C. Lazarus papers, Clark Special Collections, McDermott Library, United States Air Force Academy, CO.
25. *Ibid*.
26. "CG-4A Waco," folder 1, box 9, William C. Lazarus papers, Clark Special Collections, McDermott Library, United States Air Force Academy, Colo.
27. Dank, *The Glider Gang*, p. 194.
28. "Glider Model Horsa II," May 24, 1944, folder 1, box 9, William C. Lazarus papers, Clark Special Collections, McDermott Library, United States Air Force Academy, Colo.
29. John A. McQuillen, "American Military Gliders in World War II in Europe" (PhD diss., Saint Louis University, 1975), p. 197.
30. John C. Warren, *Airborne Operations in World War II, European Theater* (Maxwell AFB, Ala.: U.S. Air Force Historical Research Agency, 1956), pp. 65-72.
31. Murphy, *No Better Place to Die*, pp. 95-96.
32. *Ibid*., pp. 119, 123.
33. *Ibid*., p. 100.
34. Warren, *Airborne Operations*, p. 75.
35. *Ibid*.
36. *Ibid*., pp. 75-76.
37. *Ibid*., p. 76.
38. Murphy, *No Better Place to Die*, p. 92.
39. Warren, *Airborne Operations*, p. 75.
40. Charles J. Masters, *Glidermen of Neptune: The American D-Day Glider Attack* (Carbondale, Ill.: Southern Illinois University Press, 1995), p. 4.
41. Warren, *Airborne Operations*, p. 70.
42. *Ibid*.
43. James E. Mrazek, *The Glider War* (New York: St. Martin's Press, Inc., 1975), p. 108.
44. Billy J. Singleton, "Silent Wings over Mobile: The 18th Army Air Forces Glider Training Detachment," *Alabama Review* 57 (January 2004): p. 70.
45. John L. Lowden, *Silent Wings at War: Combat Gliders in World War II* (Washington, D.C.: Smithsonian Institution Press, 1992), p. 72.
46. Warren, *Airborne Operations*, p. 71.
47. *Ibid*., pp. 70-71. The calculated percentage originated from landing data during Mission Galveston and Mission Hackensack as reported in the listed pages.
48. *Ibid*., p. 71.
49. *Ibid*.
50. *Ibid*., p. 46.
51. William D. Kinckerboker, "Few Aware of Gliders' Role, Says Ex-Pilot," interview by author, *Lamesa-Press Reporter*, August 23, 1987, folder 9, box 396, William D. Knickerboker papers, Clark Special Collections, McDermott Library, United States Air Force Academy, Colo.
52. *Ibid*.
53. Edward W. Shimko, interview by Charles A. Carrell, June 1944, transcript, in "Men of D-Day," accessed January 29, 2020, http://www.6juin1944.com/veterans/shimko.php.
54. Masters, *Glidermen of Neptune*, pp. 51-52.
55. Murphy, *No Better Place to Die*, p. 213.
56. Masters, *Glidermen of Neptune*, p. 4.
57. Dank, *The Glider Gang*, p. 132.
58. *Ibid*., p. 121.
59. Roland G. Ruppenthal, *Utah to Cherbourg, 6-27 June 1944*, ed. Gordon Harrison (Washington, D.C.: U.S. Army Center of Military History, 1990), p. 40.
60. *Ibid*.
61. Roland G. Ruppenthal, "Logistical Planning in Overlord in Retrospect," box 1, Series I: Observance of June 6-7, 1969, Material Regarding 25th Anniversary of D-Day, 1969, Dwight D. Eisenhower Presidential Library, Abilene, Kans.

Minutemen and Roentgens: A History of Civil Air Patrol's Aerial Radiological Monitoring Program

Jayson A. Altieri

CAP Aircrews Training on Radiological Monitoring Equipment circa 1950's. *(CAP photos.)*

When one thinks of U.S. Air Force Cold War era aircraft, images of the Strategic Air Command's B–52 *Stratofortress*, B–58 *Hustler*, and B–36 *Peacemaker*, made famous by classic Hollywood films like *Dr. Strangelove*, *Fail Safe*, and *Strategic Bomber Command,* usually come quickly to mind. What is less well known are the roles that smaller aircraft like the Cessna L–19/O–1 *Bird Dog*, Cessna 172/T–41 *Mescalero*, and Stinson L–5 *Sentinel* played in helping prepare and respond to a possible nuclear attack on the American homeland by actively measuring radioactivity levels in roentgens, mostly through the efforts of the volunteers of the U.S. Air Force's Auxiliary, known as the Civil Air Patrol (CAP).[1] While today, CAP's primary operational missions concentrate on inland air search and rescue, aerial disaster assessment, and flight training for the organization's Cadet program, CAP's earlier roles following the Second World War involved supporting the nation's Civil Defense through Aerial Radiological Monitoring (ARM) and post-attack damage assessments of cities and key economic infrastructures. Founded on December 1, 1941, with the help of American airpower proponent Gill Rob Wilson, Texas Oilman David Harold Byrd, and New York Mayor Fiorello H. LaGuardia, the latter in his capacity as the Director of the Office of Civilian Defense, the CAP was originally formed to help supplement American military operations as an Auxiliary of the United States Army Air Forces in the early stages of the Second World War.[2]

Early in the war, as part of America's Civil Defense coordinated by the Council of National Defense, civilian non-combatant volunteers were asked to help supplement local governments and military commands based across the country with Air Raid Wardens, Auxiliary Firemen, Road Repair Crews, and Civil Air Patrols along the U.S. Atlantic and Gulf Coasts.[3] Initially using privately owned aircraft and equipment and operating from local private and publicly owned airfields, CAP volunteers became known as the *Flying Minutemen*, performing a number of wartime missions include Anti-Submarine patrols, border patrols, target towing, and messenger services.[4] By the end of the war and with the formation of an independent U.S. Air Force, President Harry Turman, signed in 1946 the congressionally approved *Public Law 79-476* establishing the CAP as both a Federally charted corporation and later in 1948, *Public Law 557* making CAP the U.S. Air Force's Auxiliary.[5] By this time, both the United States and CAP were now engaged in another war, though involving less actual conflict, none-the-less still presented an existential threat to the nation—The Cold War.[6]

U.S. Civil Defense in the Cold War

As the Cold War became a serious challenge to the United States in the late 1940's, the Defense Department began framing their missions to deal with the new threat posed by the Soviet Union, in particular its ability to develop and

CAP Florida Wing Officers and Cadets training with Radiological Monitoring Equipment circa 1970s. ***(CAP photo.)***

deploy nuclear weapons. In planning for a possible nuclear war, according to American planners, the United States would be especially vulnerable since so many of its industrial and economic centers were clustered along the east and west coasts.[7] While the U.S. Army, Air Force and Navy Departments were coming to terms with how to best employ their forces in the delivery of America's nuclear arsenal and/or defend against a Soviet nuclear attack, the Office of Civilian Defense (OCD), which had ceased operations in 1945, was reactivated in 1950 with President Truman's signing of the *1950 U.S. Civil Defense Act*, which assigned responsibility for nuclear survival plans to state and local authorities.[8] The threat to the homeland was considered very real and federal, state, and local preparations, in places like New York City, included plans on how to communities and critical industries would survive and continue to operate after a nuclear attack on America. This concept of surviving a massive attack on the United States was not as radical an idea as some today may believe, as nuclear weapons and energy programs were considered just another diplomatic, informational, military, economic tool of America's post-war power in the 1940's, 50's, and 60's.[9] Additionally, during the Second World War, experience had shown that advanced industrial nations like Great Britain and Germany, not only survived a systemic and extended strategic bombing campaigns on their cities and economic bases, but in some cases managed to increase production capacities of essential war-time products and materials.[10] As New York City Mayor Vincent Impellitteri stated during a 1950 Senate Armed Services subcommittee meeting, "industries [must not] be permitted to slacken because of an actual or threatened enemy attack, including atomic bombing."[11]

Although the argument by many civil defense planners was made that conventional bombing and nuclear bombing (atomic or hydrogen) produced the same immediate results; the radioactive after effects of nuclear weapons presented the biggest obstacle to a national post-attack recovery plan. To address this challenging environment, systemic assessments of the radioactive contamination was necessary to ensure the nation's population and economy could recover. Even before President Truman signed the legislative act that created our modern civil defense program, America's need for special radiological instruments for civil defense had been recognized. In December 1950, letters signed by James J. Wadsworth, an official in the Executive Office of the President, had been sent to State Governors encouraging them to obtain such instruments.[12] Later, the Federal Civil Defense Administration offered to pool the State orders to obtain more favorable prices through procurement in quantity.[13] All procurement costs were to be the responsibility of the states, but by December 1960, the Office of Civil Defense Mobilization (OCDM) issued an advisory bulletin announcing that federal grants were available to help defer the cost of equipment.[14] But state and local governments weren't the only agencies working to obtain radiological monitoring instruments, as organizations like CAP would add to the demand.

Radiological monitoring was considered an indispensable service to all civil defense organizations and operations. By the early 1960's, in part due to the 1961 Berlin and 1962 Cuban Missile Crises, OCDM would recommend the establishment of a nationwide network of 100,000 (later increased to 150,000) monitoring stations to provide radiological dosage information for survival and recovery actions at the state and local levels.[15] In the event of a nuclear attack, these trained monitors would have been required to furnish information essential for the protection

Colonel Jayson A. Altieri, USA, (Ret.), began his military service in 1984 as an enlisted Soldier in the 101st Airborne (Air Assault) Division and served for 33 years before retiring as the Chief of Staff of the Army's Chair, National War College, Fort Lesley J. McNair, Washington, D.C. He is a graduate of Norwich University, the U.S. Air Force's Air Command and Staff College and School of Advanced Air and Space Studies, and the U.S. Army War College. Jayson has been an active member of the Civil Air Patrol (CAP) for the past 41-years and previously served as the CAP Board of Governors Chairman from 2015-2017. A contributing author to a number of aerospace and military publications, his current book, A Guest of Mr. Lincoln: The Wartime Service of Sergeant Joseph H. Wheeless, 32nd North Carolina Regiment, CSA*, will be published in 2021. He currently serves as an Assistant Professor of Leadership at the Air University, Maxwell Air Force Base, Alabama.*

CAP L–3B Aeronca circa 1950's. ***(CAP photo.)***

CAP T–34 circa 1960s. ***(CAP photo.)***

of people and equipment in a post-attack environment. According to the OCD's *Handbook for Radiological Monitors*, *FG-E-5.9*, dated April 1963,

Monitoring services will be required from the period shortly after a nuclear attack until the radiological hazard from fallout diminishes to the point that normal activities may be resumed without significant danger to the population or a community.[16]

By the mid-1950s, through tests like *Civil Effects Test Project 38.1*, OCD realized that light aircraft owned by private individuals and business corporations flying at low altitude and slow speeds were perfect for these type of post-nuclear attack radiological surveys.[17] [18] The volunteers of CAP, and their fleet of light aircraft, some owned by the corporation and the majority by the members themselves, were a perfect fit for this type of mission and were soon tasked by the U.S. Air Force to begin implementing an ARM program. To help facilitate the cooperation between CAP and state level civil defense agencies, documents like the *Long-Range Plan for Civil Air Patrol, CAP-LRP-1*, dated 1962, were created by CAP and USAF officials in accordance with the *Civil Defense Act of 1950*.[19] This document outlined the duties and responsibilities of CAP Wings in supporting state recover efforts in both peace disasters and wartime attacks.[20]

CAP Aircraft and Aircrews

CAP's roots before the Second World War were based in the concept that civilians, using privately owned light aircraft, could serve their county by playing a role in domestic aerial security as envisioned by the previously mentioned Gill Rob Wilson. This idea was successfully implemented during the Second World War, and helped establish CAP's professional reputation as a useful tool for America's internal defense. With the General Aviation community (known then as General Utility Aviation) becoming one of the largest and fastest growing aerospace sectors of America's post-war economy, by 1953, light civilian aircraft accounted for over 13,000 of the aircraft in the United States.[21] In 1966 the number general aviation aircraft grew to 90,000 and in 1976, still at the height of the Cold War, the number of light civilian aircraft grew to more than 176,000.[22] [23] For civilian defense planners, this was an asset that could not be overlooked during national post-nuclear attack recovery. The CAP air fleet during this period consisted of a variety of single-engine and twin-engine aircraft, many surplus military aircraft sold to the public or donated to CAP after 1945.

Among the CAP's surplus military fleet available for use during a post-attack assessment were U.S. Army and Air Force surplus single-engine airplanes like the Beechcraft T–34 *Mentor*, Cessna L–19 *Bird Dog*, Cessna 172/T–41 *Mescalero*, Piper J–3 *Cub*, and Stinson L–5 *Sentinel* aircraft. These platforms, many which had seen service during the Second World, Korean, and Vietnam Wars were primarily designed as forward observation, communications, and trainer aircraft. Cessna's L–19 and 172/T–41 aircraft were particularly numerous and popular among CAP aircrews for their reliability and suitability when operating from remote locations or grass airstrips. Typical of the period, the L–19 was first flown in 1949 to meet a U.S. Army requirement for a two-place liaison airplane which could be used for close air support for ground troops and artillery units.[24] Originally, equipped with a 213-horsepower Continental 0-470-11 engine, with a high-wing and single-slotted flaps, the *Bird Dog* was well suited for both slow flight and small airfields. Over 3400 were built between 1950 and 1959, making it one of the most common aircraft operated by CAP until the mid-1980s.[25]

On the other end of the spectrum were the aircraft owned by CAP members, which included both single and multi-engine aircraft. The variety and types of single engine aircraft spanned complex aircraft like the 300-horsepower, 6-seat Beechcraft V-Tail Model 35 *Bonanza* to the 160-horsepower, 4-seat Piper PA–22 *Tri-Pacer*. Twin engine airplanes of the period were also made available to CAP by its members and included aircraft like the 450-horsepower Beechcraft Model 18/C–45 *Expeditor*.[26] While not as suitable for low-level ARM missions, these twin-engine aircraft would have served a useful role for higher altitude surveys or as communication aircraft passing along the results of surveys conducted by the slower single engine fleet to Civil Defense officials in areas unaffected by a nuclear attack.

