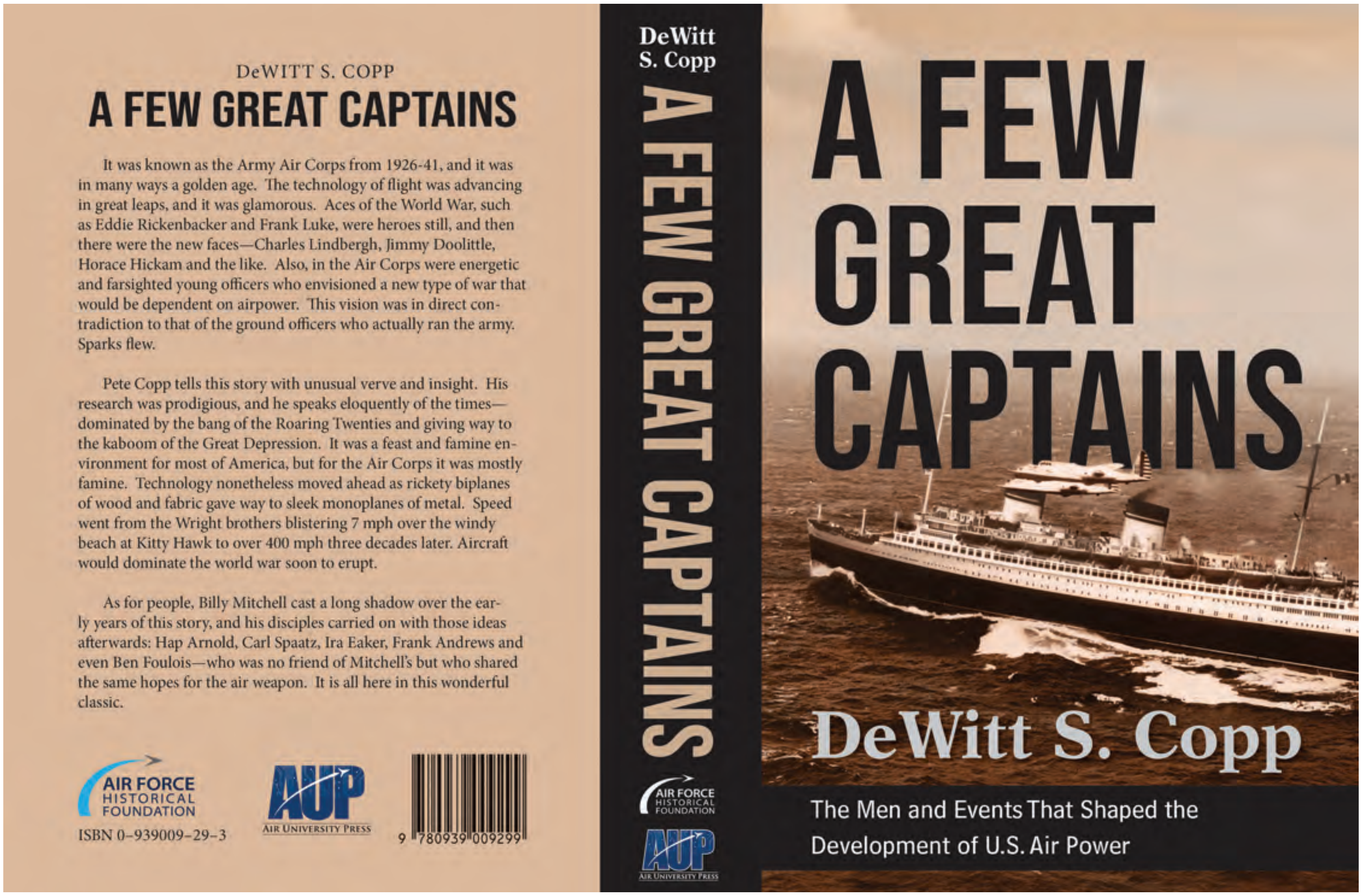
WINTER 2025 - Volume 72, Number 4
WWW.AFHISTORY.ORG

Journal of the Air Force Historical Foundation

know the past
....Shape the Future



In a joint program with the Air University Press, AFHF is proud to offer the newly published update of Pete Copp's air power classic (now expanded), *A Few Great Captains: The Men and the Events that Shaped the Development of U.S. Air Power*. The free digital version will be available soon from the Air University bookstore.

A Few Great Captains is a terrific book, suitable for airmen of any rank. Pete Copp wrote a masterpiece that takes the Air Corps and its leaders, both senior and junior, through the tumultuous period of the 1920s and 30s. Ground-oriented Army leaders felt threatened by the new weapon of the airplane and therefore labored to control it and those who flew it. For their part, the airmen refused to be bridled by the ground zealots and instead foresaw a future where the airplane would dominate war. The visions of the airmen were not completely accurate, but they were far more so than those who saw the airplane as just another weapon to support ground operations.

This publication marks the Foundation's return to publishing and disseminating important, relevant, and readable history to all.

KNOW THE PAST...SHAPE THE FUTURE!

Journal of the Air Force Historical Foundation

WINTER 2025 - Volume 72, Number 4
WWW.AFHISTORY.ORG

know the past
.....Shape the Future

FRONT COVER: Shock-absorbing tiles, which help the missile exit its canister, fall away as Peacekeeper is launched. *(U.S. Air Force photo)*
BACK COVER: The cold launch system ejects Peacekeeper from its canister with high-pressure steam. *(U.S. Air Force photo)*

Air Force Historical Foundation
P.O. Box 405
Mechanicsville, MD 20659
(301) 736-1959

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

Journal of the Air Force Historical Foundation

The Journal of the
Air Force Historical Foundation
Winter 2025 Volume 72 Number 4

Editor
Richard I. Wolf

Editor Incoming
Paul Hoffman

Book Review Editor
Scott A. Willey

Advertising
Dik A. Daso

Circulation
Angela J. Bear

Journal of the Air Force Historical Foundation (ISSN 1044-016X) is produced for Spring, Summer, Fall, and Winter by the Air Force Historical Foundation.

Prospective contributors should consult the **GUIDELINES FOR CONTRIBUTORS** at the back of this journal. Unsolicited manuscripts will be returned only on specific request. The Editor cannot accept responsibility for any damage to or loss of the manuscript. The Editor reserves the right to edit manuscripts and letters.

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

Journal of the Air Force
Historical Foundation
70 Shannon Way
Upton, MA 01568
e-mail: airpowerhistory@yahoo.com

Correspondence regarding missed issues or changes of address should be addressed to the **CIRCULATION OFFICE**:

Journal of the Air Force
Historical Foundation
P.O. Box 405
Mechanicsville, MD 20659
(301) 736-1959
e-mail: angelabear@afhistory.org

ADVERTISING

Executive Director
P.O. Box 405
Mechanicsville, MD 20659
(301) 736-1959
e-mail: xd@afhistory.org

Periodicals postage paid at Mechanicsville, MD 20659 and additional mailing offices.

Postmaster: Please send change of address to the Circulation Office.

Don’t miss our Podcast

We have a podcast that you don’t want to miss. Coming in November, join Matt Jolley for a wonderful episode of Know the Past…Shape the Future. IT IS TERRIFIC!

Our latest episode goes behind the scenes of the new Netflix documentary Air Force Elite: Thunderbirds with director Matt Wilcox and former Thunderbird Commander Colonel Justin Elliott. The film reveals the human side of the Thunderbirds—the pursuit of excellence, the progression, and the very real hardships behind the precision you see in the sky. The team’s message is resonating everywhere, from two sisters in Colorado to professional sports organizations. The Thunderbirds’ story is making an impact far beyond the flight line. Listen now and hear how it all came together. Enjoy the podcast and then have a family night to watch the movie.

www.afhistory.org/podcast/

2026 Annual Symposium and Awards Banquet

MAY 13, 2026--Save the Date and plan to attend the AFHF Annual Symposium. Next year, the event will take place in the new Air and Space Forces Association Headquarters conference center. The theme for the event is: Unmanned Air and Space Flight—1915-2025. Panels of experts will share their experiences and stories throughout the day. There will also be a working lunch session. https://afhistory.org/events/

MAY 14, 2026—Save the Date and plan to attend the AFHF Annual Awards Banquet. While the location is still a little secret, the event will take place in the greater DC area from 1800-2200 on Thursday evening, May 14th.

https://afhistory.org/afhf-symposium-and-awards-banquet/

From the Editor

It’s official. The new Editor of this journal will be Paul “Abbie” Hoffman, last seen at Air University Press. He will be phasing into the job in the beginning of 2026. We will be working together on the first couple of issues to allow for a seamless transition. Please welcome him.

Our opening article is by our honored and long-time contributor, David K. Stumpf, who documents the process by which the USAF put Peacekeeper ICBMs in Minuteman silos. It’s a fascinating, if convoluted, history

Our next article is by return contributor, Dan Haulman, with an interesting story on the use of Craig Field in Selma, Alabama as a pilot training field for 37 years.

Our third article is from first-time contributor Adam Young, who wrote this article as a student paper. It was the AFHF best paper award winner at Air War College. It’s a fascinating story of how the country of Sweden coped with its air power needs in the Cold War.

Let me encourage any of our readers to contribute that article that has been rolling around their consciousness for several years. We can always use new scholarship.

The Leadership’s Message can be found on page 4. It’s worth the read. Don’t miss Upcoming Events on page 70. And the issue closes with the Mystery on page 72. Enjoy!

Richard I. Wolf, Editor

The State of the Foundation, 2025

To all AFHF members,

It is a tremendous privilege to provide this summary of Foundation accomplishments to our membership for the 2025 calendar year. There are two specific items that are worth highlighting at the top of this report. Both have established milestones that all Foundation members can be extremely proud of.

First, through active and creative efforts, AFHF general membership has swelled from 1,000 members to its more than 5,500 individual members—its highest ever. If you are one of our newest Foundation members—WELCOME! AFHF hopes that you will find our signature programs interesting, valuable, and often beautiful. We welcome these groups to our ranks as Associate members—Arnold Air Society and Silver Wings, WW II Glider Pilots Association, Eighth AF Historical Society, National Warbird Operators Convention, and USAF Academy Department of History (DFH) Alumni.

Second, on May 22nd the Foundation partnered with Air University Press and republished the airpower classic, *A Few Great Captains*, by Pete Copp. While originally published in 1980, the lessons that can be learned from this interwar period tale are as valid today as they were back then. EVERY member of the USAF and USSF should take the time to read this classic account of technology, people, and politics with an eye to current events. This is much more than a reprint of the original work. This imprint includes a new Foreword, Afterword, a completely revised photo essay, and Copp's research and reference notes (excluded from the original by the publisher).

Get your free digital copy of *A Few Great Captains* by visiting the AFHF website here: https://afhistory.org/wp-content/uploads/2025/04/B_185_Copp_A_Few_Great_Captains-1.pdf Active duty and retired military can request a printed softbound copy by sending an email to: airuniversitypress@ua.af.edu

This year marked the completion of our first year of ***The AFHF Official Podcast: Know the Past…Shape the Future***, produced by Award winning broadcaster, Matt Jolley. We began with several episodes that focused on the evolution of technology in the USAF and ended with a captivating series of episodes recounting the origins of the US Space Force with those who were participants. Listen to the entire revealing series at this link: https://afhistory.org/podcast/

Additionally, the ***Journal of the Air Force Historical Foundation*** 2025 Special Summer Edition celebrated the 5th anniversary of the creation of the U.S. Space Force. It includes articles that describe the birth of the Space Force from insider perspectives, legacy USAF Space articles from the 1960s and 70s, and a clever piece describing the birth of the Space Force through artifacts. AFHF has published articles on space operations and technology since the 1950s and the Foundation continues to highlight USAF Space and US Space Force history. Members may access the complete archive of Journals dating to the 1950s. Find the JAFHF here: https://afhistory.org/research/the-journal-of-the-afhf/

This Day in Air and Space History continues as our single best means of communication with our membership and independent subscribers. We have expanded into several different daily formats, contributions by Foundation members, and continue to highlight historical topics that are particularly relevant to current events.

Through 2026, AFHF will continue to provide the morning releases for free to all subscribers. In 2027, only AFHF members will be able to access and receive this daily history drop. If you are currently not an AFHF member, we hope that you will consider joining at a membership level of your choice by visiting the membership link:
https://afhistory.org/support/become-a-member/

The AFHF website remains the gateway to all the Foundation's projects, programs and publications. https://afhistory.org/ The AFHF "research page" now includes video recordings from the 2023 and 2025 Symposia, links to books written by Foundation members and USAF Academy History Department alumni, Links to AU Archives, Access to critical AF Magazine stories and even the 45 minute USAF film describing the 1995 New World Vistas technology study. The AFHF Newsletter, *The Raider Chronicles*, now in its second year, it is a terrific source for Foundation news, personal stories, aviation quizzes, and "ask a researcher" opportunities. In 2026, the Raider Chronicles will change to a new LinkedIn format with similar content to the original version. Col. Eileen Bjorkman, USAF (ret), edits this excellent Newsletter. https://afhistory.org/research/

AFHF Symposium and Museums Conference, May 21, 2025. This one-day conference highlighted the US Space Force and celebrated the 5th anniversary of their creation as an independent service. It was held at the National Air and Space Museum, Steven F. Udvar-Hazy Center in Chantilly VA**.** The event was highlighted by a tremendous set of panel presentations by researchers and top Air Force influencers. The panel recordings are available at this link:
https://www.youtube.com/playlist?list=PLtKKBQ39u880_wa3hn8uKgqzYm-Zms3yv

Annual Awards Presentation and Banquet, May 22, 2025. This year's hallmark event took place at the Space Hangar at the National Air and Space Museum, Steven F. Udvar-Hazy Center. Awards were presented to outstanding USAF and USSF units, book and article prize winners, and lifetime achievement for individuals. The Foundation Board President change of command took place, and Robert B. Arnold succeeded Jonna Doolittle Hoppes as she took her well-earned leave from that position. Ms. Doolittle Hoppes was honored by the USAF when she was presented with the prestigious CSAF Award for Exceptional Public Service which is given to those who exhibit "dedication, patriotism and personal sacrifice resulting in significant contributions to the Air Force." Since 2009, only 29 of these awards have been approved. Ms. Doolittle Hoppes Award is the first since 2019.

The inaugural presentation of the Hub Zemke "Thunderbolt" trophy for the best training unit in the USAF or USSF for the calendar year (2025) was made by our Foundation Chair, Maj Gen John Barry, to the 56 FW at Luke AFB. It was a festive affair, and the trophy changed hands on stage during the Wing family event in full country and western dress.

The Foundation Executive Director delivered an artifact-related speech at the National Warbird Operator Conference in February. The highlight of that Dallas-based conference was a patriotic appearance by "Lucky" Luckadoo who was then the last surviving member of the "Bloody Hundredth" Bomb Group. Luckadoo died on September 1, 2025 at the age of 103.

In March, AFHF sponsored the Arnold Air Society top trophy for the year—The Arnold Sabre. Our Foundation was represented by Robert Arnold (Grandson of Gen Hap Arnold and incoming Board President) attended the AAS/SW National Convention to present the Sabre which is sponsored by the Foundation.

While the Arnold Sabre was being presented in Atlanta, AFHF Foundation Chair, Maj Gen John Barry, and President Jonna Doolittle Hoppes, travelled to Denver to present the Foundation's most prestigious prize—The James H. "Jimmy" Doolittle Trophy for unit valor. The 2025 award went to Space Delta 4, the first time that a U.S. Space Force unit has been so honored.

The inaugural award for Lifetime Achievement in Space recognizes an individual who has made significant contributions in their lifetime to the making of Air Force history in the Space realm and shaping the future of continued development of the U.S. Space Force. USAF astronaut and retired General, "Chili" Chilton, was the recipient.

Visit the Award recipient page to review all winners past and present:
https://afhistory.org/awards/

Images from these tremendous events are available at the AFHF flickr link:
https://www.flickr.com/photos/air-force-historical-foundation/

We at AFHF are exceptionally proud of our accomplishments in 2025, and there is more on tap for next year. The Board of Directors has approved an updated long-range plan that will challenge the Foundation to reach new heights in scholarship and philanthropy. Stay tuned for the details in the new year.

While AFHF is happily "out over its skis," creating and sustaining this kind of programing and content takes considerable time and money. Please consider increasing your membership level to support these efforts. Another financial option is a targeted donation where you may select how AFHF will spend your money (Research and Education, Digital Archives, Publishing, Podcast, Awards and Scholarships, Key Programs and Partnerships, and Special Events are all possibilities).

Please watch for the AFHF "Giving Tuesday" drive this November. Every single donation and sponsorship is important, and we appreciate them. All these options are tax deductible.

KNOW THE PAST…SHAPE THE FUTURE

Maj Gen John Barry, USAF (ret)	Mr. Robert B. Arnold
Foundation Chair	President of the Board

John H. Luckadoo
1922 - 2025

Maj. John "Lucky" Luckadoo, the last surviving B–17 pilot of the Eighth Air Force's famed "Bloody Hundredth" Bombing Group, died in his home in September, 2025, his family announced. He was 103.

Born in March, 1922, in Chattanooga, Tennessee, Luckadoo joined the U.S. Army Air Forces months after the Japanese attack on Pearl Harbor. He was just a wide-eyed 21-year-old lieutenant assigned to the Eighth Air Force's 100th Bomb Group when he manned the controls and took to the sky for his first bombing mission over Nazi Germany as co-pilot of a famed B–17 Flying Fortress. The B–17 could fly at altitudes of 35,000 feet for up to 2,800 miles. And it did so carrying a hefty bomb payload supplemented by 10 .50-caliber machine guns. Flying it, however, was deadly. So much so that the odds of a B–17 crewman surviving the 25 missions required to complete a combat tour were only one in four.

Until the 1944 introduction of the P–51 to the air war over Europe, the B–17's daylight bombing runs over Germany had to be done without fighter escorts, leaving inexperienced B–17 crews to fend for themselves against the seasoned pilots of the Luftwaffe. Moreover, German anti-aircraft batteries peppered the American bombers with "flak" that would explode within feet of a B–17 flying at its required bombing altitude.

One B–17 crew member went so far as to compare the ever-present threat of shrapnel to Russian roulette. "You were going to be hit by it," he said. "It was just a matter of where it would hit you and when." Luckadoo recalled the experiences years ago in an interview, saying the flak was "so thick that you could put your wheels down and taxi on it."

"Lucky," a fitting moniker bestowed upon him by his men, would be one of the fortunate few to beat the odds and complete 25 missions, but certainly not before the war left its mark. On Oct. 8, 1943, Lucky took to the sky for his 22nd mission, one that would be forever etched into his memory. "We experienced the heaviest anti-aircraft defense that we had ever seen," he previously told Military Times. "The Germans had moved in some 300 88mm guns to protect their targets. We had never seen them throw up such a heavy barrage of defenses. Also, what we had never experienced or witnessed before was the fact that their fighters were attacking us through their own flak."

By the end of February 1943, half of the crews belonging to the "Mighty Eighth" had been shot down. Capt. Robert Morgan, pilot of the famed B–17 *Memphis Belle*, noted that it seemed like each day, airmen would have breakfast with a crew of 10 but dinner with just two. Morgan and his crew would become the eventual subjects of Oscar-winning director William Wyler's film, "Memphis Belle: A Story of a Flying Fortress."

Lucky, meanwhile, returned to the U.S. in March 1944 and would go on to attend instrument school at Bryan Army Air Field in College Station, Texas, where he would meet his eventual wife, according to the National WWII Museum. After the war, the G.I. Bill would help Lucky earn a degree from the University of Denver. In his later years he would take on an active role in educating younger generations about the horrors and bravery of the air war over Europe.

Such advocacy led to Luckadoo being awarded in 2021 with The National WWII Museum's Silver Service Medallion. He would also be the subject of a 2022 book by Kevin Maurer, *Damn Lucky: One Man's Courage During the Bloodiest Military Campaign in Aviation History*. The book, like his nickname, bears a fitting title for one who, throughout his 103 remarkable years, acknowledged the undeniable fortune of longevity after such experiences.

"The truth of the matter is, nobody goes into battle and comes out the same," Luckadoo said. "You're a different person with a different perspective, a different psychology. You're happy to be alive and you don't really know why, but you realize that you've been spared and you just thank your lucky stars you were. You had a guardian angel on your shoulder. It was just a matter of pure luck you survived. "That's why they called me 'Lucky.' They ought to call me 'Darn Lucky.'"

Natalie W. Crawford
1939 - 2025

Natalie Wilson Crawford, whose analysis helped shape and build Air Force modernization for decades, has died at 86.

Crawford, who joined RAND Corp. in 1964 and spent more than 60 years as an analyst and expert there, was an influential and instrumental voice in the development of almost every innovation pioneered over that time, from precision weapons to stealth.

Beginning in the 1970s, when she expanded her portfolio from weapons analysis to aircraft, she flew in Air Force jets, asking pilots to spare her no quarter as they demonstrated high-G maneuvers and combat tactics. The young combat pilots who introduced her to the F-4 were surprised to find an intellectually challenging and insightful analyst whose critical thinking skills went far beyond her single education credential: a bachelor's degree in mathematics from UCLA.

Without knowing the details of the Air Force's development work on the F–117, Crawford came to the conclusion independently that the Air Force needed a low-observable penetrating aircraft that could laser-designate targets deep behind adversaries' lines. That story and many more are related in *Every Day is a School Day*, a book written by former Air Force historian Dick Anderegg that RAND published in 2017 to celebrate her half century with the firm.

Crawford was almost universally admired, both for her ability to think and analyze but also for penetrating questions, plainspokenness, and clear insight.

"Natalie Crawford was a national treasure," said former Air Force Secretary Frank Kendall III, whose 50-year career in defense trailed Crawford's by a decade or so. "Her leadership of Project Air Force helped steer the Air Force through the Cold War and into the future. I treasured her depth of knowledge, integrity and passion for sound objective analysis. Her example will always be an inspiration as the Air Force and Space Force confront new challenges. We will miss her, but her legacy is enduring and strong."

Natalie Wilson Crawford was born in Indiana in 1939 and her parents farmed and later owned a dry cleaning business. She held jobs as a teenager, and moved to Southern California with her family as a high schooler, graduating from Santa Monica High School. There she excelled in math and became fascinated by problem-solving theory.

After graduating from UCLA, she sought a role with RAND, but failing to land one, landed a job with North American Aviation as a programmer analyst. After just a couple of years, she moved to RAND, and never left. She married mathematician and educator Robert C. Crawford in 1970, of whom she told Anderegg "he taught me to think." Robert predeceased her, dying in 1994.

Crawford's many awards over the years include the U.S. Air Force Academy's 2012 Thomas D. White National Defense Award for significant contributions to national security; AFA's Lifetime Achievement Award for contributions to the advancement of aerospace science and technology; the Office of the Secretary of Defense Medal for Exceptional Public Service; a Lifetime Achievement Award from the National Defense Industrial Association's Combat Survivability Division; the Department of the Air Force Decoration for Exceptional Civilian Service (twice, in 1995 and 2003), and the Air Force Analytic Community's Lifetime Achievement Award, She also received the Lt. Gen. Glenn Kent Leadership Award, and the Vance R. Wanner Memorial Award from the Military Operations Research Society. Eventually, she would also gain an advanced degree: In 2018 she was awarded an honorary Doctor of Public Policy from the Pardee RAND Graduate School.

James Arthur Lovell, Jr.
1928 - 2025

Jim Lovell, a NASA astronaut who flew four historic missions, including the near-disastrous Apollo 13, died in August, 2025, in Lake Forest, Illinois.

Over the course of his four missions, Lovell became one of the great symbols of the U.S. space program when it was at its 1960s height. Lovell was the first person who flew to the moon twice, though he never walked on its surface or even landed. He was the first to fly in space four times, and for a time he held the record of the most sunrises seen from space: 269.

Lovell's NASA career began in the U.S. Navy, where he enlisted in the 1950s and began a career as a test pilot. NASA often mined the test pilot program for astronaut recruits, and by 1962, Lovell had been selected for the Project Gemini program.

Gemini 7, launching December 4, 1965, was Lovell's first space flight, and on it, he served as the pilot alongside Frank Borman, the command pilot. They remained in space for 14 days, a record that would stand until the Skylab program of the 1970s surpassed it. The primary mission of Gemini 7 was a rendezvous with Gemini 6A, the first of its kind, which they performed successfully. On Gemini 7, Lovell and Borman also tested and helped refine basic necessities for space travel, including food supply, waste disposal, and personal hygiene. They were able to make recommendations that would improve comfort for future missions.

Almost a year later, Lovell was the command pilot for Gemini 12, the final mission of the program, flying with spaceflight rookie Buzz Aldrin. Among the missions of Gemini 12 was to experiment with extravehicular activity, though Aldrin completed this while Lovell helmed the ship.

Shortly after the Gemini program ended, the first flight of the Apollo program launched, with the goal of reaching the moon. Along with Cmdr. Borman, Lovell would fly as the command module pilot on Apollo 8, the first of the Apollo missions to leave Earth's orbit and achieve the program's goal. This historic spaceflight produced one of the most enduring images of the 20th century – the famous "Earthrise" photograph, taken by lunar module pilot William Anders, showing the Earth rising over the surface of the moon.

In 1970, Lovell was back in space, flying as the commander of Apollo 13. The mission was intended to be a third moon landing, with Lovell joined by Jack Swigert and Fred Haise as they planned to explore the moon's Fra Mauro highlands. But things went very wrong two days after the April 11, 1970, launch.

Apollo 13 was still en route to the moon when an oxygen tank exploded, severely damaging the craft. Suddenly, landing on the moon was entirely impossible, and even a safe return to Earth seemed like a long shot. Using the moon's orbit to set them on a return trajectory to Earth and Apollo 13's lunar module as a lifeboat, the crew set out on a dangerous three-day journey home. Though the crew had to endure deprivation to reduce consumption of precious oxygen and water, they were able to solve problem after problem until their successful splashdown April 17 in the South Pacific.

Lovell retired from the military and NASA in 1973, later working in executive positions for Fisk Telephone Systems and Centel. In 1999, he and his family opened the Illinois restaurant Lovell's of Lake Forest, decorating it with memorabilia of his years in the space program. He was an advocate for science education and the space program, often speaking at schools.

The honors and awards bestowed on Lovell were many; they include the Presidential Medal of Freedom and the Congressional Space Medal of Honor. An Eagle Scout, he earned the Distinguished Eagle Scout Award as well as the Silver Buffalo Award by the Boy Scouts of America. A crater on the moon is named in his honor, as is Milwaukee's James Lovell Museum of Science, Economics and Technology.

As discussions of a manned mission to Mars ramped up in the 21st century, Lovell advocated for a return to the moon first. He explained his reasoning to Forbes: "My view is that we should go back to the moon, build up the infrastructure to make flights there commonplace – be comfortable with it – then use that infrastructure to expand and go to Mars. In space-flight terms, six landings on the moon back in the '60s and '70s doesn't mean much. Mars is a long ways away. The moon is only 240,000 miles, but Mars is in the millions. It's too risky without spending more time going to the moon."

Carl W. Reddell
1937 - 2025

Carl W. Reddel, 88, a retired Air Force brigadier general and resident of Colorado Springs, Colorado, passed away peacefully in July, 2025, at his home surrounded by his family.

During his 36-year Air Force career, Reddel held numerous positions in various locations around the world. He entered the Air Force as a Distinguished Graduate of Officer Training School in 1962. His first assignment was to Toul-Rosières Air Base, France, where he was Chief of Administrative Services for a communications group. In his off-time, he taught Russian and Soviet history for the University of Maryland and studied at the Université de Nancy. In 1967 he began the first of four assignments to the Air Force Academy's Department of History, 1967-1968, 1971-1976, 1977-1981, and finally Permanent Professor and Department Head of History 1982-1999.

His widely traveled career included a tour in Vietnam in 1968, as well as serving as the first active-duty officer on the official educational exchange with the Soviet Union at Moscow State University(1975). He was assigned by the Air Force as the liaison officer to the Western world's leading Soviet military historian at the University of Edinburgh, Scotland (1981-1982), and completed a research associateship at the National Air and Space Museum (1994), as well as an assignment in Turkey. He also reestablished and chaired the Academy's Area Studies Program. Reddel is a Russian and Soviet scholar and author of numerous publications and presentations. From 1988-1991, he provided outstanding service to the nation as Team Chief for the On-Site Inspection Agency, leading missile destruction teams and performing inspections in the Soviet Union to ensure compliance with the Intermediate-Range Nuclear Forces (INF) Treaty. He was a member of Rotary International and supported a number of public health initiatives in various countries.

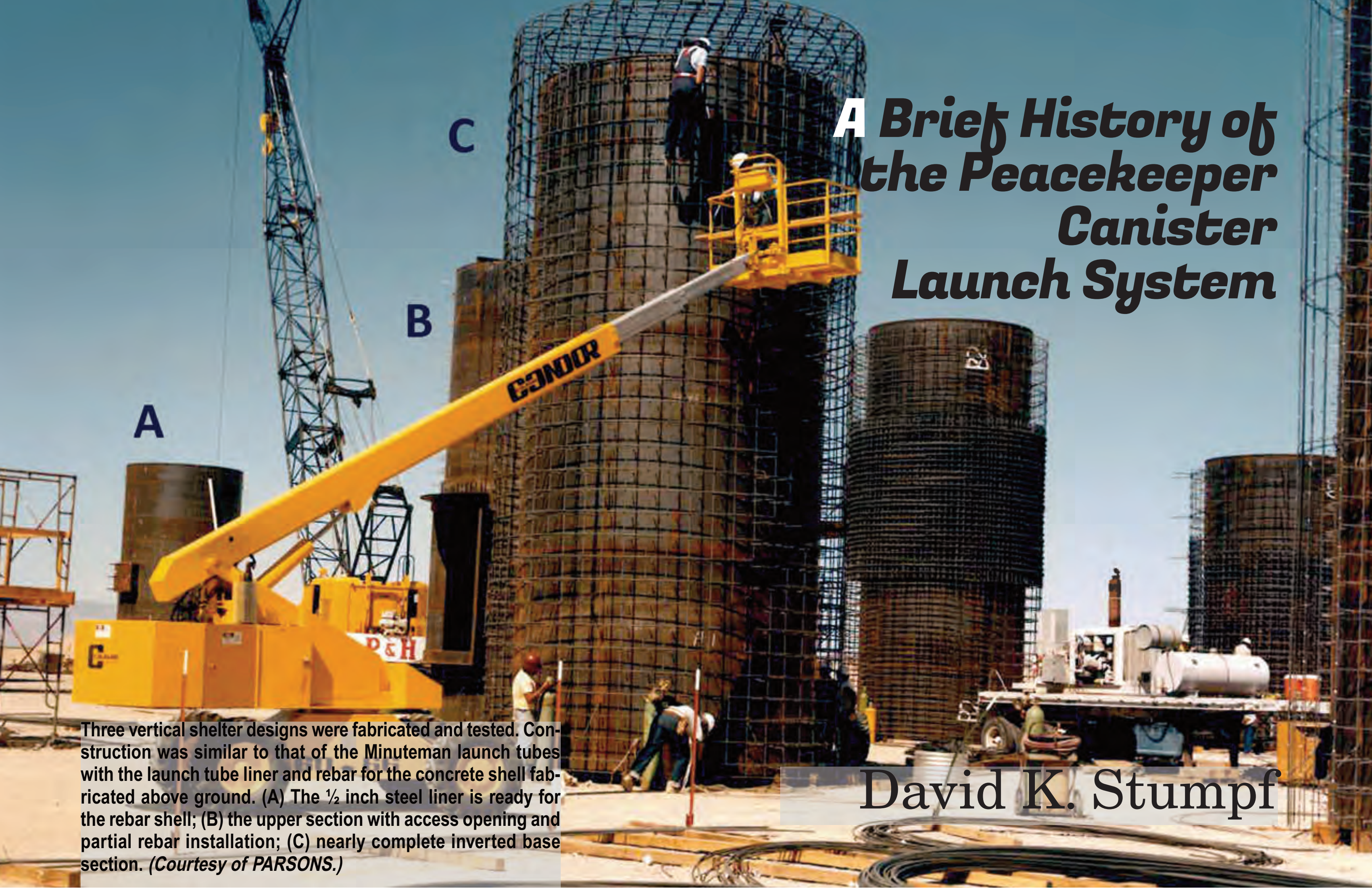
After his Air Force retirement, he had a second career building The Eisenhower Memorial in Washington D.C. Reddel became President and CEO of the Eisenhower World Affairs Institute in 1999-2000, and a Fellow in the Center for Public Service at Gettysburg College. From 2001-2021, he served as Executive Director of the Dwight D. Eisenhower Memorial Commission, charged by Congress with establishing a national, permanent memorial to the Supreme Commander of Allied Forces in World War II and the 34th President. The memorial was dedicated on September 17, 2020, in Washington, D.C.

Reddel was born in Gurley, Nebraska, in 1937, to Walter and Friedora Reddel. He attended Drake University on a track scholarship and earned his bachelor's degree in history and education in 1959. He was awarded a Woodrow Wilson Fellowship to attend Syracuse University and a Ford Foundation Fellowship to complete his master's degree in Russian studies in 1961. He received his doctorate in 1973 from Indiana University.

Reddel is survived by his wife of 62 years, Colette Marie Antoinette Reddel, and his two sons: Eric W. Reddel (Lisa M. Reddel) of Fairfax, Virginia, and Damien O. Reddel (Dawn M. Reddel) of Centennial, Colorado. He is also survived by one brother, Stan Reddel (Paulette Reddel) of Melrose Park, Illinois; and two sisters: Karen Faye Luebbe (Richard Luebbe) of Oxford, Ohio, and Mary Lou Wagoner of Clarinda, Iowa. His brothers, Gene and Mark, preceded him in death. Carl Reddel is interred at the Air Force Academy.

A Brief History of the Peacekeeper Canister Launch System

David K. Stumpf



Three vertical shelter designs were fabricated and tested. Construction was similar to that of the Minuteman launch tubes with the launch tube liner and rebar for the concrete shell fabricated above ground. (A) The ½ inch steel liner is ready for the rebar shell; (B) the upper section with access opening and partial rebar installation; (C) nearly complete inverted base section. *(Courtesy of PARSONS.)*

On October 16, 1962, the Air Force briefed 250 representatives from 88 aerospace companies on its requirements for the next generation solid propellant missile, the Advanced ICBM (AICBM). Three studies, involving 10 exploratory tasks, were described. The funded research included improved guidance systems and maneuverable reentry vehicles.[1] A wide range of basing environments were to be investigated: an encapsulated, submerged floating ICBM; dormant deployment; a mobile mid-range ballistic missile (MMRBM) designed for land and sea mobility using cold launch technology adapted from the Polaris program; the land MMRBM version would use a transporter indistinguishable from any large commercial 18-wheeler tractor-trailer.[2] The MMRBM program, designed to replace tactical aircraft in the NATO countries, was canceled on August 31, 1964 due to lack of interest. It was replaced with the semi-mobile intercontinental ballistic missile (SMICBM) program. Similar to the MMRBM concept but with intercontinental range, the SMICBM missiles would be moved on an irregular basis between multiple shelters in a "shell game" basing mode.[3]

A common denominator in the new basing modes was the concept of a "canisterized" missile. The canister would serve in the transport and emplacement of the missile. If the cold launch system the Navy had developed for Polaris worked with the much larger AICBM, the canister could serve as the launch tube as well. This might allow the use of the existing Minuteman launch facilities.

This article details the development of the silo-based Peacekeeper canister launch system from the cold launch feasibility demonstration in 1965 to the deployment of the Peacekeeper in Minuteman Silos (PIMS) system in 1986.