The Mission Pilots and Monitors (the official term for the observer conducting the survey) flying these missions

CAP L-5 Stinson during Operation Cue, Nevada Test Site, May 5, 1955. ***(CAP Photo.)***

were as varied as the aircraft they flew. Many were former military pilots with aerial combat experience dating back to the Second World War, but most were simply Private pilots, men and women who had a desire to serve their country on a part-time basis in peacetime and full time during a national emergency. This make up of aircrews is a key feature of CAPs demographics dating back to its founding in 1941. According to the OCD *Handbook of Aerial Radiological Monitors*, *FG-E-5.9.1*, dated July 1966, the primary duty of the radiological survey team was,

To provide the timeliest analysis and evaluation of the radiological hazard. Since members of the aerial survey team are required to operate under conditions of varying hazards, they must be thoroughly training in their function. Pilots and aerial monitors should be chosen from among the best qualified personnel. In addition to the requirement that aerial monitors be trained as regular monitors, all team members should participate in operational training exercises in aerial survey techniques.[27]

CAP aircrew members who flew these potentially dangerous missions, were expected to be fully trained and certified under the requirements of *CAP Manual 50-15, Emergency Services Procedures* and *CAP Manual 55-1, Operational Missions* in CAP's OPLAN 1000 (CAP support to the National Command Authority); Air Search and Rescue techniques; Communications; and have a foundational understanding of Civil Defense Preparedness, Radiological Instruments, Monitoring Operations and Techniques.[28] [29] Mission Pilots were still required to meet and maintain Federal Aviation Administration aircraft and pilot currencies. CAP awarded members who completed these training requirements were awarded a special CAP Aerial Radiological Monitor patch, complete with the trefoil or international radiation symbol, to be worn on right sleeve of flight suits, jumpsuits, and fatigue uniforms.[30]

In addition to the aerial survey's requirements, CAP aircrews and their supporting ground personnel had to be knowledgeable in radiation personal protective measures against Alpha and Beta radiation fallout including washing exposed skin, keeping outer clothing buttoned and zippered to reduce exposed skin exposure, covering the head with a hat or piece of cloth or newspapers, wearing boots or rubber galoshes, and brushing clothes and shoes regularly to remove fallout particles.[31] Similar measures were used to protect CAP aircraft and vehicles including or parking in hangars and garages or using cloth or plastic tarps to protect equipment against fallout and allow accurate radiation surveys.[32] Against Gamma radiation particles, little could be done, beside monitoring dosage levels and minimize exposure time through appropriate shielding or distancing.[33]

Radiological Survey Equipment

In order to conduct the type of aerial radiological surveys envisioned by the OCD, specialized measuring equipment was developed and manufactured by companies like Bendix, Landsverk, and Victoreen.[34] These survey instruments were divided into two classes: (1) Survey meters for measuring gamma dose rates in roentgens per hour (r/hr) or milliroentgen per hour (mr/hr), and (2) dosimeters for measuring exposure doses in roentgens (r).[35] These instruments included the Low Range (beta-gamma) Radiological Survey Meter or "Geiger Counter", CDV-700; the High-

CD CDV-700 Monitoring Equipment. ***(FEMA photo.)***

CD CDV-720 Monitoring Equipment. ***(FEMA photo.)***

Range (gamma only) Radiological Survey Meter, CDV 710 and 715 models; the individually worn Radiological Dosimeters, CDV 730 and 740; the Radiological Dosimeter Charger, CDV-750, and Aerial Survey Meter, CDV-781, Model 1.[36] The majority of this equipment was designed to be used at ground level monitoring stations like fallout shelters, high schools, and hospitals.[37]

The use of the ground measuring instruments like the CDV-700, 710, and 715 Survey Meters and the CDV-730 and 740 Dosimeters would have been vital for determining locally the amount of personal radiation exposure allowable and still support post attack recovery operations.[38] Additionally, the frequent monitoring of specific areas, facilities, and equipment like airfields and hangars, aircraft and vehicles, food and water, and large-scale decontamination sites was necessary to ensure long term national recovery. The CDV-700, 710, and 715 series instruments, while designed for ground use, were also considered suitable as an interim aerial survey instrument.[39] While the survey instruments measured contamination of personnel, equipment and facilities, the CDV 730 and 740s were designed to measure the total amount of personal radioactive exposure.[40]

The more critical item of equipment for the aerial survey aircrews was the CDV-781 Aerial Survey Meter which consisted of four major components: the detector unit, the metering unit (used to actually indicate the radiation levels), the magnetic reel tape recorder, and the simulator unit.[41] Each kit came with a comprehensive instruction and maintenance manual designed to help the monitor install in the device in the aircraft and use during the planned survey. The kit's tape recorder included 5-magnetic reels and a throat microphone allowing the aircrew to verbally record the metering units' results.[42] Power for the entire kit could be provided via the metering unit's battery supply (usually D-cell batteries) or via the aircraft's own electrical power source.[43] Depending on the type of aircraft used, a two place inline aircraft like the Stinson L–5 or a tractor type seating arrangement like the Cessna-172/T–41, the metering unit could be mounted on the back of the pilot's seat for the rear seat monitor to observe or on a monitor's lap or knee board if sitting beside the pilot.[44] The author recalls from his early CAP day's in the late 1970's and 80's, some owners of private CAP aircraft had an inch-and-a-quarter hole cut in the bottom of the fuselage with a rubber grommet around the hole which allowed a CDV-700, 710, or 715 survey probe to be inserted and thus allowing for a safer monitoring of the surrounding contaminated environment.[45]

Along with the measuring equipment, the aircrews were also issued an Aerial Radiological Survey Data Sheet, OCD Form 843, dated March 1966.[46] This form was to be used to report the location, altitude, instrument readings, and times the survey were conducted. Additionally, when LORANs were not installed in most privately owned aircraft and GPS had yet to be invented, the type of map and scale used for the survey was also considered critical in helping state and local authorities determine the amount of radioactivity in a given geographical area. Data requirements for each survey would have been dictated based on the purpose of each assessment including the extent of the blast and fire damage, as well as the surveyed radiation rates. This information was to have been collected based on OCD established aerial monitoring principles and survey techniques.

Survey Principles and Techniques

To ensure the most effective use of the Aerial Radiological Survey assets, a number of monitoring principles were developed to ensure some degree of success. The principles included: Emergency Utilization of Aircraft, Accuracy of Data, Definition of Contamination Patterns, Correction Factor Determination, Optimum Survey

CAP Pilot Coordinating with local NY Civil Defence Officials, 1960. ***(CAP photo.)***

Height, Optimum Survey Speed, Data Requirements, and Aircraft Contamination.[47] Additionally, due to the chaotic nature of a post-nuclear attack environment, and associated hazards, aerial radiological survey flights were to be conducted, according to the *Handbook for Aerial Radiological Monitors*,

In coordination as required with the Federal Aviation Agency (General Aviation District Office), State Aviation Administration, State Transportation Agency, and other governmental agencies as appropriate under state regulations. The plan developed should be in consonance with the Security Control of Air Traffic and Air Navigation Aids (SCATANA) plan and the FAA State and Regional Disaster Airlift (SARDA) planning circular. The capabilities of organized flight groups, included the Civil Air Patrol, should be considered in the development of the plan.[48] [49]

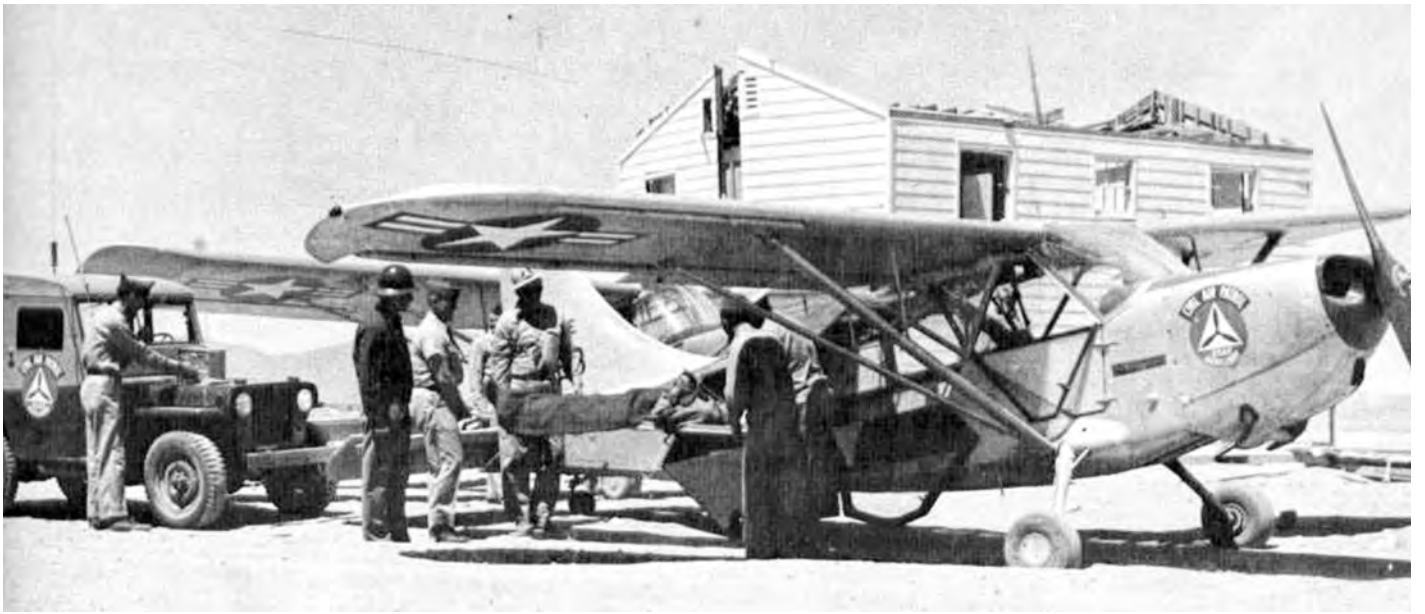
Once the ARM team was deployed, a few of the aforementioned survey principles would have to be considered. As an example, the aircrew would have to fly at survey heights as low as 300' to 500' in order to yield adequate survey data and ensure the safety of the aircrews from ground contamination.[50] Because the survey results taken at altitude would not reflect the same as "surface measurements" made a 3' above the surface, the readings taken aloft were to be corrected using a "Height Correction Factor" chart supplied in an appendix of the handbook. Aircraft speeds were also a factor and the somewhat lower speeds of Cessna and Stinson type aircraft would be more appropriate for a fairly detailed survey of an area.[51] The slow speeds were necessary to account for the recording lag times of some radiation survey instruments like the CDV-715, which could be up to 9-seconds.[52]

The slower airspeeds also allowed the aerial surveys to utilize one of four standardized survey techniques patterns based on circumstances. These patterns included the Course Leg Technique, Route Technique, and the Point Technique.[53] [54] All of these patterns were expected to be flown under Visual Flight Rules. The Course Leg Technique was designed to conduct a systematic survey of large geographical areas using readily identifiable checkpoints.[55] The Route Technique, was like the Course Leg Technique, was to be flown between identifiable checkpoints, but with a focus on highways, railroads, and powerlines.[56] Third, the Point Technique, which focused on specific prominent landmarks or manmade structures easily identifiable from the air, but only if the landmark still existed.[57] Finally, a fourth type of survey technique, the Exploratory or "Hasty" survey was a combination of the aforementioned three survey techniques and was planned to be conducted near ground zero (the point of a nuclear weapons detonation) in the early post attack period when the radiation dose rate was high and blast damage or fires might be extensive, obliterating many landmarks and manmade structures.[58]

At the completion of the aerial survey, a post-survey briefing was expected to take place between the mission planners and the survey teams. Distance or potential radiation exposures, however, may have required the aircrews to use telephones or radio communications to complete the debrief.[59] In some cases, due to contamination of aircrews or overloaded communications links, the survey reports and tape-recording reels could be airdropped in a conspicuously marked container to a local or state Emergency Operations Center. Finally, the aircraft upon returning to base was expected to be decontaminated by CAP ground personnel using water and detergent or an organic solvent such a kerosene to help reduce the contamination.[60] Areas of concern during decontamination, where significant amounts of fallout could collect, included air ducts, engine cooling systems, and engine surfaces.[61] Steam cleaning, if available, was one suggested method of cleaning these areas of contamination.