In the Beginning: Cold Launch vs Self-Eject

By 1965 there were several key technologies that needed further development as part of the AICBM program: (1) the next generation inertial guidance system; (2) independently targetable reentry vehicles; and (3) cold launch capability for an ICBM-class airframe. Fortunately for the Air Force, the Navy had perfected the cold launch system for use in the Polaris Fleet Ballistic Missile (FBM) program. The first 10 FBM submarines, five 598 George Washington Class and five 608 Ethan Allen Class, used a compressed air cold launch system. The subsequent 31 616 Lafayette class, armed with heavier A-3 missiles, used gas/steam generators for the ejection pulse. The first 10 FBM submarines were converted to gas/steam generators when they were upgraded to carry the A–3 missiles.[4]

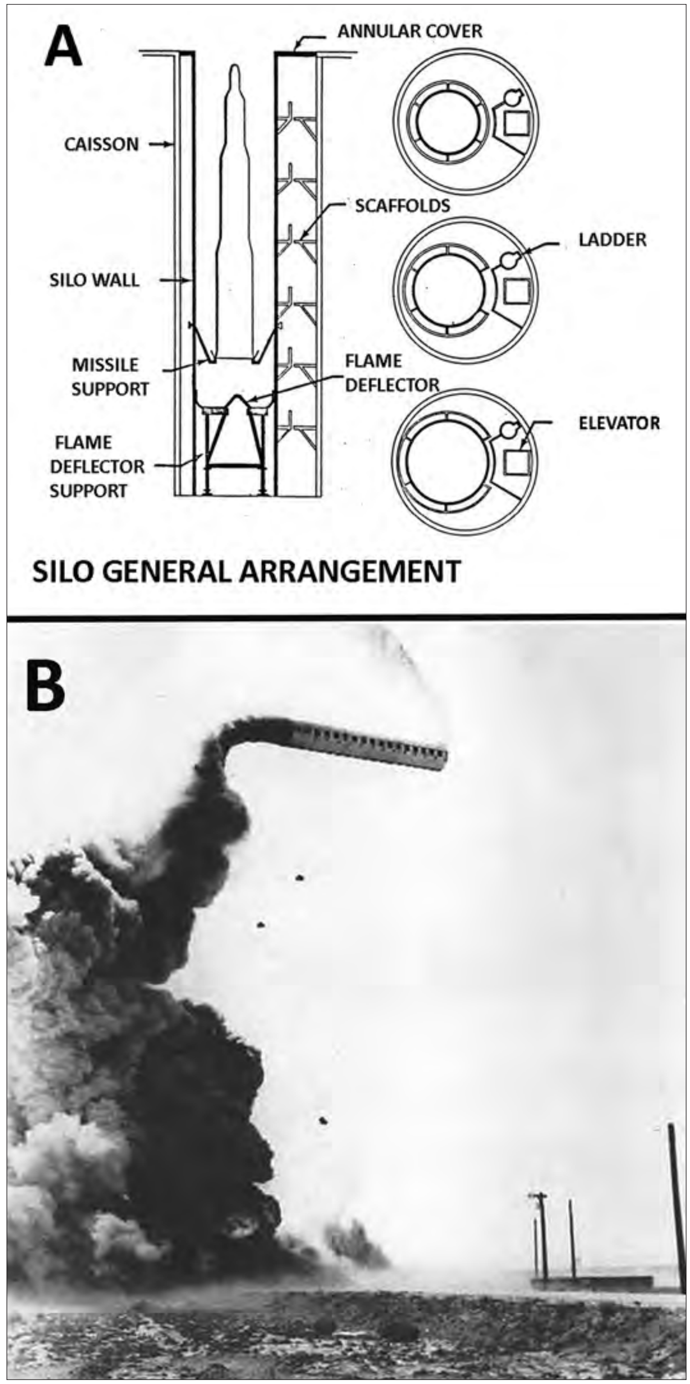
The Air Force did not have to contend with the myriad details of underwater launch, such as currents, surface waves, or wave effects at depth due to a storm on the surface. Instead, the challenge was the size of the missile. The Polaris A–3 missile was 4.5 feet in diameter, 31 feet long and weighed 36,000 pounds. The Air Force's AICBM upper limit concept was for a 10-foot diameter, 70-foot long, 340,000-pound missile.[5] The Air Force evaluated two alternatives to the customary "hot" launch technique: cold launch and self-eject (modified hot launch).

Cold Launch

The Large Cold Launch Missile (LCLM) program objectives were: (1) demonstrate the feasibility of cold launch of a large 300,000-pound class missile; (2) develop a sabot and seals for cold launch; and (3) demonstrate the feasibility of an "air elevator" for installation and removal of the missile from the canister. There were several of advantages to the cold launch concept: (1) since the missile did not ignite in the silo, there were no need to provide an annulus for the exhaust gases. Therefore, a greater portion of the interior of the launch tube could be utilized for the missile airframe. Furthermore, there would be no damage to the interior of the silo; (2) increased range since the full first stage grain was now available.

The first full-scale hardware test of the cold launch concept for a large diameter missile took place on June 25, 1965 at the Air Force Rocket Propulsion Laboratory Test Area 1-100, Minuteman Test Silo 01, Edwards Air Force Base, California. Two Minuteman test silos had been built in 1959 to evaluate various launch tube diameters. Each silo was 26 feet in diameter, approximately 75 feet deep, with provision to insert steel liners of 12-, 14-, and 16-foot diameter for use to verify the optimum silo design. For the cold launch test, Test Silo 01 was modified with a 12-foot diameter launch tube insert.[6]

The 10-foot diameter, 70 foot long, 340,000 pound (240,000 pounds of water ballast), surrogate missile was supported by a 7,000 pound, 5-foot-high sabot which formed a seal with the launch tube wall to confine the eject expulsion gas.[7] Two solid propellant motors, one each from a Zuni Folding Fin Aircraft Rocket and a Mace booster, were burned in a chamber connected to the silo. The Zuni motor was fired first and moved the surrogate missile approximately 10 feet up the launch tube. A lanyard was used

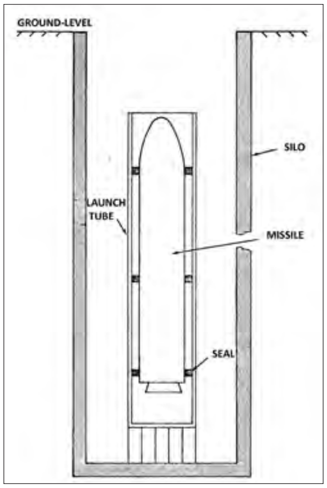


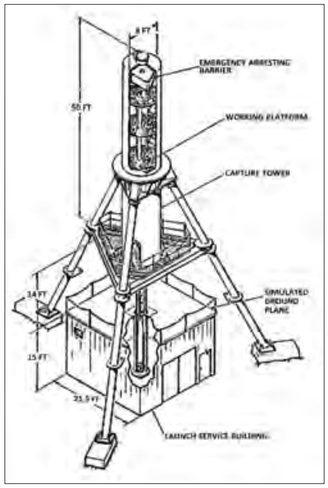
(A) The two Minuteman test silos at EAFB, built in 1958, were 75 feet deep and 26 feet in diameter. Four steel inserts, 10, 12, 14 and 16 feet in diameter and 75 feet in depth were fabricated to evaluate optimal launch tube diameter. The 12-foot diameter insert was used for the Large Cold Launch Missile program. *Boeing Minuteman Historical Summary 1958-1959*; (B) the water-ballasted surrogate missile has cleared the silo and has been pulled aside by tethers to prevent damage to the launch area. Ballast water is emptying from the missile cylinder and mixing with the smoke from the ejection charge. The three black dots are guide shoes from the launcher. *Copyright 1965. Informa.*

to trigger the Mace booster motor. As the surrogate missile left the silo, nylon tethers were released causing the dummy missile to fall 200 feet away from the silo as planned. The 30,000 gallons of ballast water was released when the sabot detached from the airframe.[8]

The LCLM was highly successful, proving the feasibil-

David K. Stumpf, Ph.D., is a retired plant biochemist living with his wife, Susan, in Tucson Arizona. He has written three nuclear weapon histories, Regulus the Forgotten Weapon*, a history of the Navy's Regulus I and II cruise missiles;* Titan II: A History of a Cold War Missile System *and* Minuteman: a Technical History of the Missile that defined American Nuclear Warfare*. His latest book,* The Last 30 Seconds*, a book about the evolution of hit-to-kill technology, will be available in September 2024. Dr. Stumpf volunteered at the Titan Missile Museum, as an historian and as a tour guide for 15 years.*





(Above left) Conceptual drawing of a self-eject launch silo. A seal was provided between the missile and the wall of the launch tube such that during the launch sequence, the pressure buildup behind the missile resulting from the exhaust flow of the rocket motor was used to eject the missile from the launch tube and silo. (*Sheeran et. al.)*

(Above right) The Cornell Aeronautical Laboratory Self-Eject Test Facility consisted of a capture tower, a launch service building and a launch control trailer. The capture tower, which contained missile guide rails and a braking system, was centered over the service building. The launch control system and data recording equipment were housed within a trailer positioned approximately150 feet from the capture tower service building. (*Sheeran et. al.*)

ity of the cold launch of large missiles as well as demonstrating that the air elevator concept could be used for assembly and maintenance of large diameter missiles within a canister.[9]

Self-Eject

Lockheed Propulsion Company received a $775,000 contract from the Air Force Systems Command Space Systems Division to demonstrate its proposed self-eject concept for the launch of solid propellant missiles from missile silos.[10] The concept involved modifying the first stage motor with a special end grain to provide controlled, progressively increasing thrust during liftoff. Ignition of the first stage grain would be delayed until the missile was 50 to 75 feet above the silo. Preliminary estimates indicated that the self-eject technique would use approximately one-twentieth of the propellant that normally would be consumed by a conventional hot launch.[11]

Phase I demonstrated the feasibility of the self-eject concept. On June 27 and July 15, 1966, two sub-scale test launches at the Lockheed Propulsion Company Potrero test facilities outside of Redlands, California, successfully demonstrated the self-eject technique. A 30-inch diameter, 80-foot tube mounted above ground was used for both launches. A modified Apollo escape tower motor was used to eject the missile out of the launch tube and then, once clear of the launch tube, the main grain ignited and propelled the 60-foot long, 13-ton vehicles (ballasted with water) to an altitude of 400 feet and 400 feet downrange.[12]

Phase II took place on October 28, 1966 at Edwards Air Force Base Minuteman Test Silo 01. The full-scale demonstration-launch of a 10-foot diameter, 349,000-pound surrogate missile was successful using a 3-foot diameter, 20-foot-long booster motor embedded in the ballasted airframe.[13]

Work refining the self-eject technique continued through 1971. Engineers at Cornell Aeronautical Laboratory used a subscale self-eject apparatus to provide experimental data for use in validating an analytical model for self-eject launch under development by Lockheed Missile and Space Company:[14]

A scaled-time dynamic test environment was used to correctly evaluate the full-scale launch process. To provide accurate simulation of the ground plane environment after broach, the model was launched vertically. The missile "flew" into a tower located above launch tube and silo where it was brought to rest intact for reuse. During the launch event the data were obtained from both "onboard" and stationary instrumentation. In these experiments there was a seal between the missile and the launch tube which fully contained the exhaust gases.

Several different launch energy conditions were investigated, as well as various launch tube and silo arrangements. A unique motor design using sheets of propellant enabled steady-state thrust levels from less than 100 pounds to over 10,000 pounds. Launch conditions involving accelerations above 160 g's and launch velocities of over 250 ft/s., were evaluated during the test program.[15]

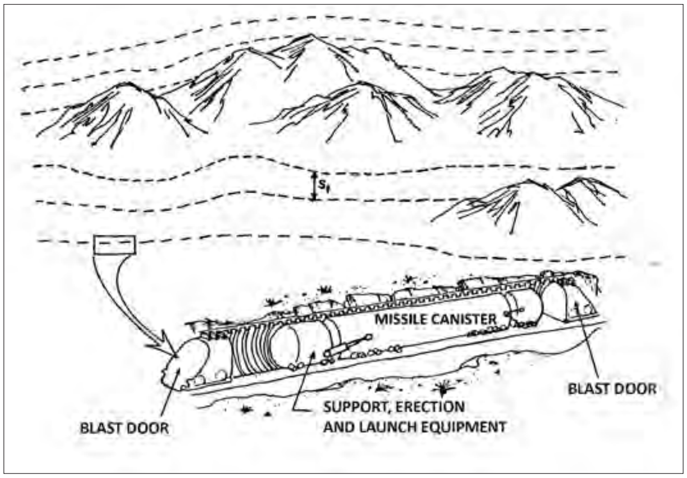
In the end, cold launch was chosen over self-eject. It is not clear why but one can speculate that the Air Force was more comfortable not modifying the end grain of the first stage propellant. Another possibility is that the Navy's years of highly successful operational experience with gas/steam generators and the Polaris A–3 was the deciding factor. Now the question was what sort of basing mode would best make use of this new launch technique?

MX is Born

On February 2, 1966, Headquarters USAF began preliminary work on the AICBM which was subsequently renamed WS 120A. The WS 120A would be capable of propelling a 7,000-pound payload to a range of 6,500 nm with a CEP of 0.2 nm. The new missile would be 90-inches in diameter (by contrast, the Minuteman first stage was 66 inches in diameter).[16]

On November 1, 1966, the Advanced Research Project Agency contracted with the Institute for Defense Analysis, DAHC I-15-67-CV-0011, Task Order T-56, to evaluate alternative basing concepts for the WS 120A.[17] The IDA alternative basing report, known as STRAT-X, was released in August 1967. The report was: [18]

a technological study to characterize US alternatives to counter the possible Soviet ABM deployment and evaluate the Soviet potential for reducing US assured-destruction-force effectiveness during the 1970's. It is desired that the US alternatives be considered upon a uniform cost-effectiveness well as from solution sensitivity to Soviet alterna-



Buried Trench. A set of shallow concrete tunnels each approximately 20 miles long containing a single mobile missile protected by mobile blast plugs both fore and aft. Following an attack, the surviving missile canister would be hydraulically erected through the tunnel roof and overburden followed by missile launch. ***MX Missile System Oversight***

tive actions. Particular attention to US technology and production limitation versus time during the mid-1970's is desired. The studies should consider further proliferation of our current forces and/or protection of these forces as well as new system concepts, both land-based and sea-based.

The STRAT-X report reviewed one hundred twenty-five basing concepts and recommended only eight for further consideration. Two of the concepts involved land-based ICBMs: *Hard Rock Silo* and *Land Mobile*.[19]

On October 4, 1967, McNamara denied a request from Headquarters Air Force to start the development of the WS 120A missile. Instead, he directed the Air Force to look at the development of a hard rock silo for Minuteman III.[20]

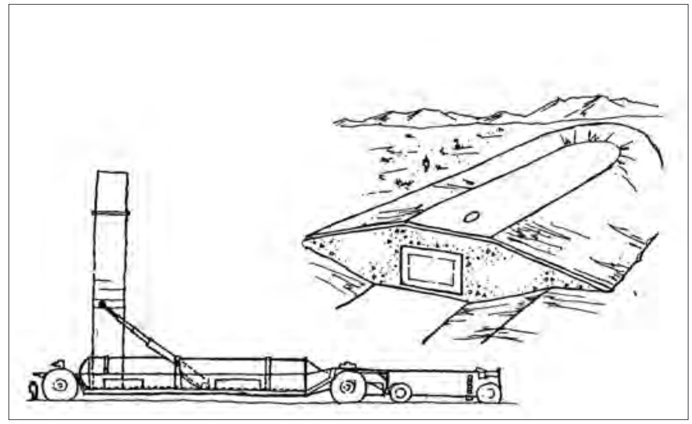
The Nixon administration was more receptive to a new strategic weapon and on November 19, 1971, Headquarters Strategic Air Command issued a Required Operational Capability for an advanced ICBM. Four months later, on April 4, 1972, the resurrected AICBM was designated as Missile-X (MX).[21]

Original MX/Peacekeeper Land-Based Deployment Modes

In December 1980, the Department of Defense published *ICBM Basing Options: A Summary of Major Studies to Define a Survivable Basing Concept for ICBMs*.[22]. The high explosive simulation techniques developed by the Air Force in the 1960s and 70s facilitated one half and full-scale evaluation of three basing concepts and their components: Continuously Hardened Buried Trench; Hardened Aim Point Buried Trench; and Horizontal Shelter (backup concept), as well as component testing for the Vertical Shelter and Verifiable Horizontal concepts.[23]

Buried Trench

Continuously Hardened Buried Trench was an array of approximately 20-mile-long concrete lined tunnels. Each



Horizontal Shelter. A series of a bermed shelters connected by a surface road network. A missile transporter/erector/launcher (TEL) would shuttle between shelters. Post-attack, the TEL driven onto an apron outside the shelter for launch. ***Cole***

tunnel would have a single transporter/launcher, protected both fore and aft with blast plugs. The missile would be moved randomly along the 20-mile system necessitating targeting the entire 20 miles of tunnel. Hardened Aim Point Buried Trench had hardened sections of the tunnel instead of continuous concrete with random movement between aim points.

Horizontal Shelter Multiple Protective Shelter

Horizontal Shelter Multiple Protective Shelter was a simplified version of the Buried Trench concept. The trench aspect was eliminated. Two hundred missile transporter/launchers would be shuttled among 4,000 horizontal shelters from which they would be driven onto an apron for launch.

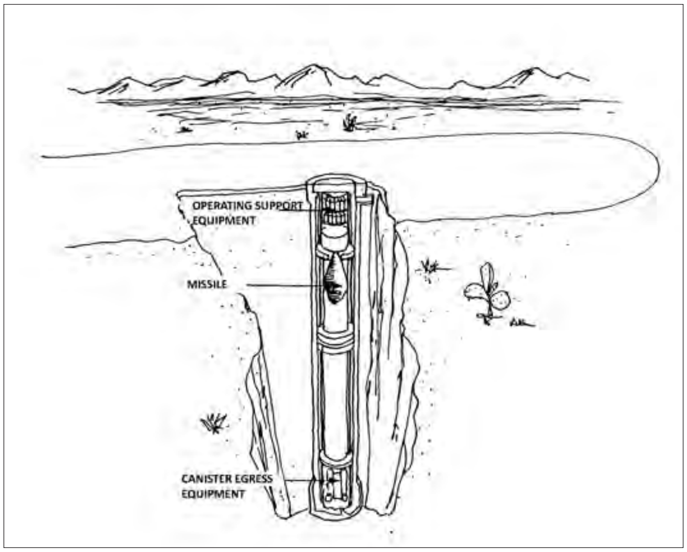
Vertical Shelter

The Vertical Shelter concept was a hardened silo with the ability to push the silo closure, using the missile canister, through up to 30 feet of crater ejecta and launch its missile. This concept evolved into the Closely Spaced Basing (CSB) concept, also known as Dense Pack. One hundred MX missiles would be deployed in 100 silos spaced less than 2000 feet apart to increase the likelihood of fratricide in the attacking missile warheads.[24]

MX/Peacekeeper Basing Mode Chronology

On September 7, 1979, President Jimmy Carter announced selection of the Horizontal Multiple Protective Shelter basing (HSMPS). Horizontal MPS was a variation of covered trench with the missiles being stored horizontally and driven out of the shelter for launch. Two hundred MX missiles would be shuttled between 4,600 shelters. The missiles would be stored, transported, and launched from a canister.[25]

On October 2, 1981, President Ronald Reagan canceled the Horizontal Shelter MPS basing scheme and announced interim deployment of MX in either Minuteman III launch



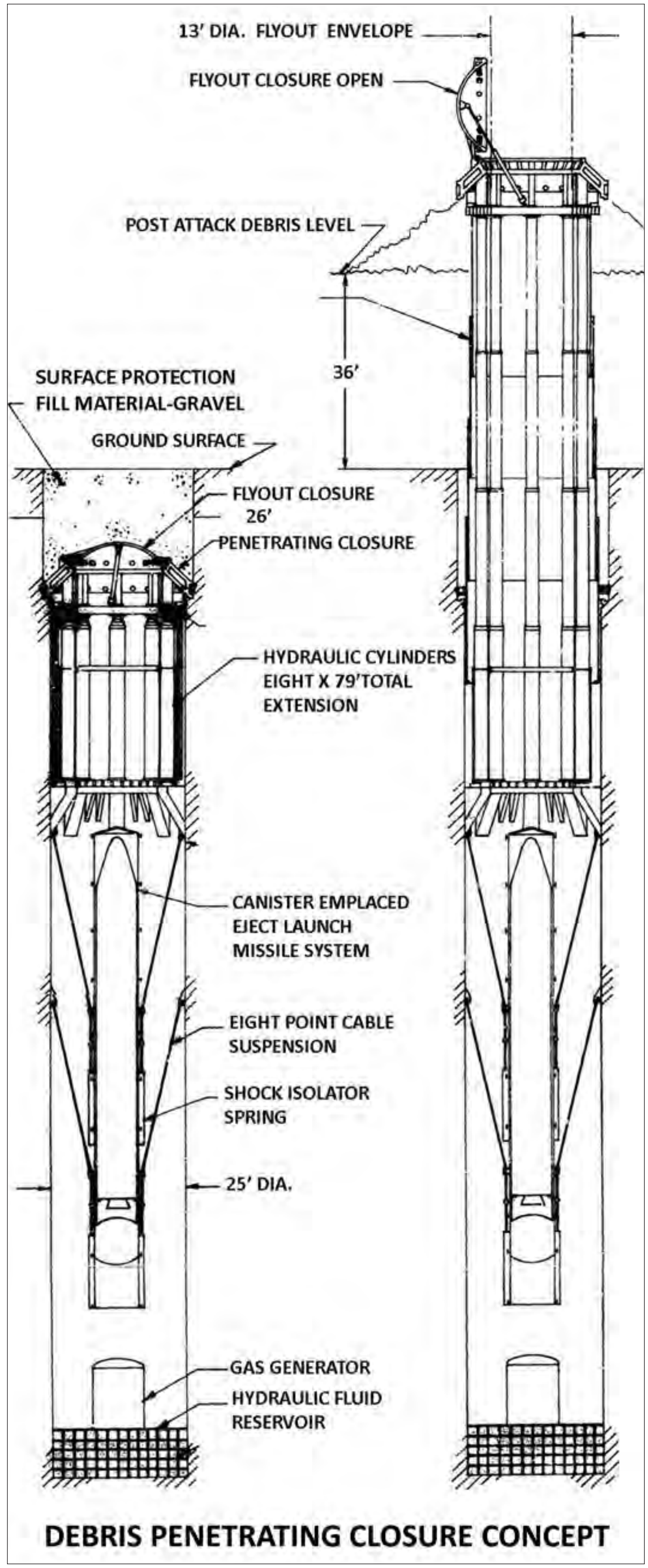
Vertical Shelter. The majority of support equipment was designed to be incorporated into the canister containing missile, which greatly simplified the shelter geometry compared to Minuteman or Titan II missiles. ***Cole***

facilities or reconfigured Titan II silos. Research would continue on alternative basing modes. The canister concept was retained.[26]

On January 30, 1982, Headquarters Air Force revised the Peacekeeper Program Management Directive to call for the deployment of 50 missiles in existing Minuteman silos.[27]

On November 22, 1982, President Reagan announced his decision to deploy Peacekeeper, the new name for MX, in the Closely Spaced Basing mode (CSB). The missiles would be moved between Vertical Shelter missile silos separated sufficiently to prevent one warhead from destroying more than one silo but close enough that targeting more than one silo at a time would result in reentry vehicle fratricide.[28] On December 7, 1982, the House voted to reject the CSB decision.[29]

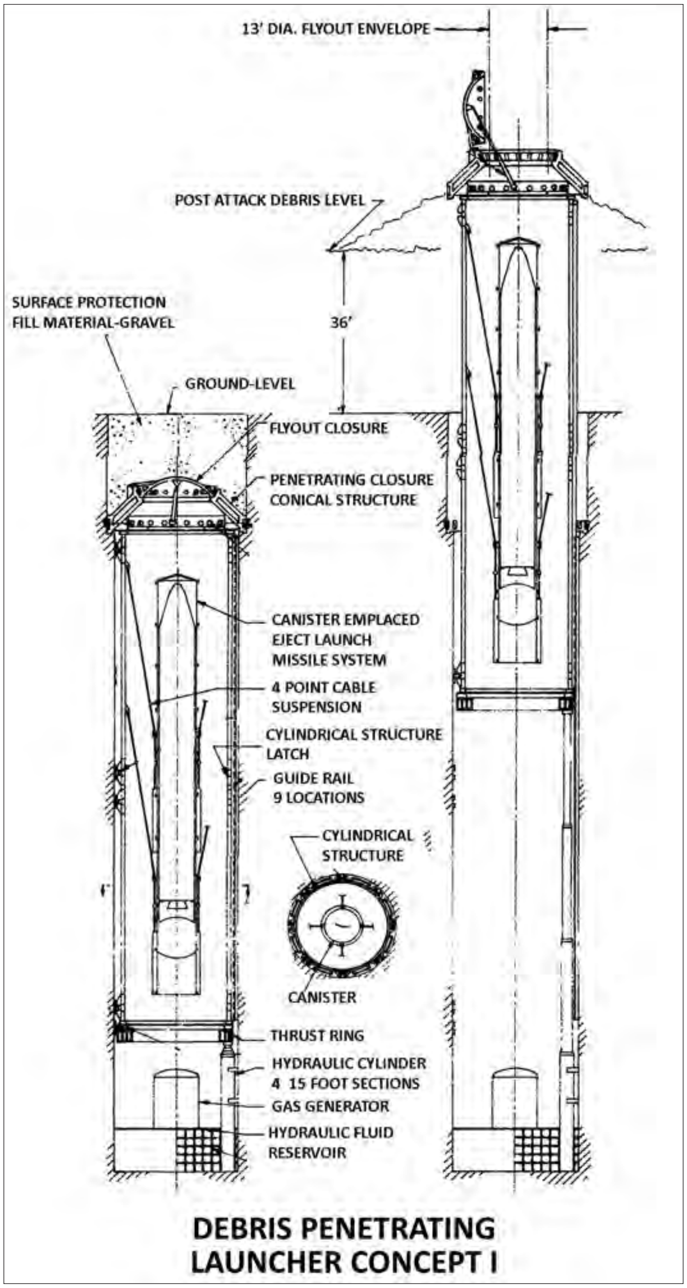
On June 14, 1983, Headquarters USAF directed the Ballistic Missile Organization to begin full-scale development of the Peacekeeper in Minuteman Silos (PIMS) basing mode.[30] On July 17, 1985, a House and Senate Conference Committee agreed to limit PIMS to 50 missiles, thereby ending further Peacekeeper deployment until President Reagan could develop a better basing mode.[31] On December 19, 1986, President Reagan announced his decision to base 50 Peacekeeper missiles in the Rail Garrison basing mode.[32] On July 12, 1989, Westinghouse Electric Company, Marine Division, conducted Peacekeeper Rail Garrison DM-1 at their Hudson, Colorado facility. A dummy missile was ejected in the test of stability of the canister erection and cold launch from a railcar.[33] On September 27, 1991, the Peacekeeper Rail Garrison program was canceled.[34]



Debris Penetrating Closure Concept for the superhardened Hard Rock Silo program. ***Defense Technology Information Center***

MX/Peacekeeper Canister Design Evolution 1965-1985

In the Fall of 1963, the Soviets began flight testing the Soviet R-36 ICBM (NATO designation SS-9 Scarp). Deployment started in 1966. The SS-9 was similar to the Titan II, using both hypergolic propellants and an inertial guidance system. The SS-9's reentry vehicles improved accuracy and large payload, ten to 25 MT, represented a direct threat to the Minuteman force.

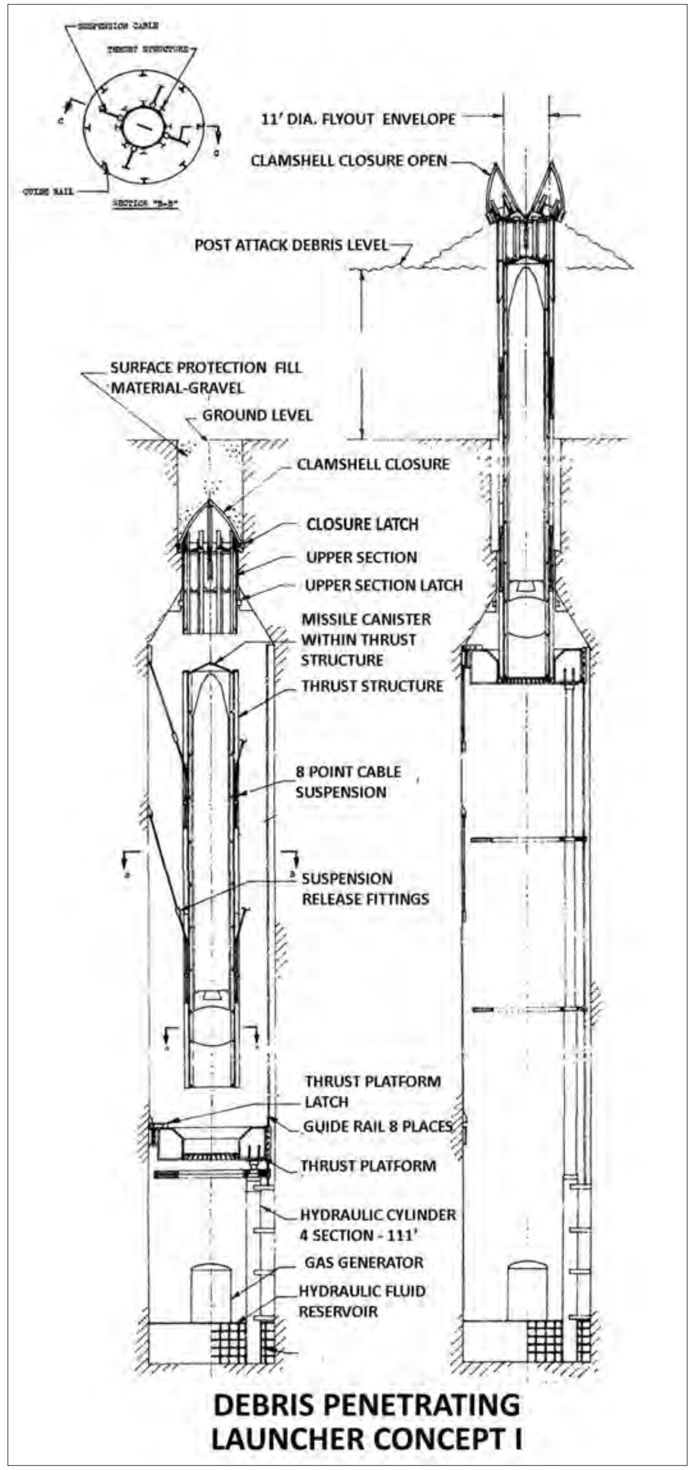


Debris Penetrating Launcher Concept I for the superhardened Hard Rock Silo program. ***Defense Technology Information Center***

In the early 1960s, the Titan II launch complexes and Minuteman launch facilities and launch control centers had been designed to survive the ground motion induced by air blast and not surface blast attacks. The Titan II silo closure system was limited to a maximum of 6 inches of debris covering the silo closure door. The Minuteman launcher closure debris limitation remains classified.[35] The SS-9's improved accuracy meant that launch facilities would need to overcome a layer of debris from crater ejecta if they survived the ground motion.[36]

Closure and Debris Handling Mechanisms

On November 12, 1967, the Boeing internally funded research program, *1967 Technical Research Program RP 363 "Superhard (Cold Launch) Missile*" was completed. A



Debris Penetrating Launcher Concept II appears to have been the basis for the vertical shelter concept developed in the 1979 MX Experimental Test Bed Program. ***Defense Technology Information Center***

canister emplaced large diameter, cold launch, solid fuel missile was used as a baseline for facility definition. A primary objective of the nine-month research study was to develop preliminary designs of launch tube and launcher closures, operating mechanisms, and methods of penetrating or removing debris resulting from an attack. The Boeing study evaluated 26 closure and debris handling methods and recommended three for further study which was carried out in 1968.[37]

Debris Penetrating Closure Concept

A multistage hydraulic actuator would drive a telescoping debris shield up through a maximum of 30 feet of soil. The debris shield consisted of four concentric shield sections each approximately 32 feet in height and fabricated out of 1.5-inch steel. The sections overlapped 12 feet resulting in an approximately 70-foot extension of the shield. There were two major drawbacks to this design: (1) the complex deployment of the shield sections; (2) the problem of flying or ejecting the missile approximately 200 feet to clear the flyout opening.[38]

Debris Penetrating Launcher Concept I

This concept attached the closure mechanism to the missile canister and pushed the canister to the surface. The advantage of this concept was that it eliminated the complex telescoping debris shield assembly. Now the cold launch system just had to eject the missile clear of canister.[39]

Debris Penetrating Launcher Concept II

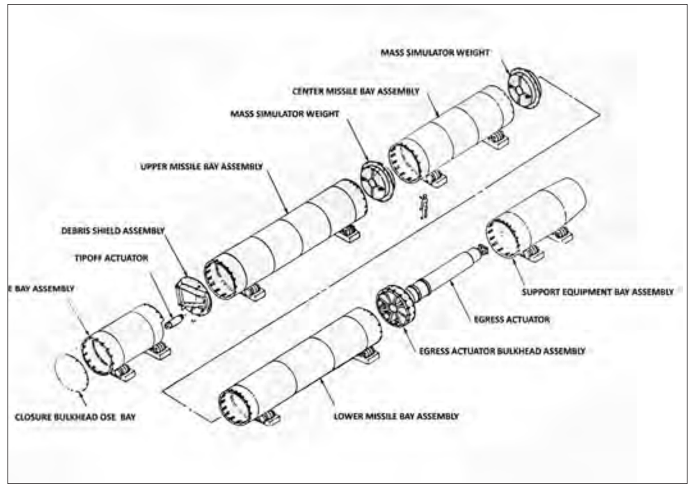
Both of the earlier designs had retained a launch tube large enough for work to be done around the missile canister. In this design, that feature was retained as well but only in the lower part of the launcher. The launch tube transitioned to a diameter just slightly larger than the canister. The debris penetration assembly was now the same diameter as the missile canister and contained only the high-pressure hydraulic mechanism for opening the closure door.[40] The Debris Penetrating Launcher Concept II served as the basis for the Boeing Closely Spaced Basing concept.

Silo-based Canister Test Programs 1979-1985

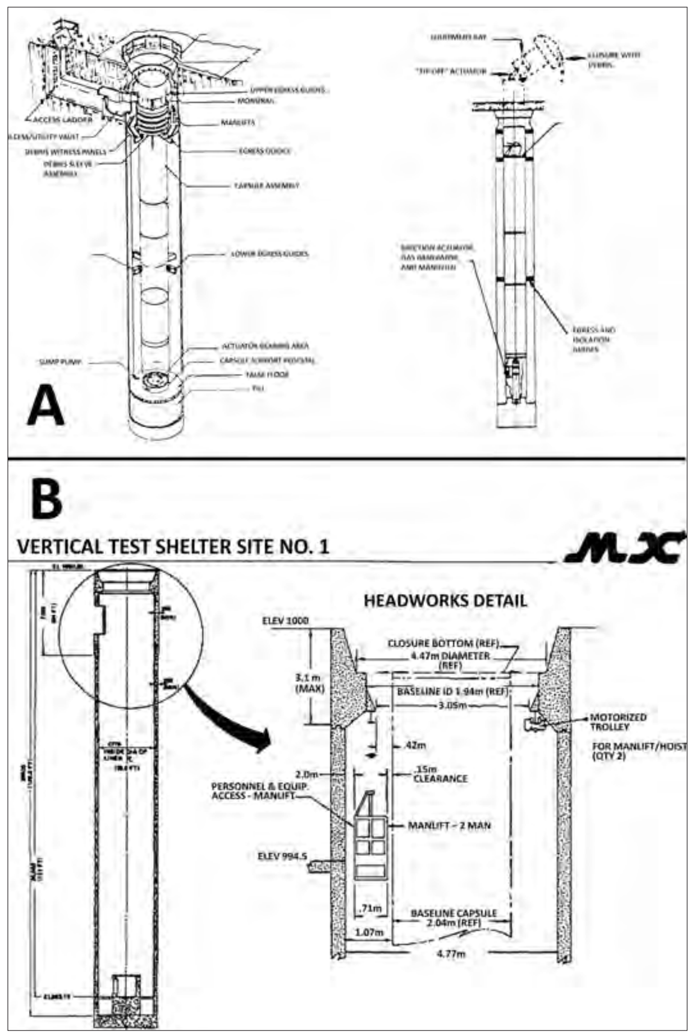
MX Engineering Test Bed Program 1979

In January 1979, the MX Engineering Test Bed Program construction began at the Jackass Flats, Nevada Test Site. Reynolds Electric and Engineering Company began excavation of the first of three test silos, a 18-foot diameter, 130-foot-deep test vertical shelter. The shelters and associated roads were part of the concept validation for the Vertical Shelter basing mode, as well as for the MX multiple protective structure (MPS). In addition, the tests would obtain engineering data to verify the preliminary design of the critical technical elements of the MPS.[41]

The test vertical shelters were designed by the Ralph M. Parsons Company. The canister was built by Boeing Aerospace Company. The test shelter held the major components of the proposed operational MPS canister/launcher. The containerized missile system was attached to the upper and lower mobile operational support equipment OSE modules (MOSE). The upper module contained the various electronics and ancillary equipment for missile environmental and launch control. Also included was the upper shelter closure interface which protected the canister, the missile, and the "tip-off" apparatus once the canister was placed in the Launch Ready



The MX Engineering Test Bed Site 1 canister/capsule major components. ***Nevada Test Site Archive***



(A) The MX Engineering Test Bed Program Vertical Shelter design had most of the major components of the proposed operational vertical shelter. The closure/canister/capsule was pushed through the soil by a multistage hydraulic actuator. The closure door was jettisoned to the side along with the OSE compartment; (B) Headworks detail for one the vertical shelter test bed silos. ***Nevada Test Site Archive***

Left: the MX Engineering Test Bed closure/canister/capsule successfully pushed through three feet of soil. The reinforced concrete closure weighed approximately 110 tons and the soil layer an additional 20 tons. Right: OSE compartment is being jettisoned, along with the three feet of soil; in the operational system, the missile could now be launched. *Pan Am Photo, Nevada Test Site Archive*

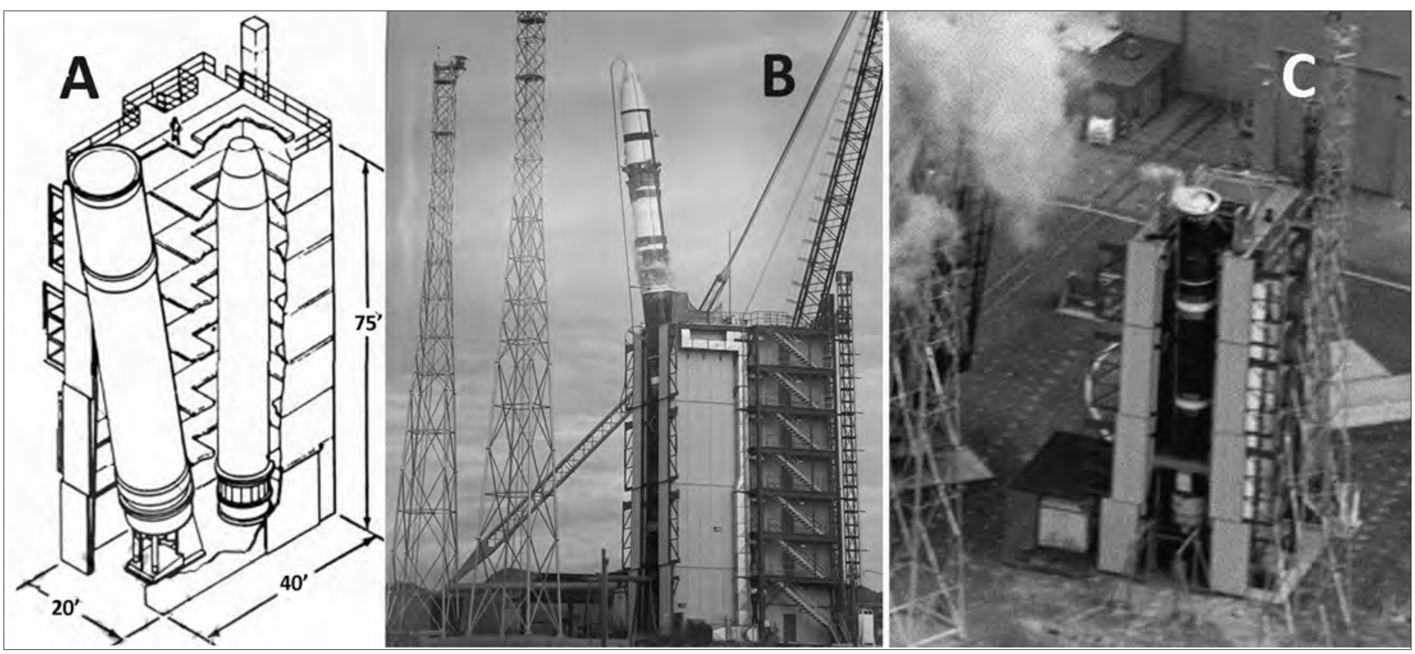
Egressed position. The lower OSE module contained the egress multistage hydraulic actuator, gas generator, survival batteries, and other associated equipment.[42]

Silo Egress Test August 23, 1979

The first ICBM silo egress system test was successfully accomplished on August 23, 1979. An empty MOSE, using weighted bulkheads to simulate the mass distribution of the operational missile, was pushed through three feet of soil until approximately 40 feet of the canister was exposed. The operational OSE and shelter closure, located at the top of the canister, was then jettisoned to the side leaving the capsule open for launch.[43] Ironically, earlier in the month SAMSO's ICBM Program Office directed associate contractors to reorient their activities from vertical to horizontal shelters.[44]

Canister Assembly Launch Test Program 1982

The Canister Assembly Launch Test Program (CALTP) experiments were designed to develop and standardize operational canister launch procedures. The program was carried out at the former Nevada Test Site (NTS) Nuclear Rocket facilities at NTS Area 25. After extensive rehabilitation of the site due to its earlier use as a nuclear rocket engine test site, a 75-foot-tall assembly and launch tower, camera towers, auxiliary test pads for gas generator tests



Left: CALTP Assembly and Test Building. The test airframes had the same mass and center of gravity as the operational missile and were assembled adjacent to the launch canister. Center: the first CALTP launch took place on the January 29, 1982. Right: all of the CALTP tests used a black graphite-epoxy canister. *Official U.S. Air Force Photograph, National Archives and Records Administration*

The last Minuteman Upper Silo Simulation launch took place on April 10, 1986. As was the case in all the previous MUSS and CALTP launches, the test missile landed in a pit approximately 100 feet from the launch tower. ***Official U.S. Air Force Photograph, National Archive and Records Administration***

and missile component handling, and a 200-ton stiff-leg crane, were installed to support the project operations. The surrogate missile steel airframe was built by Kaiser Steel, Thiokol built the ejection gas/steam generator and Hercules built the graphite epoxy canister. The goal of the series of five test launches was development of launch procedures to be used at Vandenberg Air Force Base for the full range flights down the Western Test Range.[45]

On January 29, 1982**,** a surrogate missile, 71 feet long, 92-inch diameter, weighing 196,000 pounds (ballasted with water) and with the same mass and center of gravity as a MX flight test vehicle, was ejected from the graphite-epoxy canister at a 5-degree angle and reached an altitude of 300 feet before landing nearly 100 feet downrange into a large earthen pit. The test was highly successful.[46]

On April 2, 1982**,** the second test in the series was also successful. Iterative changes were made based on the previous test(s) results. Of particular concern was the successful release of all of the missile lateral shock isolation pads before first stage motor ignition.[47]

On May 27, 1982, the first attempt to launch resulted in a "hang fire." For safety reasons there were two devices to ensure that the gas generator did not ignite accidentally. The signal to arm was not received so the signal to fire did not reach the ordnance. After 30 minutes it was safe to go and install new safe-and-arm devices and the test was successfully completed at 4 PM. Multiple systems for release of the lateral shock isolation pads were tested on this launch.[48]

On July 22, 1982, the goal of the fourth test in the series was to confirm that the mechanism to release all 145 lateral shock isolation pads worked and it did.[49]

The final launch in the series, October 15, 1982, was successful, completing the evaluation procedures for the upcoming flight test series at Vandenberg Air Force Base (VAFB). Modifications to the Minuteman III launch were behind schedule so the first eight VAFB launches would be from an aboveground canister installation.[50]

Minuteman Upper Silo Simulation (1984-1986)

After the successful conclusion of the CALTP test series, the Ballistic Missile Office began the Minuteman Upper Silo Simulation (MUSS) Program at NTS-25. The test objectives were:[51]

– Evaluate Phase II canister subsystem performance.
– Evaluate Phase II canister component performance:
– Pad/seal release timing
– Umbilical retract mechanism
– Debris collar launch clearance
– Launch eject gas generator
– Obtain launch gas dynamic data in the Minuteman upper silo simulator.
– Demonstrate Phase II ordnance initiation system.
– Obtain data relative to Phase II hardware refurbishment.

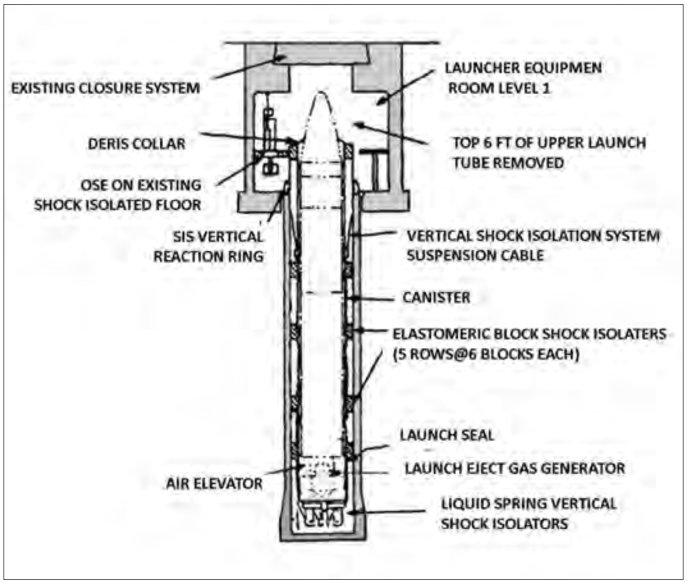
Operational Minuteman launch facilities have a two-story underground Launcher Equipment Room structure (LER) that surrounds the top of the launch tube. The 50 Minuteman launch facilities of 400th Strategic Missile Squadron, 90th Strategic Missile Wing were being modified with the removal of the upper 6 feet of the launch tube liner. This meant that Level 1 of the LER would be exposed to ejection gases. For the operational launch facilities this was of little consequence since reusing the facilities would not be an issue with a nuclear war. However, the Minuteman launch facilities at VAFB would be reused during the flight test program. Therefore, the details of the effect of the ejection gas/steam on the upper level needed to be investigated. Additionally, how the expansion of the ejection gases into the open upper level affected the launch dynamics needed to be ascertained. This did not require the launcher closure door mechanism since it would already be open for launch. This greatly simplified the construction of the LER simulator.

On June 1, 1984, the first launch took place. The 195,000-pound surrogate missile was launched slightly more than 300 feet into the air. The initial test data showed no significant problems were encountered. The MUSS consisted of five launches: June 1, 1984, September 25, 1984, March 26, 1985(first use of a steel canister), June 1, 1985 and April 10, 1986.[52]

On June 21, 1984, the Marine Division of Westinghouse Electric Corporation received a $147.5 million Air Force contract for the second phase of full-scale engineering of the MX missile steel launch canister.[53]

Peacekeeper in Minuteman Silos

It is beyond the scope of this article to detail all of the changes made to the Minuteman III facilities to modify them for the Peacekeeper missile. Instead, the focus will be on the launch facility's Launcher Equipment Room (LER) and Launch Tube (LT).



Overview of the modifications to the Minuteman III launch facility. ***Peacekeeper Program Basing System Baseline Configuration***

Launch Facility/Launcher Equipment Room/ Launcher Equipment Room Level 1

The 3/8 inch thick, 17-foot 10-inch tall, 12-foot diameter Upper Launch Tube Liner was removed and replaced with a ¾ inch thick, 11'10" tall, 12-foot diameter liner. The decrease in height allowed for maintenance access and to aid in debris management. The thicker liner allowed for added liner stiffness and ease of construction. The umbilical and its support structure were relocated to be compatible with the canisterized missile.

Launcher Equipment Room Level 2

The ring beam was modified with three attachment points for the canister vertical shock isolation system. The LER to LT EMP shield was modified. A second monorail, the first was for motor generator and battery maintenance, was added for missile guidance and control system maintenance.

The operational canisters were fabricated from a steel alloy and painted white. This canister is being readied for transport. (1) five rows of six canister lateral shock isolation system blocks are clearly shown. The face of each block had a sheet of polyethylene which served as a low friction surface to assist in emplacement of the canister into the launch tube. ***Official U.S. Air Force Photograph, Author's Collection***

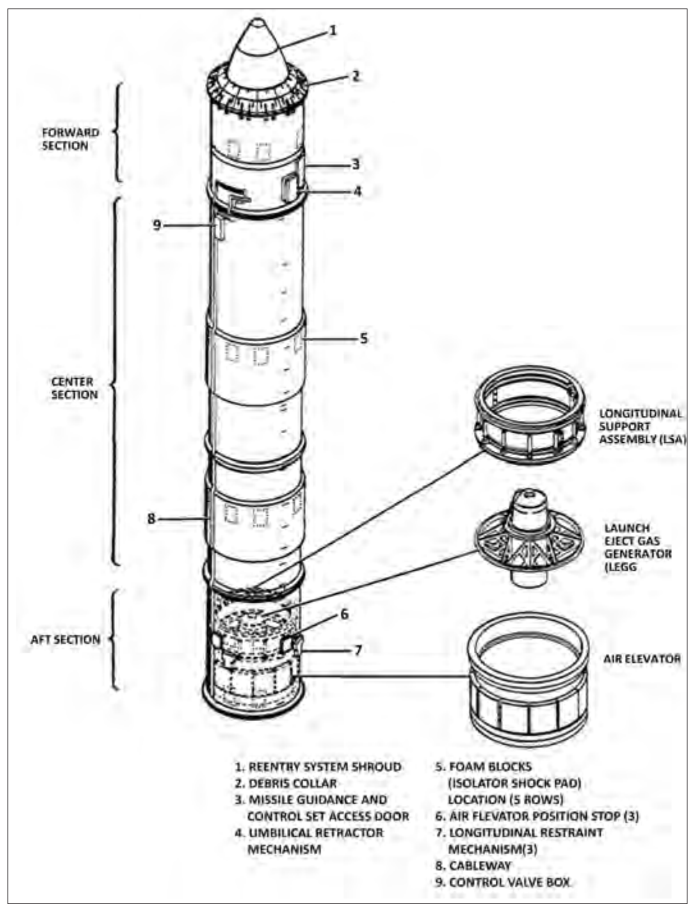
Missile Canister System

The canister consisted of a reinforced cylindrical steel tube with a closed steel breech and external and internal components that supported, protected and provided launch ejection of the missile. The canister system components were:

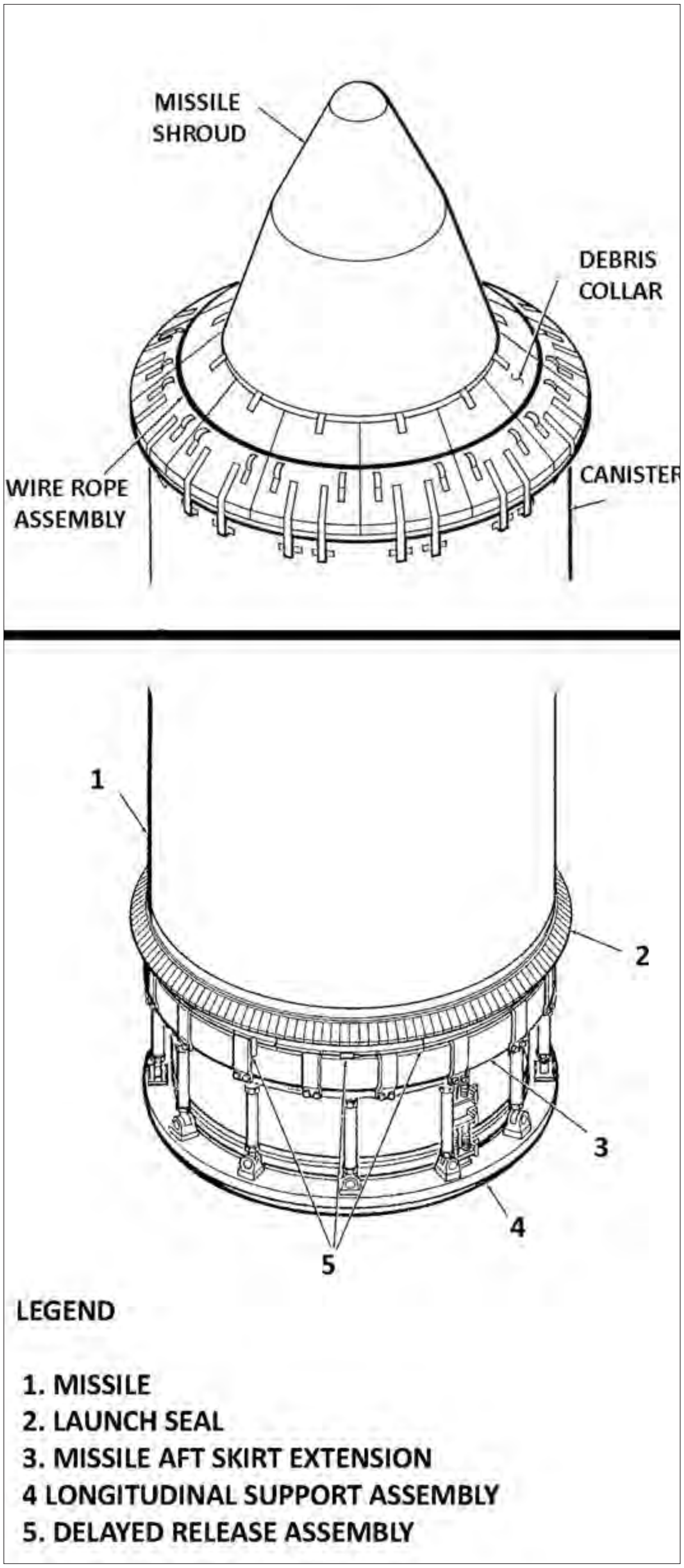
canister tube
debris collar
missile guidance and control system (MGCS) access door
umbilical release mechanism (URM)
integrated air elevator (IAE)
longitudinal support assembly (LSA)
launch eject gas generator (LEGG)
launch seal assembly
air elevator (AE)
canister shock isolation system (CSIS)
lateral shock isolation system (SIS)
vertical shock isolation system (VSIS)

Canister Tube

Three classes of material of nonmagnetic material were considered for the fabrication of the canister: stainless steel, aluminum and composite materials.[54] A composite canister was used in the CALTP program but was replaced with the ASTM A-537/ HY 100 steel canister during the MUSS program. Major components of the canister tube are



The major components of the operational canister, including debris collar. ***Technical Order 21-LG118A-1***



Upper: the debris collar consisted of 12 urethane foam blocks held in place by a wire rope assembly. Operation of the debris collar was passive and initiated by missile first motion. Upward movement of the missile placed in excess load on the wire rope assembly, causing it to break and release the collar segments. The segments were rotated away from the missile approximately 140 degrees. Lower: the launch seal was divided into eight segments and contained the pressurized launch gases of the launch eject gas generator. The seal was secured to the outside of the missile aft skirt extension with a delayed release assembly which released the seal once the missile cleared the silo and before Stage I ignition. ***Official U.S. Air Force Photograph, Author's collection***

shown in photo on page 20, bottom left. With an outer diameter of 106 inches, which included stiffeners and other external hardware, but not the URM, which extended to 114 inches, this left a 19-inch-wide annulus around most of the canister. The canister varied in thickness from 0.62-1.90 inches.

The canister tube consisted of the forward, center, and aft section. The forward section was constructed of steel alloy with forged flanges at each end. The upper flange was the mounting surface for the debris collar system. The lower half of the forward section included threaded inserts for attachment of the upper row of LSIS pads. The URM was also located in the forward section, adjacent to the MGCS access door.

The center canister section was constructed of a series of tube sections, forged rings, and two forged flanges. This section also had threaded inserts to secure two rows of LSIS pads. A ring provided a mounting interface for the VSIS cable guides.

The aft canister section was constructed of steel alloy with forged flanges at both ends. Threaded inserts were provided to secure two rows of LSIS pads. Three cutouts in the tube were for mounting the elevator position stops (EPS) and three cutouts were provided for mounting the longitudinal release mechanism (LRM).[55]

Debris Collar

The Minuteman LF's at Wing V had debris bins on the north face of the launcher closure door. These opened, as the launcher closure opened, to catch debris accumulated from a surface attack. The capacity of the bins was based on the maximum depth of deposited soil with which the launcher closure could still open (this value remains classified).

The bins were removed as part of the Peacekeeper installation modifications. Their function was replaced with the canister debris collar shown in figure at left and on page 20 (right). The collar prevented debris from lodging between the missile and the canister. Instead, the debris was deflected into LER. The collar segments were tensioned to open completely at first movement of the missile during launch.

Missile Guidance and Control System Access Door

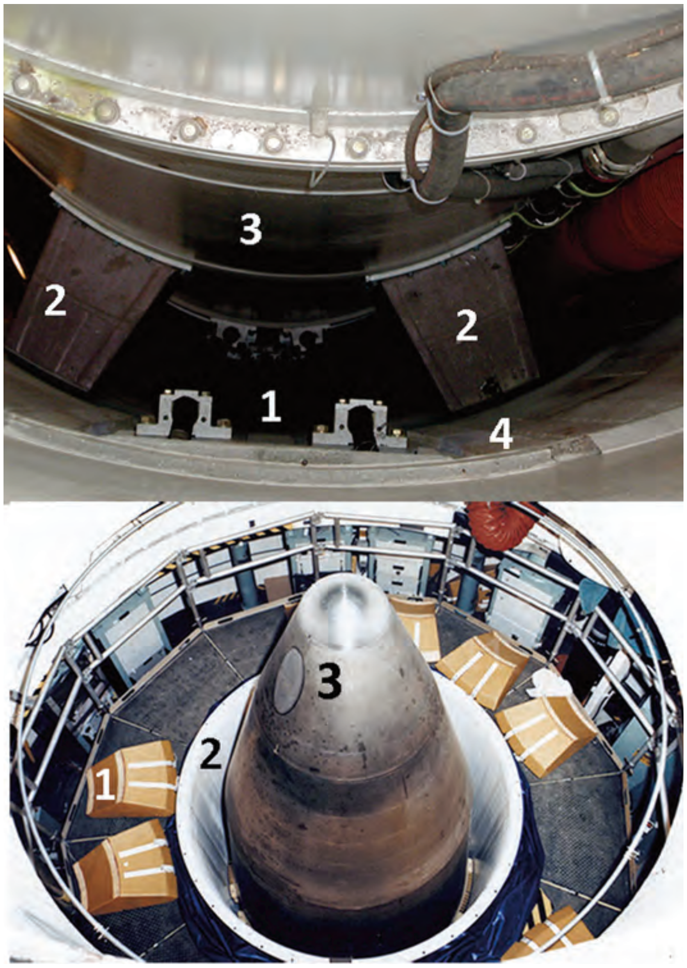
Maintenance of the Minuteman III MGCS had required removal of the reentry vehicles and post-boost vehicle. Access to the Peacekeeper MGCS was through a door in the forward section of the canister. This greatly simplified maintenance on the MGCS.

Umbilical Retract Mechanism

The URM functioned to absorb the energy of the ejected umbilical plug at launch.

Integrated Air Elevator

The IAE consisted of three major elements: the Longitudinal Support Assembly (LSA); the Launch Eject Gas Generator (LEGG) and the Air Elevator (AE).



Upper: 1-canister vertical shock isolation cable guides; 2-canister lateral shock isolation pads; 3-canister; 4-launch tube wall. Lower: 1-debris collar foam blocks; 2-canister; 3-vent cover for shroud tractor motor. *Author's collection*

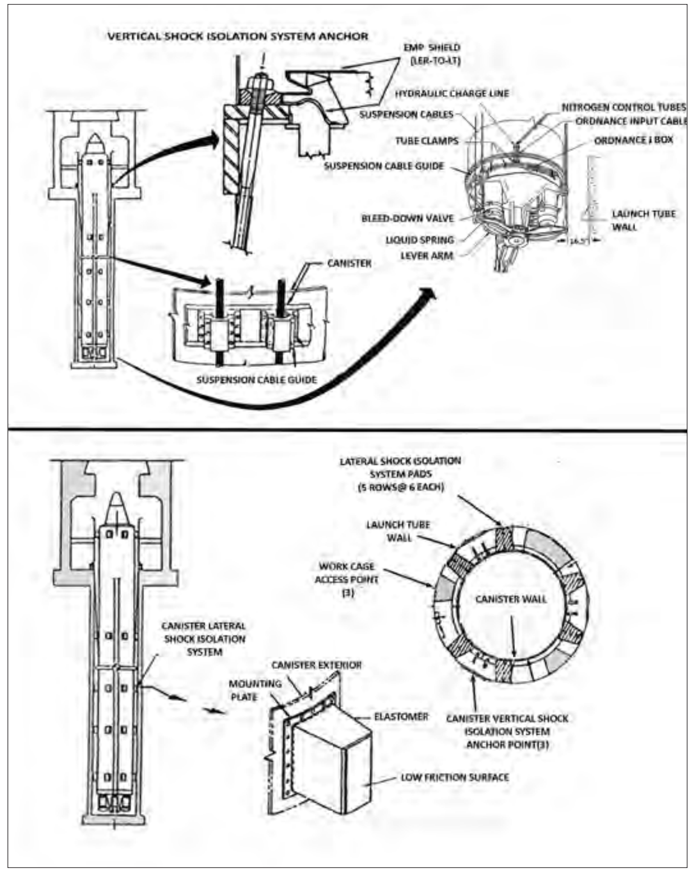
Longitudinal Support Assembly

The LSA supported and held the missile at the required axial position relative to the canister centerline. The LSA also provided lateral flexibility to prevent missile skirt overloading during shock.

Launch Eject Gas Generator

The LEGG provided pressurized hot gas/steam at 400 to 500-degrees F which was contained by the launch seal and reacted against the aft first stage and the floor of the launch tube, ejecting the missile from the canister. The LEGG consisted of a hot gas generator (HGG), a coolant chamber, a standpipe, an exhaust manifold, an upper and lower diaphragm and miscellaneous hardware.

The HGG was composed of a high-strength steel pressure vessel and igniter assembly, a solid propellant cartridge assembly with perforated propellant grain, a nozzle assembly and a burst disk assembly. The coolant assembly consisted of a coolant chamber with integral lower diaphragm, a standpipe with integral lower diaphragm, a perforated exhaust manifold and mounting bracket.[56]



Upper: location of the Canister Vertical Shock Isolation System components. Lower: location of the Canister Lateral Shock Isolation System components. There was limited work cage access to the missile. *Technical Order 21-LG118A-1*

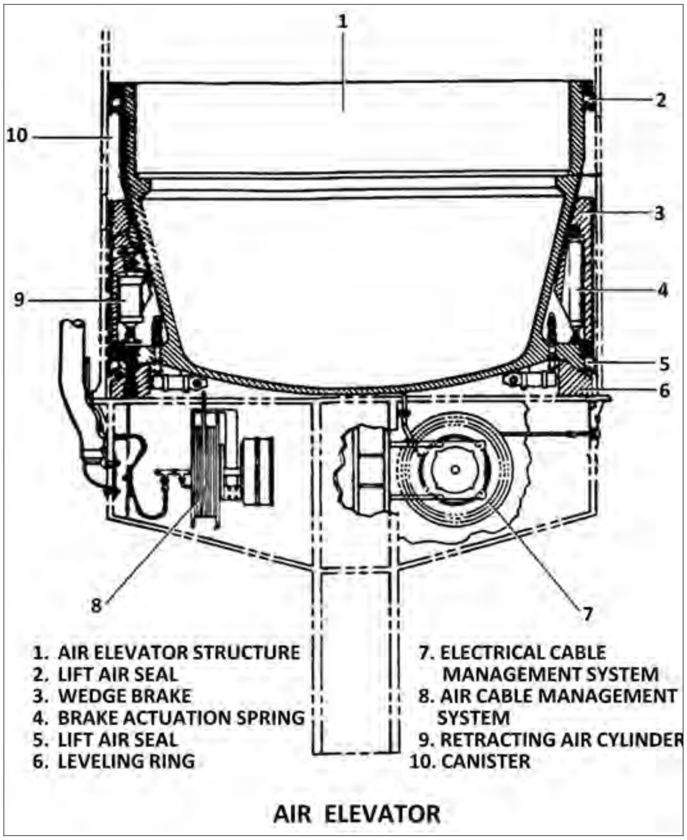
The original design used only solid propellant which provided gas at approximately 2,500-degrees F. The 7000-pound sabot used a steel plate to protect the first stage from high-temperature gas at the same time providing a seal to contain the ejection gas. The deployed design injected the hot gas into water, generating steam at 400 to 500-degrees F which did not require the heavy steel plate to protect the first stage.[57]

Air Elevator

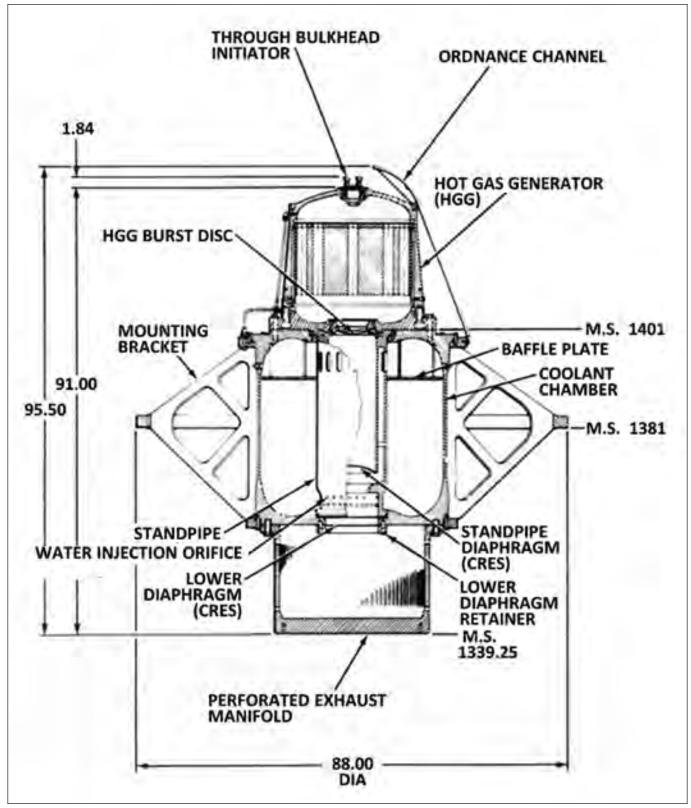
The AE had seals secured to its upper and lower ends. The LSA was attached to the AE upper end. The LSA, in turn, was secured to the missile first stage aft skirt extension. When the AE was pressurized from the above ground air elevator support trailer, the AE, LSA and missile could rise or descend in the canister tube to position the missile stage-to-stage joints at the appropriate elevation for assembly/disassembly operations. The AE position stops extended from the canister in a positive downward position control. An additional elevator component, the friction brake, provided position control as well.

Canister Lateral Shock Isolation System

The CLSIS consisted of the Lateral Shock Isolation System (LSIS) and the Vertical Shock Isolation System



Major components of Air Elevator System. *Technical Order 21-LG118A-1*



Major components of the Launch Eject Gas Generator System. *Technical Order 21-LG118A-1*

(VSIS). The two systems served to:

Position and support the canister within the launcher.
Protect the missile from nuclear attack induced ground shock.
Reposition the canister prior to missile launch ejection.
Stabilize the canister and transfer launch loads into the launcher during missile launch ejection.

Lateral Shock Isolation System

The LSIS consisted of five rows, six blocks per row, of tapered elastomeric isolator pads that were bolted to the canister exterior. Each isolator pad was faced with a polyethylene sheet to minimize friction with the launch tube wall. The LSIS prevented the canister from contacting the launch tube wall.[58]

Vertical Shock Isolation System

The major components of VSIS were:[59]

Three liquid spring isolators and actuators.
Three pairs of suspension cables, guides and ring beam attachment points.
Lower support structure housed the air elevator cables and compressed air hoses as well as serving as a breech closure for the canister; supported the vertical shock isolators and acted as a load path to the launcher floor during the missile launch ejection.

The VSIS consisted of three compression-type liquid spring isolators attached at their upper end to the lower support structure of the canister. The lower ends were attached to lever arms which were hinged to the lower support structure. Each lever arm was connected to a pair of wire rope suspension cables. Each cable pair passed through two guide fittings and terminated at the missile support ring (ring beam) at LER Level 2.[60]

Missile Group Components

Launch Seal

The launch seal contained the pressurized launch gases generated by the LEGG below the missile to prevent the missile structure above the seal from being over pressurized. The seal was secured to the outside of the missile skirt aft extension with a delayed release assembly. This assembly held the seal on the missile body until the missile cleared the silo debris plane and released the seal before first stage ignition.

Lateral Support Group

The LSG was nine rows of elastomeric pads secured by a cable assembly, 12 pads per row on the Stages I and II and nine pads per row on the deployment module (post-boost vehicle). The pads (also referred to as canister-to-missile pads, CM) served as load distributors, shock absorbers, and low friction guides to prevent the missile structure

Launch sequence of first Peacekeeper silo launch, VAFB, August 23, 1985. Flight Test Missile-9 emerges from LF-08. *Official U.S. Air Force Photograph, Courtesy of Richard McKinney*

from striking the canister wall during long-term alert, nuclear attack, and launch.

Retention and Release System

A cable assembly system secured the pads in position when the missile was being assembled in the canister and helped keep the pads in position when missile was jarred by an earthquake or ground shock during a nuclear attack. The cable assemblies were fitted with delayed-release mechanisms to automatically release the pad rows in a predetermined sequence after the missile cleared the debris layer but before first stage ignition. The pads were released sequentially from top-to-bottom.[61]

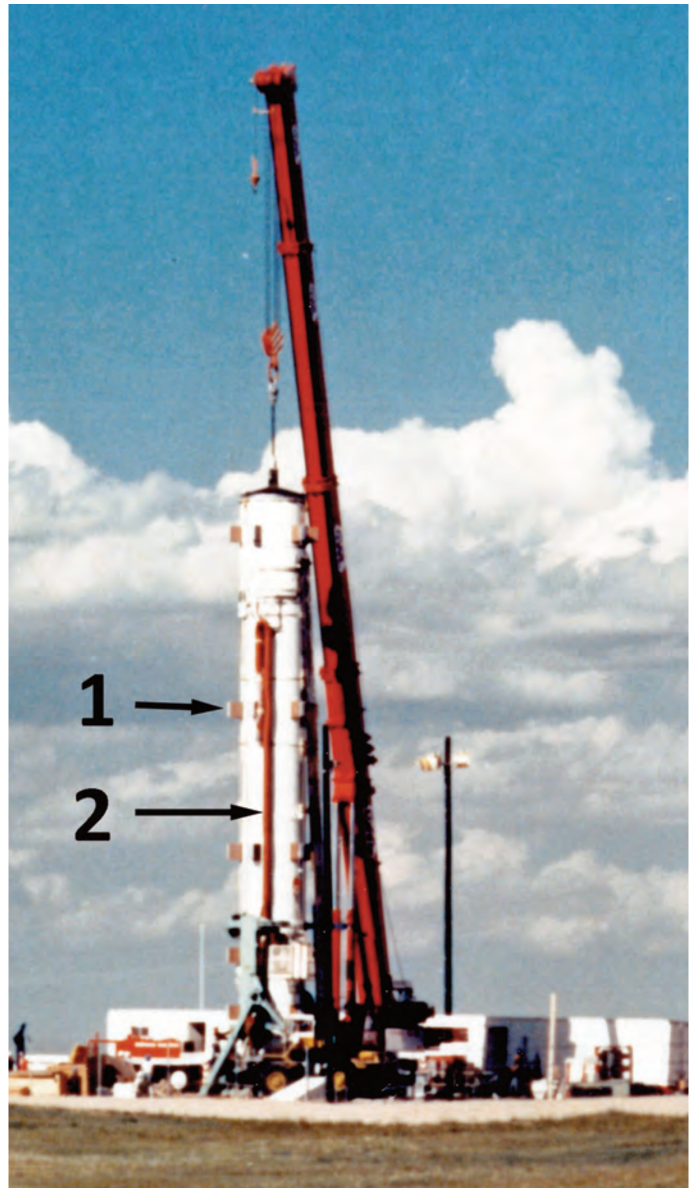
Peacekeeper Launch Sequence

T-13.24 seconds: liquid spring isolators bleed down initiated

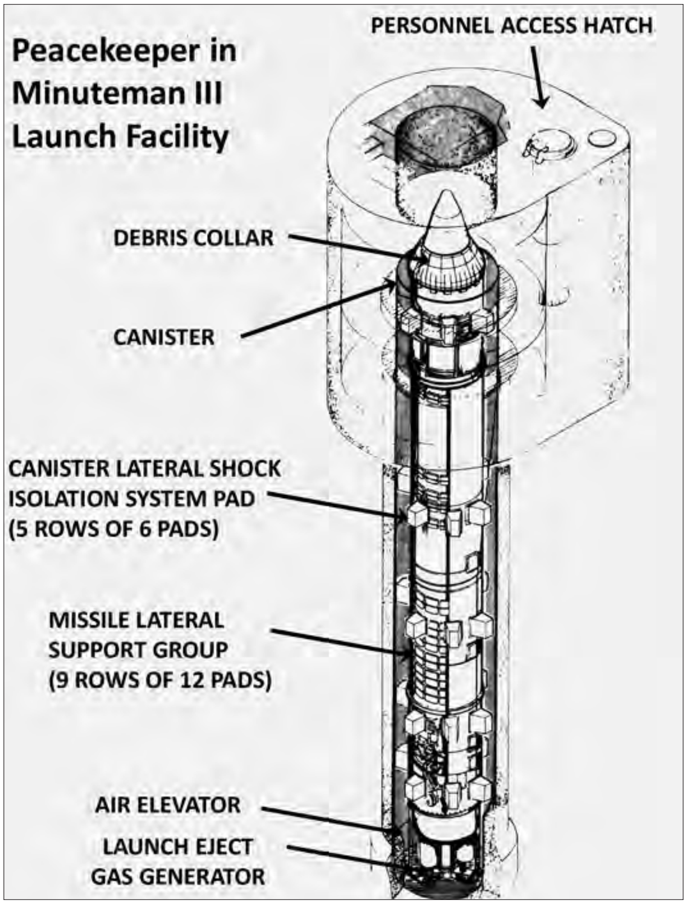
T-04.21 seconds: bleed down complete, the canister in contact with the launch tube floor.

T-0.17 seconds: LEGG activated. The igniter assembly ignited and produced hot gases that ignited the hot gas generator solid propellant grain. Hot gases from the burning propellant grain were discharged through the primary nozzle, rupturing the hot gas generator burst disk assembly and the standpipe diaphragm. Gas pressure acting on water in the lower standpipe caused the lower diaphragm to open. The nozzle of the standpipe diverted part of the gas flow through the annular space between the inner and outer pipes of the standpipe, pressurizing the bulk of the water in the coolant chamber. The pressurized water was injected through the standpipe water injection orifices into the hot gas flowing through the standpipe nozzle, and was further mixed with the gas in the exhaust manifold to form steam. The gas/steam mixture exiting the exhaust manifold, pressurizing the inside volume of the air elevator structure, resulting in pressure on the bottom of the missile, and subsequent missile ejection. The launch seal prevented the LEGG gases from blowing by the missile. The launch seal delayed release assembly held the seal on the missile skirt aft extension until the missile cleared the launcher debris plane. The seal was released before first stage ignition.[62]

T 0.00: Lift Off



Installation of a Peacekeeper canister circa 1986: (1) canister lateral shock isolation pads; (2) BT-400 canister heater tube. *Official Air Force Photograph.*



Cutaway illustration of a Peacekeeper missile and canister installation in a Minuteman III launch facility.