Operation Cue: Atomic Test

On May 5, 1955, a 29-kiloton nuclear explosion, code name *Apple 2*, was detonated in the high desert of Yucca Flats, Nevada at one of four test areas within the is the U.S. Government's Nevada Test Site (NTS). This nuclear test was part of a larger evaluation, known as *Operation Cue*, to evaluate the effects of nuclear detonations on civilian communities and the emergency response of civilian defense organizations. This operation was one of the earliest opportunities for CAP to demonstrate its role in the post-Second World War national security environment.[62] As the huge nuclear cloud began rising over the 20-mile valley, shadowing the more than 2,500 observers invited to the test, a CAP aircraft took off from the Yucca flat airstrip just 7 miles from ground zero.[63] At the controls were Major Bill Stead, CAP's Nevada Wing's Director of Operations and CAP's Project Manager for *Operation Cue*, conducting the first civilian ARM mission flown in connections with the detonation of an atomic device.[64] His passengers manning the radiological aerial survey equipment were Mr. Ben E. Clouser, a civil defense volunteer radiation monitor from Wilmington, Delaware, and Laverne Penn, Director of Radiological Monitoring for the civil defense of Milwau-



CAP Aircraft during Operation Cue, Nevada Test Site, May 5, 1955. ***(CAP photo.)***

kee, Wisconsin.[65] The aircraft flew for more than an hour in clover-leaf patterns, over pre-marked spots on the desert floor at different altitudes with the survey equipment to measure the radiation levels following the test.[66]

Major Stead's survey sortie, along with 70 others flown in *Operation Cue* for the next 3 days, helped evaluate the planning assumptions made in *Civil Effects Test Project 38.1* for CAP and state civil defense agencies.[67] The most graphic demonstrations of CAP's ability to perform in a post-nuclear attack environment, involved two CAP airplanes landing on a small stretch of gravel road on the day following the *Apple 2* test detonation.[68] There in the shadow of a typical, 1950's, two-story suburban American home reduced to shambles by the explosion, the planes were loaded with injured personnel and who were then transported to a casualty collection station at the NTS' Yucca Flats airfield.[69] Additionally, nearly ninety-precent of the recorded images of the test explosion for television and newsreels viewed at home or at local theaters and most of the still pictures in daily newspapers were flown from the test site by CAP.[70]

The importance of CAP's ARM role during *Operation Cue* was best highlighted in a joint 1956 CAP/Lear Incorporated sponsored film entitled *Sky Sentinels*. This 17-minute color film showed how CAP volunteers served their nation and their neighbors in times of disaster and for Civil Defense.[71] Narrated by Hollywood actor Tyrone Power and featuring director Henry King (who was also a CAP Colonel) as a CAP pilot.[72] The film includes scenes of a disaster drill, with CAP member owned airplanes like the North American NA–154 *Navion* being used chart the spread of nuclear fallout from the blast tests, while other aircraft are used to evacuate "wounded" civilians. [73] The film ends with a CAP search mission for a missing aircraft. The movie was directed by Robert L. Friend, who also directed episodes of *Bonanza*, *Rawhide* and *Tarzan* during a lengthy Hollywood career.[74]

Post Attack to Peace Time Monitoring

During the 1950's CAP participated a number of nationwide civil defense tests, like *Operation Alert*, which tasked CAP aircrews to demonstrate their abilities to civil defense authorities in major metropolitan areas like Chicago, Milwaukee, Philadelphia, and Washington, D.C.[75] During the these tests, CAP pilots and monitors not only provided simulated aerial radiological surveys, but transported small field hospitals and medical supplies to locations like downtown football fields.[76] In Oak Ridge, Tennessee, CAP personnel, in cooperation with officials at the Oak Ridge National Laboratory (ORNL) provided a live radioactive target for a CAP ARM sorites.[77] ORNL technicians placed a live radioactive target within a twelve-mile radius of Oak Ridge, and with ORNL personal flying with CAP crews, the aircrews soon located the target and directed local law enforcement and rescue officials to the target site to isolate the area.[78] According to Dr. K. Z. Morgan, Director of Health Physics at ORNL, the tests demonstrated that civilian aerial organizations like CAP could find, measure, and help isolate a contaminated area in a matter of hours, where ground parties might take days.[79] By the late 1960's, as the Cold War environment changed with the implementation of international nuclear arms agreements like the 1968 *Nuclear Non-Proliferation Treaty*, 1972 *Strategic Arms Limitations Talk*s, and 1991 *Strategic Arms Reduction Treaty*, the CAP ARM program began to change from one of a wartime post-attack mission, to one of a peacetime radiation monitoring mission.[80] The change, also likely facilitated by the March 28, 1979, Three Mile Island nuclear power station accident, led the Air Force to reassess the CAP ARM role. In December of that same year, the CAP National Executive Committee, realizing that the CAP ARM program was not equipped or trained to perform peacetime radiological surveys in conditions like those of the Three Mile Island incident, re-

CAP Aerial Radiological Patch circa 1970's. ***(CAP photo.)***

viewed the problem and developed a set of policy statements concerning CAP's role in peacetime radiological incidents.[81] Some of the new guidelines included the requirement that CAP would have a comprehensive agreement with state officials outlining insurance coverage and training; CAP would take a supporting role as opposed to a lead role in a radiological incident; and CAP would not accept responsibility for advising state or local official concerning the health hazards associated with a peacetime radiological incident.[82]

With the hindsight of nearly thirty years since the end of the Cold War, America's civil defense measures of the late 20th century may be seen by some, even during the atomic age, as overly optimistic, dangerously misguided, or both.[83] But given the existential threat to America's homeland poised by the Soviet Union, and the recent memories of the sense of patriotic duty felt by many citizen during the Second World War, CAP's ARM program at the time was considered both viable and necessary for any post-nuclear attack recover strategy. Even with the phase out of the ARM program by 1998, when the U.S. Air Force removed the requirements and federal funding for personal liability and insurance from *Air Force Instruction 10-2701: Organization and Function of Civil Air Patrol*, the need for this type of mission was still considered necessary by some within the organization.[84] As late as 2004, as a result of the Global War on Terrorism, the CAP's Texas Wing was still planning and training for ARM missions in support of their state interagency partners.[85] A reminder, that CAP volunteers and their aircraft were a vital part of our nation's Cold War history and can still serve as a flexible response to any future national crisis or threat. ■

NOTES

1. Roentgen is the unit used to express the amount of gamma radiation exposure an individual receives, a term first coined by Nobel Prize winning physicist Wilhelm Conrad Röentgen in 1895. Since 1998, the term "Roentgen" has been replaced with the terms "Grey", "Becquerel", and "Sievert" to define measures of ionizing radiation on the human body. "Radiation and Health", New York State Department of Health, October 2016. https://www.health.ny.gov/publications/4402/ (accessed October 28, 2020).
2. The legal basis for CAP was established on December 1, 1941 through the U.S. Government's Office of Civilian Defense's *Administrative Order 9*. The first designated CAP Commander, based on this order, was Brigadier General John F. Curry, US Army Air Corps. "Identify the purposes of the documents and public laws that affect CAP". *Legal Basis for CAP*. https://www.gocivilairpatrol.com/static/media/cms/Legal_Basis_for_CAP_091230_A912EEA18548E.pdf (accessed October 11, 2020).
3. "World War II", *Suburban Emergency Manage Project*, August 1, 2005. https://web.archive.org/web/20060127102534/http://www.semp.us/biots/biot_243.html (accessed October 11, 2020).
4. Robert E. Neprud, *Flying Minute Men: The Story of Civil Air Patrol*. (New York: Duell, Sloam, and Pearce, 1948), Forward.
5. "Identify the purposes of the documents and public laws that affect CAP". *Legal Basis for CAP*.
6. Multimillionaire and financier Bernard Baruch, in an April 16, 1947 speech given during the unveiling of his portrait in the South Carolina House of Representatives, coined the term "Cold War" to describe relations between the United States and the Soviet Union. "Bernard Baruch coins the term 'Cold War'". *This Day in History.* https://www.history.com/this-day-in-history/bernard-baruch-coins-the-term-cold-war (accessed October 11, 2020).
7. Bernard C. Nalty, Ed. *Winged Shield, Winged Sword: A History of the United States Air Force, Vol. I, 1907-1950*. (Washington, D.C.: Air Force History and Museums Program, 1997), p. 382
8. Emily Chapin, "Civil Defense During the Cold War", *Museum of the City of New York.* https://www.mcny.org/story/civil-defense-during-cold-war (accessed October 10, 2020).
9. In the post-war 20th century, buoyed by the United States' Second World War victory, atomic powered airplanes, automobiles, ships, and trains were not unthinkable. Leslie E. Neville, Ed., "Man vs. Atom – Year 1", *Aviation*, July 1946.
10. *The United States Strategic Bombing Surveys (European War and Pacific War).* (Washington, D.C.: US Government Printing Office, September 30, 1945), p. 38.
11. Emily Chapin, "Civil Defense During the Cold War", *Museum of the City of New York*.
12. "History of the Radiological Defense (RADEF) Instrument Program", *The Civil Defense Museum*. http://www.civildefense-museum.com/cdmuseum2/supply/radkits.html (accessed October 10, 2020).
13. "History of the Radiological Defense (RADEF) Instrument Program", *Community Fallout Shelter Supplies.*
14. *Ibid.*
15. *Ibid.*
16. *Handbook for Radiological Monitors, FG-E-5.9.* (Washington, D.C.: Dept. of Defense, Office of Civil Defense, April 1963), p. 1.
17. Lucas V. Beau, "The Civil Air Patrol in Operation Cue", *Cue for Survival: Operation Cue, A.E.C. Nevada Test Site, May 5, 1955*. (Washington, D.C.: U.S. GPO, 1956), p. 82.
18. *Handbook for Aerial Radiological Monitors, FG-E-5.9.1.* (Washington, D.C.: Department of Defense, Office of Civil De-

fense, July 1966), p. 2.
19. "Appendix 6, Civil Defense and Reserve Recovery Mission Support," *Long Range Plan for Civil Air Patrol, CAP-LRP-1*. (Maxwell AFB, AL: Civil Air Patrol, 1962), p. 34.
20. "Appendix 6, Civil Defense and Reserve Recovery Mission Support," *Long Range Plan for Civil Air Patrol, CAP-LRP-1,* pp. 34-40.
21. Ben S. Lee, Ed. *Aviation Fact and Figures, 1955.* (Washington, D.C., Lincoln Press, Inc., 1955), 71
22. James J. Haggerty, ed. "Civil Aviation", *The 1966 Aerospace Yearbook, 44th Edition*. (New York: Aerospace Industries Association of America, Inc.) p. 241.
23. *Your Aerospace World.* (Maxwell AFB, Ala.: Civil Air Patrol, 1977), pp. 2-12.
24. Jeff L. Rodengen, *The Legend of Cessna* (Fort Lauderdale, FL: Write Stuff Enterprises, Inc., 1998), p. 109.
25. So popular was this model of aircraft that an L–19 *Bird Dog* in CAP livery is, to this day, mounted on a pedestal in front of CAP National Headquarters, Maxwell Air Force Base, Alabama. Jeff L. Rodengen, *The Legend of Cessna*, p. 109.
26. An undated (circa 1950s-70s) photo of a lineup of a Beech C–45 *Expeditor* & several T–6 *Texans* of the San Fernando Airport CAP 35th Squadron indicates that older model twin-engine aircraft were popular among CAP pilots. "California - San Fernando area", *Abandoned and Little-Know Airfields*, October 10, 2016. http://members.tripod.com/airfields_freeman/CA/Airfields_CA_SanFernan.htm (accessed October 11, 2020).
27. *Handbook for Aerial Radiological Monitors*, FG-E-5.9.1., p. 2.
28. "Chapter 2 - Operational Specialty Ratings/Performance Standards", *CAP Regulation 50-15, Operational Missions.* (Maxwell AFB, Ala.: Civil Air Patrol, February 1, 1996), p. 10.
29. "Chapter 6 – OPLAN 1000, Civil Defense, and Wartime Disaster Relief Operations", *CAP Regulation 55-1, Emergency Services Mission Procedures*. (Maxwell AFB, Ala.: Civil Air Patrol, October 15, 1998), pp. 22-24.
30. "Chapter 5 – Insignia, Badges, and Devices", *Civil Air Patrol Uniform Manual, 39-1.* (Maxwell AFB, Ala.: Civil Air Patrol, June 3, 1991), p. 88
31. *Handbook for Radiological Monitors, FG-E-5.9.,* pp. 11-12.
32. *Ibid,* p. 13.
33. *Ibid,* p. 11.
34. "Commercially Sold Radiation Meters for CD Use", The Civil Defense Museum.
35. *Handbook for Radiological Monitors, FG-E-5.9*., pp. 11-12.
36. "History of the Radiological Defense (RADEF) Instrument Program", *The Civil Defense Museum.* http://www.civildefensemuseum.com/cdmuseum2/radkits/commrad.html (accessed October 12, 2020).
37. *Ibid.*
38. *Handbook for Radiological Monitors*, FG-E-5.9., p. 2.
39. *Ibid,* p. 6.
40. According to the U.S. Department of Health and Human Services, doses of 100 Roentgen equivalents will result in Acute Radiation Syndrome to include nausea and vomiting within 48-hours/300-400 Rem will result in 50% of exposed individuals will die within 30-days without appropriate medical care. "Common Radiation Exposures vs. Exposures in Radiation Events", *Radiation Emergency Medical Management*, August 10, 2020. https://www.remm.nlm.gov/remm_RadPhysics.htm#allowableLimitsExposure (accessed October 11, 2020).
41. *Handbook for Aerial Radiological Monitors*, FG-E-5.9.1., p. 25.
42. *Ibid,* p. 26.
43. *Ibid.*
44. *Ibid,* p. 16.
45. John "Moose" W. Desmarais, Director of Operations, Civil Air Patrol National Headquarters. Telephone interview with the author, Maxwell AFB, Alabama, October 15, 2020.
46. *Handbook for Aerial Radiological Monitors, FG-E-5.9.1*., p. 21.
47. *Ibid,* pp. 4-7.
48. The SCANTA plan has only been implemented once (other than tests) since its inception, and then was a modified version. On September 11, 2001, the codeword was broadcast ordering that all U.S. air traffic be grounded, after the September 11 attacks. Even in that instance, the emergency plan was only partially implemented as the Defense Department left command and control of the air traffic system with the FAA and intentionally allowed all radio navigational aids to remain in operation to aid in the process of controlling and landing the thousands of planes which were aloft in domestic airspace. Ralph Eberhart, "Transcript: 9/11 Commission", *The Washington Post*, June 17, 2004.
49. *Handbook for Aerial Radiological Monitors*, FG-E-5.9.1., p. 4.
50. *Ibid,* p. 6.
51. *Ibid,* p. 7.
52. *Ibid*.
53. These detailed aerial route surveys techniques are still used by the US military including US Army Aviation aircrews. "Section IV. Nuclear, Biological, Chemical Operations", *Aviator's Handbook, FM 1-400.* (Washington, D.C.: Headquarters, Department of the Army, May 1983), pp. 2-40 – 2-42.
54. *Handbook for Aerial Radiological Monitors, FG-E-5.9.1.,* p. 10.
55. *Ibid,* p. 10.
56. *Ibid.*
57. *Ibid,* p. 11.
58. *Ibid.*
59. *Ibid*, p. 15.
60. *Ibid,* p. 9.
61. *Ibid.*
62. Lucas V. Beau, "The Civil Air Patrol in Operation Cue", *Cue for Survival: Operation Cue, A.E.C. Nevada Test Site, May 5, 1955*, p. 82.
63. *Ibid,* p. 82
64. *Ibid.*
65. *Ibid.*
66. *Ibid.*
67. *Ibid,* p. 84.
68. *Ibid,* p. 85.
69. *Ibid.*
70. *Ibid,* p. 84.
71. *Sky Sentinels*. Directed by Robert L. Friend. Hollywood, CA: Lear Incorporated, 1956.
72. *Sky Sentinels.* Directed by Robert L. Friend.
73. *Ibid.* Lucas V. Beau, "The Civil Air Patrol in Operation Cue", *Cue for Survival: Operation Cue, A.E.C. Nevada Test Site, May 5, 1955*, p. 84.
74. *Sky Sentinels.* Directed by Robert L. Friend.
75. Lucas V. Beau, "The Civil Air Patrol in Operation Cue", Cue for Survival: *Operation Cue, A.E.C. Nevada Test Site, May 5, 1955*, pp. 83-84
76. *Ibid.*
77. *Ibid.*
78. *Ibid.*
79. *Ibid.*
80. Major Fred Ayoub, USAF, "Peacetime Radiation Monitoring Is Different", *Civil Air Patrol News*, March 1980. https://history.cap.gov/files/original/8a15202c26ec73349a873685fd938fe0.pdf (accessed October 10, 2020).
81. Major Fred Ayoub, USAF, "Peacetime Radiation Monitoring Is Different", *Civil Air Patrol News*, March 1980.
82. *Ibid.*
83. Philip Bolsover, "Civil Defence: The Cruelest Confidence Trick," *The Campaign for Nuclear Disarmament*, 1982. https://digitalarchive.wilsoncenter.org/document/110891.pdf?v=9d4dbd60a0c54c2688414e1b232aa1e0 (accessed October 12, 2020).
84. John "Moose" W. Desmarais, Director of Operations, Civil Air Patrol National Headquarters. Email message to author, Maxwell Air Force Base, Alabama, September 29, 2020.
85. "Radiological Monitoring Briefing, TX Wing/CC – Col Eldridge", *Civil Air Patrol National Board Minutes*, August 19-20, 2005. https://history.cap.gov/files/original/da61751ae7d0 86f5417b7cc7e9405eb8.pdf (accessed September 29, 2020).

Over There in the Air: The Fightin' Texas Aggies in World War I, 1917-1918. By John A. Adams, Jr. College Station TX: Texas A&M University Press, 2020. Photographs. Appendix. Notes. Pp. 129. $29.95. ISBN: 978-1-62349-845-0

In his latest book, Adams attempts to give the reader a sense of the contributions made by students, former students, faculty, and even coaches of Texas A&M University in the skies over France during the First World War. These men served in the British and French air forces and, later, the air arms of the U.S. Army and Navy.

In laying out his arguments about how important the Aggies' contributions were, Adams covers a lot of ground. He discusses the contributions of several of the university's presidents in preparing the school—albeit at times unknowingly—for what it would face during the war years as it moved from being a primarily educational institution to one that spent most of its resources preparing young men for war. He also discusses the conversion of school buildings to classroom and training facilities (e.g., the livestock barn to a maintenance hangar), as well as construction of new facilities to support the growing number of young men on the campus.

The information he presents regarding participation in Europe is sound. Adams is able to provide firsthand accounts of various actions and accomplishments of Aggie pilots in various combat operations. Unfortunately, a more personalized look at these individuals that chronicles their thoughts and personal experiences during their time in France is lacking. Adams also acknowledges the role played by Aggies in the training of new pilots once in theater and their role in airborne coastal and seaborne patrol actions.

For all of its merits, the book leaves a great deal to be desired. While Adams does cover the contributions of certain Aggies in the skies over France, and the Atlantic, he only discusses a relative handful of them—and that is almost wholly relegated to one chapter. Much of the book is spent discussing the development of training operations during the early days of the war, along with the contributions of university presidents prior to, and during, the war. Adams also spends a great deal of time discussing the problems of trying to conduct training operations during the Spanish influenza epidemic of 1918. He even, albeit briefly, discusses the contributions of an Aggie who served in tanks. The book would be better served if it strictly focused on those Aggies who chose to fight in the air. The book is also the victim of numerous typos. In such a short work from a scholarly press, these are unacceptable.

The book illustrates the cult that is the Corps of Cadets at Texas A&M. This makes sense. As a 1973 graduate of the university and holder of a doctorate from it, Adams has written other works on A&M traditions and contributions to various war efforts. It is clear that he shares that great sense of pride that all Aggies do.

Despite its flaws, the book provides a fair amount of original, never-before-published, first-hand accounts of life in the Army's air arm during the war years, both at home and abroad. Thus, it is an invaluable asset for those who want to study the air war over France and for proud Aggies who seek further confirmation that their school and alumni are important to the nation.

MSgt Dennis H. Berger, USAF (Ret), Ph.D., DPAA Fellow in Residence, Texas Tech University

Assured Destruction: Building the Ballistic Missile Culture of the U.S. Air Force. By David W. Bath. Annapolis: Naval Institute Press, 2020. Maps. Photographs. Notes. Bibliography. Index. Pp. xii, 238. $39.95. ISBN: 978-168247493-8

In *Assured Destruction,* historian and former Air Force missileer David Bath explores the rise and fall of the Air Force's ICBM weapon systems during the Cold War. Using missileers' personal recollections and school-house papers from professional military education courses, he reveals "the impact that the Cold War and establishment of the Air Force as a separate service had on the new ballistic missiles and those that worked with them." Ultimately Bath argues that Air Force leaders were divided on the ICBM program and that outside forces stemming from the Cold War greatly influenced its path forward.

The first four chapters document the U.S. military's development of the atomic bomb and subsequent ballistic missile development following World War II. In these chapters, Bath shows how defense policy makers sold missiles as the "ultimate weapon without regard to the political and social implications of nuclear warfare." Given the scale and scope of World War II, the U.S. sought to stay in front of the Soviet Union, its emergent adversary, and prevent future conflict. Following the USSR's Sputnik launch and the supposed "missile gap," President Eisenhower named the ICBM as the highest priority among new weapon systems in development. This decision ran afoul of flyers within the Air Force—Gen Curtis Lemay was the best example—who sought to maintain the branch's flying mission above all else. From the beginning, the ICBM's success depended upon its advocates and was safe as long as international and domestic politics demanded it.

Bath's greatest contributions to the ICBM's history are his chapters on the Cuban Missile Crisis and decline of the mission in its wake. While conventional wisdom places the ICBM's nadir at the end of the Cold War in in the early 1990s, he skillfully demonstrates that the crisis—largely seen as the apex of the ICBM mission—actually led to its downfall; it persuaded the U.S. and Soviet Union that nuclear weapons were a threat to both sides equally rather than to one another separately and should be used only as a deterrent. As a result, the U.S. deactivated all long-range

missile systems except for Minuteman and Titan II. Once ICBM advocates left the Pentagon, and General Lemay became the Chief of Staff of the Air Force, anti-missile forces prevailed and shifted the Air Force's focus to strategic bombing and later tactical air. In a paradoxical conclusion, as quickly as missileers rose to prominence they found themselves relegated to a secondary status within the Air Force. According to Bath, "This greatly influenced the nascent culture of missileers, preventing the group from adequately addressing significant concerns that haunted missileers into the twenty-first century."

Assured Destruction is a welcome addition to the literature on the ICBM weapon systems. It is the first book to incorporate missileers into its history and adds to the growing literature of Air Force policy making and weapons development during the Cold War. Despite being an academic title, Bath's compelling and easy-to-read narrative is accessible to both the general public and professional historians. It is well-suited for the coffee table and classroom alike.

Dr. Troy A. Hallsell, Historian, 341st Missile Wing, Malmstrom AFB MT

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Unforgotten in the Gulf of Tonkin: A Story of the U.S. Military's Commitment to Leave No One Behind. By Eileen Bjorkman. Lincoln NE: U of Nebraska Press (Potomac Books), 2020. Map. Photographs. Notes. Bibliography. Pp. 256. $34.95. ISBN: 978-164012191-1

Eileen Bjorkman is a retired USAF flight test engineer, commercial pilot, and certified flight instructor. She grew up in a USAF family and has been interested in aviation from her earliest years. With this, her second book, she has firmly established herself as a top historian and storyteller.

On November 18, 1965, naval aviator Willie Sharp launched from the carrier *USS Bon Homme Richard* in his Vought F–8 Crusader on yet another of many fighter-bomber mission over North Vietnam. He was hit and had to eject over the Gulf of Tonkin where he was picked up by North Vietnamese fishermen. He fought his way off the boat and was picked up by a rescue helicopter and eventually returned to his carrier. That's a great story in itself, but note Bjorkman's subtitle about the U.S. commitment to leave no one behind. That has to mean there is going to be more about air-sea rescue.

When I was in college, I had to read Cervantes' *Don Quixote*. I hated it because of the constant diversions into side stories. Just couldn't follow the story. However, Bjorkman has the superb ability—as demonstrated in her first book about her dad, *The Propeller Under the Bed* (2017)—to tackle a lot of different stories and weave them into a fine, seamless tapestry. *Unforgotten* certainly gives the reader the story of Willie Sharp's life, the ejection mission, and the PTSD problems that resulted. But it also presents a fine summary history of the U.S. military's efforts to rescue downed airmen; and a look at the histories of both the *Bonnie Dick* and the Crusader. Again, this is all so cleverly intertwined that the book reads smoothly from cover to cover.

Bjorkman probably could have used any number of Vietnam rescue missions as the focal point of her story—there were certainly hundreds to choose from. But Sharp's particular story (he had to kill one of the fisherman with his pistol in order to escape) gave her the basis to conclude the book with how America deals with treating its military PTSD victims and continues to attempt to account for its large number of MIAs.

The research done was extensive and included a number of interviews with participants, included many with Willie Sharp himself over a period of several years. What results is a compelling story from the air war over Vietnam and one participant's struggles with the resulting demons. I don't know what Bjorkman has lined up for her next release, but if it is written anywhere near as well as *Unforgotten*, I can't wait to read it.

Col Scott A. Willey, USAF (Ret), Book Review Editor, and Docent, NASM's Udvar-Hazy Center

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Race of Aces: WWII's Elite Airmen and the Epic Battle to Become the Master of the Sky. By John R. Bruning. New York: Hachette, 2020. Photographs. Notes. Bibliography. Pp. 522. ISBN: 978-0-316-50862-9

General Kenney's famed Fifth Air Force spawned many innovations that enabled it to produce dominant airpower in World War II in the South West Pacific. This lively book relates how Kenney motivated fighter pilots Richard Bong, Tommy McGuire, Neel Kearby, Charles MacDonald, Gerald Johnson, and Tom Lynch to become the highest-scoring USAAF fighter aces of all time as part of that strategy.

Military historian and journalist John Bruning, who reported on combat in Afghanistan, has several military histories to his credit. Among them are *Jungle Ace* (2001), a biography of Fifth Air Force ace Gerald R. Johnson; and *Indestructible* (2016), a biography of legendary gunship developer Pappy Gunn.

Finding a worn-down, dispirited command on his arrival in July 1942, Kenney quickly reinvigorated the Fifth with groundbreaking new weapons and tactics. He introduced drop tanks, skip bombing, and para-frags, and converted medium bombers into strafing gunships. He overhauled the logistics system, replaced ineffective leaders, exploited the powerful P–38, and courted the press to assure continued support from Washington.