Summary

As early as 1962, the Air Force realized that a new ICBM basing mode, as well as a new ICBM, would be necessary to counter improvements in Soviet ICBM accuracy and warhead yield. Experiments in 1965 and 1966 demonstrated that the new missile could be cold launched, obviating the need for a hardened launch facility. Now the missile could be transported and launched using the canister system. Nearly two decades and 30 basing mode concepts later, the Peacekeeper canister launch system ended up in Minuteman III launch facilities. The canister system greatly simplified the shock isolation system when compared to Minuteman III missile suspension system. It also facilitated the increase in missile diameter from 66 to 93.4 inches. ■

On June 17, 1983, Peacekeeper Flight Test Missile-1 was successfully launched from Peacekeeper Aboveground Canister TP-01, Vandenberg Air Force Base, California to a broad ocean area target in the Kwajalein Missile Range. Due a delay in the modification of Minuteman III Launch Facility 08 for use with Peacekeeper, TP-01 enabled flight testing of operationally configured missiles, preventing delay in deployment. *Official U.S. Air Force Photograph.*

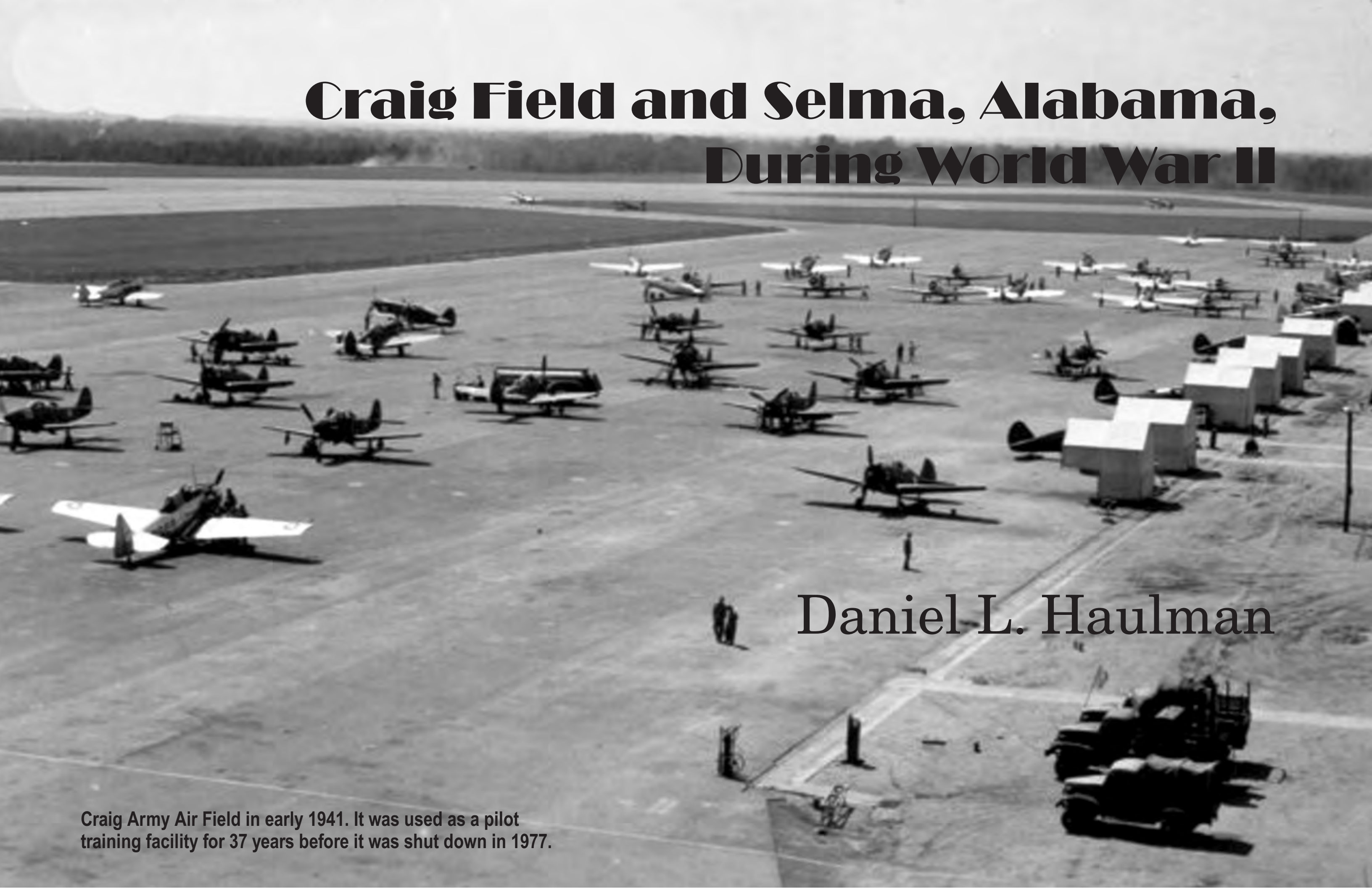
NOTES

1. Miller, B., "USAF Planning Advanced ICBM Studies," *Aviation Week and Space Technology (AWST),* November 5, 1962, p. 103.
2. "USAF Explores Orca Missile Concepts," *AWST*, October 15, 1962, p. 29.
3. Stone, I., "ICBM Studies Focus on 156-inch Motors," *AWST,* March 15, 1965, pp. 141-43.
4. Fuhrman, R. A., "The Fleet Ballistic Missile System: Polaris to Trident," *Journal of Spacecraft and Rockets,* Vol. 15, No.5, September-October, 1978, p. 10; Adcock, A., *U.S. Ballistic Missile Subs in Action,* (Squadron/Signal Publications, 1993), pp. 10, 13.
5. Stone, I., "Launch of Large Solids from Silos Studied," *AWST,* September 6, 1965, pp. 69-70; J.P. McManus, *A History of the FBM System*, (Lockheed Missile and Space Company, Inc., Sunnyvale, California, 1989), B-3. The A–3 was deployed in September 1964.
6. "Large Cold Launch Missile Feasibility Demonstration," Defense Technology Information Center (DTIC), AD0365487,1 September 1965, p. 1. Unclassified abstract; "Minuteman Historical Summary, 1958–1959" (The Boeing Company, Seattle, WA, 1974), D2–26485, pp. Sheet IX, 1, 5, 12.
7. A sabot is a component used in firearm/artillery munitions to keep a smaller diameter projectile aligned in the center of the barrel when fired. In this case, the 7000-pound steel plate was used to protect the surrogate missile from over-pressurization and high-temperature by containing the ejection gases below the surrogate missile airframe.

8. The article states 40,000 gallons of water ballast or 240,000 pounds. 1 gallon of water weighs 8.3 pounds at 20°C, so the volume of water was more like 27,000 gallons rounded to 30,000.
9. Stone, p. 69; *Feasibility Demonstration, p.* 1.
10. "Rocket Shot Out of a Tube in Efficient New Technique," *New York Times,* November 30, 1966, p. 57.
11. Stone, p. 69; "Lockheed to Evaluate Low-G Launchings," *AWST,* March 14, 1966, p. 35; "Slow Liftout from Silo," *Air Force Magazine and Space Digest*, May, 1969, p. 52. It is unclear whether there was any sort of seal between the missile and the launch tube. An illustration in a report from Cornell Aeronautical Laboratory shows a seal in place. The self-eject final report is designated Controlled Unclassified Information, CUI, and was unavailable to the author.
12. "LPC Tests Techniques for Rocket Launches*," Redlands Daily Facts*, November 14, 1966, p. 4; Dudley, T.H., Taffe, J.B., MacLennan, (Lockheed Missiles and Space Company, Sunnyvale, California, February, 1967), pp. 5-6. DTIC, AD0379337. This document is CUI, the abstract data reported is not.
13. "Self-Eject Launch*,*" *AWST,* November 21, 1966, p. 35; Dudley, pp. 5-6.
14. Sheeran, W. J. And K. C. Hendershot, "Dynamic Simulation of the Silo Launch Sequence of Solid Propellant Missiles," AIAA/SAE Seventh Propulsion Meeting Joint Specialist Conference, Salt Lake City, Utah/June 14-18, 1971, p. 1.
15. Sheeran, p. 5.
16. *Chronology of the Ballistic Missile Organization: 1945-1990, Volume I*, (History Office, Ballistic Missile Organization, August 1993), p. 107. Hereafter referred to as *BMO Chronology*; Nalty, B.C., *USAF Ballistic Missile Programs: 1967-1968*, (Office of Air Force History, September 1969), pp. 56-61.
17. *The STRAT-X REPORT*, *Volume 1, August 1967*, (Institute for Defense Analyses, Research and Engineering Support Division, Arlington Virginia), p. 1. Only STRAT-X Volume 1 has been declassified. Author's collection. I thank Jim Myers for my copy.
18. *STRAT-X*, p. 1.
19. Grier, P., "STRAT-X," *Air Force Magazine,* January 2010, p. 54.
20. *SAC Missile Chronology: 1939-1988,* (Office of the Historian, HQ Strategic Air Command, Offutt AFB, Nebraska, May 1990), p. 53; *BMO Chronology,* p. 115.
21. *BMO Chronology,* p. 158-168.
22. *ICBM Basing Options: A Summary of Major Studies to Define a Survivable Basing Concept for ICBMs*, December 1980, (Office of the Deputy Under Secretary of Defense for Research and Engineering), pp. 1-84.
23. Cole, D. M., "MX Basing Design Development Derived from H. E. Testing," *Physical Modeling Techniques for Missile and Other Protective Structures,* American Society of Civil Engineers, National Spring Convention, Las Vegas, Nevada, April 1982, p. 1-61.
24. Cole, p. 3.
25. *Strategic Air Command Missile Chronology,* p. 68.
26. "Reagan's Decision on MX Is Reported," New York Times, November 22, 1982; *BMO Chronology, p.* 8; *Space and Missile Systems Organization: A Chronology 1954-1979*, p. xviii.
27. *BMO Chronology,* p. 164.
28. *BMO Chronology,* p. 166.
29. *BMO Chronology,* p. 167.
30. *BMO Chronology,* p. 168.
31. *BMO Chronology,* p. 177.
32. *BMO Chronology,* p. 183.
33. *BMO Chronology,* p. 198.
34. Bush, G.W., "Address to the Nation on Reducing United States and Soviet NuclearWeapons," September 27, 1991*,* American Presidency Project, University of California, Santa Barbara.
35. Stumpf, D. K., *Titan II: A History of a Cold War Missile System*, (University of Arkansas Press, 2000), p. 121.
36. Stumpf, D. K., "A Question of Vulnerability," *Journal of the Air Force Historical Foundation, Winter 2024,* pp. 25-38.
37. Franklin, B., *Closures and Debris-Handling Concepts for Superhard Missile Launch Facilities, D2-125499-1, 1967,* (The Boeing Company, Seattle, Washington), p. Sheet 1.8.
38. *Closures and Debris Handling Concepts,* pp. Sheet 121-Sheet 127.
39. *Closures and Debris Handling Concepts,* Sheet pp. 127-Sheet 130.
40. *Closures and Debris Handling Concepts,* Sheet pp. 130-Sheet 135.
41. In the 1979 timeframe, the MPS had a vertical shelter option which later became the CSB. *MX Engineering Test Bed Program*, (Boeing Aerospace Company, July 1979), p. 2; MX Vertical Shelter Program, (Parsons, Pasadena, California). Author's collection.
42. *MX Engineering Test Bed Program,* p. 4.
43. "MX Missile Silo Passes One-Shot Launch Test," *Indianapolis Star*, August 25, 1979; p. 37.
44. *BMO Chronology,* p. 158.
45. *Nevada National Security Site*, DOE/NV-775, August 2013; "Simulated MX Missile in Canister Ejection Tests," *AWST,* April 12, 1982, p. 21.
46. "MX Missile, Shelter, and Launch Methods Undergo Testing," *Nevada Test Site News and Views*, April 1993, pp. 10-11; "MX Launch Tube Weight to Be Reduced," *AWST,* November 24, 1980, p. 62; "Tube Section for MX Canister Delivered," *AWST,* April 13, 1981, p. 22.
47. "Simulated MX missile,"; "CALTP #2," *Nevada Test Site News Bulletin,* April 9, 1982, p. 1.
48. "CALTP Has 'Hang fire,' Then Success," *Nevada Test Site Bulletin,* June 4, 1982, pp. 1-2.
49. "Fourth CALTP Test Successful," *Nevada Test Site Bulletin,* July 30, 1982, pp. 1-2.
50. "Final CALTP Test in This Series Was Successful," *Nevada Test Site News Bulletin,* October 22, 1982, p. 2.
51. "Another Successful Test in Area 25 Paves Way for Peacekeeper," *Nevada Test Site News Bulletin,* April 19, 1985, p. 1.
52. June 1, 1984, *AWST*, June 4, 1984, p. 26; September 25, 1984, "CALTP Launch #2 a Booming Success," *Nevada Test Site News Bulletin*, October 9, 1984, p. 1. The article text incorrectly called the launch a fifth CALTP launch, it was a MUSS program launch; March 26, 1985, ("Another Successful Test, 1); June 1, 1985, (National Archives and Records Administration NAID 6402179) and April 10, 1986 (National Archive and Records Administration NAID 6402180).
53. "Westinghouse," *The New York Times,* June 21, 1984, p. 76.
54. Hollmann, M. and D. A. Macnab, "Composite Materials for the Missile X Canister," American Institute of Aeronautics and Astronautics, 22nd Structures, Structural Dynamics and Materials Conference, 6 April 1981-8 April 1981, pp. 374-380.
55. "Missile Canister System," Technical Order 21-LG118A-2-241, November 1, 1988, Technical Order Change Notice, March 20, 2000, Section 1-4 to 1-5. Author's collection.
56. *Peacekeeper Weapon System*: *Baseline Configuration Description March 1985*, (Directorate of Engineering, Ballistic Missile Office, Air Force Systems Command), Section 3-1 to 4-12. Hathitrust.
57. "MX Launch Technique Changed," *AWST,* June 16, 1980, p. 28.
58. *Peacekeeper Weapon System Description*, Technical Order 21-LG118A-1, 1 October 1986, Change 15-13 December 2000, Section 14, p. 18.
59. *Peacekeeper Weapon System Baseline, March 1985*, Sections 3-1 to 4-12; "Missile Canister System," Section 1-5.
60. *Peacekeeper Weapon System Description*, Section 14, p. 18.
61. *Missile Canister System,* Section 1, p. 11.
62. *Peacekeeper Weapon System Description*, Section 2, p. 12; Section 5, p. 25.

Craig Field and Selma, Alabama, During World War II

Daniel L. Haulman



Craig Army Air Field in early 1941. It was used as a pilot training facility for 37 years before it was shut down in 1977.

Craig Field in Selma, Alabama, was one of the most important Army Air Forces training bases during World War II. Thousands of American, British, French, and other Allied fighter pilots received their advanced single-engine and transition flying training there. Many of those pilots took part in combat overseas, contributing immeasurably to Allied victory. The base contained a diverse population, with whites and blacks, military members and civilians, and men and women, working together to help defeat a common enemy overseas.

Origins

How did the base come to be? German dictator Adolf Hitler invaded Poland in September 1939, triggering World War II in Europe, and by the middle of 1940, he had taken over Denmark, Norway, the Netherlands, Belgium, Luxembourg, and France. German planes rained death and destruction on Britain, which, alone among the Allies, continued to resist. Meanwhile, Joseph Stalin's Soviet Union took over eastern Europe, annexing eastern Poland, eastern Finland, Estonia, Latvia, and Lithuania. Meanwhile, the Japanese Empire, which had already taken over large parts of China, occupied French Indochina. Although the United States had not yet entered the war, President Franklin D. Roosevelt and Congress prepared for the possibility by greatly expanding the armed forces and their training, including the building of flying training bases all over the country. Through Lend-Lease, he also provided extensive aid to Britain.

In the summer of 1940, Selma Mayor Lucien P. Burns and Harmon Hunt Frazier of the Selma Chamber of Commerce met at Maxwell Field in Montgomery, Alabama, with Colonel Walter Weaver, commander of the Air Corps' Southeast Flying Training Center. They asked him to consider land four to six miles southeast of Selma as a site for a new flying training base. The land available was largely agricultural, with few buildings to remove, and the terrain was already flat and well drained. The central Alabama climate provided year-round good flying weather. The site was bordered by Highway 80, which was being extended and improved, and an adjacent railway line, which, along with the Alabama River in Selma, provided excellent transportation options. The Edmund Pettus Bridge over the Alabama River in downtown Selma had just been completed that same year. E. C. Wilson of the Alabama Power Company joined Burns and Frazier in their efforts. The Selma population in 1940 numbered approximately 20,000, about half black and half white, and the small city promised infrastructure support for a military base nearby. For about $140,000, the Selma City Council had purchased 1,986 acres from eight local property owners, four white and four black. They offered to lease it to the government for only a dollar a year for 99 years. Burns and Frazier took a land donation letter to Washington, D. C., to make their case to the Air Corps leadership. Alabama Senator Lister Hill and Alabama Congressman Sam Hobbs supported the application. On June 2, 1940, the War Department approved the site, and the lease was signed on July 1.[1]

The first U. S. military personnel, 2 officers and 120 enlisted men, arrived in Selma on August 4-5, 1940, and cleared the first ground on the site three days later. Actual construction began on August 10. At a formal ceremony dedicating the field, on August15, Mayor Burns turned a shovel of dirt before press cameras. Colonel Vincent B. Dixon was designated the project officer, and on August 27, he was named commander of the newly activated Air Corps Specialized School, Selma, Alabama (redesignated as the Air Corps Advanced Flying School, Selma, Alabama on December 31). The base was then called Selma Army Airfield. By then the field had 40 completed structures, and on January 25, 1941, private construction contractors turned them over to the Corps of Engineers.[2]

Like all the military flight training bases in the country at the time, the new base at Selma was designed to train white pilots. In January 1941, the War Department announced it would also begin training black pilots, but those pilots would be trained separately, at Tuskegee, Alabama, almost 100 miles east of Selma. The first black flying unit was constituted and activated in March 1941, and its pilots did not begin training at Tuskegee until August of that year. By then, Craig Field was already training white pilots.[3]

Daniel L. Haulman recently retired as Chief, Organizational Histories, at the Air Force Historical Research Agency, Maxwell AFB, Alabama. After earning a BA from the University of Southwestern Louisiana and an ME (Master of Education) from the University of New Orleans, he earned a Ph.D. in history from Auburn University. Dr. Haulman has authored several books, including Air Force Aerial Victory Credits, The USAF and Humanitarian Airlift Operations, *and* One Hundred Years of Flight: USAF Chronology of Significant Air and Space Events, 1903-2002. *He has written several pamphlets, composed sections of several other USAF publications, and compiled the list of official USAF aerial victories appearing on the AFHRA's web page. He wrote the Air Force chapter in supplement IV of* A Guide to the Sources of United States Military History *and completed six studies on aspects of recent USAF operations that have been used by the Air Staff and Air University. He has also authored* The Tuskegee Airmen Chronology. *The author of forty-seven published articles in various journals, Dr. Haulman has presented more than twenty historical papers at historical conferences and taught history courses at Huntingdon College, Auburn University at Montgomery, and Faulkner University. He co-authored, with Joseph Caver and Jerome Ennels, the book* The Tuskegee Airmen: An Illustrated History, *published by New South Books in 2011.*

2d Lieutenant Bruce Kilpatrick Craig, Jr., namesake for Craig Field.

Eight months after its construction began, Selma Army Airfield was operational, and soon it was among the largest of all the Air Corps flying fields. The first cadets arrived as early as April 1941, and that same month, the first of 150 training aircraft arrived at the post, because the runways and taxiways had been completed enough for them.[4]

Mayor Burns of Selma declared May 29, 1941 as "Flying Cadet Day" at Selma Army Airfield, the first specialized single-engine training school in the southeastern United States. In July 1941, the Air Corps changed the term "Flying Cadet" to "Aviation Cadet," as the Air Corps evolved into the Army Air Forces. That same season, buses and taxi cabs began running between Selma and the field, further linking them. Increasing numbers of Selma civilians, both men and women, found employment on the base.[5]

In the summer of 1941, Selma Army Airfield was renamed Craig Field, to honor 2d Lieutenant Bruce Kilpatrick Craig, Jr., a Selma native who grew up in the city, and who was killed while test-flying a B–24 bomber at San Diego, California on June 2 of that year. Craig had attended Selma High School, from which he graduated in 1931. He graduated from Georgia Tech in Atlanta and became a civilian aeronautical engineer for American Airlines. He later served as a civilian test pilot for Consolidated Aircraft Corporation. Bruce Craig had never belonged to the Air Corps, but he had formed a glider club while attending Dinkins Military Academy (also in Selma), and because he had served also in the U.S. Army, as a reservist in the infantry, the Army posthumously granted him second lieutenant officer rank.[6]

On December 7, 1941, when the United States entered World War II following the Japanese attacks on Oahu in the Hawaiian Islands and Luzon in the Philippines (December 8 on the other side of the international date line), Craig Field was already a functioning advanced flying school, with 259 officers, 2,031 enlisted men, and more than 100 cadets about to complete their advanced flight training. On December 12, 120 of them graduated in class SE-41-I. Eventually, Craig Field was home to more than 4,000 personnel, including military officers and enlisted personnel and civilians, including whites and blacks, including men and women, including foreigners and Americans.[7]

Base Facilities

By September 1941, Craig Field had 175 of its approximately 2000 acres paved for runways, taxiways, parking areas, and streets. Half of those acres were reserved for the landing field. It covered an area of about two square miles, larger than the landing field at Maxwell Field in Montgomery, and twice as large as most Army Air Corps fields in the United States in 1941. Five runways were planned, the longest one 5,200 feet long, one 4,700 feet long, two of them each 4,500 feet long, and one 3,000 feet long. Three of those runways were 300 feet wide. The Craig Field runways were sufficiently constructed by early May 1941 for the first advanced flight training classes to start using them.[8]

The field's largest hangar was 40,638 square feet and had a door 120 feet long and 28 feet high. Its other facilities were comparable to those at other Army Air Forces flying fields around the country. Like most of them, it had a headquarters building, a control tower, a hospital, a chapel, sets of modern barracks, a base theater, a commissary, a supply warehouse, a gym, a guard house, an officers' club, a non-commissioned officers or NCO Club, and a host of other facilities. The post hospital was completed on June 3, 1941.[9] Engineers constructed an artificial lake by damning a small stream in the middle of the base, between the housing area and the flight line. The project not only enhanced the beauty of the field, but also helped provide better drainage and a source of water for operations.[10]

The first personnel at the field had been housed in tents, but many of the officers and enlisted men found lodging in Selma homes, some of which were turned into apartments for military personnel. As barracks multiplied on base, the tents gradually disappeared, and more of the military personnel moved on to the base itself. Private contractors constructed a new housing development adjacent to the field, Nathan Bedford Forrest Homes (named after the Confederate general that had defended Selma during the Civil War), which was available for white base personnel, including non-commissioned officers and civil service workers. By August 1941, approximately 200 homes were available in the subdivision.[11]

Craig Field facility construction included a chapel for religious services and a hospital. The chapel eventually accommodated four chaplains and held services for Protestants, Catholics, and Jews, supported by local Selma churches and a synagogue. In 1943 alone, the base held 593 religious services and performed 77 marriages, 24 baptisms, and 4 funerals. The Craig Field hospital, during 1943, delivered an average of twelve babies per month, and in July alone, the dental clinic served 1600 patients.[12]

After the United States entered the war, Craig Field grew as did other flying training bases across the United States. More than half of its personnel were military, but it eventually had approximately 1,400 civilian employeaes. Military personnel had to wear their uniforms when they ventured into Selma, and they changed the appearance of the town. Security on base increased, officers wore side arms, and military police at Craig and civilian police in Selma worked increasingly together.[13]

Construction at Craig Field continued throughout the war. The base's first pool opened on June 8, 1943, and on May 6, 1944, a new swimming pool opened at the Officers' Club. in June, a Visiting Pilot's Lounge and Operations Lounge became available. Also in the summer of 1944, a new mess hall was opened to accommodate pilots in transition training.[14]

Auxiliary Fields

Like many other advanced flying training fields around the country, Selma's Craig Field was surrounded by auxiliary fields that provided landing areas for the flying cadets to practice. Craig Field had five such fields: the Selma Municipal Airport (sometimes called Selfield), 7 miles north of Craig; Furniss Field, 8 miles west-southwest of Craig near Cahaba; Henderson Field, near Millers Ferry, 28 miles southwest of the main field; Mollette Field, sixteen miles southeast of Craig near Orville; and Autaugaville Field, 18 miles east-northeast of the main base.[15]

Aircraft Types

Cadets undergoing flying training at Craig Field were expected to have already received their primary and basic flying training at other bases. The advanced phase was the third and final phase, before the pilots were given their wings and commissioned as officers in the Air Corps (Army Air Forces). Craig Field's first airplanes arrived on April 26, 1941, when the base was still called Selma Army Airfield. In October 1941, Craig Field hosted 95 AT–6 and 26 AT–12 airplanes, for advanced phase flight training, and seven P–36s and 3 P–35s for transition training. There were also a few other kinds of aircraft at Craig at the time, including four PT–17s, normally used for primary flight training. By late 1941, there were approximately 150 airplanes at Craig Field, mostly AT–6s, AT–12s, and P–35s.[16] Eventually, the AT–6 aircraft type became the most common plane at Craig Field for the advanced flight training, and the P–40 for transition training. The total number of airplanes at Craig totaled almost 200 for most of the war.[17]

Craig Field maintained a few multi-engine planes not directly associated with its primary mission. In early 1945, for example, a set of TB–25s replaced a set of AT–10s, normally used for twin-engine training at bases such as Turner Field in Georgia. At Craig, such planes provided transportation services, and allowed some of the twin-engine pilots stationed at Craig to maintain their flying proficiency.[18]

Key Personnel

Craig Field experienced many changes of command during World War II. Col. Vincent B. Dixon assumed command of the post on August 5, 1940. Lt. Col. Julian B. Haddon succeeded him the next August, and rose to the rank of brigadier general by the time he was succeeded in turn by Col. Earl L. Naiden on November 17, 1942. Col. Charles H. Anderson assumed command of Craig Field at the beginning of 1943, and on February 27, 1944, more than a year later, Colonel Jasper K. McDuffie succeeded him. On December 16, 1944, Col. Ray W. Clifton assumed command of the field, and remained commander until the end of the war. Other important officers who served at Craig included a director of training, a director of flying, a director of the ground school, a commandant of cadets, a post surgeon, a post chaplain, a provost martial, a post engineer, and many others.[19]

Major Organizations

The Army Air Forces' Air Training Command stationed a host of Army Air Forces organizations at Craig Field during World War II. The most important of these at first was the 57th Base Headquarters and Air Base Squadron. It was activated as the 67th Air Base Group at Maxwell Field, Alabama, in Montgomery, on November 1, 1940, with 145 men assigned. On December 16, it moved to Craig Field, and on January 17, 1941, the group was redesignated as the 57th Air Base Squadron (Special). That unit was redesignated as the 57th Base Headquarters and Air Base Squadron on July 3, 1942. In February, 1943, the organization had 413 personnel assigned.[20]

Among Craig Field's single engine flying training squadrons, or school squadrons, were the 90th, 92d, 380th, 381st, 382d, 910th, and 911th. Some of these served at other bases before arriving at Craig Field because its construction had not yet been completed. For example, the 90th and 92nd School Squadrons were first activated at Maxwell Field on September 1, 1940. While destined for Selma, the units were moved in December to Barksdale Field, Louisiana, because Craig Field was not yet completed. On May 2, 1941, the squadrons arrived at Craig. They were redesignated as the 90th and 92nd Single Engine Flying Training Squadrons on October 20, 1942. At first their personnel allotment was around 100, but later rose to almost twice as many men. Between mid-June and mid-July 1941, the 380th, 381st, and 382nd School Squadrons were activated at Craig. Five school squadrons were already training pilots at Craig before the United States entered World War II in December of that year.[21]

Each of the seven school squadrons was authorized 200 men, but the numbers fluctuated, with some of them having well over that number. On May 1, 1943, the seven flying training squadrons at Craig Field were reorganized into two training squadrons. The Flying Cadet Advanced Training Group was activated at Craig Field on May 3, 1941. It was redesignated as the Aviation Cadet Advanced Training Group on July 12 of the same year.[22]

Craig Field also hosted many other non-flying organizations during World War II. Among the squadrons were the 14th Aviation Squadron and the 955th Guard Squadron, which was activated at Craig on August 24, 1942. In February 1943, the 14th Aviation Squadron had 249 personnel assigned. Most of its personnel were black, but it had a white officer in command. In 1942, the 955th Guard Squadron, which normally had 4 officers, had 223 personnel in February 1943, but its number of enlisted men declined from well over 200 to 151 in May of 1943, and to only 90 in January of 1944. Another ground squadron serving at Craig early in the war was the 73d Materiel Squadron. Most of the Craig Field personnel served on the ground, and never flew an aircraft, even in training.[23]

There were also quartermaster platoons stationed at Craig Field. The 727th Quartermaster Platoon, which served at Craig early in the war, transferred to Rome, New York during 1942 and its function was filled by the 947th Quartermaster Platoon, Transportation, Air Base, which was activated at Craig on August 14, 1942. The 947th Quartermaster Platoon operated the base motor pool, and provided drivers and transportation for the units and personnel at Craig Field during most of World War II. In February 1943 it had 101 men assigned to it.[24]

The 610th Army Air Forces Band (formerly the 310th Army Air Forces Band) began functioning as a band at Craig Field on May 6, 1942. It had 29 members as of November 1942. Eleven of the band members formed a dance orchestra for dances held on the base.[25]

During World War II, Craig Field also hosted many detachments of various companies, such as the 717th and 777th Chemical Companies, the 856th Signal Service Company (Aviation), the 907th Quartermaster Company, Aviation (Service), and the 2062 Ordnance Company. Some of these company detachments, such as the 856th, were parts of organizations headquartered at nearby Maxwell Field. Detachments of the 4th Weather

Recruits learn aircraft maintenance at Craig Field near Selma, ca. 1943. (*Courtesy of the Air Force Historical Research Agency*)

Squadron and the 4th Communications Squadron served at Craig. Craig Field also had medical, finance, chemical warfare, and ordnance detachments.[26]

There were also detachments for the Women's Army Corps (WAC), medicine, veterinary medicine, finance, chemical warfare, and ordnance. Many consisted of personnel assigned to larger units, stationed at Craig Field to perform specific functions there. Some of the detachments had significant numbers of personnel, corresponding to squadron numbers. For example, the Medical Detachment had 131 personnel assigned in February 1943, most serving at the base hospital. The WAC Detachment had 59 personnel assigned in July of that year. Other detachments were far smaller. The detachment of the 4th Weather Squadron had only 19 personnel in February 1943. The 4th Airways Communications Squadron detachment had eight assigned in the same month. The Veterinary Detachment had only 3 in February 1943. Depending on the organization, some were all-white, some were predominantly black (with white officer leadership), and some of them were female. Many of the organizations at Craig Field during World War II went through a series of redesignations, and the those mentioned are only some those designations.[27]

In 1942, Craig Field temporarily hosted an Air Corps Provisional Recruit Training Center, and in October of that year, over 1600 men applied for enlistment at Craig Field. By the end of the year, more than 2,000 recruits were processed and provided initial basic training at Craig. After basic training, hundreds of the new airmen deployed to other posts at places such as Tuckerman, Arkansas and Seymour, Indiana. Despite the recruitment and basic training function, Craig Field's primary mission remained advanced single-engine flight training.[28]

On May 1, 1944, Air Training Command reorganized the personnel at Craig Field, replacing most of them with the 2138th Army Air Forces Base Unit and a set of eight sections, identified alphabetically, from A through F, and H and T. Section or Squadron A administered the base, while B handled ground training. Section or Squadron C handled supplies and maintenance, while D was composed of women (WACs). Section or squadron E included the medical and veterinary detachments, while F was composed of black personnel. Section or squadron H included French personnel, while T consisted of combat returnees. The reorganization was not unique to Craig Field. Other flying training bases underwent the same transition to army air force base units with alphabetical sections or squadrons.[29]

On January 8, 1943, the War Department activated twelve flying training wings under the Army Air Forces Eastern Flying Training Command. The 28th Flying Training Wing served first at George Field, near Lawrenceville, Illinois, and coordinated the operations of primary, basic, and advanced flying schools in seven states: Arkansas, Indiana, Illinois, Mississippi, Missouri, Ohio, and Tennessee. In mid-September 1943, the command moved the wing to Craig Field, with Colonel Leonard H. Rodieck as commander, and the 28th began overseeing the operations of seven flying schools in the southeastern United States. The schools in Alabama included Craig Field in Selma, Tuskegee Army Airfield near Tuskegee, and Napier Field in Dothan. Other flying schools under wing jurisdiction were Marianna Army Air Field in Florida, Riddle-McKay Field at Clewiston, also in Florida, Spence Field near Moultrie in Georgia, and Jackson Army Air Base near the capital of Mississippi. The gunnery school at Elgin Field, Florida, also fell under its purview. The Tuskegee school was unique because it was the only one training "colored" pilots. The Clewiston school trained British pilots after Craig stopped training them. At the time, Craig Field was the only one providing advanced single-engine flying training for French pilots. The wing also supervised the postgraduate course in P–40 training at Craig Field.[30]

On May 1, 1944, the Army Air Forces redesignated the 28th Flying Training Wing as the 2102nd Army Air Forces Base Unit (28th Flying Training Wing, Headquarters) at Craig, under command of Colonel Rodieck, but in the spring of 1945, Colonel Charles J. Daly succeeded him. On May 19, 1945, Brigadier General Winslow C. Morse became the 2102d Army Air Forces Base Unit commander. In July, he was succeeded by Brigadier General Clinton Vincent, as acting commander. Vincent also commanded the 27th, 29th, and 30th Flying Training Wings. Although he was the highest-ranking officer at Craig, he did not serve as the base commander. The 2102d Army Air Forces Base Unit continued oversight of seven flying schools in the southeastern United States.[31]

From May 1, 1944 through the end of the war, Craig Field was home to two Army Air Forces base units, the 2102nd, and the 2138th. The Craig Field organizations continued reporting to the Army Air Forces Eastern Flying Training Command, headquartered at Maxwell Field, Alabama, fifty to sixty miles east of Craig Field.[32]

Ground School

Although the primary mission of Craig Field was to train pilots, using aircraft, the cadets first had to attend ground school to prepare themselves. Ground school courses covered such subject as the Air Forces, squadron duties, signal communications, photographic interpretation, aircraft and naval vessel recognition, training in the use of guns, operational engineering, gunnery, code, navigation, oxygen equipment, chemical warfare, and armament. The cadets also used primitive flight simulators called Link Trainers.[33] The first two classes in the Ground School Department, in the late spring of 1941, had forty men each. The third class had 100, and the numbers grew even larger after the United States entered the war at the end of 1941.[34]

Court martials at Craig Field were relatively rare. In July and August 1944, there were only three each month. In March 1945, there were five, but in April of that year, there were three.[35] Disease was a factor at Craig Field. In 1943, newly arriving cadets were quarantined for 14 days as a safeguard against a national measles epidemic. Venereal disease was a problem, but it seemed to affect the ground personnel more than the flying cadets.[36]

Flying Training

Army Air Forces pilots went through three phases of flight training before receiving their wings and commissions as officers. Those who trained at Craig had already completed the first two phases of flight training, primary and basic, at other bases. They already had an average of 120 hours of flying time. Many of the cadets who arrived at Craig came from basic flight training at Gunter Field in Montgomery, Alabama. At Craig, they received advanced single-engine flight training. Those who completed that training were pilots, but many of them also undertook transition training to familiarize themselves with flying fighter airplanes of the types used in actual combat. Some of the graduates instead became flying training officers to help train other cadets in what they had already learned, but most became fighter pilots.[37] When they graduated, most of the new pilots received the rank of second lieutenant, but a minority became flight officers instead. Enlisted personnel sometimes availed themselves of limited opportunity to train to become officers and pilots.