Recognizing that an aggressive, competitive spirit in his fighter pilots was a key component of the Fifth's success, in November 1942, Kenney challenged them to a race

of aces to beat Rickenbacker's record of 26 air-to-air kills. Thus encouraged, the Fifth's fighters steadily drove the enemy from the skies. Bong was declared the winner in April 1944. This book argues, however, that instead of ending, the race of aces then spiraled out of control. Although they had completed their tours, the aces expressed such eagerness to continue flying combat that Kenney deferred sending them home. They often went "hunting" off the books. Eventually this resulted in the needless deaths of Kearby, McGuire, and Lynch – all talented field-grade officers.

Bruning has thoroughly mined previously untapped personal papers as well as official records, newspapers, magazines, and radio-show transcriptions. He interviewed participants and family members. Most of the photos appear for the first time.

Many histories have captured the dramatic Southwest Pacific air war, starting with General Kenney's memoirs (*General Kenney Reports*, 1949), and the official AAF history by Craven and Cate (1950). Steve Birdsall's *Flying Buccaneers* (1977) and Kenn Rust's *Fifth Air Force Story* (1973) remain classics. *Race of Aces* meaningfully adds to this historiography.

This book does not fully exploit the evidence, however. The revolution in weapons and tactics of the low-level attack (gunships) and bomber units paralleled the race of aces in many ways. Although cited in passing, a fuller citation of their exploits would have magnified the book's impact. See Henebry's *The Grim Reapers* (3rd Attack Group) (2002), Stout's *Air Apaches* (345th BG) (2019), andAlcorn's *The Jolly Rogers* (90th BG) (1981) for the exploits of the gunships and bombers.

The narrative effectively evokes the deleterious effects on planes and pilots of the uncompromising South West Pacific war. There is plenty of air combat action. The book movingly relates the anxiety of families waiting at home, the shock of learning of the deaths of those who did not return, and the ultimate effect on their subsequent lives.

Contemporary jargon adds authenticity, but absent a glossary, its significance is lost. Occasional lapses into modern slang are jarring. The absence of maps diminishes explanations of the effects of aircraft range on strategies and tactics in the enormous distances of the South West Pacific. No endnotes are present to enable corroboration of source use.

This book adds substantially to our understanding of the Army Air Force's top aces. Hopefully a future edition will add maps and endnotes. This subject deserves it.

Steven Agoratus, Hamilton NJ

Iraqi Mirages: The Dassault Mirage Family in Service with the Iraqi Air Force, 1981-1988. By Tom Cooper and Milos Sipos. Havertown PA: Casemate Publishers, 2020. Maps. Tables. Illustrations. Photographs. End notes. Glossary. Bibliography. Pp.viii, 88. $29.95 paperback. ISBN: 978-1-9123900-31-1

This is an excellent book on a topic that is poorly understood by western readers. Well-researched and intricately sourced with 200 end notes and over 100 photos, the book is a wealth of information about the last major war that saw a prolonged, multi-year, air-combat campaign between two air forces.

Cooper and Sipos superbly cover the air campaigns of the Iran-Iraq War from start to finish. What was especially helpful was the story of the Iraqi Air Force from its earliest days: how the Ba'ath Party shaped the Iraqi Air Force in the 1960s and 1970s, and how previous efforts by Iraq to acquire Mirage jet fighters were unsuccessful. Readers may feel that they've learned all that is available to learn about the use of Mirages by Iraq. Indeed, the book is interesting enough that the reader is left wanting for more—and frustrated, knowing that what isn't in the book simply does not exist anymore in written records after the 1991 Persian Gulf War and the 2003 invasion.

Two especially appealing features of this book were the discussion of Phoenix missile kills by Iranian aircraft and the in-depth analysis of strike effectiveness by Iraqi aircraft. Most readers will be unaware of the vast number of Phoenix kills during the war. Additionally, for those who enjoy intelligence analysis, the authors' decision to compare Iraqi claims versus Iranian claims, using open source information (e.g., Lloyds of London reports on ship damage for insurance purposes), made the text all the more interesting.

As a veteran of *OPERATION IRAQI FREEDOM*, I found a lot of personal joy in reading about the operational histories of air bases familiar to Americans: Q-West, H-3, and Balad Air Base, among many others. Especially interesting are pictures of these bases in their heyday, before being bombed or converted into American installations.

Unfortunately, the book does require several improvements. This is the second book I've reviewed from this publisher; and, in both, multiple pages fell out simply from turning the pages while casually reading the book. I suspect that the glue being used for the binding is not strong enough for the weight of paper being used. The other issue is the paucity of maps. Indeed, the first map doesn't appear until the second half of the book and merely shows the location of air bases across Iraq. Since the map doesn't include range rings of Mirage fighters operating from those locations, or where the ground battlefields were, it is essentially useless. Maps are essential. Unless readers know where Khuzistan and Abadan are, they are at a loss when the book describes the ground conflict and how the air campaigns supported that conflict.

Overall, the book is a must read for anyone interested in Middle East military history, the study of Iran, or Mirage

jet fighters. The book absolutely satisfies a niche in Western printing that has been unfilled.

Cpt George W Runkle IV, III Corps (US Army) Command Historian

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Israeli Eagles F–15A/B/C/D/I. By Amos Dor. Novara, Italy: RN Publishing, 2020. Tables. Diagrams. Illustrations. Photographs. Pp. 238. $56.00. ISBN: 978-88-95011-18-9

Amos Dor is an Israeli now living in Italy who grew up around the Israeli Air Force (IAF) and aero industry and served in the IAF himself. He has written a number of books on the history and heritage of the IAF.

The IAF was the first foreign user of the U.S. Air Force's then quite new F–15 Eagle. Israel was so desperate to obtain the capabilities of the new aircraft that they talked the U.S. into selling them four of the 20 test-and-evaluation aircraft from the USAF in order to start their own force early. Eventually, 123 F–15s were provided to the IAF under a series of PEACE FOX foreign military sales programs.

This book does not have a lot of text. It is more like a smaller-format coffee-table book. Its primary strength is the wealth of photos documenting all of the airframes in a wide variety of settings both home and abroad. These are in color and generally very good. However, that is not to say that there isn't highly useful text. There are opening remarks by two now-retired IAF generals who were there at the beginning of the IAF's Eagles. Dor's introduction provides a wonderful summary of the F–15s association with the IAF. Three squadrons operated (and still fly) the Eagle. Each of these is covered in a chronological format that outlines all of the important events: first aircraft delivery, combat operations, aircraft losses, etc. Unfortunately, most of this century's events are omitted, because much of this history is still classified.

The first kill ever achieved by an F–15 was that of then-Maj Moshe Melnik (now Brig Gen Ret.) on June 27, 1979. Melnik wrote this section describing the encounter with Syrian MiG-21s that resulted in the loss of five MiGs and no F–15s.

Another page describes the development of the CFTs (conformal fuel tanks) that came about because of Israeli needs and became standard on the F–15E. Also provided is a section that outlines IAF F–15 activities with foreign air forces. What I found most interesting were descriptions of three major international exercises: Blue Flag 2017 (held in Israel with eight participating nations), Cobra Warrior 2019 (in the UK with five Air Forces), and Blue Flag 2019 (held in Israel with five participants). One gains a real appreciation for the complexity of these exercises and the amount of planning and preparation required.

Toward the end of book is a table showing each of the 50.5 kills awarded to IAF pilots (out of the 104.5 Eagle kills worldwide vs. 0 losses). All of these are MiG-21/23/25 kills with the exception of one Gazelle helicopter.

Without question, this is a book that will be appreciated by anyone in the modelling business. However, any reader interested in the more than 40 years of service the Eagle has given to Israel (with probably another decade to go) will find this to be about the best resource available.

Col Scott A. Willey, USAF (Ret), Book Review Editor, and Docent, NASM's Udvar-Hazy Center

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Many a Close Run Thing: From Jet Fighter Pilot to Airline Captain. By Tom Enright. New Zealand: HarperCollins, 2020. Photographs. Pp. 308. $20.98 paperback. ISBN: 978-1-7755-4143-1

Tom Enright is from New Zealand, served in the RNZAF for a time, and went on to become a pilot for New Zealand Airlines. His book delights the reader with interesting stories from his flying experiences. Some outcomes were dicey—"close run things."

Born in 1934, Enright saw aircraft flying around the islands—a wonderment to everyone. He and used any chance to go see one if it was landing nearby or flying over. After World War II, his family moved to nearby Dunedin where the RNZAF had a fleet of Tiger Moths. He enrolled in the Air Training Corps where he got one afternoon and evening per week of aviation and military knowledge. He was determined to become a pilot and absorbed everything he could about flying. While there, he had his first airplane ride in a Tiger Moth.

At age 16, he was accepted into a 3 year RNZAF engineering program. He did so well the first year that he was sent off to England to continue his education at the RAF Halton training center. Most of his flying time there was in Tiger Moths,

He left Halton after three years and was selected for pilot training flying the Provost. Following high-performance training in the Vampire—where he also went to jump school to be parachute qualified in case of ejection—he graduated from the RAF College Cranwell in 1957, winning all six graduation awards—the only student ever to do so.

Enright was posted to New Zealand in a Vampire fighter unit and served there for four years. One of his duties was to fly in the RNZAF flight demonstration team of Vampires and perform in many air shows. Once his stint was done in fighters, he moved into the four-engine Short Sunderland. He well describes what it was like to traverse the South Pacific in a large seaplane while hauling passengers, delivering medicine, transporting officials, and conducting search-and-rescue operations. Several close run things occurred while landing these large seaplanes in swelling waves.

When the RNZAF changed over to the Orion, he qualified in them and completed his 20 years in the RNZAF. Enright was immediately hired by New Zealand Airlines. He first flew the DC–8. One close run thing happened while hauling horses; one had to be destroyed during the flight after it went wild kicking the fuselage.

The airline later upgraded to the DC–10. Enright thinks it was a wonderful aircraft to pilot and discusses some of the DC–10's accidents. He comments on his feelings about pilot error, and then discusses his final aircraft, the Boeing 747. Here he ably describes the process of a crew from the time they arrive at the airport until they land at their destination, relating the planning, communications, and activities necessary to provide passengers with a safe flight.

The last chapter is devoted to the missing Malaysian 777 and the known details of that flight. His conclusion is that we cannot have one until the wreckage is found.

His book is a delight to read and never boring. Enright relates many small but interesting tales of problems and how they were resolved. In flying, the unexpected can always happen, so it's best be ready by practicing, practicing, practicing so one will know how to react to any close run thing.

Tony Kambic, NASM restoration volunteer, Fairfax VA

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Beyond Valor: A World War II Story of Extraordinary Heroism, Sacrificial Love, and a Race Against Time. By Jon Erwin and William Doyle. Nashville TN: Nelson Books, 2020. Photographs. Notes. Appendix. Bibliography. Pp. 213. $26.99. ISBN 978-1-4002-1683-3

This biography of Medal of Honor (MOH) recipient Red Erwin is overdue. Written by his grandson Jon Erwin and collaborator William Doyle, this moving volume reveals how Erwin's courage and indomitable spirit enabled him to survive life-threatening injuries suffered on a B–29 combat mission.

Born in poverty in Alabama, Erwin was a steelworker and married by the time of Pearl Harbor. Although unlikely to be drafted, he felt a strong sense of duty and enlisted. Trained as a B–29 radio operator, he deployed to Guam in January 1945 with the 52nd BS, 29th BG. Severely burned and blinded on April 12, 1945, by a faulty phosphorus marker bomb, Erwin picked up the 1500-degree flare, made his way to the cockpit, and threw it out the co-pilot's window. His crewmates quickly administered first aid. The pilot raced for Iwo Jima, the nearest airstrip with an emergency medical facility. Evacuated to the States, he weathered almost four dozen operations over the next few years and went on to live a fulfilling, happy life raising a family and helping fellow veterans as a counselor for the Veterans Administration.

Jon Erwin confesses that he did not know of his grandfather's courageous action until his funeral, with full military honors, in 2002. Inspired, he began what became fifteen years of research. Seeking to understand why his grandfather risked his life to save his plane and crew, he sought out Gary Littrell of the Congressional Medal of Honor Society. Littrell, himself a recipient, helped Erwin appreciate that the moment in which such experiences occur prompts selflessness and a willingness to sacrifice one's self on behalf of others. Many MOH recipients express this simply as "not letting down my crew, unit, or friends."

Intended for a general audience, the book explains military and medical concepts, especially on the science and treatment of burns, to help the reader comprehend the severity of Erwin's near-fatal wounds. Readers familiar with airpower historiography may detect a lack of balance in brief but adeptly written summaries of strategic bombing and the B–29. However, the background is just there to help the reader understand how Red Erwin performed his act of courage.

Although hardcover, the paper is pulp, the photographic reproduction hazy, and there are no maps. Readers seeking further insights on how people react at such critical moments will gain much from a recent biography of Maynard H. "Snuffy" Smith (Joe Pappalardo, 2020), an MOH recipient who fought fires, manned guns, and tended to the wounded in a damaged B–17 under enemy attack over Europe on May 1, 1943. Although his life took a different path than Erwin's, both were men of determined will who responded similarly to difficult choices thrust upon them. Although brief, Daniels Simmons' account (2018) of John C. "Red" Morgan flying a damaged B–17 with one hand under enemy fire while keeping the wounded pilot off the controls with the other on July 26, 1943, similarly provides further perspective on an individual suddenly plunged into a dire situation.

Beyond Valor is highly recommended and should be required reading for all those interested in understanding the sacrifices required for freedom.

Steven Agoratus, Hamilton NJ

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The Freedom Shield: When We Were Young, We Were There, By John D. Falcon. Havertown PA: Casemate Publishers, 2020. Photographs. Glossary. Appendix. Index. Pp. x, 323. $34.95. ISBN 978-1-61200-860-8

The 191st Assault Helicopter Company activated at Ft. Bragg NC, married up with hand-me-down equipment, and then provided direct combat support in the Mekong Delta of Vietnam for five years. Many histories of small units (30 helicopters and 225 soldiers in this case) generate about the same excitement as a metronome. Not so here. If some-

one ever asked me what I did in the war, I would hand over this book and say, "Read this. I did this. It is all here."

Falcon wrote this book at the express request of his comrades. It was designed to be a narrative cradle-to-grave history and certainly meets that requirement. But, it's much more. Falcon retired from the Army with 20 years of service. He spent a year in the unit as both the executive officer and as an assault platoon leader. Readers get an inside and balanced education on basic combat leadership.

The book was written in a third-person style that generates an easily readable story complete with shoot-'em-ups, heroes, screw-ups, and everything and everybody in-between, but it still accomplishes the goal of illuminating the unit's significant combat contributions.

The book's true contribution is that one can read it and walk away with an insider's working knowledge of what an assault helicopter company was, why it was necessary, how it came about, and how it operated day-to-day. It is an extremely informative description of how any Army unit designed to engage the enemy operates on the battlefield and in garrison. There were about 70 of these companies in Vietnam, organized into battalions containing three companies, assigned to aviation groups in the 1st Aviation Brigade, and further assigned as direct support units to the large maneuver units such as divisions. Additionally, divisions had their own integral aviation battalions, generally containing three similar companies.

Falcon organized the narrative around significant unit actions, several notable individuals, and the commanding officers. The action sequences all illustrate a point while acknowledging the contribution of individual unit members involved. Chapters on the commanders and their subordinate leaders tell how the unit leadership dealt with the pressures of the battlefield and highlight how their personal leadership styles affected unit operations. Unit performance tends to reflect the personality of the commander. Everyday personnel problems, maintenance issues, security issues, and the inevitable bureaucratic pressures from higher command are all unavoidable and constant mission detractors. Leadership examples abound—most of them good to great—and include everybody from the assault and gunship pilots and crews (who flew all day and worked on the aircraft most of the night) to the mess sergeant and maintenance personnel. It even provides a combat assault flying lesson or two!

One chapter has the reader as a fly on the wall of the cockpit during an assault. By the end of this adventure, you feel you know exactly what was supposed to be happening and why it did or did not. From mission planning to the assault, you are there. Another chapter takes you on a gunship mission. You end up feeling glad to be back on the ground.

There are no maps. A map of the South of Vietnam would have been most helpful for orienting readers and to illustrate the amount of ground these units covered. The book has a terrific glossary that is useful for Army Aviation readers in general.

All films or illustrated books about Vietnam contain pictures of the ubiquitous UH–1 Huey helicopter executing a variety of missions, especially combat assaults. Most of those pictures are of aircraft and crews assigned to assault companies. They were everywhere, seemingly tireless, relentless, and courageous. *The Freedom Shield* tells you why and how.

Bill Staffa, Colonel of Aviation, USAR (Ret), docent at both NASM and NMUSA

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Champions of Flight. By Sheryl Fiegel and Theodore Hamady. Havertown PA: Casemate, 2020. Photographs. Drawings. Illustrations. Pp. 294. $49.95. ISBN: 978-161200779-3

I have observed that many aviation aficionados are also image junkies. Photographs, illustrations, and drawings with an aviation theme immediately attract our eye. The tremendous growth in digital imagery has increased the availability of these images to both the casual and professional historian. But this book takes the reader to an earlier time when capturing visual images was the purview of the artist or illustrator. From 1920 to 1950, the preeminent aviation illustrators were Clayton Knight and William Heaslip. Aviators themselves, these men used the full spectrum of tools available to artists of their era to produce aviation images that are still visually stunning 100 years later.

Fiegel and Hamady are art and aviation historians, respectively, whose skills clearly complement each other in telling the story of Knight and Heaslip. Fiegel makes learning about the types of lithographs and the difference between oils and watercolors pleasurable. And Hamady places the works of the artists into historical context. While artwork is the heart of the book, the narrative and historical research are solid. The resulting product is far more than a coffee-table art book.

Man's earliest attempts at illustrating both lighter- and heavier-than-air flight quickly encountered a significant obstacle. By definition and medium, illustration captures a static moment in time. But aviation is moving, fluid, and dynamic. The successful aviation artist or illustrator must master showing that which is dynamic in a static medium. Knight and Heaslip mastered that challenge early in their careers. Their simplest renderings seem ready to fly off the page. And for much of their careers, they had a significant advantage over photography: their works were in vivid, attention-grabbing color.

Interestingly, Knight used his fame in aviation circles to form (along with famed World War I ace Billy Bishop) the Clayton Knight Committee, a group whose function

was to recruit Americans into the Royal Canadian Air Force before America entered the Second World War. The committee eventually recruited 2,650 much-needed airmen and earned him award of Knight the Order of the British Empire in 1946. Both Knight and Heaslip also found a solid market for their work in "juvenile" books and magazines, attracting generations to careers in aviation. Just as I did, many readers will probably look at one of the book's images and remember seeing it before in an old magazine or the cover of a book.

This proved to be a truly extraordinary book—visually stunning and very readable. It was so much more than the coffee-table tome I expected. It is a book that will provide enjoyment to both the art and aviation historian.

Gary Connor, Docent, Smithsonian National Air and Space Museum's Udvar Hazy Center

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Tower of Skulls: A History of the Asia-Pacific War July 1937-May 1942. By Richard B. Frank. New York: W. W. Norton, 2020. Maps. Tables. Notes. Photographs. Bibliography. Index. Pp. 751. $40.00. ISBN: 978-1-324-002 109

A recognized authority on the Pacific war, Richard Frank previously produced a biography of Douglas MacArthur and books on the end of Imperial Japan and the Battle of Guadalcanal. *Tower of Skulls* is the first of three volumes covering the Asia-Pacific war in its entirety. Beginning with the Japanese assault on China in July 1937, he proceeds chronologically.

The first half of the book emphasizes the war in China up to the Japanese attack on Pearl Harbor. After introducing the reader to the key figures on both sides, Frank details the various Japanese axes of attack and the Chinese response. Generally, he credits the Chinese as a formidable opponent underestimated by their enemy and their eventual allies.

However, the Chinese civilian population paid dearly both in treasure and lives. On the other hand, opposition to Japan fostered a sense of national identity. Besides its inability to satisfactorily disengage from the war in China, the Japanese army also suffered defeat at the hands of the Soviet army along the Manchurian-Mongolian border in 1939.

Frank devotes considerable attention to the internal political conflicts of the belligerents. He discusses in detail the internal challenges Japan's leaders faced in trying to reach accommodation with the United States concerning two major issues: China's future, and access to raw materials in light of America's embargo on strategic materials and oil. Washington's crude efforts to turn its code-breaking success into usable intelligence are scrutinized, as are the conspiracy theories about the American administration's insights into a potential attack on Hawaii.

With the Japanese engaging the United States, Great Britain, Australia, and the Netherlands in war beginning December 8 (Tokyo time), the emphasis shifts from China to the various Japanese successes. In five months, the Imperial Army and Navy conquered Hong Kong, Burma, the Philippines, Guam, Malaya, Singapore, the Dutch East Indies, the Gilberts, and portions of New Guinea and the Solomons. More than 500-million people in seven time zones resided under Japanese rule (by comparison, German domination extended to just over 350 million people). All of Japan's military successes are detailed, whether at sea or on land.

Readers interested in Frank's perspectives on the various military actions will find this book rewarding. However, this work's real strength lies in its balancing of operations and policy decisions, both domestic and among coalition partners. About 25 percent of the content is devoted to notes and bibliography. However, I hope the publisher will reconsider its handling of citations. They are enumerated by page number in the notes section with no visible reference in the text itself. Those with patience should consider using a pencil to link the text to the appropriate citation.

All in all, this is a first-class work. I eagerly await the second volume,

Steven D. Ellis, Lt Col, USAFR (Ret); docent, Museum of Flight, Seattle

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Widowmaker: Living and Dying with the Corsair. By Tim Hillier-Graves. Havertown PA: Casemate, 2020. Pp. xiii, 202. Photographs. Bibliography. Index. $34.95. ISBN: 978-1-61200-912-4.

A retired Royal Navy officer, Hillier-Graves follows up his previous effort, *Heaven High, Ocean Deep*, about the Grumman F6F Hellcat-equipped 5th Fighter Wing aboard *HMS Indomitable* in the final year of the Pacific War. Relying on extensive interviews, diaries, and letters, he focuses on the personal accounts of the Royal Navy pilots who initiated the Vought F4U Corsair's operational baptism as a carrier-based fighter.

Before discussing the Corsair in combat, Hillier-Graves devotes the early chapters to the airplane's development. Readers are introduced to Rex Beisel, Vought's lead engineer, and the emergence of Vought as a competitor to Grumman vying for U.S. Navy aircraft contracts. He discusses the first production Corsairs' considerable shortcomings. These negative features resulted in the U.S. Navy initially banning the Corsair from its aircraft carriers. The first two Navy squadrons operated from land bases in the Southwest Pacific.

However, the aircraft's overall performance resulted in continued production. Land-based U.S. Marine Corps units

received the Corsair. The Royal Navy, meanwhile, chose to force the issue by acquiring the high-performance fighter, despite its obvious shortcomings, for its aircraft carriers. So began a lengthy transition process, where many very inexperienced pilots from all over the British Commonwealth journeyed to the United States to learn how to fly what, in its early days, was a very unforgiving aircraft.

Because most of the memoirs recounted in this work come from a fairly small number of pilots, the earliest deployed Corsair squadrons, operating from *HMS Illustrious*, receive the most attention. The earliest Royal Navy Corsair squadrons to see action supported attempts to sink the German battleship *Tirpitz* anchored in a Norwegian fjord in the first half of 1944.

In the summer and fall of 1944, what became known as the British Pacific Fleet operated from Ceylon (today Sri Lanka). The carriers emphasized targets in the Dutch East Indies with special attention directed toward oil fields on which Japan was severely dependent.

For most of 1945, the British Pacific Fleet closely cooperated with the U.S. Navy in the far west Pacific. British Corsairs saw extensive action in the Okinawan campaign. Most missions involved suppressing the Kamikazes operating from Formosa (Taiwan) and the southern Japanese home islands. Preparing for the invasion of Japan, British carriers conducted extensive strikes against the home islands in the summer of 1945.

Hillier-Graves has deftly integrated the pilots' memoirs into the bigger picture. Nearly every British Corsair lost seems to be documented in the narrative. Besides including these details, the book outlines the significant operations conducted by the British Pacific Fleet, with credit given to other aircraft types when appropriate.

This very readable account should appeal to anyone interested in learning about Britain's naval contributions in the Pacific. The absence of maps and notes is unfortunate, and the small format chosen for the wide array of photographs reduces their impact. Hillier-Graves would have benefitted from having a second pair of eyes more familiar with the American military review the manuscript, because there are far too many "nitpick" errors that could have been avoided.

Steven D. Ellis, Lt Col, USAFR (Ret); docent, Museum of Flight, Seattle

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The Women with Silver Wings: The Inspiring True Story of the Women Airforce Service Pilots of World War II. By Katherine Sharp Landdeck. New York: Crown. 2020. Photographs. Notes. Index. Pp. 435. $28.00. ISBN: 978-152476281-0

Throughout the history of aviation, a number of organizations have achieved mythic status due to their accomplishments and heroism: the Lafayette Escadrille, Flying Tigers, Night Witches, and Ninety-Nines are just few. Landdeck proposes that the Women's Airforce Service Pilots (WASP) belongs in this pantheon of aviators.

Landdeck is an academician who is meticulous in documenting and citing her research. Her writing flows evenly although her decision to mix a chronological structure with biographical sketches is a bit clunky at times. There are a few photographs scattered throughout the book, but the photo reproductions are of poor quality and seldom impacted the narrative.

Of course, it would be impossible to tell the WASP story without telling the story of Jacqueline Cochrane and her lesser known contemporary, Nancy Love. Cochrane and Love took opposite approaches to using woman aviators to fill pilot positions to release men for combat duties. Love advocated for a small cadre of highly skilled and accomplished aviators capable of ferrying any aircraft anywhere it was needed. Cochrane painted her vision of the WASP with a broader brush, envisioning a training pipeline that would take raw aviators, train them in the Army way of flying, and supporting the USAAF mission as needed.

But there was a bigger and more fundamental difference. Cochrane spent as much time designing stylish uniforms and picking fabric as building training curricula. She insisted that WASPs include weekly visits to beauty parlors and refrain from any "scandalous" behavior. Cochrane used her wealth, public recognition, and personal relationships with military and political leaders as much for her personal benefit as for the WASP. Love, on the other hand, avoided the spotlight and focused on improving the skills and opportunities available to women aviators. As legislation needed to bring the WASP into the USAAF was making its way through Congress, Cochrane and Love were divided. The inevitable, and sad, result was failure of the measures. This directly contributed to the gross inequities so notorious within the WASP story.