The first class to graduate from advanced flight training with the 90th and 92d School Squadrons was SE-41-C, but that class graduated at Barksdale Field, Louisiana, because Craig Field was still under construction. The SE stood for single engine, since they were training in single engine aircraft for future fighter missions. The 41 stood for the year 1941 and the C stood for the month (March) or sequence. The next class, for example, was SE-41-D. There was some overlap in the training classes. While 41-C was still training, 41-D began training. The training for each class took about nine weeks. Those failing in the training in one class would sometimes be held over to train in the next or a subsequent class.[38]

Advanced flying training at Craig Field began on May 3, 1941. Two hundred fifty cadets of class SE-41-D arrived from Barksdale Field, Louisiana, to complete the course. At the same time, scores of students in class SE-41-E arrived at Craig from basic flying schools, some from Gunter Field in Montgomery, Alabama, and some from Texas. Class SE-41-D was the first to graduate at Craig Field, on May 29, 1941. The graduation ceremony was held at the Wilby Theater in downtown Selma. Colonel Vincent B. Dixon, then Craig Field commander, presided. In each of the many classes trained per year, in the single-engine advanced flight training, there were eliminations of cadets who were said to have "washed out." Some of them were reassigned to ground units on base, but many of them went on to train at other bases as potential bomber crew members, such as navigators or bombardiers or radio-gunners. A few with potential were held over for a subsequent class. The percentage of cadets eliminated varied from class to class, but was generally low, and sometimes depended on the demand for pilots overseas. If not as many pilots were needed in combat overseas, more were eliminated so that only the best would graduate.[39] Half of the cadets in each class trained in the morning, and half in the afternoon, which allowed the base to have enough airplanes for all the cadets, and some spares. The arrangement also helped reduce traffic in the airspace over Craig and on the runways.[40]

Each class of advanced single-engine flying cadets spent two weeks of aerial and ground target gunnery training at Eglin Field, Florida, before returning to Craig to finish their training. Eglin provided gunnery training not only for the Craig cadets, but also for other cadets from advanced flight training schools around the southeastern United States. For example, black cadets from Tuskegee Army Air Field in Alabama also deployed to Eglin for gunnery training. It is possible that some of the Craig Field and Tuskegee Army Air Field cadets in gunnery training came into contact with each other, but the prevailing culture at the time was still racial segregation.[41]

Craig Field personnel took part in gunnery competitions at other bases, after training at Craig and Elin Fields. For example, on March 20, 1944, 2d Lt. John R. Whitten of class 44-B won the third "Buzz Wagner" aerial gunnery meet at Matagorda Island Range in Texas, receiving a silver trophy. On May 15-16, 1945 at another gunnery meet held at Foster Field, Texas, Lt. Jules C. Santoro, an instructor pilot from Craig, won the Buzz Wagner trophy for first place, and Lt. Orval C. Jansen, also from Craig, won first place in the student competition. Another such gunnery meet was held on June 19-20. Lt. Charles E. Johnson won, with 2d Lt. Duane B. Monk coming in second. Third place was won of 2d Lt. R. V. Clayton, a student from Tuskegee Army Air Field.[42]

The standards for admission to flying training in the

Cadets leave lockers for the field still smiling over their hearty meal of fried chicken supplied through the "Food for Defense" program. Craig Field, Southeastern Air Training Center. Selma, Alabama.*(Courtesy of the Library of Congress.)*

Army Air Forces changed during World War II. At first, in 1941 and 1942, flying cadets needed 2 years of college or to have passed an exam covering college material. Half of the cadets were college graduates. They also had to pass physical fitness tests, and had to be unmarried. Many young, well-educated, and fit single young men found girlfriends in Selma, and at first they could bring their own automobiles. Later in the war, the Army Air Forces changed the rules. Cadets no longer needed college beforehand, and could receive some higher education in college training detachments. Cadets could be older and no longer needed to be single. They were no longer welcome to bring their own cars to Craig, partly because of gasoline rationing, and had to rely on base or local public transportation options such as buses and taxis.[43]

Training British and Dutch Pilots

While Craig Field had been built primarily to train American fighter pilots, it also trained pilots for allied nations. All of the members of the first wartime class at Craig Field, Class 41-I, that graduated on December 12, 1941, just five days after the Pearl Harbor attack, were Americans, but the first 122 British flying training cadets had already arrived at Craig Field on November 1, 1941 under what was called the "Arnold Plan," for the training of British pilots in the United States. They arrived at Craig for advanced single-engine flight training after having graduated from primary and basic flight training at other bases, such as Gunter Field in Alabama and Cochran Field near Macon, Georgia.[44]

While the British flying students at Craig Field could speak English, obviously, many of them still had communication problems, because the British dialect was considerably different from the various American ones, including the local Southern one. Those British personnel who were able to drive often had difficulty driving on the opposite side of the highway than they were used to. Even the way they saluted was different from that of the Americans. These were some of the same problems that Americans encountered when they deployed to Britain during the war.[45]

On January 3, 1942, 199 British cadets graduated in class 42-A, the first British class at Craig. Class 42-B had already arrived on December 15, 1941. Classes 42-A, 42-B, 42-C, and 42-E consisted of British cadets, while classes 42-D and 42-F were mostly British but included some Americans. Class 42-G had about equal numbers of British and American students. The classes also generally grew in size as time went on, from 168 graduates in class 42-D to 176 in class 42-F to 191 in class 42-G.

Classes 42-G through 42-K all had 190 or more. The largest 1942 class was 42-H, with 197 graduates.[46]

The United States entered World War II in early December 1941, but for the next year, Craig Field trained more British than American pilots. By the end of 1941, more than 2,200 men were stationed at Craig Field. In 1942, almost 2,000 cadets entered advanced flight training at Craig. Flying training resulted in some fatal aircraft accidents, as at all other flying training bases. In 1942, sixteen cadets were killed at Craig. Eleven of them were British, and five were Americans.[47]

Many of the officers at Craig Field were British flying officers helping to train their cadet countrymen. In October 1942, there were at least 21 of them. During 1942, more than twice as many British pilots graduated at Craig Field than American pilots. In that year, the base seemed to be more a British than an American pilot training facility, except in leadership. After training at Craig Field, the British pilots went to Moncton in New Brunswick, Canada. British trainees who were eliminated also went there.[48]

After class 42-H, the number of British students decreased relative to the number of Americans. During the period from December 7, 1941 and the end of 1942, 1,947 cadets completed flight training at Craig Field. 1,219 were British and only 728 were Americans. In the same period, there were 55 eliminations, 46 of them British and 9 of them Americans. By February 23, 1943, fourteen classes of British cadets had trained and graduated at Craig Field. Lend-Lease funded their training. British flight training at Craig ended with class 43B in February 1943, but the last British flight instructors did not leave the field until August. In the spring and summer of 1943, they helped train American cadets. Much of the British flight training moved to British or British Commonwealth facilities in other countries, but some of it moved to Clewiston, Florida, where there was another flight training base.[49] A total of 1,392 British pilots graduated from advanced single-engine flight training at Craig Field during World War II.

Ten Dutch pilots trained at Craig. They knew how to speak English, and no problems were reported with their training. Although the Netherlands had been taken over by Germany in 1940, some of the Dutch pilots came from the Netherlands East Indies. The Dutch pilots were in classes 43-F, 43-G, and 43-I at Craig Field. In other words, the flight training of Dutch pilots at Craig began after the training of British pilots there ended, and the flight training of French pilots started after the training of the Dutch pilots at Craig had ended.[50]

Training American Pilots

During World War II, approximately 6000 pilots graduated from advanced single-engine flight training at Craig Field during World War II, and of these, almost two thirds, or almost 4,000, were Americans. Their training evolved. Certain former enlisted personnel were al-

Flight instructors E. E. McTaggart, left, and J. C. Gumison converse before their students take off at the Craig Field Southeastern Air Training Center in Dallas County in August 1941. ***(Courtesy of the Library of Congress.)***

lowed to train to be pilots, and thus become officers. Ages of the flight cadets ranged from 18 to 27, with the average age being 22.[51] In 1942, eighteen wives of cadets established residence in Selma. In 1943 the number grew to 43. Married cadets were given passes to visit their wives. In May of 1943, a Cadet Wives Club was established, and in November, an Enlisted Wives Club as well.[52]

Most of those who entered the advanced single-engine pilot training went on to graduate and receive their wings and commissions, but some were eliminated. Eventually, Craig Field coordinated a Pilot Salvage Program, which allowed eliminated students to continue their training at twin-engine schools at other bases, where some of them trained to be navigators, bombardiers, and radio operator-gunners in bomb crews.[53]

In May 1943, the Air Training Command allowed only 70 percent of flying training cadets to receive gunnery training at Eglin Field, which qualified them to become future fighter pilots. The other 30 percent became flight instructors, or became pilots for Air Transport Command, or flew other kinds of aircraft for the service. The decision hurt morale for those not selected to be fighter pilots, which was the dream for most of the cadets.[54]

Each graduating class was given a buffet super at the mess hall, followed by a graduation dance at the Officers' Club. Parents and friends came to Selma for the graduation ceremonies. In winter, the Post Theater hosted the events, but in better weather seasons, many of the graduations were held at the Pecan Grove outside. Class 44-A, which graduated in January 1944, had 287 graduates, the largest class to that time. Most became second lieutenants, but 36 of them became flight officers, based on their proficiency.[55]

By the beginning of February 1944, more than 4,471 flying cadets had received their wings at Craig Field. 3,069 were Americans, 1,392 were British, and 10 were Dutch. After Craig stopped training British and Dutch pilots, it began training French ones, in 1944, but it continued also training American cadets to become pilots and officers.[56]

Craig Field Pilots in Combat

Many of the fighter pilots who had graduated from advanced flight training at Craig Field later excelled in combat overseas. Captain James H. Martin, Jr., for example, visited Craig Field in January 1944, after having shot down 3 Japanese planes off Australia and winning the Medal of Honor. Lt. Hoyt A. Eason of class 41-H was the first Craig graduate to become an ace. He shot down six Japanese planes in January 1943 while serving in the Southwest Pacific Theater of Operations. Lt. Donald M Morse, who scored six aerial victories in the spring of 1943, was another Craig Field graduate who became a World War II ace. Major Edward Cragg, another Craig Field graduate, shot down 14 Japanese planes in the Southwest Pacific. He was reported missing on December 26, 1943, off New Britain. By the end of 1943, nine Craig Field graduates had won the Distinguished Flying Cross in combat overseas.[57]

Some of the Craig Field pilot graduates also served in the Mediterranean or European Theaters of Operation. For example, Captain John C. A. Watkins flew P–40s over Tunisia and Pantelleria, sometimes escorting medium bombers, flying the same kinds of missions that the Tuskegee Airmen's 99th Fighter Squadron was flying at the same time and place, with the same kind of aircraft. Watkins shot down three enemy airplanes, and Major General James Doolittle, commander of the Twelfth Air Force, awarded him a Distinguished Flying Cross in October 1943. That same month, another Craig Field graduate was reported to have dived his P–47 Thunderbolt fighter at a record speed in a dogfight over Germany. The speed was not confirmed, but Knapp flew in the 78th Fighter Group of the Eighth Air Force in the European Theater of Operations.[58]

Training French Pilots

As noted earlier, Craig Field had already trained thousands of American, British, and Dutch fighter pilots when, during 1943, it began training French pilots. The French personnel came at first from French colonies in North Africa, such as Morocco and Algeria, which Allied forces had liberated from Axis control during Operation Torch (November 1942). The first French cadets sailed from Casablanca to Boston, where they arrived on June 24, 1943. Two days later, 107 of them arrived at Craig Field, which had been designated as the base for a French "pool" of future pilots.[59]

Before undergoing advanced single-engine pilot training, the French flying cadets had to complete nine to ten weeks each of primary and basic flying training at other bases, just like the Americans. After orientation and preflight courses at Craig, for up to five weeks, some of them had their primary flight training at Van de Graaf Field in Tuscaloosa, Alabama, home of the Alabama Institute of Aeronautics, Incorporated, while others had their primary flight training at the Hawthorne School of Aeronautics at Orangeburg, South Carolina. Both the Alabama Institute of Aeronautics and the Hawthorne School of Aeronautics were civilian-run schools that operated under contract with the War Department, similar to the one under which the Tuskegee Institute operated a primary flight school for black military cadets at Moton Field, Alabama. The first French cadets entered primary flight training in Tuscaloosa on 5 July 1943.[60]

In the first eighteen months after the first French personnel arrived at Craig, approximately 2,500 of them were processed. More than 2000 of them went on to Orangeburg. The number of French students that were sent from preflight training at Craig to primary flight training at Orangeburg was typically 150 per month.[61]

French cadets who graduated from primary flight training went on to basic flying training at Gunter Field in Montgomery, just like the British pilots before them. The first French cadets who had graduated from primary flight training in Tuscaloosa arrived at Gunter Field on 1 September 1, 1943. There were seventy-five of them. Approximately 1,300 French cadets graduated from basic flight training at Gunter Field. Eliminations totaled 314. There were twenty classes.[62]

Near the end of December 1943, Craig Field began advanced single-engine flight training for French cadets who had completed their basic flight training at Gunter, which was only fifty-four miles away. The first French pilots graduated at Craig in class 44A on January 7, 1944. There were 41 of them. While most of the French students went on to receive their advanced single-engine flight training at Craig Field, where they had already been stationed for preflight training, others went to advanced twin-engine training at Turner Field in Albany, Georgia. At one point, sixty percent of the advanced flight cadets went to Craig for single-engine flight training to become future fighter pilots, while forty percent went to Turner for twin-engine training to fly multi-engine aircraft such as bombers. In other words, considerably less than the 1300 French cadets who graduated from basic flight training at Gunter entered advanced flight training at Craig, and less than the number of cadets who entered the advanced phase graduated from it.[63]

At first, the French cadets from basic flight training at Gunter had to transition from BT–13 aircraft to AT–6 aircraft, but after mid-1944, Gunter began training them with the same kinds of AT–6 aircraft that they used later for advanced flight training at Craig. The use of the same kind of aircraft for basic and advanced flight training reduced eliminations by dropping the need to learn how to fly a different aircraft type at Craig.[64]

The number of French personnel at Craig Field was significantly higher than the number of those who graduated as pilots there, considering those in preflight training and the French pool. Some of the French flying students were eliminated in the primary and basic phases of flight training at the other bases, and some went on to twin-engine flight training in Georgia, but many returned to Craig Field for advanced single-engine flight training and, after that, for transition training there. French cadets who were eliminated from advanced flight training at Craig often deployed to other training bases in the United States to become members of bomber flight crews, such as bombardiers, navigators, radio operators, or gunners. British advanced single-engine flight training in the United States had taken place at both Craig Field and Maxwell Field, before it moved to Florida, but French advanced single-engine flight training took place only at Craig Field.[65]

Part of the advanced flight training at Craig Field for the French cadets, as before for the British and American cadets, involved deploying to Eglin Field near Valparaiso, Florida, for gunnery training. Eglin also provided gunnery training for advanced flying cadets from other training bases around the southeastern United States, including the black flying cadets from Tuskegee Army Air Field. While black and white flying cadets were stationed at Eglin at the same time, they were grouped in segregated classes, and returned to their advanced flight training bases without much racial interaction. Nevertheless, the French cadets from Craig came from a less racist environment than those of their American or British counterparts. French culture was more tolerant of what some called "race mixing." In fact, during World War I, the first African American pilot in history, Eugene Bullard, found himself welcome to fly with the French Air Service, but not in the American Air Service. Some of the French cadets at Selma's Craig Field probably wondered why segregation was enforced so much in central Alabama.[66]

Americans at Craig Field and in Selma were generally hospitable to the French cadets and pilots, despite language differences. Some of the people of Selma opened their homes to the French for social events, as they had for the British. They appreciated the foreigners who were training to fight alongside Americans for the liberation of their country, especially as the Allies prepared for the June invasion of Normandy.[67]

The training of the French pilots was more difficult than the training of the British, Americans and Dutch, partly because of language differences. The French were not required to learn English before commencing their flying training. Few of the could speak or read English very well, and the Army Air Forces invited or reassigned American military personnel who knew French to be instructors or translators at Craig Field. Language continued to be a problem even after more French-speaking instructors were assigned to Craig Field, and instruction manuals were translated into French. French officers were sent to Craig to help train the French pilots, just as British officers had also deployed earlier to Craig to help train the British personnel. Among the ground courses French flying training cadets took at Craig were English, code, arms, recognition, and physical training.[68]

Language was not the only problem. Many of the French were considerably shorter than the average American and British cadets who trained at Craig before. Some of them used seat cushions to help them see better from the AT–6 cockpits, but found themselves less able to reach the aircraft rudder pedals with their feet. Some of the French cadets resisted the physical education requirements, or became frustrated with failures to communicate, and asked to be eliminated.[69]

Regardless of the language and stature differences, the French who did complete the training at Craig became excellent fighter pilots. After their training, the French pilots went to Bolling Field in the District of Columbia, or Mitchell Field, New York, for transportation back to North Africa. After the Allied invasion of Normandy, some of the Craig Field-trained French pilots returned to France to take part in the liberation of the rest of their country, many of them flying P–47 Thunderbolt airplanes. Even some of the twin-engine French pilots, who trained in the advance phase at Turner Field in Georgia rather than Craig, had once been stationed at Craig, when they were in the French pool of cadets or in preflight training.[70]

In classes 44-A through 44-G, between January and July 1944, 342 French cadets graduated from advanced flight training, while 43 others were eliminated. During that year, 377 French pilots graduated from advanced single-engine flight training at Craig Field. The total number of French pilots who graduated from flight training in the United States by the end of October 1945 was 1,165, but not all of them graduated from advanced or transition flying training at Craig Field. As noted, some of them received advanced flight training in multi-engine aircraft at Turner Field near Albany, Georgia. Almost 650 French pilots graduated from advanced single-engine flight training at Craig Field during World War II. Almost all of the French pilots started out in orientation or preflight training in the French pool at Craig, even though not all of them returned there for the advanced flight training phase.[71]

At first, American flying students outnumbered French ones, but as the need for American combat pilots declined, Craig Field began training more French than American pilots. Starting with class 45-C, the number of Americans in flight training at Craig Field declined dramatically. The number of AT–6s in commission assigned to the French section increased from 14 to 22 between the spring and summer of 1945. Their noses were painted orange, to distinguish them from those reserved for the American trainees. On June 27, 1945, after World War II in Europe ended, flying class 45-D at Craig Field graduated, with 34 Americans and 44 French pilots re-

The pages from a World War II-era yearbook show how extensive the establishment at Craig Field was. The large numbers of cadets and students required a large physical plant.

ceiving their wings and commissions. When World War II ended in the Pacific in September, American pilot trainees at Craig Field were given the option of discontinuing the training. At first, they declined the offer almost unanimously, but before long, Craig Field ceased training American pilots. Americans in class 45-G went down from 37 to 11. By the end of 1945, only French pilots were graduating from pilot training at Craig Field. Class 45-I consisted of only French students.[72]

Preflight training for the French at Craig Field ended on July 24, 1945, after World War II in Europe had ended, but there were many French flying training cadets in the pipeline, some in primary flight training at Orangeburg, some in basic flight training at Gunter, and some in advanced flight training at Craig.[73]

French flying training students continued to train at Craig Field when the war ended in September 1945, but did not last very long after that. French flying training ended there on January 18, 1946. Eventually, between 1,165 and 1,339 French pilots trained in the United States during World War II, and formed the nucleus of the rejuvenated French Air Force after the war. After advanced flight training at Craig Field, about 150 of the French pilots received operational flight training at Oscoda Army Air Field in Michigan between July 1944 and March 1945. That was not unusual. Many of the black pilots who completed advanced flight training at Tuskegee Army Air Field had also received operational flight training at Oscoda. Following the Oscoda transition training, the French pilots returned to France for combat operations, as did many who received their transition training at Craig Field. A total of 23 classes of French pilots graduated from advanced flight training at Craig Field.[74]

Aircraft accidents and disease took the lives of some of the French cadets during their training in Alabama, and many of them are buried at Oakwood Cemetery in Montgomery, along with some of the British cadets who also died during training in Alabama, either in primary flight training at Tuscaloosa, basic flight training at Gunter, or advanced or transition flight training at Craig.[75]

Transition Flight Training

Craig Field also trained many pilots in transition training, after they received their wings and commissions at the conclusion of their advanced single-engine flight training. The transition training, like the advanced phase, took about ten weeks. As noted earlier, at first various fighter types were used, including P–36s, P–39s, and P–40s, but P–40s became the most common type during most of the war. At the end of 1943, there were 24 P–40s at the base. The formal Transition School began operations in January 1944, with 7 instructors and 30 planes assigned,25 of them operational. By June 1944, over 200 officers were undergoing P–40 transition training. Craig Field also provided transition flight training for contingents of cadets from the United States Military Academy at West Point. For example, in February 1943, 43 West Point graduates arrived at Craig for P–40 transition flight training. In July 1944, 34 other West Point cadets arrived for the same kind of training. In 1944, the standard transition flying training involved 66 flying hours and five weeks. During that year, 1,443 pilots graduated from transition flight training at Craig. Of these, 1,237 were Americans and 206 were French. During the same year, 122 of the pilots were eliminated, with about equal percentages for each category. By the end April 1945, the Transition Training Unit had an inventory of 47 airplanes. Eleven of the men assigned to the unit as instructors had combat experience. The number of students per instructor varied, sometimes from 10 to 17. As with the advanced single-engine flying training at Craig Field, the number of American students declined relative to the number of French students starting with the spring of 1945, as the World War II approached its end.[76]

Women at Craig Field

While the majority of personnel at Craig Field during World War II were white men, there were also significant numbers of women and African Americans. While serving in generally subordinate units or positions, they contributed greatly to the functioning of the base and its success as a producer of fighter pilots for the Allied cause. The history of Craig Field cannot be fully understood without considering their contributions.[77]

Many of the women working at Craig Field served as military nurses or civilian Red Cross volunteers at the post hospital, where they cared for patients and assisted doctors. There were at least ten nurses pictured in a 1942 Craig Field yearbook. The head nurse at the time was 1st Lieutenant Elizabeth N. Johnson. All of the nurses at Craig Field were officers, and the base officers' club was open to them. Many of the relationships that

Cadets R.J. Neal and G.D. Mabds climb into their pursuit plane at Craig Field, Southeastern Air Training Center, Selma, 1941. ((*Courtesy of the Library of Congress.)*

developed between men and women at Craig Field resulted in engagements and marriages. For example, Kitty Driscoll of Selma, one of the nurses, met and married a soldier from Vermont named Wendell Barber. She died in Italy in 1944.[78] On February 14, 1943, the daughter of Lt. Gen. Carl Spaatz, then commander of the Twelfth Air Force in Italy, married an aviation cadet at Craig Field.[79]

Later in the war, some of the Craig Field women were pilots, members of the Women Airforce Service Pilots (WASP). On January 1, 1944, the first two WASP members arrived at Craig Field: Margaret E. Slaymaker (later, McNamara), and Marilyn L. Seafield, but they were hardly the last. They were assigned as engineering check pilots, test flying many of the field's aircraft, usually the AT–6s used for the single-engine flying training. The women pilots at Craig had learned to fly at Avenger Field, near Sweetwater, Texas, where they had received their wings. After arriving at Craig Field, they were given check rides and became better acquainted with the AT–6s, since they had trained in Piper Cubs. An example is Jane Tedeschi, a WASP pilot who graduated from flight training in May 1944 and then went to Craig Field to help test aircraft. The WASP duty hours were nine-hour days. The Flight Test Section was organized in February. Some of the Craig Field women pilots flew ferry missions for the Eastern Flying Training Command. Documents confirm the excellence of the women pilots, and mention no discipline problems. As of December 18, 1944, there were no WASP flying accidents reported. The women pilots were generally housed with the base's nurses. Like the nurses, they were given the same privileges as the post officers, including use of the Officers' Club. The need for women pilots at Craig Field declined during 1944, and the program there was discontinued by the end of the year.[80]

Other women at Craig Field belonged to the Women's Auxiliary Army Corps (WAAC), or its redesignation, Women's Army Corps (WAC). The WACs performed tasks formerly done by men, to release more men for combat duty. At Craig Field they served as clerks, stenographers, typists, cooks, bakers, mail orderlies, sheet metal workers, messengers, radio mechanics and operators, photo lab technicians, telephone operators, and hospital orderlies. The first WAAC detachment arrived at the base on June 7, 1943. The numbers grew as time went on, from 12 in June, to 59 in July. After July, the numbers declined somewhat, with 51 in August and 48 in September. On September 20, the WAAC was replaced by the Army Air Forces Women's Army Corps. Numbers continued to fluctuate, with 48 in October, 49 in November, and 55 in December. In January 1944 there were 60 WACs at Craig Field. In subsequent months, the numbers stayed between 60 and 70. Mildred Inez Caroon Bailey was a member of the Women's Army Auxiliary Corps in World War II at Craig Field. One of her duties there was to teach English to French cadets there. On May 1, the women at Craig were reorganized into Section (later Squadron) D of the 2138th Army Air Forces Base Unit.[81]

Blacks at Craig Field

African Americans also served in important capacities at Craig Field during World War II, although very few of them were officers. Most of the predominantly black units had white officers. The most important of the early black organizations at Craig was the 14th Aviation

Squadron, first activated on April 12, 1942. It began with 25 enlisted men, but later included three officers, a captain, a first lieutenant, and a second lieutenant and as many as 250 enlisted men. Among the squadron commanders were Captain Harold L. Scott, Major Frank M. Crittenden, and Major Harold B. Donaldson. Donaldson was white, and in 1942, he was in charge of at least 159 black airmen, all enlisted. Despite its name, the squadron was a ground unit that never flew any airplanes. It handled ground maintenance, certain military police, hospital orderlies, drivers, and construction. It worked closely with another black organization at Craig Field, Company K of the 31st Quartermaster Regiment (Truck), which provided important transportation service around the base. Later, the base's 947th Quartermaster Company also had black personnel. The first black personnel at Craig had their own mess hall. At first, they lived in tents, but in October 1943, they moved into newly completed wooden barracks.[82] Most of the white leaders at Craig Field did not believe that blacks and whites should mix socially, especially in an environment in which men and women were in close contact. There is no evidence showing that the few black officers at Craig Field attempted to use the Officers' Club, where white women officers were welcome, despite Army regulations stipulating that membership should be open to all officers on a base. Blacks had their own recreation hall, and black women were welcome there.

While most of the predominantly black organizations had white officers, and therefore had both black and white personnel assigned, some of the other predominantly white military organizations at Craig Field during World War II also included both black and white personnel. For example, a 1942 Craig Field yearbook shows that 13 of 100 Medical Detachment personnel were black. They were pictured as if they served together in the same unit. In 1944, the Aircraft Maintenance Section at Craig Field included 48 African Americans, about half the total personnel of that section.[83]

While the white officers leading Craig Field enforced much racial segregation on the base, consistent with the segregation in the civilian regime in Selma and the surrounding area of central Alabama, they also encouraged black morale. Athletic and recreational events included boxing matches and baseball games, picnics and dances. Sometimes an orchestra from Tuskegee Army Air Field visited Craig Field to furnish music. On May 15, 1943, the black USO center on Franklin Steet in Selma hosted a gala dance. In July, another large dance was held in the 14th Aviation Squadron's Recreation Hall at Craig. The same site hosted a festive Thanksgiving dinner in November of that year, and a Christmas party in December at which black members of the 947th Quartermaster Platoon were invited. Black young ladies from Selma were welcomed at such events. "Colored" citizens of Selma, composing half of the city's population at the time, supported such events enthusiastically, as did Selma University.[84]

After the units at Craig were reorganized on May 1, 1944, all the black personnel on post were reassigned to Section F of the 2138th Army Air Forces Base Unit. In March 1945, Squadron F had 182 personnel, 163 of them assigned to the Air Corps, and 19 of them to the Quartermaster Corps.[85]

The black personnel at Craig Field suffered from a strict segregation policy, not only on base, but off. While Selma was approximately half black and half white, Dallas County at the time was three quarters black. Local white civilians objected to any efforts to increase the number of black personnel at Craig Field, and base commanders often supported them. The commander also forbid Craig Field military personnel to use facilities that did not separate the races, such as an establishment called John Brown's Place. He feared that if black and white personnel drank together, they would more likely become involved in violent racial clashes. There were two USO facilities in Selma, one for whites and one for blacks.[86]

Occasionally, black personnel, like the white personnel, were court-martialed, but those convicted were not imprisoned together. In December 1941, the Craig Field guard house had no facilities for segregating the prisoners, and base leaders made temporary arrangements with Selma city officials to incarcerate the black ones in the Selma city jail. On November 5, 1942, a new guard house opened at Craig Field, and the old guard house became a prison for black personnel who had been convicted in courts martial.[87]

There had been friction between "colored" and white military personnel riding buses between Selma and Craig Field, partly because of disagreements about where in the bus they should sit. Early in the war, in late 1941 there was an altercation between a black soldier and a white civilian clerk at the main post exchange. The clerk was reprimanded and instructed to give black military personnel the same service in the main store as that afforded white military personnel. Even before all the black personnel at Craig Field were assigned to Section F, they had their own recreation hall and their own mess hall. On August 17, 1944, the Army Air Forces issued letter 35-128 that directed that all personnel regardless of race be afforded equal opportunities to enjoy recreational facilities at base facilities. While the base recreational facilities were technically open to personnel of all races, Squadron F continued to use its own. Dances, movies, and picnics were popular among the black personnel at Craig, and some of them were open to black visitors from Selma and the surrounding area. The city of Selma continued its strict segregation policies.[88]

Craig Field had two baseball teams, one for the white personnel called the Craig Field Flyers, and one for black personnel called the Craig Field Monarchs. The Monarchs played games against the teams of other bases, including not only the black team at Tuskegee Army Airfield, but also white teams at Maxwell and Gunter Fields in Montgomery. The Flyers and Monarchs probably never played each other, since base histories do not indicate such games. Sometimes the Monarchs played games in places farther afield, as far as Pensacola, Florida. Other games were played at Marion and in Selma itself. Boxing matches were also popular in Squadron F[89].

As the war wound down, the number of black personnel at Craig declined. By the end of the war, all the military police on the post were white. Some of the black mechanics at Craig Field went to Tuskegee Army Air Field for 3 months of training. Occasionally, some black personnel at Craig were transferred to Tuskegee Army Air Field, where the majority of personnel were black, but not in the base leadership.[90]

One of the first black pilots in the Air Corps, later Army Air Forces, was Selma native Mac Ross, who eventually flew in combat in Italy. He was killed on a transition training flight in July 1944, as the 332d Fighter Group was transitioning from P–47 to P–51 aircraft. Ross did not train at Craig Field, which trained only white pilots, but at Tuskegee Army Air Field. Another irony: both Mac Ross and Kitty Driscoll Barber, a white nurse who had served in the Craig Field hospital and who had married an American soldier, and who was also a Selma native, are buried in the same American cemetery at Nettuno, Italy. Both had died in Italy in 1944.[91]

The venereal disease rate among black personnel at Craig Field became a major problem in 1945. In May, the rate per 1,000 personnel was 135.42 for blacks and 14.33 for whites. In June, the rate per 1,000 was 528.81 for blacks and 19.27 for whites. Abundant social interaction opportunities between black personnel on base and in Selma contributed to the high rate of infection.[92]

White racism continued to affect the Army Air Forces during World War II, despite the achievements of the black Tuskegee Airmen of the 332d Fighter Group overseas. The Army Air Forces Eastern Flying Training Command, headquartered at Maxwell Field in Alabama during World War II, had jurisdiction over both Tuskegee Army Air Field to the east and Craig Field to the west. One of the command's histories from July and August 1944 reports the following on August 27, 1944: "Private Thomas J. Murphy was reported to have been associating with colored persons, both civilian and military, in Selma, and to have 'possibly' been causing racial agitation with talk concerning racial equality as it exists in Brooklyn, New York. Murphy, who is white, has been placed under surveillance." Apparently speaking about racial equality was considered dangerous in Alabama in the summer of 1944, requiring surveillance.[93]

Civilians at Craig Field

While there was always a majority military population at Craig Field, there were also hundreds of civilian employees there, including both men and women, whites and blacks. In November 1942, there were 680 civilian employees, but a year later there were more than 900. In January and February 1945, there were almost a thousand. The civilian employees relieved military personnel of duties that might have interfered with their training. They worked 48 hours per week, with one day off. Before September 1, 1943, all the civilians were paid in cash, but afterwards, by check. The civilians were paid at first twice a month, but eventually every two weeks. The civilian income helped enrich the economy of Selma and Dallas County.[94]

Military leaders at Craig Field often invited civilian celebrities to entertain the troops stationed there. Show business personalities often performed with USO shows, some of which were held in Selma, and some on the post. Among some of the celebrities who entertained at Craig were comedian Bob Hope and former heavyweight boxing champion Jack Dempsey.[95]

Craig Field and Selma

Craig Field and Selma had a symbiotic relationship, each contributing to the life of the other. Like other communities, Selma conducted War Bond drives, encouraging people to lend their money to the war effort, and enforced the rationing and induction rules for the city and Dallas County, of which it was the seat. Both the city of Selma and local businesses supported the Craig Field military personnel, offering facilities such as swimming pools, tennis courts, and the golf course, to most of them (if they were not black). Residents in private homes welcomed not only American but also British and French cadets. Many of the cadets found romance in Selma, judging by the high number of weddings. Black Selma residents invited many Squadron F personnel to their homes for Christmas dinner in 1944. The old YMCA on Broad Street became the Soldiers' Club, and was later transformed into the United Service Organization (USO) facility for white personnel, and there was another black USO, sometimes called the "Colored Community Center," in another section of town. White businesses served white soldiers, and black businesses, although fewer and smaller, served African Americans stationed at Craig Field. Selma's WHBB radio station hosted a show called "On the Beam," which focused on the military personnel training at Craig Field, and welcomed information from the base public relations office. Media at Craig Field included a base newspaper, initially published weekly but later biweekly or twice a month. It normally had only four pages per issue. [96] Editors of the Selma and base newspapers traded and shared stories. The white Craig Field Flyers baseball team played its opening game at Selma's Rowell Field, against a team from Maxwell Field.[97]

Craig Field leaders specified off-base facilities in Selma that were off-limits, because they were unsanitary, encouraged prostitution, demonstrated a lack of respect for military personnel, or served both black and white patrons. After August 1944, base recreational facilities were technically to be open to all military personnel regardless of race, but that did not apply to off-base facilities. Base commanders did not want to upset the segregation policies of Selma, Dallas County, or Alabama, and also feared that if the black and white personnel mingled in private drinking establishments, there would be more chances of racial violence.[98]

Craig Field increased the population of Dallas County, which encouraged the growth of local churches and the emergence of new ones in Selma, in spite of the fact that the base had a chapel and chaplains. In 1943, both West End Baptist Church and Northside Baptist Church were born in Selma. Worship services then were still segregated and black worshippers of Selma attended their own churches, such as Tabernacle Baptist Church, whose attendance increased significantly during the bustling World War II years of Craig Field.[99]

Craig Field occasionally opened its gates for public events to which the people of Selma were invited. For example, on Army Day, April 7, 1942, more than 2,600 visitors came to Craig. They viewed combat aircraft such as the B–24 and the P–40, and the base commander spoke to them. In April 1943, a war bond rally included a parade on Broad Street in which the Craig Field band took part. Selma Bank representatives sold war bonds. On August 1, 1945, Craig Field hosted an air show, with Selma Mayor Ralph Nicolson as a special guest. On April 15, 1945, the base held a memorial service for President Franklin D. Roosevelt, not long after his death. Four thousand people attended the services, including citizens of Selma.[100]

During World War II, Craig Field trained approximately 6,000 American, British, Dutch, and French advanced single-engine fighter pilots. Two thirds of them were Americans. More than half of the approximately 2,000 foreign pilots trained there were British. Craig Field also invigorated the economy of Selma and Dallas County. Although its diverse military and civilian personnel endured unequal treatment, based on rank, race, and gender, the various elements cooperated on efficient operations, and there is little evidence of any significant racial confrontations or violence either on base or in Selma during the war. Craig Field is a good example of the mutually beneficial effects of military flight training on a community, and of a community on military flight training. The influx of thousands of white military personnel in the area did not significantly threaten the segregation norm in the Selma area, and probably retarded its erosion. Selma, about half white and black during World War II, did not become predominantly black, like Dallas County as a whole, until after the war.[101]

After World War II ended, Craig Field temporarily stopped flying training pilots and became an Air University facility, home of the Special Staff School. Between 1946 and 1950, no pilots trained at Craig. In 1947, the United States Air Force was established, and Craig Field became Craig Air Force Base. After the Korean War broke out in 1950, and the United States found itself needing more pilots again, Craig Field returned to its primary mission of training American and Allied pilots, many of which later took part in the Vietnam War. Craig's flying training mission continued until 1977, after the war in Southeast Asia had ended. The Air Force closed the base 37 years after its inception.[102] ■

NOTES

1. Robert Mueller, *Air Force Bases,* volume I (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), 43; Airport Directory, Continental United States, (U.S. Army Air Forces, 1945), volume I, Alabama folder) pp.22-27 (Air Force Historical Research Agency call number 260.277; Carl C. Morgan, Jr. "Craig Air Force Base: Its Effect on Selma, 1940-1977," *The Alabama Review* (special publication, April 1989), 84-88; Leo Thole, *Forgotten Fields of America,* volume 2 (Missoula, MT: Pictorial Histories, 1999), 127; William Warren Rogers, Leah Rawls Atkins, Wayne Flynt, *Alabama: The History of a Deep South State* (Tuscaloosa, AL: The University of Alabama Press, 1994), 513.

2. Robert Mueller, *Air Force Bases,* volume I (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), 43; Carl C. Morgan Jr., "Craig Air Force Base: Its Effect on Selma, 1940-1977," *The Alabama Review* (special publication, April 1989), 87-91; *Alabama: A Guide to the Deep South* (New York, New York: Hastings House, 1975, 222; Alston Fitts III, *Selma: A Bicentennial History* (Tuscaloosa, AL: the University of Alabama Press, 2016), 1-2; "Varied History Marks 30 Years at Craig Field," *Selma Times Journal,* 1970, 30 (COPY IN Craig Field/Craig Air Force Base folder at the Selma Public Library).