At the end of the day, Landdeck successfully builds the case that Cochrane saw the WASP as women first and aviators second. She shows that Cochrane failed to use the WASP's outstanding service record to build a consensus to merge with the USAAF and refused to use Love's approach to gain more support. While Cochrane was a historic figure who used her husband's money and close friendship with Chuck Yeager to become the face of the American female aviator after the disappearance of Amelia Earhart; in many ways she was her—and the WASP's—own worst enemy.

The Women with Silver Wings was not what I expected. Landdeck dedicated little to the aviation challenges the WASP faced, focusing instead on personal stories and struggles. For example, it was not uncommon for a WASP to be certified on 50 or more aircraft types. How were they trained and certified to maintain type currency? WASPs flew unsophisticated trainers cross country in all weather conditions. How did they receive weather information?

How were the aircraft maintained on these cross-country junkets? Unfortunately, Landdeck spends more time on the drama and tension between Cochrane and Love—and against the male aviation community—than the natural drama of the life and death challenges these superb aviators faced.

Gary Connor, docent, Smithsonian National Air and Space Museum's Udvar-Hazy Center

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Day Fighter Aces of the Luftwaffe: 1939-1942 *and* **Day Fighter Aces of the Luftwaffe: 1943-45**. By Neil Page. Havertown PA: Casemate, 2020. Photographs. Illustrations. Pp. 128 each. $24.95 paperback each. ISBN: 978-1-61200-848-6 and 978-1-61200-879-0

It would be an overstatement to say the literary market is flooded with books about Luftwaffe aces, but a simple google search reveals 14 pages of works on the subject. Since Tolliver and Constables published their seminal *Fighter Aces of the Luftwaffe*, exploring the lives of one-time adversaries has proved fertile ground for authors. When a reader picks up Page's two-volume set, the first question that should come to mind is, "What will it say that hasn't been said before?" For me, surprisingly, the answer proved to be "quite a lot."

Page focuses his work on the Luftwaffe's day-fighter force; of course, most of the Luftwaffe's efforts were focused on day-fighter operations throughout the war. In the early days, day sorties primarily supported offensive operations. In the later stages of the war, defense of the Reich took ever increasing numbers of aircraft and aircrews. Vol 1, covering 1939-1942, and Vol 2, covering 1943-1945, parallel this evolving mission.

Volume 1 covers the salad days of the Luftwaffe's efforts. High morale, constantly improving technologies, and holding the offensive initiative set the stage for success. For the skilled daytime fighter pilot, victory numbers climbed steadily. Even the embarrassing losses of the Battle of Britain were deemed acceptable. Veterans of the Condor Legion (Spanish Civil War) and early campaigns (Poland, the West, and Russia) were able to build on their experience and all important victory totals and pass on lessons learned to a new generation of hunters. Page does a great job conveying the atmosphere of the time.

In Volume 2 the story changes. The experienced pilots referred to themselves as *Alte Hasse* or "Old Hares"—no longer wolves or lions who hunt and prey, but rabbits who merely try to survive one day at a time until they meet a preordained fate. Page communicates the hopelessness and despair that typified the later stages of the war for the Luftwaffe. While Sonderkommando Elbe directed pilots to fly suicide missions, other pilots chose to commit suicide while seated in their cockpit after returning from a sortie. For me, Page's ability to convey the emotion and atmosphere of this period is what sets *Day Fighter Aces of the Luftwaffe* apart from many other books on the subject.

Day Fighter Aces of the Luftwaffe: 1939-1942 and *Day Fighter Aces of the Luftwaffe: 1943-45* are excellent. The books are quality products printed on quality stock which shows unique images in detail. The organization and factual content make them an excellent introductory resource on the Luftwaffe's day fighter operations. They also provide a satisfying read for the *experten* on the subject.

Gary Connor, docent, Smithsonian National Air and Space Museum's Udvar Hazy Center

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The Petlyakov Pe–2: Stalin's Successful Red Air Force Light Bomber. By Peter C. Smith. Barnsley UK: Pen and Sword, 2020. Photographs. Map. Illustrations. Tables. Appendices. Notes. Pp. 436. $42.95. ISBN: 978-1-52675-930-6

Some years ago, I had the opportunity to visit the Bulgarian National Air and Space Museum in Plov Div. The museum is small with most artifacts displayed in the open, but it has an interesting collection of Russian, German, and French artifacts. The aircraft displayed include one of five surviving Petlyakov Pe–2 dive bombers. The *Peshka* was not a particularly attractive aircraft, and one has to wonder why the Soviets built such a large twin-engine dive bomber with such a small payload. Smith's book on the Pe–2 should have provided answers to those questions and many more.

The Petlyakov Pe–2 is a word-for-word reprint of an earlier edition. This new edition is described as lacking a color-image section included in the earlier version. The book itself is a solid volume, printed on high-quality paper that shows most images in some detail.

The Pe–2 *Peshka* was a widely used dive/light bomber and the third-most-produced twin-engine aircraft of World War II after the Ju 88 and Vickers Wellington. It came into service just in time to meet the onslaught of the German's Operation Barbarossa and stayed in service throughout the war. Its deployment was plagued by poor materials and shoddy workmanship, ill-trained aircrews, and the lack of a clear strategic or tactical vision for its employment. Its primary operational advantage was speed, and that was squandered by the lack of a dependable engine and constant redesigns that added weight and drag. Even in 1944-45, with the Red juggernaut sweeping west, the best dive bomber in Soviet service was used as a fighter, level-bomber, reconnaissance platform, and trainer. Throughout the book, Smith labors unsuccessfully to convince the reader that the Pe–2 was a more effective weapon than the Il-2 Sturmovik.

This book is an exceedingly difficult read. Smith incorporated large portions of apparently machine-translated Russian publications throughout the book. While offering primary source detail, the grammar became mechanical and the syntax awkward, creating a discordant reading experience and doubt as to the objectivity of the research. Smith includes numerous profiles of Pe–2 aircrew, most of which read like something out of an Orwellian "agitprop" office. He also makes a habit of including critical "factual" information in the book's end notes, where they are unlikely to be read. Taken in total, these missteps detract from what should be an interesting story. For example, much of the Pe–2's design and production planning took place while the primary designer, Vladimir Petlyakov, was in the NKVD's Camp #29 on trumped-up political charges. He was released and honored just in time to die in the crash of a Pe–2. Responsibility for the Pe–2 program eventually fell to V.M. Myasishchev, himself a survivor of Camp #29. Myasishchev is credited as primary designer of the Pe–2B, Pe–2I, Pe–2M, DIS, DB-108, M-4, 3M, and M-50.

This book is a deep dive into a niche subject. It is crammed full of arcane detail on every facet of the aircraft: its design, crews, and operational use. It could be of use to the military/aviation historian seeking details on Soviet frontal aviation during Great Patriotic War—if one chooses to trust the content. Perhaps a modeler could gain information on color and livery, although Smith points out that the various manufacturers of the Pe–2 ignored guidance on paint schemes. No doubt, my introduction to the Pe–2 in Bulgaria might have been more meaningful if I had Smith's book to read ahead of time. But, then again, maybe not.

Gary Connor, docent, Smithsonian National Air and Space Museum's Udvar Hazy Center

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Jayhawk: Love, Loss, Liberation and Terror Over the Pacific. By Jay A. Stout with George L. Cooper. Havertown PA: Casemate, 2020. Maps. Photographs. Bibliography. Notes. Pp. vii, 252. $34.95. ISBN: 978-1-61200-883-7

This is Jay Stout's ninth book on American air combat of in World War II. He has previously covered the 303rd and 345th Bomb Groups; the 352nd Fighter Group; and individual pilots Elwyn Righetti, the "King of the Strafers" in the ETO, and Hamilton McWhorter, the U.S. Navy's first Hellcat ace. Stout brings to his writing his 20 years as a Marine Corps fighter pilot who flew 37 combat missions during the first Gulf War.

Jayhawk grew out of Stout's history of the 345th Bomb Group, the Air Apaches, who flew B–25s on dangerous low-level attacks with the Fifth Air Force. This is the remarkable story of George Cooper, a pilot of American and Philippine descent who flew B–25s with the Air Apaches and later A–26s with the 3rd Bomb Group. Stout benefited from Cooper's remarkable memory at age 99 to record his story. His father was an American teacher in the Philippines who later became a businessman. His mother was a Filipina teacher. He grew up in a privileged household in Manila with other American and Filipino friends who shared many of the same experiences as their counterparts in America. Cooper was at the University of Kansas when the war intervened. The fall of the Philippines cut him off from his family; he would not see or hear from them for three-and-a-half years.

Cooper progressed from trainee pilot to join the 345th Bomb Group on its formation, He met and married his wife, Betty. Using Cooper's memories and extracts from letters, Stout shows the strains of trying to maintain a relationship with the constant moves between bases, leaving family behind to go to war, and the ever-present knowledge that death could come just as easily through accident as in combat. Carrying the added burden of not knowing what had happened to his father, mother, and younger sister in Manila, Cooper went overseas and started flying combat in the summer of 1943. He named his B–25 *Jayhawk*, the U of Kansas mascot. One virtue of the book is its descriptions of Cooper's early missions during the period when the 345th switched from medium-altitude bombing to low-level strafing missions. The raids on Rabaul in November 1943 were particularly harrowing, as Cooper and his squadron mates raced across the airfields and harbor through heavy anti-aircraft fire and under air attack. Through his 50+ missions, Cooper gained a reputation as a hot pilot. He survived, where many of his friends did not.

Cooper returned to the U.S. but, after some months as a B–25 and A–26 instructor pilot, requested return to combat. In early 1945, he joined the 3rd Bomb Group in the Philippines. Landing at the recently recaptured Clark Field, he borrowed a jeep and drove through a shattered, barely recognizable Manila for a reunion with his family. He continued to support the Army's slow advance against the Japanese on Luzon before the 3rd Group converted to the A–26 in July 1945 and moved to Okinawa. Cooper flew his final missions over the Japanese homeland.

The focus is on one man's experiences in combat, though Stout does bring in descriptions of what life was like for Cooper's mother and sister in wartime Manila and his father's difficult internment in the infamous Santo Tomas camp. Cooper's comments on the differences between the airplanes he flew in combat were particularly interesting, while the descriptions of his combat missions have a sense of immediacy. The book is an enjoyable read.

Edward Young, PhD candidate, King's College, London

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Ace of the Black Cross: The Memoirs of Ernst Udet. By Ernst Udet. London: Frontline Books, 2020. Photographs. Appendix. Index. Pp xiii, 202. $22.95 paperback. ISBN: 978-1-56278-127-7

Originally published in 1935 and reprinted in 2013 with an introduction by noted military aviation historian Richard Overy, this autobiography highlights the most memorable events in Udet's distinguished career up to 1935. By the early 1930s, Udet was one of the three best known male aviators—along with America's Charles Lindbergh and England's Alan Cobham—in the western world.

Overy's introduction briefly covers Udet's service under *Luftwaffe* commander Herman Goering from the mid 1930s until his suicide in 1941. Much has been written about Udet's failures during that time. While sparse in detail, the autobiography offers some insight into why Udet proved to be such a disappointment.

Like the great athlete who fails as a coach because the sport came too easily, Udet was an exceptional pilot but, as it turned out, a dreadful manager. So eager to fly at the beginning of World War I, he turned to his father, who paid for private lessons. Initially too young to fly for Germany, he eventually received his chance when an observer recruited him to fly his plane. In the early years of World War I aviation, the enlisted ranks frequently served as pilots; while officers filled the roles of observers or bombardiers or both.

Promotion to lieutenant, followed by a transfer to single-seat fighters, unleashed his career. The result was 62 victories, the second most of the entire war. In nearly three years of aerial combat, he flew several different German fighters. In the book, Udet seldom shared details of his aerial combats. However, he devoted a significant passage to what he claimed was a duel with France's Georges Guynemer. Overy questioned the validity of Udet's description.

Late in the war, Udet escaped death by parachuting from his badly damaged aircraft. Interestingly, the British air ministry discouraged the use of parachutes. That, and peer pressure against their use, contributed to many of that nation's pilots dying needlessly.

After the war, Udet established a reputation as an exceptional aerobatic flyer and air racer. He competed in the United States and worked as a stunt pilot in several Hollywood films. George Roy Hill's 1975 homage to American barnstormers of the 1920s, *The Great Waldo Pepper*, includes a number of scenes featuring a German pilot based on Udet.

In the early 1930s, Udet worked as an aerial explorer photo pilot traveling to, among other places, Africa and the Arctic. In 1933, he joined the Nazi party. He concluded the book, "We have now unfurled our flag once more. The Führer restored it to us. For old soldiers life is again worth living."

This book is best suited to generalists unfamiliar with World War I aviation but who would like to gain some insight into early aerial combat. The appendix listing Udet's victories is interesting in that most were against other fighter aircraft. By comparison, the war's leading ace, Manfred von Richthofen, primarily preyed on reconnaissance aircraft.

Steven D. Ellis, Lt Col, USAFR (Ret), docent, Museum of Flight, Seattle

Fallschirmjäger!: A Collection of Firsthand Accounts and Diaries by German Paratrooper Veterans from the Second World War. By Greg Way. Warwick UK: Helion & Company, 2020. Bibliography. Index. Glossary. Photographs. Pp xxi, 307. $ 31.70. ISBN 978-1-912866-18-2

This is much more than a simple collection of interviews and diary excerpts from former German Second World War paratroopers (*Fallshirmtruppe*). These are very personal and detailed accounts from those who fought in key battles and campaigns throughout Europe and North Africa. One gets a feet-on-the-ground sense of what these battles were really like.

In one account, a *fallschirmjager* unit is thrown into battle to block the American breakout at St. Lo after the Normandy landings. It is fascinating to "experience" being under attack by advancing Sherman tanks and infantry while being pounded by unopposed allied warplanes circling over the battlefield. Other vignettes center on the invasion of the Low Countries during one of the earliest phases of the war. This part of the war has received only brief discussion in most war histories, aside from the audacious glider assault on Fort Eben Emael (recalled with captivating detail in this book). One learns from another reminiscence that the Dutch military, often discounted in other narratives, actually put up stiff resistance to the Germans. Likewise, the parachute assault on the Greek Isthmus of Corinth comes alive when a Ju 52 aircraft, approaching the drop zone, crashed into a mountain side while others came under heavy fire. The more well-known parachute assault on Crete is described as ten days of bitter fighting by many of the veterans. Several veterans recalled the atrocities committed by civilians on wounded soldiers. In other accounts, paratroopers describe the winter fighting in bitterly cold Russia and, in particular, the struggle to survive while under continual and heavy attack by Russian forces. The accounts of the retreat from the USSR remind one of similarly horrific stories once told by survivors of Napoleon's army during its retreat from Moscow.

Interspersed are accounts of challenging and sometimes famous missions. One chapter covers the incredible glider raid on Mount Gran Sasso, ordered by Hitler himself, to liberate Mussolini from imprisonment. On a more

technical note several of the veterans discuss the various aircraft (including bombers) used as jump platforms, the unusual methods for exiting them, and the very low altitudes for conducting combat jumps.

Another interesting experience explored is that of being a prisoner-of-war. One paratroop talks about his capture after German units in the stronghold of Brest had capitulated to U.S. forces. He was soon taken by ship to the U.S. and held at Camp Chaffee, Arkansas. It is entertaining to read about the schemes practiced by prisoners during their incarceration and compare them to American POW experience in Germany as told in *Stalag* 17 and, more humorously, on *Hogan's Heroes*. A much more serious subject for the POWs was the return home to discover a totally devastated and divided Germany under military occupation.

The memories of battle captured in this book provide insight into the war as it actually was fought, especially since they come from members of an elite fighting force that saw extensive combat. Much can be learned by reading this book. During the Cold War, I made jumps with a *fallschirmjager* group and was impressed by the same unit spirit this book's contributors expressed. I will always remember their traditional refrain: *Glück ab*—Good luck jumping.

John Cirafici, Milford DE

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Mystery of Missing Flight F-BELV. By Stephen Wynn. Barnsley UK: Pen & Sword, 2020. Map. Table. Photographs. Sources. Index. Pp. xiii, 128. $25.80. ISBN: 978-1-47384-595-4

Stephen Wynn is a retired Essex, England, police constable who has written a number of crime mysteries and books on historical subjects. An uncle was one of the passengers aboard the final flight of Boeing 307 F-BELV.

On October 18, 1965, an aircraft owned by Paris-based Compagnie International de Transport Civil Aériens (CITCA) departed the airport in Vientiane, Laos, and headed to Hanoi, North Vietnam. The flight was chartered by the International Commission for Supervision and Control (ICSC) with four French crewman and nine ICSC members aboard. The ICSC was the organization responsible for monitoring adherence to the provisions of the Geneva Conference on Indochina. One of the member nations—Canada—had three representatives aboard, one of whom was Sergeant James Byrne, Royal Canadian Army. Following a radio message sent 15 minutes after takeoff, the occupants and aircraft were never seen or heard from again.

Because the National Air and Space Museum has the only remaining Boeing 307 of the ten built, I was very interested in learning the answer to the mystery of the one registered F-BELV. The fate of all is known—except for this aircraft. Unfortunately, I still don't what happened to the aircraft. Wynn sets forth a lot of information on a number of topics. But he comes no closer to solving the mystery of this aircraft than the books dealing with Amelia Earhart's disappearance have accomplished.

After the loss of the aircraft, CITCA, ICSC, and concerned governments' authorities made numerous inquiries of North Vietnamese and Laotian officials. With the confusing political situation in that area of world at that time with Pathet Lao, Royal Laotian, Viet Cong, regular North Vietnamese, and local tribal forces in play, inquiries were made; but answers were long in coming or didn't come at all. Overflights of the heavily forested and highly mountainous terrain spotted nothing. Decades later, Wynn had no more success.

On top of this, Wynn's organization of the story is choppy. When he starts off one chapter with, "I gave this chapter quite a lot of thought before deciding whether to include it . . ," one has to wonder how much thought was really given to organization of the material. There are chapters on the CIA, North Vietnamese soldiers, the accident, weaponry in the area, James Byrne, Air America, searches, the 307 Stratoliner, and others. Material in some chapter could have fit better elsewhere. Some was repeated. Much of it was interesting, but some fit in the "so-what" category. In the end, there is speculation that Byrne might have been involved in intelligence and was found out by someone, but speculation doesn't solve any mysteries.

If one would like to know about one small incident in a very long and complex war, this book provides some detail. It also well describes the often overlooked mission of the ICSC. But don't expect to have any mysteries solved.

Col Scott A. Willey, USAF (Ret), Book Review Editor, and Docent, NASM's Udvar-Hazy Center

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PROSPECTIVE REVIEWERS

Anyone who believes he or she is qualified to substantively assess one of the new books listed above is invited to apply for a gratis copy of the book. The prospective reviewer should contact:

Col. Scott A. Willey, USAF (Ret.)
46994 Eaker St
Potomac Falls VA 20165
Tel. (703) 620-4139
e-mail: **scottlin.willey@gmail.com**

Compiled by
George W. Cully

In light of the coronavirus pandemic, events listed here may not happen on the dates listed here, or at all. Be sure to check the schedules listed on the individual organization's web sites for the latest information.

March 8-27, 2021
The **National Council on Public History** will hold its annual meeting over the course of several weeks using a virtual format. For program details, registration and other information, see the Council's website at https://ncph.org/conference/2021-annual-meeting/

March 18-21, 2021
The **Society for Military History** will hold its 87th annual meeting in Norfolk, Virginia. This year's theme will be "Turning the Tide: Revolutionary Moments in Military History." For additional details as they become available, see the Society's website at https://www.smh-hq.org/smh 2021/index.html.

April 8-10, 2021
The **Vietnam Center and Sam Johnson Vietnam Archive** at Texas Tech University in Lubbock,Texas, will present a Symposium in combined in-person and virtual form entitled "1970-1971: Nixon, Discord, and the US Withdrawal from Vietnam." For registration and more information, see the Center's website at The Vietnam Center and Sam Johnson Vietnam Archive: Events (ttu.edu).

April 15-18, 2021
The **Organization of American Historians** will hold its annual meeting and conference at the Sheraton Grand Hotel in Chicago, Illinois. The theme of this year's gathering will be "Pathways to Democracy." For further information, see their website at https://www.oah.org/meetings-events/oah21/.

April 21-23, 2021
The **Army Aviation Association of America** will host its annual Mission Solutions Summit at the Gaylord Opryland Hotel and Convention Center in Nashville, Tennessee. For more details as they become available, see the Association's website at https://s15.a2zinc.net/clients/aaaa/aaaa21/Public/Enter.aspx.

May 3-6, 2021
The **Association for Unmanned Vehicle Systems International** will present Xponential 2021, its premier annual event, at the Georgia World Congress Center in Atlanta, Georgia and also in virtual form. For registration, scheduling and other details, see the Association's webite at Events | Association for Unmanned Vehicle Systems International (auvsi.org).

May 11-13, 2021
The **Vertical Flight Society** will host its 77th Annual Forum & Technology Display, the world's leading event in vertical flight technology, in West Palm Beach, Florida. For more information, see the Society's website at VFS - Forum 77 (vtol.org).

May 20-23, 2021
The **Society for Military History**, working in conjunction with the Armed Forces Staff College, will present its 87th Annual Conference at the Hilton Hotel in downtown Norfolk, Virginia. The theme of this year's gathering is "Turning the Tide: Revolutionary Moments in Military History." For further details, see the Society's website at 2021 Call for Papers | The Society for Military History (smh-hq.org).

June 7-11, 2021
The **American Institute of Aeronautics and Astronautics** will hold its annual Aviation Forum at the Marriott Wardman Park Convention Center in Washington, D.C. For registration and other details, see the Institute's website at AIAA AVIATION Forum and Exposition | AIAA.

July 7-10, 2021
The **International Womens Pilot Association**, better known as **The Ninety-Nines**, will hold their annual meeting on board the SS Queen Mary moored in the harbor of Long Beach, California. For registration, see their website at https://travelplannerstexas.swoogo.com/99s2021/333555.

July 25-31, 2021
The **International Committee for the History of Technology** will hold its 26th annual meeting in virtual form. This year's theme is "Giants and Dwarves in Science, Technology and Medicine." For registration and more information, see the Committee's website at ICHST 2021.

August 23-26, 2021
The **Space Foundation** will host its 36th annual Space Symposium at the Broadmoor Hotel in Colorado Springs, Colorado. For registration and other details, see the Foundation's website at https://www.spacesymposium.org/.

September 9-11, 2021
The **National WWII Museum** will host "Memory Wars: World War II at 75," an international conference to address the shifting landscapes of popular memories of this world-altering conflict. The gathering will be held at the new Higgins Hotel & Conference Center in New Orleans, Louisiana. For more information, see the Museum's website at Home | The National WWII Museum | New Orleans (nationalww2museum.org).

September 18-21, 2021
The **Air Force Association** will host its annual convention at the Gaylord Convention Center in National Harbor, Maryland. This will be immediately followed by the Association's annual Air, Space & Cyber Conference at the same site. For more details as they become available, see the Association's website at https://www.afa.org/events.

October 5-6, 2021
The **Aviation Engine Historical Society** will conduct its annual gathering at the Hilton Doubletree Hotel in Dearborn, Michigan. Expected site visits include the Henry Ford Museum, Greenfield Village, Automotive Hall of Fame and the Yankee Air Museum. For further information as it becomes available, see the Society's website at http://www.enginehistory.org/.

Readers are invited to submit listings of upcoming events Please include the name of the organization, title of the event, dates and location of where it will be held, as well as contact information. Send listings to:

George W. Cully
3300 Evergreen Hill
Montgomery, AL 36106
(334) 277-2165
E-mail: warty@knology.net

History Mystery Answer

Born in Texas and raised in Louisiana, Claire Lee Chennault joined the Army in 1917 ultimately obtaining his goal of becoming a pilot. A strong advocate for pursuit aircraft, he established the "Three Men on the Flying Trapeze" aerobatic group. Frustrated with the Army Air Forces' lack of focus on pursuit aircraft, Chennault retired in 1937 and shortly thereafter became an air advisor to Chiang Kai-shek's Chinese Air Force. With the Japanese having invaded China, Chennault returned to the U.S. to advocate for aircraft and the establishment of a volunteer force to fight with the Chinese against Japan. The United States would divert P-40B Tomahawks to China for this effort. These aircraft along with the ~300 volunteers (pilots and maintenance troops) would become the American Volunteer Group, or more commonly known as the "Flying Tigers." The AVG began training in Burma in July 1941. The "Flying Tigers" became known for the Shark's Teeth they painted on the noses of their aircraft. After the Japanese attacked Pearl Harbor, the AVG began combat operations against the Japanese despite having less than 50 aircraft and lacking adequate supplies. During its short operational life (Dec 1941 – Jul 1942), the "Flying Tigers" would shoot down 296 Japanese aircraft. The Flying Tigers disbanded in July 1942 when the U.S. Army Air Forces arrived in theater. Nineteen pilots would become aces during their time flying with the "Flying Tigers." Two Flying Tiger Alumni would go on to earn the Congressional Medal of Honor winners [Greg "Pappy" Boyington and James Howard).

To learn more about:

Claire Chennault: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/196772/maj-gen-claire-chennault/

The Flying Tigers: https://media.defense.gov/2010/Oct/28/2001330217/-1/-1/0/AFD-101028-007.pdf

P-40 Warhawk: https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/ Article/ 196309/curtiss-p-40e-warhawk/

Explaining the images on the question page: The group photo is of the pilots of "Three Men on a Flying Trapeze" and their mechanic. Chennault is the second from the right. The fourth man was their mechanic. The pilot in the Corsair is Medal of Honor Winner Greg "Pappy" Boyington who flew briefly in the AVG

New History Mystery

by Dan Simonsen

This issue's quiz:
This two part question relates back to a topic we've addressed before in previous questions. American aviators have historically come to the aid of foreign nations by volunteering to fly as part of their Air Forces or as an independent organization. This includes World War I, the Spanish Civil War and World War II. This edition's question focuses on another group of American Aviators and their leader. This group's leader retired from the Army Air Forces in 1937 after a somewhat controversial career because of his staunch advocacy for pursuit aircraft. After retiring, he became an air advisor to a foreign government. As World War II approached, he led efforts to acquire American fighter aircraft and establish an American Manned air unit. Can you name this man and the volunteer organization he established?

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