3. Robert J. Jakeman, *The Divided Skies* (Tuscaloosa, AL: The University of Alabama Press, 1992), 221.

4. Robert Mueller, *Air Force Bases,* volume 1 (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), 43.

5. Carl C. Morgan, Jr., "Craig Air Force Base: Its Effect on Selma, 1940-1977," *The Alabama Review* (special publication, April 1989), 89-90.

6. Carl C. Morgan, Jr., "Craig Air Force Base: Its Effect on Selma, 1940-1977," *The Alabama Review* (special publication, April 1989), 91. "Craig Field Names for Selma Pioneer," newspaper clipping in Craig Field/Craig Air Force Base folder at the Selma Public Library; Conversation of author with Rufus Craig, cousin of Bruce Craig, on 3 August 2022; Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 129; Alston Fitts III, *Selma: A Bicentennial History* (Tuscaloosa, AL: The University of Alabama Press, 2016), 202; Robert Mueller, *Air Force Bases,* volume I (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), p. 43.

7. Craig Field history, January 1943-1 February 1944, copy of military history in Craig Field/Craig Air Force Base folder at Selma Public Library; Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 127.

8. Robert Mueller, *Air Force Bases,* volume I (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), 43-44; Airport Directory, Continental United States (U.S. Army Air Forces, 1945), volume I (call number 260.277 at the Air Force Historical Research Agency at Maxwell AFB, AL), Alabama folder, 22-27.

9. Airport Directory, Continental United States (U.S. Army Air Forces, 1945), volume I (call number 260.277 at the Air Force Historical Research Agency at Maxwell AFB, AL), Alabama folder, 22-27.

10. Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 130.

11. *Craig Field Yearbook,* 1942 (Wings Over America Series, Army and Navy Publishing Company), copy at Craig Field Museum room at old Craig Air Force Base headquarters building in Selma; Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 46; Craig Field History, January 1943-January 1944, (AFHRA call no. 281.90-3, volume I), 249-250, 252-253.
12. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 137-138, 252-253.
13. Carl C. Morgan, Jr., "Craig Air Force Base: Its Effect on Selma," *The Alabama Review* (special publication, April 1989), 93; Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 1-2.
14. Craig Field history, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 146; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 28, 133; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 45.
15. Robert Mueller, *Air Force Bases,* volume I (Maxwell AFB: Albert F. Simpson Historical Research Agency, 1982), 44; Airport Directory, Continental United States (U.S. Army Air Forces, 1945), volume I (AFHRA call number 260.277), 22-27; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 7.
16. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 11; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume II), plate BG; Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 10-11, 13.
17. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 11; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume II), plates A, AB, and BF; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 116; Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 10-11.
18. Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 10-11.
19. "Varied History Marks 30 Years at Craig Field," *Selma Times Journal* 1970 (copy of article in Craig Field/Craig Air Force Base folder at Selma Public Library); List of Craig Field Commanders, 1940-1945 (copy of list in Craig Field/Craig Air Force Base folder at the Selma Public Library; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 157a; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 1; Craig Field History, November-December 1944 (AFHRA call number 281.90-5, volume I); Craig Field History, March-April 1945 (AFHRA call no. 281.90-7, volume 1), 3-4. Craig Field History, July-August 1945 (AFHRA call no. 281.90-9) 53; Robert Mueller, *Air Force Bases* volume I (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), 43;
20. *Craig Field Yearbook,* 1942 (Wings Over America Series, Army and Navy Publishing Company), copy at Craig Field Museum room, old Craig AFB headquarters building, Selma; Robert Mueller, *Air Force Bases,* volume I (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), 43; Craig Field History, 1942-1944 (AFHRA call no. 281.90-3, volume 3); Craig Field History, 1 May 1944-15 Dec 1945 (AFHRA call no. 281.90-4, volume X).
21. *Craig Field Yearbook,* 1942 (Wings Over America Series, Army and Navy Publishing Company), copy at the Craig Field Museum room, old Craig AFB headquarters building, in Selma; Craig Field History, 1942-1944 (AFHRA call no. 281.90-3, volume III) plates A-D, H; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 116; Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume 9).
22. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume 1), 60, 63.
23. *Craig Field Yearbook,* 1942 (Wings Over America series, Army and Navy Publishing Company), copy at Craig Field Museum in old headquarters building of former Craig Air Force Base, Selma; Craig Field history, 1942-1944 (AFHRA call no. 281.90-3, volume III), plate G.
24. *Craig Field Yearbook,* 1942 (Wings Over America series, Army and Navy Publishing Company), copy at Craig Field Mmseum in old headquarters building of former Craig Air Force Base, Selma; Craig Field history, 1942-1944 (AFHRA call no. 281.90-3, volume III).
25. Craig Field History, 1942-1944 (AFHRA call no. 281.90-3, volume III), plate G; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I) 125-126; Craig Field History, January-February 1945 (AFHRA call no. 281.90-6, volume I).
26. *Craig Field Yearbook,* 1942 (Wings Over America series, Army and Navy Publishing Company), copy at Craig Field Museum in old headquarters building of former Craig Air Force Base, Selma; Craig Field History, 1942-1944 (AFHRA call no. 281.90-3), plates A-D; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 243.
27. *Craig Field Yearbook,* 1942 (Wings Over America series, Army and Navy Publishing Company), copy at Craig Field Museum in old headquarters building of former Craig Air Force Base, Selma; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 43; Craig Field History, February-1 May 1944 (281.90-4, volume V), 10-11; Craig Field History, 1 Feb-1 May 1944 (AFHRA call number 281.90-4, volume VI), 12.
28. Craig Field History, 7 December 1941-December 1942 (AFHRA call no 281.90-2, volume II), 185; Craig Field History, August 1940-January 1944 (AFHRA call no. 281.90-1, volume III), 48-49.
29. Robert Mueller, *Air Force Bases,* volume I (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), 43; Craig Field History, 1942-1944 (AFHRA call no. 281.90-3, volume III); Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 53; Craig Field History, Febraury-1 May 1944 (AFHRA call no. 281.90-4, volume V), 10-11; Craig Field history, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume VIII); Craig Field Histories 1 May 1944-15 Dec 1945 (K281.90-4, volumes IX, X and XI).
30. Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 8; Craig Field History, February-October 1944 (AFHRA call no. 281.90-4, volume XIII); Craig Field History, January-February 1945 (AFHRA call no. 281.90-6, volume I).
31. History of 2102d Army Air Forces Base Unit (28th Flying Training Wing), February-June 1944 (AFHRA call no. 230.028, volume I); Army Air Forces Flying Training Command General Order 13 dated 13 April 1944.
32. Robert Mueller, *Air Force Bases,* volume I (Maxwell AFB, AL: Albert F. Simpson Historical Research Center, 1982), 44.
33. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 92; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 19, 34; Craig Field History, 1 September 1944-1 February 1946 (AFHRA call no. 281.90-4, volume XII); Craig Field History, February-October 1944 (AFHRA call no. 281.90-4, volume XIII); Craig Field History, January-February 1945 (AFHRA call number 281.90-6, volume I); Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 12, 24.
34. Craig Field History, July-August 1945 (AFHRA call number 281.90-9), 12, 24.
35. Craig Field History, 1 January 1943-31 January 1944 (AFHRA call no. 281-90-3, volume I), 76; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 41; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 39.
36. Craig Field History, 1 January 1943-31 January 1944 (AFHRA call no. 281.90-3, volume I), 77.
37. Craig Field History, January 1943-January 1944 (AFHRA

call no. 281.90-3, volume I), 69-72; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 38; Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume XI).

38. Craig Field History, January 1943-1 February 1944 (copy of document in Craig Field/Craig Air Force Base folder at the Selma Public Library.

39. Craig Field History, January 1943-1 February 1944 (copy of document in Craig Field/Craig Air Force Base folder at the Selma Public Library; Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 127.

40. Craig Field History, July 1940-December 1941 (AFHRA call no. 281.90-1, volume IV).

41. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), p. 88; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 17; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 10.

42. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 90; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 44.

43. Craig Field history, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 62, 81; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III) 31.

44. Carl C. Morgan, Jr., "Craig Air Force Base: Its Effect on Selma, 1940-1977," *The Alabama Review* (special publication, April 1989), 92-93.

45. Craig Field History, 7 December 1941-31 December 1942 (AFHRA call no. 281.90-2, volume I), 56, 107.

46. Craig Field History, 7 December 1941-31 December 1942 (AFHRA call no. 281.90-2, volume I), 56-58.

47. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 85; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume II), plate A R; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 6.

48. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 93; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume II), plate A-O.

49. Craig Field History January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 48, 57, 93; Lou Thole, *Forgotten Fields of America*, volume II (Missoula, MT: Pictorial Histories, 1999), 131-132.

50. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 58; Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 132.

51. Carl C. Morgan, "Craig Air Force Base: Its Effect on Selma," *The Alabama Review,* (special publication, April 1989), 91; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 62-65; Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume XI).

52. Craig Field History, 1 January 1943-31 January 1944 (AFHRA call no. 281.90-3, volume I), 79-80, 129.

53. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 22, 87; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 42-43; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 52; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 51; Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, v. XI).

54. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 88-89; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 37; Craig Field History, 1 May 1944-15 Dec 1945 (AFHRA call no. 281.80-4, volume XI).

55. Craig Field History, 1 January 1943-31 January 1944 (AFHRA call no. 281.90-3, volume I), 82.

56. Craig Field History, January 1943-1 February 1944 (copy of that document in the Craig Field/Craig Air Force Base folder at the Selma Public Library; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 2, 85; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume II), plate A O.

57. Craig Field History, January 1943-3 January 1944 (AFHRA call no. 281.90-3, volume I), 26, 100-105; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume II), plate A S.

58. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 105, 108; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 49.

59. Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 132; Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 2, 8, 58-59, 96; Craig Field History, February-October 1944 (AFHRA call no. 281.90-4, volume XIII); Craig Field History, November-December 1944 (AFHRA call no. 281.90-5, volume I).

60. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 96; Craig Field History, 1 Feb 1944-30 June 1944 (AFHRA call no. 281.90-4, volume I), 45; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 13-14; Craig Field History, February-October 1944 (AFHRA call number 281.90-4, volume XIII); Craig Field History, November-December 1944 (AFHRA call no. 281.90-5, volume I).

61. Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 6, 54; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 8-9; Craig Field History, February-October 1944 (AFHRA call no. 281.90-4, volume XIII); Craig Field History, March-April 1945 (AFHRA call no. 281.90-7, volume I), 8-10.

62. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 96; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 6; Craig Field History, March-April 1945 (AFHRA call no. 281.90-7, volume I), 9-10.

63. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 8, 96, 98; Craig Field History, 1 February 1944-30 June 1944 (AFHRA call no. 281.90-4, volume I), 46; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 7-8.

64. Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 18.

65. Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 47-48; Craig Field History, February-October 1944 (AFHRA call no. 281.90-4, volume XIII); Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume XI); Craig Field History, November-December 1944 (AFHRA call no. 281.90-5, volume I); Craig Field History, March-April 1945 (AFHRA call no. 281.90-7, volume I), 17; Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 15.

66. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 88; Craig Field History 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 17; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4), 54.

67. Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 39; Craig Field History, March-April 1945 (AFHRA call no. 281.90-7, volume I), 8.

68. Craig Field History, February-October 1944 (AFHRA call no. 281.90-4, volume 13); Craig Field History, July-August 1944 (281.90-4, volume 2), 6, 16; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 8-9; Craig Field History, November-December 1944 (AFHRA call no. 281.90-5, volume I); Craig Field History, July-August 1945

(AFHRA call no. 281.90-9), 25.

69. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 10.

70. Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 15-16.

71. Craig Field History, November-December 1944 (AFHRA call no. 281.90-5, volume I); Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume XI); Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 14; Note of Colonel John A. DeVries (flight instructor at Craig Field) to John Meyer, 10 January 1999 (in Craig Field/Craig Air Force Base folder at the Selma Public Library).

72. Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume XI); Craig Field History, March-April 1945 (AFHRA call no. 281.90-7, volume I), 9; Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 8, 13.

73. Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 48; Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 15.

74. Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 7; Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 137.

75. Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 6; Craig Field History, January-February 1945 (AFHRA call no. 281.90-6, volume I).

76. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 56, 91, 100; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 4, 35, 40; Craig Field History, February-October 1944 (AFHRA call no. 281.90-4, volume XIII); Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume XI); Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 10, 50; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 17-20, 50; Craig Field History, January-February 1945 (AFHRA call no. 281.90-6, volume I); Craig Field History, March-April 1945 (AFHRA call no. 281.90-7, volume I), 10, 20-21; Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 12.

77. Craig Field History, August 1940-January 1944 (AFHRA call no. 281.90-1, volume 3), 35; Craig Field History, 1944 (AFHRA call no. 281.90-4, volume IV); Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II); Craig Field History, November-December 1944 (AFHRA call no. 281.90-5, volume I); Craig Field History, May-June 1945 (AFHRA call no. 281.90-8, volume I), 68-69, 80, 103.

78. History of Advanced Flying School, Selma, Alabama, November 1941-October 1942 (AFHRA call no. 281.90-2, volume II); Craig Field History, 1 May-7 December 1941 (AFHRA call no. 281.90-1, volume V).

79. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 157a, 249-250.

80. Craig Field History, 1944 (AFHRA call no. 281.90-4, volume 4), 2-10; Craig field History, July-August 1944 (AFHRA call no. 281.90-4, volume 2); Craig Field History, November-December 1944 (AFHRA call no. 281.90-5, volume 1); Kevin Bohn, "Unsung World War II Heroes Finally Get Their Due," CNN article in Craig Field/Craig Air Force Base folder at the Selma Public Library.

81. Craig Field History, 1942-1944 (AFHRA call no. 281.90-3, volume III), plates C and G; Craig Field History, 1942-1944 (AFHRA call no. 281.90-3, volume 7); Craig Field History, 1 February-1 May 1944 (AFHRA call no. 281.90-4, volume 7), 13-14; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 53-54; Mildred Inez Caroon Bailey, WIKIPEDIA article printed and in Craig Field/Craig Air Force Base folder at Selma Public Library.

82. *Craig Field Yearbook,* 1942 (Wings Over America Series, Army and Navy Publishing Company (copy at Craig Field Museum room at former headquarters building of Craig Air Force Base, Selma, Alabama; Craig Field History, 1942-1944 (AFHRA call no. 281.90-3, volume III); Craig Field History, 1 May 1944-15 Dec 1945 (AFHRA call no. 281.90-4, volume X).

83. *Craig Field Yearbook*, 1942 (Wings Over America series, Army and Navy Publishing Company) copy at the Craig Field Museum room, old headquarters building at former Craig Air Force Base; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 63.

84. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 184; Craig Field History, 1 May 1944-15 Dec 1945 (AFHRA call no. 281.90-4, volume X).

85. Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 53-55; Craig Field History, 1 May 1944-15 Dec 1945 (AFHRA call no. 281.90-4, volume X).

86. Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 104; Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 44.

87. Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume III), 43.

88. Army Air Forces Flying Training Command, file 323.7 (30 Apr 1942); file 322.97 (17 December 1941), from Pro Quest History Vault.

89. Craig Field History, 1 May 1944-15 December 1945 (281.90-4, volume X); Craig Field History, July-August 1945 (AFHRA call no. 281.90-9), 26.

90. Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume X); Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 45; Craig Field History, September-October 1944 (AFHRA call no. 281.90-4, volume 3), 27, 60.

91. Eastern Flying Training Command History, 1 January 1939-7 December 1941 (AFHRA call no. 222.01, volume II) section 3, chapter 11, exhibits 1-5.

92. Craig Field History, May-June 1945 (AFHRA call no. 281.90-8, volume I), 80.

93. Army Air Forces Eastern Flying Training Command history, 1 July-31 August 1944, volume 2, appendix to section 3 (AFHRA call no. 222.01).

94. Craig Field History June 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 259.

95. Craig Field History, 1 May 1944-15 December 1945 (AFHRA call no. 281.90-4, volume 10).

96. Craig Field History, July-August 1944 (AFHRA call no. 281.90-4, volume II), 40.

97. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 130, 149-150; Craig Field History, 1 May 1944-15 Dec 1945 (AFHRA call no. 281.90-4, volume X; Craig Field History, July-August 1944 (AFHRA call no 281.90-4, volume II), 40; Carl C. Morgan, Jr., 'Craig Air Force Base: Its Effect on Elma," *The Alabama Review* (special publication, April 1989), 93-94.

98. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 184; Craig Field History, 1 February-30 June 1944 (AFHRA call no. 281.90-4, volume I), 104.

99. Craig Field History, January 1943-January 1944 (AFHRA call no. 281.90-3, volume I), 137.

100. Craig Field History, July-August 1945 (AFHRA call no. 281.90-9, volume II).

101. Craig Field History, January-February 1945 (AFHRA call no. 281.90-6, volume I); Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 129; Alston Fitts III, *Selma: A Bicentennial History* (Tuscaloosa, AL: The University of Alabama Press, 2016), 101.

102. Lou Thole, *Forgotten Fields of America,* volume II (Missoula, MT: Pictorial Histories, 1999), 102; Alston Fitts III, *Selma: A Bicentennial History* (Tuscaloosa, AL: The University of Alabama Press, 2016), 277; William Warren Rogers, Robert David Ward, Leah Rawls Atkins, and Wayne Flynt, *Alabama: The History of a Deep South State* (Tuscaloosa, AL: The University of Alabama Press, 2016), 581.

Analyzing Sweden's Cold War Air Operations Dispersion Strategy and Lessons for the U.S. Air Force

Adam Young

A Bas 60 road runway with a small runway apron visible on the right. *(Photo by Bene Riobó from Wikipedia.)*

On August 23, 2022, the United States Air Force released an official doctrine note entitled Agile Combat Employment (ACE).[1] Intending the note to serve as the foundation for the development of future ACE doctrine, ACE is the Air Force's answer to generating air power in the face of modern threats, which make its bases—"previously considered sanctuaries" highly vulnerable to attack.[2] Citing a 65 percent decrease in its overseas basing, advances in Intelligence, Surveillance, and Reconnaissance (ISR) capabilities, and all-domain long-range fires, the U.S. Air Force believes its operational concept of ACE will allow it to reliably generate air power.[3]

The U.S. Air Force's formal acknowledgment that its air bases are under threat is a new development. However, air power theorists have long believed that air bases are the easiest place to destroy an enemy's air forces. For example, Guillo Diouhet noted in his seminal work, *Command of the Air*, which was published in 1921, that:[4]

The surest and most effective way of achieving this end [i.e., destroying an adversary's air forces] is to destroy the enemy air force at its bases, which are found on the surface. This is the principle which governs the situation: it is easier and more effective to destroy the enemy's aerial power by destroying his nests and eggs on the ground than to hunt his flying birds in the air. And every time we ignore this principle we commit an error.

While there have been historical instances[5] in which the U.S. Air Force took the issue of defending its own air forces on the ground as a priority, for most of its history the service has believed that its air forces were best used to project power, giving only minor attention to the defense of its air bases.[6] As the ACE doctrine note reveals, ensuring that its air forces on the ground remain safe from enemy attacks is now a critical problem for the Air Force to solve.

In seeking to generate air power in light of modern weapons that can quickly destroy its air forces on the ground, the U.S. Air Force has advanced the concept ACE, which relies on principles of dispersion above all else.[7] By "shift[ing] operations from centralized physical infrastructures to a network of smaller, dispersed locations," the U.S. Air Force believes that its chances of survival are improved.[8] At its core, ACE is an operational concept that is intended to to overcome modern weapons and a lack of investment in air base defense. It also allows the U.S. Air Force to hold on to its long-held offensive-dominant thinking. contending that the "value [of ACE] is derived from the ability to hold adversary targets at risk from multiple locations."[9] With this language coming from the U.S. Air Force's ACE doctrine note, it is clear that defensive thinking has yet to firmly take root.

While not explicitly stated, ACE is the Air Force's answer to conducting air operations with a fleet of aircraft that are not optimized for long range operations. For myriad reasons that go beyond this paper's purpose, the current Air Force inventory is heavily dominated by advanced and range-limited fighter aircraft. Of the 2,234 combat aircraft in the U.S. Air Force inventory, 2,093 are short range fighters while only 141 are long range bombers.[10] At present, there are no medium-range aircraft. For short range fighters to operate in the vast distances of the Pacific, U.S. Air Force combat aircraft will be heavily reliant on tanker aircraft, whose support is uncertain in anti-access, area denial environments.

In charting what steps to take in the pursuit of guaranteeing that its combat aircraft can be used in a conflict against a peer adversary, the U.S. Air Force will be well served in evaluating its ACE concept in regard to the historical examples of air forces that have employed a similar model. Perhaps the most successful case in this regard occurred during the Cold War in Sweden. In what Sweden called its Flygbassystem-60 (Bas-60) and Flygbassystem-90 (Bas-90) or Air Base Systems 60 and 90, the U.S. Air Force will benefit from studying Sweden's real-world experience.[11]

Facing a formidable and numerically superior force from the Soviet Union, then neutral Sweden's Bas 60 and Bas 90 presented a resilient air operations dispersal strategy that was sure to give any invading force pause. It took the Swedes time (decades) and money (billions) to master its air operations dispersal strategy. It also required that the Swedish Air Force establish entire systems—Bas-60 and Bas-90—to succeed. Focusing solely on the operational concept of dispersing its aircraft from one location to another would have failed had Sweden not developed the required aircraft, equipment, and uniquely trained personnel required for the entire system to succeed.

This article chronicles the origins and outcomes of Sweden's Bas-60 and Bas-90. In doing so, it examines the core elements—tactics and tools—that were required for its success. This paper evaluates the U.S. Air Force's ACE concept in view of Bas-60 and Bas-90, concluding that the U.S. Air Force's current fleet of combat aircraft are not optimized for dispersed operations. The result of this finding must spur the U.S. Air Force to invest in passive defenses—hardening, deception, decoys, etc.—until its fleet of combat aircraft, personnel, and support equipment are ready to support ACE or a future dispersed air operations concept.

Hardening efforts (Hardened Aircraft Shelters, aircraft support facilities, etc.) are the most important of the passive measures needed to protect the U.S. Air Force's combat aircraft today. In believing its bases to be places of sanctuary for so long, the U.S. Air Force is woefully behind in protecting its aircraft on the ground. If the U.S. Air Force does not act quickly to protect its eggs in the nest through passive measures it may not have aircraft to fly, fight, and win.

While this paper makes a clear and urgent recommendation for the U.S. Air Force to heavily invest in air base hardening, it also recommends that the U.S. Air Force continue to develop and employ its concept of ACE. In doing so, the U.S. Air Force can and should take numerous actions today to improve its dispersal concept of operations, which will increase its chances of surviving air base attacks. Much like the Swedes, who were initially limited to within-base dispersal options, the U.S. Air Force should focus first on its within-base dispersal operations, quickly followed by increasing its operations beyond the borders of its bases. Only when the U.S. Air Force possesses the unique capabilities for a dispersion-based air operations system—including the aircraft, ground support vehicles, personnel, *inter alia*—should ACE be adopted in full.

To shape future U.S. Air Force discussions on establishing an air base dispersal operations system, this paper concludes by recommending the core attributes a conceptual future system called Air Base System X (ABS-X) should possess. ABS-X puts the concept of ACE into practice, but it integrates lessons learned from Sweden's Bas-60 and Bas-90. It also acknowledges that without the equipment, organization, and training to succeed, Air Base System X will never fully materialize, resulting in a higher risk to the force. To that end, this paper views ABS-X as a comprehensive air operations dispersal concept, accounting for active defenses; passive defenses; C2; intelligence, surveillance, and reconnaissance (ISR) capabilities; operational employment, organizational structures; uniquely trained personnel; and purpose-built equipment—including aircraft and ground support equipment.

Lt. Col. Adam B. Young received the Foundation's General Benjamin O. Davis for this paper, originally his thesis while a student at the USAF Air War College. He is a career U.S. Air Force intelligence officer, holding degrees from the Naval Postgraduate School (Ph.D.), the University of Kansas (M.A.), the Air University (M.A.), and the University of Southern California (B.S.). His research interests include military history, technology, strategy, organizational culture, and politics.

Flygbassystem 60 (Bas-60 or Air Base System 60)

Following the Second World War, Sweden focused its armed forces on defending its borders from Soviet expansionism.[12] Already facing a numerically superior foe, the Soviet Union's acquisition of atomic weapons made the problem of beating back an invasion force even more challenging. Knowing that they could not match the Soviets in manpower, the Swedes believed its air forces offered the small country its best chance at surviving and repelling an attack.[13]

Assessing that its air bases would be targeted early in an invasion, the Swedes were pressed to quickly develop an operational and/or technological solution, en-

Preparation of two Saab JA 37 Viggen under Töreboda arches. 1986 Flygvapenmuseum from Wikipedia

abling the independent country to swiftly get its aircraft airborne and beat back a Soviet invasion. Hardening its air bases and aircraft support facilities (e.g., aircraft hangars, support facilities, etc.) was considered; however, it was viewed as far too costly to implement.[14] Given that hardening was cost prohibitive, the Swedes conceived of a plan built on the principle of dispersion—a concept that was viewed as the right balance between cost and operational effectiveness.

The concept that emerged in the 1950s was called Flygbassystem-60 (Bas-60) or Air Base System-60. Instead of aggregating its air forces in a sanctuary location, Sweden sought to disaggregate its air forces within its air bases and across newly constructed air bases. In dispersing its air forces at distances beyond the blast zones of early atomic weapons, Sweden's Air Force and defense leaders believed they could surive an initial attack and reliably get the majority of its aircraft airborne.[15]

In fully adopting Bas-60 as an operational concept in 1958, Sweden's Air Force spent the next two decades implementing and improving it.[16] At the core of Bas-60's dispersal concept was keeping its aircraft on the ground a safe distance away from one another, from the base's runways, and from the base's support facilities.[17] By dispersing its air forces on the ground, the Swedes believed that an adversary would be challenged in confidently knowing where to strike. Sweden assessed that an attacker would be thus be deterred, given the many weapons that would be required to fully destroy its aircraft.

At the time of Bas-60's adoption, Sweden possessed 39 air bases.[18] Bas-60's "Plan for the Expansion of Air Bases," however, called for a total of 70 air bases to increase force survivability and the cost of an attack.[19] The locations of the new bases were selected set mostly on Sweden's Eastern borders, approximately 30 kilometers inland—locations that were far enough inland to keep the air bases safe from naval bombardment but close enough to quickly get its aircraft into the fight, should an attack occur.[20] The assessed cost of the additional 31 air bases was estimated to be approximately 250 million Kronos (49 million U.S. dollars) in 1958.[21]

While Sweden set its sights on a total of 70 air bases, not all of the bases were to be of equal capability. As a cost-saving measure, some of the bases were identified for continuous operations ("O-bases"), some identified only for temporary use ("T-bases), and some identified only for use in wartime conditions under favorable weather conditions.[22] The majority of the bases (46 of the 70 bases), however, were identified for continuous operations.[23]

O-bases, the most capable of the bases, were equipped to support a variety of aircraft, while "T" bases were primarily used as locations to catch and launch dispersing aircraft.[24] To accommodate for various runway length requirements for its in-service aircraft—the Saab 29 Tunnan and Saab 32 Lansen multi-role aircraft—

runway lengths at O and T bases were set at between 2000 to 2300 meters with variable widths between 25 and 30 meters.[25] Bas-60 conceived of using road runways in straight stretches of approximately 1500 meters, but it was not until Bas-90 that road runways became better integrated into the overall system.[26] Nevertheless, Bas-60 started the identification and widening of civilian roadways for future air operations.[27]

Due to the fact that its aircraft were mostly limited to operating from established bases, Bas-60 was mostly a within-airbase dispersal strategy. Aircraft would remain far from runways and "hidden maintenance area[s] several miles from the runway," leaving only alert fighters on the runways.[28]At each end of a Bas-60 runway, Sweden established taxi routes and nearby forward preparation areas, creating what looked like a running track, allowing for quick takeoffs and landings as aircraft transitioned from rear and forward preparation areas.[29] Rear preparation areas were located approximately 8-10 kilometers from the main runway and included between 15-20 parking spots.[30] Where possible, aircraft hangars were built into blasted out rock features for added protection, but hardening efforts were not the primary effort in Bas-60.[31] Camouflage, Concealment, and Deception (CC&D) efforts were also made via the use of mesh netting to prevent visual detection, adding to Bas-60's passive defenses.[32]

Bas-60 bases called for underground fuel depots (approximately 2/3rds of its fuel storage) positioned approximately five kilometers from the main runway for survivability.[33] Fuel tankers would retrieve fuel from the depot locations and fuel aircraft at predesignated forward preparation locations.[34] Bases were equipped with a 3-4 week supply of fuel at wartime burn rates.[35] Ammunition depots were also hardened and kept in the rear preparation areas, following a similar procedure to Bas-60's fueling operations with ground crews bringing up ammunition to the forward staging areas.[36]

Each Bas-60 air base called for standardized C2 operations, which were critical in directing the complex orchestration of dispersed air operations. C2 functions mostly occurred in hardened facilities (i.e., reinforced concrete bunkers), however, mobile command vehicles with integrated communications systems were also procured for redundancy.[37] Each base was commanded by a battalion commander with the following units:[38]

Staff Company: Administration and command and control systems, etc.

Station Company: Preparation and maintenance of aircraft.

Campus Management Company: Fuel, food, transport, clothing materials, etc.

Airfield Workers' Company: Maintenance and repair of runway systems and roads, etc.

Protection company: Guarding, ammunition clearance, fire brigade, etc.

Medical platoon: Unit locations, health checks, medical care, etc.

A defence unit and an anti-aircraft unit from the Army could also be added to the base.[38]

Depending on the base, the number of personnel assigned could range anywhere from 1200 to 1500.[39]

Knowing when and where to disperse aircraft and where to vector launching aircraft to intercept incoming bombers was critical to the success of Bas-60. Sweden's combat control and air surveillance network—Stridsledning och luftbevakning or Stril 60—was critical in providing an "up-to-date situational picture of what was happening in the air."[40] Orders would come to the bases from a centralized air defense center, providing general alerts, launch orders, and air defense orders.[41] Over time technological advancements allowed Sweden's air picture to be more easily shared across its network of air bases and then directly into its interceptor aircraft.[42] In the 1960s, however, most pilots received their updates via voice from the controllers at the Stril center.[43]

Given the complicated nature of dispersed air operations, Sweden invested heavily in training its personnel and ensuring they procured the necessary equipment—both ground equipment and aircraft—for Bas-60 to succeed. While Sweden had grown accustomed to servicing its aircraft in centralized locations, Bas-60 called for mobile maintenance, rearming, and refueling. Perfecting dispersed ground operations required time, training, and money, but it was necessary for the system to succeed.

In terms of ground equipment, Sweden designed and procured purpose-built equipment to support Bas-60's dispersed air operations. Moving aircraft to where they needed to be and ensuring they the aircraft were fueled and armed required the procurement of hundreds of vehicles.[44] At the time of Bas 60's full implementation in 1958, the Swedish Air Force possessed a mere 25 fuel trucks out of the 325 required.[45]

In terms of aircraft, the initial seeds that led to what became known of Bas-60 influenced the requirements for Sweden's new multi-role interceptor aircraft, called the Saab-35 Draken (Dragon). Accordingly, the Draken's requirements included modern warfighting requirements (e.g., supersonic speeds) and requirements that would optimize it for dispersal air operations, such as being able to takeoff and land from short distances (~2,000 meters).[46] The delta wing Saab-35 Draken (Dragon) was delivered in 1959 as Bas-60, enabling the concepts of Bas-60 to materialize.

As the Drakens assembled in Sweden's operational Air Force, Sweden's Supreme Commander approved the design specifications for the Draken's replacement in June 1961.[47] As more was known about Bas-60 and how to improve its next evolution, the Swedish Air Force called for its new aircraft—the multi-role Saab 37 Viggen (The Thunderbolt)—to possess even more versatility than the Draken, requiring an even shorter Short Take Off and Landing (STOL) distance at just 500 meters.[48] This Viggen was also designed as a durable aircraft, enabling it to takeoff and land on damaged runways and on a variety of landing surfaces under poor

Line-up of JA– 37 Viggen and preparation vehicles according to the mobile preparation principle, on which Bas 90 was based, here during public display

weather conditions.[49] Key to the Viggen's capabilities was the introduction of a thrust reverser, which allowed the aircraft to taxi backwards, reducing the need for ground equipment at dispersed locations.[50] The aircraft was also designed for ease of maintenance, resulting in an aircraft that could be rearmed and refueled by a small crew of one professional serviceman and five conscripts in less than ten minutes.[51] The Viggen joined Sweden's operational force in mid-1971 as Bas-60 began to be phased out for Bas-90.[52]

Bas-60 was a credible and mostly within base dispersion-based operational concept centered on preventing an adversary from being able to neutralize Sweden's air forces on the ground. Designed to survive against known blast radii from atomic weapons, Sweden's Bas-60 validated its ability to deliver airpower after an attack. The Draken was critical to the early achievement of Bas-60, however, the concept became much more potent with the introduction of the Viggen in 1971. Were it not for these purpose-built aircraft and uniquely trained personnel, Bas-60 would have failed.

Flygbassystem-90 (Bas-90 or Air Base System 90)

In the late 1970s, after approximately two decades of implementing Bas-60, Sweden's armed forces sought to modernize its Bas-60 concept in what came to be called Bas-90.[53] After witnessing the destruction of Egypt's sanctuary-based air forces during the 1967 Six-Day War, Sweden was encouraged that its air operation dispersal concept was sound and necessary.[54] Unlike Bas-60, a concept that was focused on surviving an attack from atomic weapons, the growing nuclear taboo resulted in Bas-90's emphasis on surviving after attacks from conventional cluster munitions.[55] To overcome these area weapons, Bas-90 sought to significantly expand "the number of takeoff and landing options while improving protection measures for its personnel and materiel."[56] Bas-90 also sought to enhance its operational "endurance," which is how the Swedish characterized the critical capabilities necessary for repairing the critical ground-based infrastructure needed to generate air power following an attack.[57] Each of these are explored below.

Key to the Bas-90 concept was the expansion of available runways and aircraft dispersal locations. Based on an analysis of cluster munitions, Bas-90 stipulated that the "distance between parked aircraft will be large enough that attacks with modern air-launched weapons would require unacceptably high resource investments from an attacker to destroy multiple aircraft."[58] While Bas-60 set the stage for using public roads as runways, Bas-90 integrated them directly into the overarching concept.

As was the case with Bas-60, Sweden's "O-bases" served as the primary operating locations for its air forces, but the O-base infrastructure was expanded to mitigate attacks from cluster munitions. In addition to the main runways that had been established under Bas-60, Bas-90 called for the construction of three shorter runways, providing alternative takeoff and landing locations connected via paved taxiways.[59] The shorter runways (approximately 1200 meters long) provided alternative takeoff and landing locations, despite lacking the full supporting features of the main runways, such as lighting systems.[60] As with Bas-60, aircraft parking areas were dispersed across the base, but Bas-90 increased the number of parking spaces.[61] By having more aircraft parking locations than aircraft at each base, and moving them regularly, the Swedes believed they could complicate enemy targeting and reconnaissance operations.[62]

In addition to the expanded within-base runway options, Bas-90 was conceived to leverage locations beyond its base boundaries. Thanks to Bas-60 initiatives to

Viggen's and Gripen's STOL capability reduced the need for longer runways.

widen civilian roadways and with the knowledge that the Saab 37 Viggen could takeoff and land in less than 500 meters, using civilian roadways significantly increased the number of takeoff and landing locations under Bas-90.[63] Supporting aircraft at these locations, which were tens of kilometers away from the main base's infrastructure, however, required improved logistical support and new measures of security.

Given the criticality of ground support to dispersed air operations, Bas-90 established the Basbataljon 85 (Battalion 85) as the primary unit to operate its bases. This new organization, like the aircraft and ground equipment required for Bas-90 to succeed, was designed to exploit mobility for survivability. For the functions that already existed under Bas-60, Bas-90 sought to improve and augment them.

Under Bas-60 mobile ground crews mostly operated within base boundaries, however, Bas-90 required that crews operate beyond the sanctuary of the base, requiring crews to operate for temporary periods on their own. New vehicles were designed and acquired to support these mobile ground crews, including improved refueling trailers, ammunition trailers, all-terrain vehicles, and fueling vehicles.[64] Unlike Bas-60, ground crews were envisioned to live and operate for short periods in the dispersed locations beyond the bases.[65]

As the number of aircraft parking and runway locations grew under Bas-90, ground security became an increased priority. Crews were no longer protected by base boundaries, requiring a new approach to security. Believing that the Soviet Union would attempt to counter Bas-90's dispersal strategy with simultaneous ground and air attacks, Sweden created the Air Base Rangers to provide security for Bas-90.[66] Established in 1983, Sweden's Air Base Rangers were tasked with ensuring that Sweden could generate air power from its dispersed locations unmolested from ground attackers.

Unlike Bas-60, Bas-90 called for "endurance" or the ability to quickly resume air operations after an attack. For endurance to be achieved, Bas-90 called for crews to be capable of quickly repairing runways and taxiways, deal with unexploded ordnance, decontaminate the effects from chemical attacks, and put out fires.[67] It also called for the development of the equipment that would support these new missions.[68] While personnel and equipment to perform these functions were added, Bas-90 also better hardened its facilities against fire damage and chemical attacks.[69]

Given the expanded operating areas called for in Bas-90, providing reliable C2 was critical to the concept's success. Communications systems were modernized, and some external-to-the-base operating areas were outfitted with power and cable networks for direct aircraft connection to the base's command center.[70] Mobile units of all types were equipped with modernized radios, allowing for improved battery life and encryption to support dispersal operations while keeping communications safe from intercept.[71]

A Gripen takes off from a road runway.

With advances in communications capabilities in the twenty years since Bas-60, Bas-90 included its Stril air defense system modernization as key to the overall success of Bas-90.[72] In coordination with Saab, Sweden's Air Force designed Stril-90 to leverage modern radar systems and advancements in processing, resulting in improved situational awareness and integration across Sweden's military services.[73] Stril-90's C2 centers were mostly located within physically hardened facilities and many were fortified against cyber and electronic warfare attacks.[74]

Augmenting its dispersal-based strategy, the Swedes expanded their use of Camouflage, Concealment, and Deception (CC&D) and hardening to protect its aircraft. Dummy aircraft were deployed at many of its airbases, including decoys with heat sources beneath the aircraft to aid in its deception efforts.[75] Bas-90 CC&D efforts employed "modern camouflage techniques, such as pattern painting, toned-down surfaces, and camouflage nets" to decrease detection and leverage the natural cover of the forests and terrain as much as possible.[76]As was the case with Bas-60, limited budgets only allowed for the construction of Hardened Aircraft Shelters (HASs) at only a small number of the operating locations.[77]

The construction of HASs, many of which were hangars blasted out of rock features nearby, were prioritized for air bases without access to nearby roads for the building of fortified facilities.[78] The Swedes also experimented with using cheaper hardened facilities via composite structures to protect aircraft and personnel from shrapnel and cluster munitions, but they were not adopted across the all Bas-90 bases.[79] While hardening was too costly to be implemented on a vast scale, the Swedes implemented layered defenses, integrating HASs when affordable.

As technologies improved and Bas-90's requirements were better known, Sweden pursued a new combat aircraft to replace the Viggen.[80] In addition to integrating advanced communications and weapons requirements that would seamlessly integrate with Stril-90, the JA– 39 Gripen was designed to support dispersed operations.[81] Accordingly, the Gripen's requirements called for an aircraft that could taxi at high speeds to dispersed road-based runways and remain capable of taking off and landing within those short distances.[82] And much like the Viggen that preceded it, the Gripen was designed for only "simplified servicing," resulting in an aircraft that could arrive at a dispersed parking location, have its general maintenance needs tended to, be refueled, rearmed, and get back in the air in 10-15 minutes.[83] The first production JAS–39 Gripen was delivered on June 8, 1993.[84]

Much like the Bas-60 concept that preceded it, Bas-90 was a well thought-out operational concept. Both concepts were built on the principle of dispersed air operations; however, Bas-90 took the concept much further. It made better use of civilian roadways and expanded its within-base runway options, giving the

Mobile preparation – tools and equipment were transported on a preparation cart.

Swedish Air Force many more locations to operate. In dispersing its air operations so widely, Sweden greatly improved its ability to withstand an attack from cluster munitions. It also made an attack more difficult and costly for an adversary to execute, given the numbers of weapons an adversary would have to expend against all the locations that a Swedish combat aircraft could be. An adversary would also have to bomb multiple runways, roadways, and hardened facilities (e.g., C2 facilities, fuel depots, etc.) to fully take Sweden's Air Force out of the fight.

Conclusion and Recommendations

Following the collapse of the Soviet Union and the end of the Cold War, Sweden mostly abandoned Bas-90. Like most of the world's nations, Sweden sought to reap the fruits of the peace dividend, dropping its number of available air bases to 26 by 1994.[85] However, as the peace dividend quickly proved illusory and a resurgent Russia is again threateing Sweden's sovereignty once more, the Swedish Air Force is quickly reviving the core tenets of Bas-60 and Bas-90.[86] The Swedes are also lucky to possess the highly durable JA–39 Gripen, which is allowing it to quickly reimplement a dispersal air operations strategy.[87]

As this article illustrated, the histories of the Bas-60 and Bas-90 dispersal air basing concepts employed by Sweden in the 1950s to the early 1990s offer invaluable lessons for any air force seeking to employ a similar concept. As the U.S. Air Force looks to codify and implement its ACE concept, the service would be well served in understanding Sweden's Bas-60 and Bas-90 systems.

While there is recent reporting that the U.S. Air Force has been engaging with its new NATO allies in Sweden to learn how best to conduct dispersed air operations, the U.S. Air Force needs to go much further.[88] Specifically, the U.S. Air Force needs to comprehend the foundational concepts that make dispersed air operations possible by adopting an entirely new mental model for its approach in providing air power—one that is as equally focused on defense as it is on offense. This new mental model needs to be built on the conceptual underpinning that the days of reliance on sanctuary basing are fundamentally over.

In line with this necessary shift in thinking towards generating air power, the U.S. Air Force should expand its ACE concept to a system-based concept, comparable to that of Bas-60 and Bas-90. For illustrative purposes in this paper, a Swedish-like system is advanced under the name Air Base System X or ABS-X.

ABS X should be tailored to each combat theater and its associated threats, however, each ABS-X design should include core tenets that are outlined below.

A survivable base design (e.g., multiple runway locations on a base) for within base dispersion

Plans for external-to-the-air-base dispersion locations

Plans for mobile logistics, including prepositioned logistics
Plans for force protection
Plans for active defenses owned by the U.S. Air Force
Plans for passive defenses, especially hardening measures
Plans for intelligence support and organic ISR capabilities
Plans for C2
Regular exercises
Purposefully designed aircraft and equipment to support Air Base System X.

ABS-X bases, like those in Bas-60 and Bas-90, should be designed to support dispersed air operations. ABS-X bases should include multiple runway options that are connected via multiple taxiways and have parking areas that are far enough away from runways and other aircraft to make single attacks unlikely to destroy multiple aircraft. Additionally, ABS-X bases should include staging areas that are offset from runway locations, allowing aircraft to survive attacks against runways while allowing aircraft to takeoff fully loaded with fuel and munitions.

In addition to redesigning existing air bases, the U.S. Air Force should also pursue efforts to establish new bases that are optimized for dispersed operations. As was true in Sweden's Bas-60 and Bas-90 systems, the more locations an air force has at their disposal increases that air force's chances of survival while increasing an adversary's cost to attack. Having numerous air bases to operate from will also present targeting challenges to an enemy, requiring an adversary to use limited ISR resources in identifying aircraft locations, which would otherwise be used to gain intelligence against other targets.

In addition to redesigning ABS-X bases for within-base dispersed options and increasing the number of air bases available, ABS-X must also identify and establish operation locations that can support air operations from beyond a base's boundaries. Much like Sweden did with Bas-60 and Bas-90, the U.S. Air Force should identify, develop (if necessary), and exercise using civilian roadways that are reasonably close to its bases, providing it a myriad of operating locations should its Main Operating Bases become unusable.

Acknowledging that its air bases are no longer places of sanctuary, logistics and maintenance crews will need to adopt a dispersed operating mindset. A new or reimagined organization, similar to that of Basbataljon 85, should be established to support dispersed air operations. While economies of scale in maintenance and logistics support were gained by keeping the eggs of the nest together, new support operating methods are required to operate in an era where bases are no longer places of sanctuary.[89] Accordingly, ABS-X bases must be supported by mobile ground crews, and equipment and infrastructure designed to support dispersed operations. Accordingly, fuel depots, maintenance stores, and munition depots will need to be dispersed across ABS-X bases for survivability.

As the Swedes discovered in their employment of Bas-60 and Bas-90, having a dedicated protection force—Sweden's Air Base Rangers—to defend its dispersed air operations is a critical requirement for the concept to succeed. History is replete with examples of aircraft being destroyed on the ground from sabotage (e.g., British Special Air Service attacks against Axis aircraft while parked during World War II) and ABS-X must acknowledge that its aircraft are at risk from threats from the from the ground as well as from the air. Accordingly, the U.S. Air Force should develop highly trained defenders that can defend dispersed air operations locations that are outside of an air base's normal boundaries. These forces should also be prepared to defend its ABS-X personnel and equipment against modern weaponry, including First Person View drones armed with small explosives.

In addition to the dispersed operations concepts and associated personnel and equipment needs stated above, ABS-X bases should also field active defense measures. Active defenses should include kinetic and electronic warfare (non-kinetic) systems, and they should be fully owned by the U.S. Air Force. Accordingly, the Key West Agreements from 1947, which specifies that the U.S. Army will provide defense of U.S. Air Force bases, should be immediately revised.[90] The reasons for this go beyond the scope of this paper, but suffice to say, no one cares more about their survival than the one who is under threat.

In addition to active defenses, ABS-X should also employ a robust set of passive defenses, including CC&D and hardening. As dispersion-based air strategies are aimed at blunting an adversary's ability to attack and to target an aircraft on the ground, it is critical to provide as many targets—fake and real—as possible. Dummy aircraft, camouflage netting, fake heat sources are all good options that will complicate an adversary's targeting.

Due to the high costs of hardening its aircraft shelters and support facilities, Sweden only used hardening to a limited degree in Bas-60 and Bas-90. ABS-X, however, should invest much more heavily in this area, given the massive per unit costs of its aircraft. While expensive, hardening will severely challenge an adversary's ability to hold air operations at risk. ABS-X bases should use natural terrain features where and when able to cut down on costs. Building underground air bases should also be considered. Technologies to build underground air bases have advanced in recent years (e.g., The Boring Company's Prufrock tunneling machine can dig a one-mile tunnel of a twelve-foot diameter in a week[91]), offering the U.S. Air Force a tremendous opportunity to support its operations. Aircraft, C2 facilities, fuel storage and key functions should all be considered for protection by the earth's terra forma.

It is beyond the purpose of this paper to provide insight into why the U.S. Air Force has and is currently re-

The traffic leader at the field (TLF), was stationed at the main runway and assisted the air traffic operations. In an emergency, it took over operations. The TLF operated from a special cart equipped with base radio, air traffic radio, telephone and controls for runway functions such as lighting

sisting hardening its air bases, but it does seem to be true that the U.S. Air Force is failing to invest in hardening its bases. Members of the U.S. Congress agree, issuing an open letter on the lack of attention given to base hardening to the Secretaries of the U.S. Air Force and the U.S. Navy on May 8, 2024.[92] Citing a recent Center for Strategic and International Studies war game, which assessed that the U.S. would lose approximately 90 percent of its aircraft on the ground (a range somewhere between 168 to 372 combat aircraft) to Chinese attacks, the bi-partisan Congressional authors find that there is an "alarming lack of urgency by the DOD in adopting such defensive measures."[93] The concern is punctuated by the fact that China has constructed over 400 HASs in the last decade as compared to the U.S. Air Force's 22.[94]

The fact that the U.S. Air Force's most recent budget submission for Fiscal Year 2025 and its recently issued *Installation Infrastructure Action Plan* fail to address hardening efforts are clear examples of the U.S. Air Force's resistance to passive defenses.[95] Even the U.S. Air Force's plan to protect its forthcoming B–21 bomber, which is estimated to cost over $1 billion per aircraft, is equally alarming, given the nation's air leg of the nuclear triad will only be protected with what appears to be a thin sheet of aluminum—protection from rain and not much else.[96] Protecting these nuclear bombers from a $200 dollar drone with a grenade affixed to it appears to have been neglected.

The U.S. Air Force is neglecting hardening efforts to its own peril. The cost of hardening pales in comparison to the cost of the U.S. Air Force's advanced aircraft (i.e., 6-7 million dollars for a modern Hardened Aircraft Shelter versus an F–22, which has a per unit cost of $143 million—a figure that does not account for its development cost of 32.4 billion).[97] If the U.S. Air Force is unable to generate air power, the U.S. Air Force will not only be held on the sidelines of a future fight, but the U.S. Air Force could find itself completely defanged for years to come, given the many years it takes to conceive of and field modern military aircraft. As a recent and alarming study by Thomas Shugart and Timothy Walton of the Center for Strategic and International Studies concludes, it is in the United States' immediate interest to "enhance the resilience of its military infrastructure, including but not limited to expanding the capacity and hardening of airfields in the continental United States,

An AJ 37 Viggen of The Swedish Air Force being served by groundcrew at a wartime air base. Wikipedia

the Indo-Pacific, and beyond."[98] Why the U.S. Air Force is not immediately heeding these calls for action from Congress and defense think tanks is of concern.

As a complex system, ABS-X, like Bas-60 and Bas-90, requires robust and resilient C2. The U.S. Air Force is fervently working with the Joint Force to ensure that it can command and control its forces in future operating environments via concepts such as Mission Command and the Advanced Battle Management System (ABMS). That said, ABS-X will require unique C2 systems and procedures to manage the complexity inherent in dispersed air operations.

Intelligence plays a vital role in ABS-X. Intelligence personnel must be integrated into the ABS-X organizational structures. Intelligence forces should also be equipped with organic ISR systems as reliable connections to theater and national-level intelligence sources cannot be assured in times of conflict. ABS-X intelligence forces must not only be capable of surveilling the immediate surroundings, but they must maintain an ability to receive indications and warnings of long-range strikes that could destroy aircraft. Knowing when and where to disperse its aircraft is a vital part of ABS-X.

ABS-X dispersion exercises should be conducted regularly. Not only will exercising ensure that the U.S. Air Forces is ready for combat, but exercises demonstrate to its adversaries that the U.S. Air Force has the capability to thwart modern threats.

Finally, ABS-X should drive future U.S. Air Force aircraft requirements and inform modification decisions for aircraft that are already in its inventory. Given that the majority of combat aircraft in the U.S. Air Force, including the F-22 and F-35 stealth fighters, were conceived of during a period in which air bases were considered sanctuaries, they are not optimized for dispersed air operations. To put it simply, the U.S. Air Force does not possess the equipment required for its concept of dispersed air operations—ACE—to succeed.

The findings in this paper should command immediate attention from the U.S. Air Force and the entire U.S. defense apparatus. Ensuring that the U.S. Air Force can survive in the modern era must be an immediate priority. The recommendations provided in this paper via the ABS-X concept should inform the U.S. Air Force's next steps, but, more foundationally, the U.S. Air Force must shift its thinking from a purely offensive-minded force to one that equally prioritizes the defense of its eggs in the nest. If it fails to do so, the U.S. Air Force may be out of the fight before it starts, leaving the joint force without air power—an outcome that would severely decrease U.S. national security. The time for action is now. ■

NOTES

1. United States Air Force, "Agile Combat Employment," Air Force Doctrine Note 1-21. 23 August 2022.
2. United States Air Force, "Agile Combat Employment," 1-2.
3. *Ibid*.
4. Guillo Douhet, *Command of the Air* (Maxwell AFB: Air University Press, 2019), p. 49.
5. For more on other historical attempts by the Air Force to defend its air bases, see John Halliday, *Tactical Dispersal of Fighter Aircraft: Risk, Uncertainty, and Policy Recommendations*, N-2443-AF (Santa Monica, CA: RAND, 1987), p. iii.; William Pinter, "Answering the Emerging Antiacess Challenge in the Pacific Rim," (Ma Thesis., School of Advanced Air and Space Power Studies, 2007), p. 18.
6. Barry Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars, 1st ed.* (Ithaca: Cornell University Press, 1984), p. 15.
7. United States Air Force, "Agile Combat Employment." pp. 3, 9.
8. *Ibid*., p. 3.
9. *Ibid*., p. 4.
10. Air Force Association, "2024 Almanac" *Air and Space Forces*, May/June 2024, p. 56
11. Many of the documents related to Sweden's Bas-60 and Bas-90 are in Swedish. Thanks to advances in artificial intelligence, the author was able to translate many of the Swedish references used in this paper into English.
12. Kent H. Harrskog, "Sweden's Air Power Doctrines 1926-2000" (Research Report, Air War College, 1988). pp. 21-24.
13. *Ibid*., p. 24.
14. Tommy Pettersson. *Med invasionen i sikte : flygvapnets krigsplanlaggning och luftoperativa doktrin 1958 - 1966*. (Hallstavik: Svenskt Militarhistoriskt Bibliotek, 2009), p. 76.
15. Harrskog, p. 24.
16. Jorgen Rystedt, "Flgybassystem Bas 60," The Armed Forces' Historical Telecommunications Collection, Selection Group for the Air Force, October 1, 2005; Pettersson, *Med invasionen*, p. 76.
17. Harrskog, *Sweden's Air Power Doctrines,* p. 26.
18. Rystedt, "Flgybassystem Bas 60, p. 2
19. Rystedt, "Flgybassystem Bas 60, p. 2.; " Pettersson, *Med invasionen i sikte,* p. 76.
20. Pettersson, *Med invasionen i sikt,* p. 75.
21. Rystedt, "Flgybassystem Bas 60", p. 2.
22. *Ibid*.

23. *Ibid*.
24. Pettersson, *Med invasionen I,* p. 76.; Harrskog, *Sweden's Air Power Doctrines 1926-2000*, p. 26.
25. Rystedt, "Flgybassystem Bas 60,"; Pettersson, *Med invasionen i sikte,* p. 76.
26. Rystedt, "Flgybassystem Bas 60," p. 6.
27. *Ibid*.
28. Harrskog, *Sweden's Air Power Doctrines 1926-2000*, p. 26.
29. Rystedt, "Flgybassystem Bas 60," p. 10.
30. *Ibid*., p. 9.
31. Pettersson, *Med invasionen i sikte,* p. 76.
32. Rystedt, "Flgybassystem Bas 60," pp. 19-20.
33. Pettersson, *Med invasionen i sikte,* p. 76.
34. Rystedt, "Flgybassystem Bas 60," p. 10.
35. Pettersson, *Med invasionen i sikte,* p. 76.
36. Rystedt, "Flgybassystem Bas 60," p. 19.
37. *Ibid*., p. 2.
38. *Ibid*., p. 3.
39. *Ibid*., p. 10.
40. Robert F. Dorr, *SAAB Viggen*, (England, Ian Allan Ltd, 1985), p. 11.; Rystedt, "Flgybassystem Bas 60," p. 3.; Arash Pashakhanlou, "Swedish Air Power History: A Holistic Overview," *Air Power History*, Vol. 65 no. 3, (2018), p. 12.
41. Orjan Eriksson & Bengt Eklof, "Strilsystem m/60," The Armed Forces' Historical Telecommunications Collection, Selection Group for the Air Force, March 21, 2016, pp. 133-34.
42. Dorr, *SAAB Viggen*, 11.; Eriksson & Eklof, "Stril 60", p. 133-134.
43. *Ibid*.
44. Pettersson, *Med invasionen i sikte*, p. 77.
45. *Ibid*., p. 78.
46. Hans G. Andresson, *SAAB Aircraft* (London: Putnam, 1989), 126.; Dorr, *SAAB Viggen*, p. 23.
47. Andersson, *SAAB Aircraft,* p. 143.
48. *Ibid*., p. 144.
49. Andersson, *SAAB Aircraft,* 144.; Rystedt, "Flgybassystem Bas 60," p. 21.
50. Anders Annerfalk, *Flygvapnet: An Illustrated History of the Swedish Air Force*, (Sweden: Aviatic Forlag AB, 1999), 158.
51. Andersson, *SAAB Aircraft,* p. 162.
52. *Ibid*., p. 148.
53. Rystedt, "Flgybassystem 90," pp. 4-5.
54. *Ibid*., pp. 3-4.
55. *Ibid*., pp. 4-5.
56. Bo Hofvander, "Bas 90: Flygvapnets nya bassytem" *Flygvapennytt* (in Swedish, issue No. 5.) 1981. p. 5.
57. Bo Hofvander "Bas 90: tioåring på väg att bli stor," *Flygvapennytt* (in Swedish, issue No. 2) 1994., p. 1.
58. Hofvander, "Bas 90: Flygvapnets nya bassytem." p. 5.
59. Rystedt, "Flgybassystem 90," pp. 4-5, 9-10.
60. *Ibid*., pp. 9-10.
61. *Ibid*.
62. *Ibid*., p. 13.
63. *Ibid*., pp. 4-5.; Rystedt, "Flgybassystem Bas 60," p. 5.
64. Bo Hofvander, "Den Nya Klargöringsorganisationen" *Flygvapennytt* (in Swedish, issue No. 5)) 1981.
65. JR, "Bas 90: Air Base System 90, Swedish Air Force (1986) [English subtitles available]" video, YouTube, June 4, 2017, https://www.youtube.com/watch?v=MNak9lB_q00
66. *Ibid*.
67. Hofvander, "Bas 90: tioåring på väg att bli stor," pp. 5-10.
68. *Ibid*., pp. 9-10.
69. *Ibid*.
70. Rystedt, "Flgybassystem 90,"p. 10.
71. *Ibid*., p. 8.
72. Mats Björling, "Stril 90: Flygvapnets nya luftförsvarsledningssystem" *Flygvapennytt* (in Swedish, issue No. 5), 1986., p. 4.
73. Björling, "Stril 90", pp. 4-8; *Pashakhanlou, Swedish Air Power History,* p. 13.
74. Björling, "Stril 90", pp. 4-8.
75. Rystedt, "Flgybassystem 90," p. 13.
76. Bo Hofvander, "Den Nya Klargöringsorganisationen" *Flygvapennytt* (in Swedish, Issue No. 5), 1981.
77. Hofvander, "Bas 90: tioåring på väg att bli stor," pp. 5-6.
78. Hofvander "Bas 90: Flygvapnets nya bassytem," p. 5.
79. Hofvander "Bas 90: tioåring på väg att bli stor," pp. 8-9.
80. Anders Annerfalk, *Flygvapnet: An Illustrated History of the Swedish Air Force*, (Aviatic Forlag AB), 1999, p. 166.
81. *Pashakhanlou, Swedish Air Power History, 13;* Annerfalk, *Flygvapnet,"* p. 170.
82. Annerfalk, *Flygvapnet,"* p. 170.
83. *Ibid*.
84. *Ibid*., p. 171.
85. Hofvander, "Bas 90: tioåring på väg att bli stor." p. 8.
86. Elisabeth Braw, "Old MacJohan Had a Fighter Jet," *Foreign Policy*, August 23, 2024. https://foreignpolicy.com/2024/08/23/sweden-nato-gripen-rural-runway-fighter-jet/
87. Saab, "Gripen Dispersed Operations," video, Feb 13, 2024, YouTube: https://www.youtube.com/watch?v=HWYLgEU_92M
88. Gareth Jennings, "USAFE 'excited' to learn SwAF Aircraft Dispersal Techniques." August 31, 2022, Janes. https://www.janes.com/osint-insights/defence-news/defence/usafe-excited-to-learn-swaf-aircraft-dispersal-techniques
89. Thomas Shugart and Timothy Walton, "Concrete Sky: Air Base Hardening in the Western Pacific," Hudson Institute, January 2025, p. 27.
90. "Army – Air Force Agreements as to the Initial Implementation of the National Security Act of 1947," (Compiled by the Offices of the Deputy Chief of Staff and the Deputy Commander of the Army Air Forces. Sept 15, 1947) In Richard I. Wolf, *The United States Air Force Basic Documents on Roles and Missions*, (Washington, D.C., Office of Air Force History, 1987), p. 159.
91. The Boring Company, "Prufrock," Accessed online on 21 January 2025 at https://www.boringcompany.com/prufrock
92. John Moolenar, et al., Open Letter to the Honorable Frank Kendall and Carlos Del Toro on Base Hardening, May 8, 2024.
93. John Moolenar, et al., Open Letter to the Honorable Frank Kendall and Carlos Del Toro on Base Hardening, May 8, 2024. Mark Cancian, et al., *The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan*, (Washington, DC: Center for Strategic and International Studies, 2023), p. 87.
94. Thomas Shugart and Timothy Walton, "Concrete Sky: Air Base Hardening in the Western Pacific," Hudson Institute, January 2025, p. 17.
95. Department of the Air Force, Office of the Assistant Secretary for Energy, Installations, and Environment, *Installation Infrastructure Action Plan*, November 2024; Department of the Air Force, *Military Construction Program: Fiscal Year 2025 Budget Estimates*, February 2024.
96. Shugart and Walton, "Concrete Sky," p. 9.; Department of the Air Force, "B-21 Prototype Environmental Protection Shelters Construction, Test Underway," March 3, 2021, https://www.af.mil/News/Article-Display/Article/2523354/b-21-prototype-environmental-protection-shelters-construction-test-underway/
97. Name Redacted, "Air Force F-22 Fighter Program," CRS Report RL31673, July 11, 2013, https://www.everycrsreport.com/files/20130711_RL31673_c70b986e6de321f9f00ccbb5173d56d3fc781d1a.pdf; US Air Force, "F-22 Raptor Fact Sheet," https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104506/f-22-raptor/. Of note, the F-22 also took close to twenty-five years to transition from concept development to IOC.; Estimated cost based on Hardened Aircraft Shelter construction cost at Kunsan Air Base in Korea. See, Will Bracy, "Hardened Aircraft Shelters Constructed at Kunsan," 8th Fighter Wing Public Affairs, https://www.kunsan.af.mil/News/Article/ 2301980/hardened-aircraft-shelters-constructed-at-kunsan/
98. Shugart and Walton, "Concrete Sky," p. 8.

Desert Cats: The RAF's Jaguar Force in the First Gulf War. By Danny Burt. Barnsley UK: Air World Books, 2023. Photographs. Appendices. Pp. 216. $60.00. ISBN: 978-1-52678-245-8

During the First Gulf War, the British Royal Air Force (RAF) sent a small contingent of Jaguar fighters as part of Operation *Granby*, the code name for British military operations during *Desert Shield* and *Desert Storm*. Burt, a serving British officer with experience in the British Army and the RAF, has written an account of the Jaguar Force's operations in support of the Allied invasion of Iraq.

Burt begins with a brief history of the RAF's participation in the Iraq air war. This involved use of Tornadoes, Jaguars, and refueling aircraft, and the upgrades to the Jaguar to prepare the fighter for the conflict. He covers all missions flown by the Jaguar Force during the war, drawn from the Operations Record Book. The pilots in the Jaguar Force, drawn from No. 6 and No. 41 Squadrons as well as the Jaguar Operational Conversion Unit, had to make a radical change in the tactics they were to employ over Iraq. They were trained for low-level attack over Europe, where they could use terrain to mask their approaches and exits from a target. Through training missions conducted before the start of the war on January 17, 1991, the pilots found that flying at low level over featureless desert posed too great a risk in the face of the Iraqi multi-layered air defense system. In addition, the lack of terrain features made target acquisition more challenging. Shortly before the war started, the Jaguar Force shifted to attacking from medium altitudes, using high-angle bombing against their targets. The pilots made the transition to the new tactics with minimum training.

The Jaguars primarily flew interdiction missions against SAM sites, *Silkworm* missile sites, ammunition dumps, and artillery positions using 1000-lb bombs. They also handled some combat air patrols and tactical-reconnaissance missions. The 22 pilots in the Jaguar Force flew 617 sorties without loss during the six weeks of the air war. The most interesting part of the book contains personal anecdotes from many of the pilots who flew these missions. Their candid descriptions are riveting. The squadron engineering officer provides a view from the ground relating to the challenges of keeping the Jaguars fully serviceable in a demanding environment.

The book is profusely illustrated with color photographs of the airplanes and their pilots. Prior to going out to the Gulf, the Jaguars received a new Desert Sand paint scheme. Most of the airplanes had distinctive nose art, some featuring characters from *Viz*, the British adult comic book. The appendices include technical information on the Jaguar in the Gulf War, a section on the nose art of each aircraft, and the transcript of a 20-minute presentation given by Wing Commander Bill Pixton, who commanded the Force during the air war.

This was an enjoyable and informative book on a little-known aspect of the First Gulf War.

Edward M. Young, PhD, Volunteer, Museum of Flight, Seattle

◆◆◆◆◆◆

The Great War Ace, The Red Baron and Beyond: The Life and Achievements of Air Vice Marshall Sir Brian Baker, KBE, CB, DSO, MC, AFC. By Jacquie Buttriss. Barnsley UK: Pen & Sword Aviation, 2024. Photographs. Bibliography, Notes. Index. Pp. x, 162. $39.95. ISBN: 978-1-39905-831-5

This is an easy read, although not historically useful. The title is misleading, as more of the book is devoted to Baker's RAF service during the interwar years, World War II, and after than to his service in World War I. Further, he was *an* ace in the Great War, not "the Great War Ace."

As Buttriss makes clear, this is a "family biography" written at the request and full cooperation of surviving members of the family. Consequently, primary resources are largely letters, articles, and other memorabilia saved by the family. Unfortunately, Buttriss did little research beyond that.

In the first chapters, the principal sources are his letters home and stories he sent to his old school's magazine. Predictably, readers get less war-related information, as he didn't wish folks back home to think he was in any great danger. There's also a scrambled time-line. Episodes from his first posting to the front (which ended in early 1916), a period of medical treatment and recovery, flying-instructor duties, second combat tour (mid-1917 on), and command of a home defense squadron are intermingled. Some of his memories may have been misfiled, as a quote by him of "The radar gave a warning on the old siren . . ." is included!

After the war, Baker was assigned in Dublin, the Central Flying School, and Egypt and Aden. His letters home from there were more concerned with his off-duty activities than professional duties.

He returned to England to command the Experimental Section of the Royal Aircraft Establishment. In 1932, he became chief instructor at RAF Leuchars, responsible for preparing naval pilots for carrier operations. Although naval aviators had been operating off British aircraft carriers since World War I, Baker had to learn how to do this well enough to teach others. He then had two carrier tours before he was named a station commander in Scotland. The latter seems to have been more to his liking than sea duty, as the station was also involved in combined operations and developing methods for use of radar. While there, he concentrated on training airmen in torpedo and radar techniques for the anticipated war.

On its outbreak, he was promoted to Air Commodore Commanding 15 (Operations and Training) Group. Again, Buttriss again scrambles the timeline as she intermixes these duties with a number of commands in Coastal Command: RAF Reykjavik, 16 Group, and 19 Group. In discussing his service up to D-Day, Buttriss commits her most glaring howler: Eisenhower's message to the troops on the eve of D-Day was twice attributed to President Eisenhower.

Toward the end of the war, he was promoted to Air Vice Marshal and became Officer Commanding RAF East Africa. In 1947, as an Air Marshal, he took over RAF Transport Command. He held this position through the Berlin Airlift and until 1950, when he retired from the RAF. He died in 1979 at the age of 83.

There are no footnotes; the timeline is frequently twisted, and Buttriss doesn't seem to have a firm grasp of her subject. Because the chief sources are Baker's writings to his family and school, there is more about his leisure activities than about his actual work. As something the family can look at with fond memories, this book succeeds. As a historical document, it fails.

Jon Barrett, volunteer photographer/researcher, National Air & Space Museum

◆◆◆◆◆◆

War in Ukraine: Main Battle Tanks of Russia and Ukraine, 2014-2023 Volume 4: Soviet Legacy and Post-Soviet MBTs *and* **Volume 5: Post-Soviet Ukrainian MBTs and Combat Experience**. By Wen Jian Chung. Warwick UK: Helion, 2023. Bibliography. Notes. Appendices. Photographs. Illustrations. Pp. 84 and 60 respectively. $29.95 paperback each. ISBN: 978-01-804513-067-5 and 978-01-804514-25-2

Russia's 2022 invasion of Ukraine precipitated the largest war in Europe since 1945, and main battle tanks (MBT) have played an important role on both sides. Volume 4 focuses on their design features, characteristics, weaponry and capabilities. The adversaries share a common heritage of armor and its employment in battle going back to the Soviet military forces. Consequently, there are parallels in fielded armor, and this has allowed Ukrainian forces to capture, repair, and easily integrate Russian tanks into their own units.

Those of us who served during the Cold War in central Europe recall the concern that a Red Army attack on NATO would have seen thousands of tanks rolling across the German border. Intimidating, but this monograph reminds us that Soviet armor had, and continues to have, inferior features to American, British, and German armor. Both the American M60 and formidable British Chieftain MBTs of that time were, in many ways, superior to those fielded by the Red Army in protective armor, main guns, rate-of-fire, and barrel life.

Chung focusses on those same Soviet MBTs that are the preponderance of armor fighting in the current war. Analysts disagree as to whether the Russian T-64, T-72, T-90 (an improved T-72) or T-80—all engaged in the current fighting—is the superior tank. To help readers contrast the merits of the different tanks, technical data and detail are provided. Chung discusses how the crew, employing various systems, is able to maneuver, defend, and engage on the battlefield. Chung discusses the gunner's sight, the main gun's loading cycle (something I experienced on a Russian-built T-72 trainer), the protective armor on the various MBTs, and their automotive design. Interestingly, a T-90A captured by Ukrainian forces was sent to the Aberdeen Proving Ground in Maryland for evaluation by US military armor experts.

Volume 5 focuses on both sides' employment of MBTs, their tactics, and how they have fared in combat. Both sides emerged from the fall of the Soviet Union with little funding to support a robust military, leaving units poorly trained or prepared to engage in combat. In Russia, I witnessed the depressing state the Russian military had descended into.

Chung amplifies this point. Units in both countries suffered from chronic understaffing and were ill-prepared to mobilize, if called upon. The underfunded Ukrainian army was in terrible disarray with little training and underequipped units. The disastrous Donbas War in 2014 made it clear that radical change was imperative. Fortunately, Ukraine began to train with NATO forces, learned better tactics and, at the same time, upgraded its MBTs. Since the largest former-Soviet tank manufacturing facility was located in Ukraine, it could domestically produce MBTs. One highly effective Ukrainian innovation was development of ERA (explosive reactive armor). For those not familiar with ERA, Chung provides an explanatory appendix.

One might imagine opposing MBTs engaging in classic tank battles, as in World War II. That, however, is by exception, and the more common dangers to tanks came from UASs unmanned aerial systems (UAS), anti-tank guided missiles (ATGM), artillery, and anti-tank mines. Actual tank losses give pause for thought. In the first year of the invasion, from February 2022 to April 2023, Ukraine lost some 453 tanks, while Russia lost at least 1800.

There is speculation that the era of the tank is passing. John Antal's *7 Seconds to Die* (2022) was a military analysis of the Second Nagorno-Karabakh War and the future of warfighting. It raised the issue of MBTs surviving in future wars where UASs would dominate the battlefield. Consequently, the conduct of war is being reshaped by the conflict in Ukraine, and the role of tanks in particular is being carefully analyzed.

This volume provides a better understanding of MBTs' role in the war. Both volumes provide a better understanding of what is transpiring on the battlefield in Ukraine.

John Cirafici, Milford DE

◆◆◆◆◆◆

War in Ukraine Volume 7: Air and Missile Warfare, March-June 2022. By Tom Cooper, Adrien Fontanellaz, and Milos Sipos. Warwick UK: Helion & Company, 2024. Bibliography. Notes. Photographs. Illustrations. Pp. 93. $29.95 paperback. ISBN: 978-1-804515-79-2

When Russia began its invasion of Ukraine in early 2022, predictions were that Ukraine would quickly succumb. Instead, Ukraine was able to defend itself and, in particular, counter the assault on land, sea, and in the air. This volume is a continuation of a mini-series on the war in Ukraine, in this case focusing primarily on air and missile operations and air defense systems. Previously, Volume 6 addressed the air war from February to March 2022. This volume continues with the air war over Ukraine through June, with emphasis on the Russian missile offenses, the Ukrainian response, and air warfare in general. It also devotes chapters to Russia's multi-pronged thrust into Ukraine and how it was stopped.

It's interesting that the Russians had the capabilities and weapons systems to dominate the battlespace over Ukraine yet lost the initiative due to uneven application of tactics and operational planning. In the air, Russian forces did successfully integrate their capabilities, with attack aircraft supported by airborne early warning and control, airborne command posts, and electronic warfare aircraft. In contrast, when Ukrainian interceptors went airborne to attack those assets, their communications and radars were severely jammed. Yet, Ukrainian pilots were able to destroy a number of attacking Russian aircraft while, unfortunately, suffering unsustainable losses. Thus, the first months of the war became a learning experience for both sides. Responding to the initial assault, Ukraine was able to revitalize its Integrated Air Defense System (IADS) in certain sectors, inflicting large losses on attacking Russian air assets. In contrast, the Russians were able to unleash large numbers of ballistic and cruise missiles from standoff platforms such as Tupolev Tu–95 and Tu–22 bombers and special MiG–31s equipped with hypersonic Kinzhal missiles.

What should be of special interest to the reader is Ukraine's response to the sea blockade by Russia's Black Sea Fleet. In what otherwise appeared to be a land-based war, Ukraine was faced with attacks from the sea beginning with the seizure of a strategic island important to the defense of the major port city of Odessa. Russian warships then moved in to shell the coast, while the guided missile cruiser *Moskva*, flagship of the Black Sea Fleet, provided surface-to-air missile coverage of its vessels from air attack by Ukraine. In mid-April, Ukraine, in a surprise move, scored a much-needed victory. Employing Neptune anti-ship missiles (only recently made operational), Ukrainian forces struck the *Moskva*, mortally wounding it. Other vessels of the fleet were then compelled to move much further out of range. Russia's sought-after quick victory soon became unreachable, as the war fell into a stalemate.

This volume, as with all in the series, is well complemented by abundant illustrations, photographs, maps, and tables of data. Air tactics are nicely illustrated, and numerous maps are provided, paralleling the narrative. The various configurations of aircraft are represented in both photographs and in perfectly rendered illustrations. The entire series provides easy-to-access reference material and has proven highly useful in understanding the war on the battlefield.

John Cirafici, Milford DE

◆◆◆◆◆◆

War in Ukraine: Volume 6: The Air War: February-March 2022. By Tom Cooper, Adrien Fontanellaz, and Milos Sipos. Warwick UK: Helion & Company, 2024. Maps. Bibliography. Notes. Photographs. Illustrations. Pp. 86. $29.95 paperback. ISBN: 978-01-804515-78-5

So much of the conflict in Ukraine is illustrated with scenes from the ground war. But what of the air war? The authors of volume 6 in the "War in Ukraine series" have focused on that very aspect by taking the long view—beginning with the lingering impact of Cold War doctrine—because both militaries are offsprings of the Soviet Union.

Paralleling doctrine are the aircraft, designed and built in the Soviet Union and employed in the current conflict. The authors explain why Soviet-designed aircraft were developed with limited capabilities based on Soviet air force tactics. In contrast, American and NATO aircraft and crews were and are far more flexible tactically. For instance, a Russian pilot was not given freedom of action to execute his mission. He was vectored to a target and told to release his ordnance. Training was very limited, as were hours flown. The situation worsened with the difficult times after the collapse of the Soviet Union. Both combatants underwent a drastic reduction in equipment and manpower and had limited capabilities on the eve of the current war.

With this in mind, the authors then describe the aircraft employed by both sides, the weaponry, and the order of battle. Supporting the narrative in this monograph are extensive illustrations and photographs of the aircraft and helicopters serving in the war. These are accompanied by maps that link bases with their assigned units and aircraft.

Unmanned vehicles are not overlooked by the authors. Guided missiles that have played an important role in the aerial bombardment of Ukrainian cities and infrastructure are also described, as are the aircraft from which they were launched. Russia has also relied heavily on cruise missiles to penetrate Ukrainian defenses. Their reliability, however, has been poor. On the other hand, every air launch of Russian cruise missiles is supported by effective use of multilayered electronic countermeasures. These target not only Ukrainian long-range surveillance radars, but also NATO's E–3 Sentry AWACS on station over Poland and Romania. In addition to guided and cruise missiles, Russian forces have also employed the Kinzhal hypersonic air-launched ballistic missile.

Readers who have a special interest in the types of aircraft and helicopters employed by both sides will not be disappointed. The Sukhoi family of interceptors, tactical bombers, and close air support aircraft; Mikoyan i Gurevich (MiG) aircraft; Ilyushin transports, tankers, airborne command posts, and ELINT/SIGINT aircraft; Antonov transports; and Tupolev bombers and unmanned aerial vehicles are all here. Likewise, Mil and Kamov transport and gunship helicopters are represented, and the role they played during the initial assault on Ukraine is highlighted.

The second half of this monograph moves on to critical events that took place early in the war and the role played by aviation assets.

Volume 6 informs the reader about much of what has been happening over the skies of Ukraine and helps to balance the picture presented by the ground war. For that reason alone, one should consult this monograph to acquire a rounded discussion of the conflict.

John Cirafici, Milford DE

◆◆◆◆◆◆

AH–1 Cobra Gunship vs NVA Armor 1967-1973. By Peter E. Davies. Oxford UK: Osprey Publishing, 2025. Maps. Illustrations. Photographs. Glossary. Index. Pp. 80. $19.60 paperback. ISBN: 978-1-47286174-0

Peter Davies has written extensively on military aircraft, with many subjects that include the B–52 and the EF–111. In this book, he provides an excellent account of why and how the Bell AH–1G Cobra gunship was employed against North Vietnamese Army (NVA) armored forces in the Vietnam War.

The Cobra was developed primarily for a potential European land war against the Soviet Union, the major focus of US military planning during the Cold War. It was also deployed to Vietnam, where it escorted air assault units into and out of hot landing zones. In 1971, when the NVA began making greater use of tanks, armored personnel carriers (APC), and artillery, the task of countering these weapons fell to the AH–1G.

The aircraft could carry a variety of weapons, but its primary armament consisted of 40-mm grenade launchers, two- and six-barrel 7.62-mm miniguns, 2.75-in rockets, and a 20-mm rotary cannon (one has to wonder why Davies doesn't mention the **t**ube-launched, **o**ptically-tracked, **w**ire-guided (TOW) missile, which was designed specifically for the anti-armor role and was used in many Cobra units). In addition to its impressive array of weapons, a selling point for the Cobra's deployment to Southeast Asia was its parts commonality with the ubiquitous UH–1 Huey: 80 percent of the parts on the Cobra were used on the UH–1, which simplified the supply chain for maintenance personnel.

The Cobra's primary armored targets were World War II-vintage T-34 tanks, more modern T-54 and T-55 tanks, PT-76 APCs, and anti-aircraft artillery (AAA) units using the ZSU-57. The Cobra had mixed success against these weapons. At one end of the spectrum, it was ineffective against the armor of a T-54, while the lightly armored ZSU-57 was a relatively soft target, provided the Cobra could avoid the fire from its twin 57-mm guns.

Davies does an excellent job of describing several major armor operations and uses these combat accounts to explain gunship tactics and how the tactics evolved during the war. Early on, the typical approach would be for one or two Cobras to be teamed with a scout helicopter. The scout would fly at tree-top level, with the Cobras trailing at 1500 feet. The scout would locate suitable targets, marking the location with smoke. The Cobras would execute the attack, often supported by OV–10 Broncos if additional firepower were needed.

But the ZSU-57 took a large toll on the Cobras, and this situation became worse when the Strela shoulder-fired missile (NATO codename SA-7 *Grail*) was deployed. As a result, US fighter-bombers were often called in to attack enemy armor, and these fixed-wing aircraft accounted for the majority of the damage to enemy forces. By itself, the Cobra produced limited results. But the combination of the Cobra gunship and tactical air was an effective combination when enemy armor was present.

Davies' book is well-researched and well-written. Scant material has been published about armor operations in the Vietnam War; this book would be a good addition to the library of a reader interested in this rarely addressed topic.

Lt Col Joseph Romito, USA (Ret), docent, National Air and Space Museum

◆◆◆◆◆◆

B–26 Marauder vs Me 262: Europe 1945. By Robert Forsyth. Oxford UK: Osprey Publishing, 2025. Maps. Diagrams. Illustrations. Photographs. Bibliography. Index. Pp. 80. $23.00. ISBN: 978-1-47286259-4

Forsyth is the prolific author of more than 30 publications with Osprey. One of the foremost authorities on German aviation in the Second World War, he conducted innumerable interviews with participants in the war and, in the process, collected an extraordinary archive of unique and irreplaceable histories and photographs which importantly supplement his writings. This book reflects his invaluable research.

This is not Forsyth's first book detailing the confrontations of the B–26 and German jets over Germany. In 1999, he and Jerry Scutts co-authored *Battle Over Bavaria: The B–26 Maurader Versus the German Jets***.** With this new book, however, he "focuses on the actions fought between a number of USAAF B–26 medium bomber groups and the Me 262 jet interceptors of the Luftwaffe's JV 44 over southern Germany between early April 1945 to the end of the war, a period of less than two months. In doing so, Forsyth illuminates the final hostilities of the legendary Generalleutnant Adolf Galland, a German fighter ace with 104 aerial victories, who briefly commanded JV 44, a small group of jet defenders of the skies south of Berlin.

Galland took his first flight in the swept wing Me 262 in May of 1943, ten months after its first test flight, and concluded that "It felt as if angels were pushing." He became an instant and vociferous champion of the Me 262 which led to a confrontation over fighter strategy and tactics with Reichsmarschall Hermann Göring. This inevitably resulted in Galland's dismissal as General of Fighters and reassignment. Eventually resurrecting his career, Galland commanded JV 44. This unit's assignment was to attack medium bombers (principally Martin B–26 Marauders) over southern Germany as the Allied "Heavies" pounded Berlin in the Spring of 1945. JV 44 was a small group of very talented and experienced fighter pilots, who, like Galland, had at one time or another had issues with Göring's war management. Forsyth refers to them as "mutineers."

As with all of Forsyth's Osprey publications, this book is richly illustrated and visually appealing. There are over 50 black-and-white photos, many from Forsyth's personal collection. Most impressive are a dozen newly commissioned, color, digital illustrations which excel at describing the interiors of both aircraft types. A few images are dramatic aerial battle scenes.

Forsyth does his customary yeoman's job in describing and chronicling the history of both the Me 262 and its B–26 opponent, from Hitler's ill-founded desire for the Me 262 to be a fighter-bomber to the Marauder's successful effort to overcome its quirky flying characteristics and unfortunate moniker as a "widow maker." He concludes that during this short period of conflict at the end of the war, fewer than ten Marauders were lost to aerial combat with the Me 262, and only one or two of the jets were destroyed by defensive fire. He notably transcends the customary historic sketch with his remarkable personal interviews with the participants of this brief and concluding aviation clash over Germany in April and May of 1945.

David S. Brown, Jr., volunteer, Museum of Flight, Seattle

◆◆◆◆◆◆

Operation *Steinbock* 1944: The Luftwaffe's Disastrous Last Blitz over England. By: Chris Goss. Place: Oxford UK: Osprey Books, 2025. Photographs. Maps. Drawings. Index. Bibliography. Pp. 96. $25.00 paperback. ISBN: 978-1-47285532-9

This book is a compelling and well-researched account of the Luftwaffe's final sustained bomber offensive against Britain, launched in the winter of 1944. Goss' work is more than a battlefield chronicle: it is a study in desperation, leadership failure, and strategic decline. He brings depth to this little-covered campaign, skillfully blending operational details with firsthand recollections from aircrew on both sides, making the human cost of the campaign palpable.

Goss's meticulous research stands out throughout. Drawing from official records, mission reports, and personal memoirs, he offers both clarity and nuance. His smooth, accessible narrative is supported by meaningful anecdotes from combatants, giving the reader a visceral sense of the challenges faced during night bombing over a well-defended Britain. The plentiful archival photographs and maps complement the text, and Goss' commentary on losses, crew composition, and sortie results adds precision without overwhelming the reader.

Steinbock was, at its core, another flawed initiative driven by Hermann Göring, who remained detached from operational realities. By 1943–44, the Luftwaffe's bomber force had failed to mature beyond its early tactical roots. It still lacked the aircraft, targeting systems, and night-navigation aids necessary for a strategic air campaign. While Goss does not dwell extensively on doctrine, Luftwaffe operational leaders favored precision strikes on targets of strategic value: power plants, transport nodes, and industrial infrastructure. However, the political leadership, seeking retribution for Allied bombing of German cities, diverted the campaign's purpose toward cultural and population centers in London. This split in objectives undermined operational coherence.

Goss did the reader a bit of a disservice by not including any information on Luftwaffe reconnaissance efforts in support of *Steinbock*. Clearly, the Luftwaffe knew about the Allies pre-D-Day buildup and targeted the main ports and harbors on the south coast. The information to make those decisions had to come from some source such as the Ju 86P-2 or recce variants of tactical platforms. In either case, the book could have added information and clarity.

Although Goss leaves the broader RAF–Luftwaffe doctrinal comparison to the reader, the contrast is stark. While Bomber Command was not adept at hitting small precision targets either, its use of pathfinder squadrons and bomber streams allowed it to conduct effective area bombing. The Luftwaffe attempted to replicate these tactics in *Steinbock* but lacked the scale, coordination, and navigation technology to do so. The results were predictably disjointed and ineffective.

The RAF's integrated air defense system proved devastating. Radar-guided Mosquito and Beaufighter night fighters inflicted unsustainable losses on German bomber crews. Goss captures this tactical imbalance well, especially as the Luftwaffe bled irreplaceable aircrew talent in each sortie. Early losses of experienced leaders left the force even more vulnerable.

By the end of *Steinbock*, Germany's bomber arm was spent—exhausted, demoralized, and unable to influence the coming Allied invasion of France. Most damning, the Luftwaffe learned little from the campaign. Operation *Bodenplatte*, launched six months later, repeated many of the same errors with slightly greater short-term success but even costlier long-term consequences.

In summary, this is an expertly crafted, visually rich, and engagingly written examination of a little-known campaign. Goss succeeds in giving voice to the airmen and context to their mission, capturing both the futility and tragedy of one of the Luftwaffe's final offensive efforts. For readers interested in air power history, this is essential reading.

Gary Connor, docent, National Packard Museum, Cortland OH

◆◆◆◆◆◆

Manfred von Richthofen: His Life and Times in Pictures. By Tim Hillier-Graves. Havertown PA: Pen & Sword, 2024. Photographs. Bibliography. Index. Pp. xi, 160. $39.95. ISBN: 978-1-03610-031-5

Hillier-Graves previously wrote *Manfred von Richthofen: The High Price of Glory* (reviewed in the Spring 2025 issue of this journal). With access to many excellent photos, he chose to produce this separate volume as a supplement. He includes more than 350 images, distributing them throughout the introduction and seven parts (chapters) that mark various stages in von Richthofen's life.

Von Richthofen's early years and initial military service (May 1892-April 1915) as a calvary officer before transferring to aviation in May 1915 are covered in Part 1. After very brief flight training, von Richthofen initially flew two-seaters on the Eastern and Western fronts until September 1916, when he transferred to fighters. Part 2 covers this period, May 1915-August 1916.

In Part 3 (September 1916-March 1917), Hillier-Graves discusses von Richthofen's initial fighter experience after joining the squadron commanded by Oswald Boelke, Germany's pre-eminent fighter pilot. Before the winter weather reduced flight operations, von Richthofen benefitted from fighting the Royal Air Force during its quest to achieve air superiority over the Battle of the Somme. By the end of 1916, he had 15 kills and a new aircraft type (Albatros D.III). He would begin 1917 with a new responsibility: command of *Jasta* 11.

Part 4 (April 1917-June 1917) and 5 (July 1917-September 1918) contain more than half of the photographs. By this time, von Richthofen had achieved celebrity status as the world's most recognizable fighter pilot. With conditions on the home front deteriorating due to the British blockade, the German government capitalized on von Richthofen's achievements and created a national icon. Consequently, photographers received almost unlimited access to document the ace in his military environment.

Part 6 (January 1918-April 1918) shows how continuous combat and the impact of a serious head injury wore down von Richthofen before his death. He chose to continue leading his squadron despite physical and mental exhaustion that, most likely, contributed to his decision to chase an RAF fight at low altitude over enemy lines.

Hillier-Graves concludes with Part 7, Aftermath. Here he examines von Richthofen's legacy regarding his family.

Most of the photos come from Hillier-Graves' personal collection. Those images featuring aircraft are usually displayed in a reasonably large format. However, many other images of individuals are much too small to be of real interest. Presenting fewer images in a larger format might have improved this work. Another option might have been a large-format book, commonly known as a "coffee table" book.

This book is best suited for von Richthofen aficionados fixated on the German pilot's image.

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

◆◆◆◆◆◆

Red Bandit: The MiG–29 in Combat. By Mike Guardia. Maple Grove MN: Magnum Books, 2025. Photographs. Bibliography. Pp. 166. $21.95 paperback. ISBN: 979-8-991-79812-9

Red Bandit attempts to chart the combat history of the MiG–29, one of the Cold War's most iconic Soviet fighter jets. Published by Magnum Books—an imprint that appears to be a small, independent, or one-off press (what was once called a vanity press)—the volume has a distinctive look and feel that immediately sets it apart, and not in a good way.

The physical reading experience is surprisingly comfortable. The large typeface, generous margins, and spacious layout give the impression of a large-print edition, making it easy on the eyes. However, this design choice also reveals how little content fills the book's pages. While the text is stretched across the format, its substance does not match the book's physical size.

On the positive side, the book's numerous photographs are well-curated and presented on lightweight pages. The visual material is evenly distributed, adding interest where the prose falters.

Unfortunately, the narrative is stiff and mechanical, with repeated phrasing and unexplained technical terms that suggest a lack of editorial polish. The writing lacks flow, and style issues hamper readability.

Still, Guardia's research efforts are evident. Accessing Soviet and post-Soviet sources and assembling credible details from closed societies are not easy feats. There are glimpses of solid material here—names, sorties, and technical breakdowns—but they are not woven into a compelling story.

Ultimately, *Red Bandit* feels more like a research sketch than a finished work. It may interest MiG–29 enthusiasts, but it is not a title I would recommend for general readers.

Gary Connor, docent, National Packard Museum, Cortland OH

◆◆◆◆◆◆

Spitfire I: Phoney War and Battle of France. By Tony Holmes *and* **Normandy 1944: The 'Transportation Plan' to Cut D-Day Communications.** By: Julian Hale. Both Oxford UK: Osprey, 2025. Photographs. Bibliography. Illustrations. Index. Pp. 80 and 96. $23.00 and $25.00 paperback respectively. ISBN: 978-1-47285767-5 and 978-1-47286580-9

I am an enthusiastic fan of Osprey publications. While formulaic, they are consistently focused, concise, well-researched, and well-written, with strong use of photographs, drawings, and artwork. But reviewing Osprey titles has sometimes been frustrating because of their lack of depth. I have, cheekily, described them as "literary hors d'oeuvres."

So, before tackling these latest publications, I researched the recent history of pamphlets. Pamphlets are described as unbound printed publications known for their brevity, portability, and affordability. They typically present a focused treatment of a single topic; whereas books usually aim for broader or deeper exploration, with more complex structure and sustained analysis.

While Osprey products are physically bound and marketed as books, their format—short length, focused subject matter, high image-to-text ratio, and reliance on standardized templates—evokes the pamphlet tradition. Each title addresses a narrow topic (a specific campaign, unit, or weapon system) and does so in a compact, visually guided manner. When combined with strong research and writing, Osprey products give the reader a solid foundation for further study—just as great hors d'oeuvres whet the gourmand's appetite for future courses.

Spitfire I offers a sharp, well-paced account of the Spitfire's earliest wartime actions. Focused on the Phoney War and the Battle of France, the narrative is concise yet vivid, supported by personal stories that humanize the broader campaign.

The photography is a standout—carefully selected, well-captioned, and deeply tied to the text. Holmes' research is solid, and his writing skill ensures that even technical detail remains readable and engaging. The book's accessibility never comes at the cost of accuracy. Less effective are the stylized battle diagrams. Though colorful and energetic, they often confuse more than clarify, lacking spatial coherence or tactical insight.

Holmes provides a particularly strong treatment of the Spitfire I's armament, highlighting the limitations of its eight .303 Browning machine guns. The lack of hitting power against German bombers is clearly explained and placed in proper operational context.

This compact volume meets all the essential criteria of a modern pamphlet: concise, informative, and tightly focused on a single subject. It is a well-executed introduction to the Spitfire's baptism of fire.

Normandy 1944 offers a compelling analysis of the air campaign designed to cripple German mobility ahead of D-Day. One of the book's key strengths is its nuanced treatment of personalities—leaders such as Leigh-Mallory, Tedder, and Spaatz emerge as influential figures whose temperaments and rivalries shaped the plan's development. Hale insightfully explores how, despite mutual dislike and friction, Allied leaders and their staffs managed to collaborate effectively. The discussion of the Transportation Plan's roots in the Pantelleria campaign is intriguing, though the book leaves open whether such a small-scale precedent justified broader strategic extrapolation.

A particularly valuable element is Hale's critical reassessment of outcomes. While the plan succeeded in disrupting German transport, Hale argues its effect was less decisive than is often assumed. The real collapse, he suggests, came from the German logistics system cracking under sustained pressure—not from Allied bombing alone. This reinterpretation is supported by detailed operational evidence.

The book does not shy away from difficult topics. Hale highlights RAF Bomber Command's lack of precision and its operational limitations. Most significantly, he addresses the heavy civilian toll, emphasizing the moral complexity of the campaign.

Normandy 1944 is an essential, thought-provoking study for anyone examining air power in World War II. Compared to Holmes' *Spitfire I*, which offers a focused tactical snapshot, Hale's book is a strategic study with deeper analysis and broader implications. Both are concise, informative, and recommended—Hale's especially for students of airpower doctrine and Allied decision-making.

Gary Connor, docent, National Packard Museum, Cortland OH

◆◆◆◆◆◆

Argentine Skyhawks in the Falklands War: **Targeting the Task Force in the South Atlantic in 1982.** By Salvador Huertas. Barnsley UK: Air World, 2025. Photographs. Index. Pp. 198. $49.95. ISBN: 978-1-03612688-9

This engaging contribution to the growing body of Falklands literature is unique in that it tells the story from the Argentine point of view. The narrative offers readers access to the experiences, motivations, and hardships of the Argentine pilots who flew one of the war's most iconic aircraft, the Douglas A–4 Skyhawk.

One striking strength is the book's wealth of photographs. Images of Argentine aircraft, flight crews, and maintenance personnel are seldom reproduced in English-language publications. They provide an immediacy and humanity that balance the operational history, reminding readers that the Falklands War was not only a clash of ships and planes, but also a test of young men flying in extraordinarily dangerous circumstances.

Huertas provides a comprehensive backstory to the Skyhawk's presence in Argentina. "Heinemann's Hot Rod," as the A–4 was nicknamed after its designer Ed Heinemann, was not simply a fighter-bomber acquired off the shelf. Its procurement illuminates the broader patterns of American foreign policy which routinely granted modern weapons to allies while withholding them from regimes judged less reliable. Argentina's Skyhawks were acquired in the context of this delicate balancing act. Particularly fascinating are the anecdotes suggesting that Washington authorized the sale only after Argentina showed interest in Britain's Harrier. The episode underscores how aircraft sales were instruments of diplomacy as much as defense, a theme Huertas weaves into the technical and operational narrative with considerable skill.

Large sections of the book are written as first-person accounts, vividly describing the experience of flying low-level strike missions against the formidable British task force. These chapters are excellent—honest, sometimes raw, and deeply compelling. They elevate the book beyond straightforward military history into something closer to oral testimony. To his credit, Huertas also incorporates material from RAF and Royal Navy participants, which provides balance and prevents the work from becoming narrowly partisan. The British accounts sharpen the reader's sense of the odds the Argentine flyers faced and the respect they earned from their adversaries.

Unfortunately, the book's opening chapters appear to have been produced with a crude Spanish-to-English machine translation. The prose in these sections is stiff, awkward, and in places nearly unreadable with awkward word order, syntax, and vocabulary; misused prepositions or articles; inconsistent terminology; word-for-word translations of idioms; misaligned pronouns and tenses; and a lack of idiomatic rhythm and natural flow that is characteristic of a translation created for English readers. In Huerta's work, this is especially disappointing given the quality of the content that underlies it. Later chapters, thankfully, improve markedly. While machine translation is an extraordinary technological advance which can increase global access to information (when well executed), the unevenness of the machine translation here makes for a jarring reading experience and reflects poorly on the editorial standards of the publisher, who allowed such a weak product to reach print.

Despite this, the book is valuable and even essential. Its insights into the conflict, its unique Argentine perspective, and its focus on the role of the Skyhawk make it stand out in a field dominated by British narratives. Readers with an interest in the Falklands, Cold War aviation, or the geopolitics of arms sales will find much to appreciate. However, while it is a book worth reading for its substance, it demands patience in navigating the clumsy translation of its early chapters.

Gary Connor, docent, National Packard Museum, Cortland OH

◆◆◆◆◆◆

Hard Broke: Asymmetric Warfare, Great Power Competition, and Institutional Paralysis. By Colonel M.D. Matter, USA (Ret). Havertown PA: Casemate, 2025. Notes. Bibliography. Photographs. Illustrations. Pp. 255. $34.95. ISBN: 978-1-63624443-3

It is important to grasp Matter's key points early on in order to fully appreciate this book: the US now engages enemies who are often weaker militarily than we are and who, by default, engage in asymmetrical warfare, the key tactic being the casualty-producing use of improvised explosive devices (IED).

Matter has a great deal of experience in this arena. His frustrating experiences on several tours in Iraq, during which he struggled to convince leadership to make changes in tactics that allowed insurgents to exploit vulnerabilities. He also recognized the greater problem: lack of a winning strategy that properly reflected why we had invaded Iraq in the first place. Beyond that, he highlights evolving tactics—e.g., use of unmanned aerial-vehicle systems (UAS) and cyber warfare—that are changing the nature of war.

In order to flow with Matter's arguments, one has to recognize that US forces in Iraq never had a clear vision of what was supposed to be achieved and, just as important, how to get there. We never really knew what we were doing in Iraq or Afghanistan. As a fellow veteran of that misguided conflict and one who had been involved in the antiterrorism mission, I totally agree. Counterproductive actions by senior leadership—the self-defeating policies promulgated by Paul Bremer, head of the Coalition Provisional Authority and, essentially, viceroy of Iraq—only encouraged armed resistance to our presence and promoted recruitment of insurgents. Coupled with the disastrous misconduct at Abu Ghraib, the war was soon being lost. Matter makes clear that to have won, we needed to operate with an understanding of the political and cultural environment, while seizing the initiative from the enemy by denying him predictability of coalition forces' operational behavior and, simultaneously, targeting his IED system across its spectrum.

For the past 30 years, we have lacked strategic patience while engaging an enemy employing asymmetrical warfare. Matter uses the Somalia operation (1991-1993) to illustrate his point. He maintains that the loss of 18 soldiers in a battle in Mogadishu expedited our departure from there. Looking at Somalia from the national security perspective, there was no compelling reason to remain there following initial success with the humanitarian mission. In December 1991 in Mogadishu, President Bush said that as soon as the humanitarian operation was completed, we needed to exit Somalia. We did not under President Clinton, thereby creating a dichotomy between national security objectives and a dramatically shifting mission on the ground. The rest is history. Our military should not be sent on ill-defined missions that create an environment for insurgency, and the National Command Authority is negligent when it puts lives at risk without a clearly defined purpose and goal.

Matter has further assessed that the nature of war itself has changed; therefore, the strategy we employ must evolve to respond appropriately. The war in Ukraine has demonstrated that UAS warfare adds another dimension to asymmetrical warfare, one that illustrates how a weaker combatant can target an enemy's superior weapons at low cost to the attacker. Ukraine's recent destruction of Tu–95 bombers on several Russian bases with inexpensive drones should focus attention in this country on the vulnerabilities of our own high-value assets. That attack demonstrated that asymmetrical warfare can bring the battle to the US. Matter recognizes the growing threat of UAS warfare and devotes an entire chapter to it. He also sees its utility for US forces in that it provides 24/7 surveillance of enemy activity. Cyber warfare is another example that is already being experienced in this country.

Matter's conclusion is that we are not learning the lessons of asymmetric warfare. The US has institutional paralysis and is, therefore, likely to make the same errors with the same results. This may prove costly in the future. This book draws attention to those areas we badly need to improve upon and incorporate those lessons in training at all levels to influence the way we conduct operations. If future editions are printed, an index and glossary should be included to give the book even greater utility by a wider audience.

John Cirafici, Milford DE

◆◆◆◆◆◆

DFS230 Combat Glider. By Neil Page. Horncastle UK: Tempest Books, 2025. Photographs. Maps. Index. Pp: 182 Cost: $25.99. softcover. ISBN: 9781911704263.

This book is a detailed and visually rich account of the Luftwaffe's primary combat glider. Although compact in format, the book provides an in-depth look at the conception, development, and operational use of this unique aircraft that played a key role in the evolution of German airborne warfare.

One of the glider's chief advantages over conventional paratroopers—clearly explained by Page—was its ability to land troops as a single, cohesive unit precisely where they were needed. Paratroopers dropped from transport aircraft were frequently scattered by wind, terrain, and flak, delaying the concentration of force. In contrast, the DFS 230 could deliver an entire squad directly onto a target with relative silence and precision. This tactical advantage was especially critical in early-war operations such as the capture of the Belgian fortress of Eben-Emael in 1940, where gliders landed troops directly on top of the fort.

Page's comparison of the DFS 230 to its Allied and Axis counterparts is concise but informative. The German glider was smaller and more maneuverable than the British Horsa or the American Waco CG–4A, though it sacrificed payload capacity. Whereas Allied gliders could carry heavy equipment such as jeeps and artillery, the DFS 230 was limited to 9-10 troops or light cargo, making it best suited for surgical strikes rather than mass logistics. Compared to the Japanese Ku8 and Ku-7, the DFS 230 stood out for its operational use in daring and high-risk missions—something the Japanese glider program rarely achieved.

Page devotes ample space to the varied combat applications of the DFS 230. In addition to its use in airborne assaults during the invasions of Belgium, Crete, and operations in North Africa and the Eastern Front, the book discusses the glider's later role in transporting supplies, ammunition, and spare parts to isolated German units. By 1943–44, the glider's combat value had waned, but the Luftwaffe still relied on it for resupply missions to encircled garrisons, such as those in the Caucasus and later in East Prussia. The desperate use of such a small-capacity vehicle for vital logistics illustrates the increasingly grim conditions of the Wehrmacht's retreating forces. Of course, the use of gliders requires localized air superiority, if not air supremacy. As the war progressed, the Allies had control of the skies and the Germans did not. So, the Allies could mount massive air assaults with gliders while the Axis powers could not.

Throughout the book, Page includes first-person anecdotes from glider pilots and paratroops, enriching the narrative with human detail. His meticulous research into each major operation, including glider serial numbers, unit deployment, and tactical results is commendable and provides valuable reference material for enthusiasts and scholars alike.

However, the book's narrative structure occasionally undermines its strengths. The writing feels stiff and fragmented at times, lacking the engaging flow that might bring the broader story to life. Despite this, the photography is excellently curated, clearly reproduced, and thoughtfully captioned, offering readers a visual understanding of the glider's role and design.

In summary, *DFS 230 Combat Glider* is an insightful and well-researched study of a key Luftwaffe innovation. Though gliders were eventually made obsolete by helicopters and modern airmobile doctrine, Page's work preserves their unique place in airborne history.

Gary Connor, docent, National Packard Museum, Cortland OH

◆◆◆◆◆◆

Far Beyond the Lines: A Story of Strategic Aerial Reconnaissance in the First World War. By Friedrich Wilhelm Radenbach. Reno NV: Aeronaut Books, 2025. Illustrations. Photographs. Maps. Appendices. Index. Pp. 281. $59.99 paperback. ISBN: 978-1-964637-26-6

Radenbach's wartime memoir of strategic aerial reconnaissance received a superb English translation and scholarly expansion by Adam M. Wait. The result is a deeply enriching work that not only brings Radenbach's rare, first-hand account into accessible form, but also situates his experiences within the broader context of the German air effort during the First World War.

A long-range reconnaissance pilot with Flieger-Abteilung 23, Radenbach originally penned *Weit im Rücken des Feindes* in 1938. In this new edition, Wait presents the work with expanded annotations and carefully restored material, offering readers a rare and vivid glimpse into the vital, yet often overlooked, world of strategic reconnaissance missions deep within enemy-held territory. Unlike the more celebrated fighter-pilot memoirs of the era, this book highlights the indispensable contributions of the *Arbeitsflieger*—the dedicated working pilots, "quiet heroes"—whose arduous missions, flown through hostile skies, gathered the intelligence that shaped the course of operations at the highest levels of command.

This annotated translation is methodical and thoughtful. Part I presents Radenbach's narrative in vivid, highly readable prose, capturing the exhilarations, technical challenges, and somber reflections of a reconnaissance pilot. Wait's decision to restore omitted sections from Radenbach's original manuscript, along with judicious corrections to chronology and narrative flow, ensures that the reader benefits from both authenticity and coherence.

Part II, the extensive "Commentary," elevates the volume significantly beyond the realm of mere memoir. Wait reconstructs the operational history of Flieger-Abteilung 23 from 1917 to 1918 using a variety of archival sources, including aerial photographs, official German documents, and the writings of Radenbach's observer, Alfred Kuermann. The Commentary's detailed target analyses, cross-referencing with broader Western Front operations, and visual documentation bring new understanding to the essential, but often overlooked, role of strategic aerial reconnaissance.

Visually, the book is exemplary. With over 300 illustrations, including photographs drawn from little-known archives and at least 50 maps, the volume provides an impressive visual counterpart to the text. Readers can trace not only Radenbach's individual missions, but also the larger movements of armies and the vital logistical networks he was tasked with observing.

Among the book's many strengths are the rich appendices that significantly enhance its research value. These include a comprehensive roster of Flieger-Abteilung 23 aircrew, an annotated catalog of surviving reconnaissance photographs, and a technical note on Rumpler aircraft development. Together, they offer vital tools for future researchers, illuminating the personnel and operational and technological frameworks underpinning German aerial reconnaissance. The final appendix, a study of the pioneering *Reihenbildner* sequential camera system, further deepens the reader's appreciation of how advances in aerial photography critically supported the strategic missions described throughout the book. Collectively, these materials complement and extend the main narrative, establishing *Far Beyond the Lines* as a foundational reference work for aviation historians.

In sum, this is a masterful and necessary addition to the literature of WWI aviation. Wait has not only preserved a unique primary source but has greatly enhanced it, providing a layered, insightful, and beautifully presented work. It is highly recommended for aviation historians, scholars of the First World War, and anyone with an interest in the pioneering spirit of early airmen.

Carl J. Bobrow, Quondam Alfred Verville Fellow, National Air and Space Museum

◆◆◆◆◆◆

Spitfire Ground Crew Under Fire: An RAF 'Erk's' War from the Battle of Britain to D-Day and Operation Bodenplatte. By Joe Roddis with Mark Hiller. Barnsley UK: Air World, 2025. Photographs. Pp. 152. $39.95 paperback. ISBN: 978-1-39905986-6

This is a compelling and deeply personal memoir that fills a long-neglected gap in the history of the Second World War. Told through the eyes of Joe Roddis, an RAF ground crewman who served from the earliest days of the war through the early Cold War era, this book shines a much-needed spotlight on the unsung heroes behind the scenes—the "erks" and "fitters" who kept the aircraft flying and the air war effort alive. For those unfamiliar with RAF slang, Roddis helpfully explains that "erk" was a nickname for low-ranking aircraftmen—the grunts of the air force—while "fitter" referred to the skilled technicians who handled mechanical repairs. These men, though rarely mentioned in glamorous airwar narratives, were vital to every successful mission.

Roddis's extraordinary career provides the backbone for this narrative. He witnessed the full arc of the war, from the desperate early days in Britain through to the final victory in Europe, and even into the dawning years of the nuclear age. But what makes this book truly resonate is its grounded, human voice. Roddis's memories have been expertly shaped into a flowing narrative by a knowledgeable ghostwriter (Hillier) who draws on personal interviews to preserve the veteran's tone, humor, and reflections without losing sight of the larger historical framework. The book is comprised of Roddis's memories interspersed with Hillier's additional comments. This format adds excellent context and makes the book informative to the novice historian.

Unlike many traditional military histories that focus primarily on operations and strategy, *Spitfire Ground Crew* offers a rich account of daily life at the airfields. Readers learn about the often-overlooked realities of living conditions, the endless struggle with food quality, the cramped sleeping quarters, and the fraternal relationships that developed in these high-stress environments. Roddis vividly recounts the camaraderie, boredom, and moments of terror that defined life on the ground. This texture is what makes the book so valuable: it captures the full human experience of war, not just combat.

However, readers looking for detailed technical explanations may be left wanting. There is little discussion about the practical challenges of maintaining complex engines such as the Rolls-Royce Merlin under field conditions. For example, while American ground crews famously struggled with the B–29's engines, this book does not delve into how the RAF managed to keep its own high-performance aircraft operational under similar constraints. These omissions, though noticeable, do not detract from the book's overall power and appeal.

One of the most touching aspects of the book is its portrayal of the close bonds formed between ground crews and the pilots they supported. In units with a strong presence of New Zealanders and Canadians, whose more relaxed military cultures fostered informality, these bonds could be deeply personal and lasting. Roddis conveys this connection with affection and pride.

In sum, this book is a remarkable and warmly recommended read. It offers a refreshing and deeply human perspective on the air war over Europe. For anyone seeking to understand what it really took to win the skies—beyond the dogfights and aircrew—this book is essential reading.

Gary Connor, docent, National Packard Museum, Cortland OH

◆◆◆◆◆◆

Seaplane Station Windau 1916–1918. By Michael Schmeelke. Reno NV: Aeronaut Books, 2025. Photographs. Maps, Illustrations. Appendices. Pp.182. $59.99 paperback. ISBN: 978-1-964637-29-7

This book is a carefully constructed account of one of the Imperial German Navy's most consequential seaplane installations on the Eastern Front. As a companion volume to Schmeelke's earlier work on Zeebrugge, this study shifts focus from the North Sea to the lesser-known, but strategically vital, Baltic theater. Here, in the contested waters off Courland, Windau emerged as a critical node in Germany's naval aviation network—its aircraft flying reconnaissance, bombing, and torpedo missions in support of both coastal defense and offensive operations, most notably the Battle of Oesel.

The book unfolds chronologically, establishing first the maritime-strategic posture of the Kaiserliche Marine in the Baltic and the embryonic state of its naval aviation assets. Drawing on war diaries, contemporary dispatches, and personal reports, Schmeelke reconstructs the transformation of Windau from a marginal harbor into a fully operational seaplane station. His treatment of the logistical improvisation required—from initial deployment aboard aircraft mother ships such as *Santa Elena*, *Answald*, and *Glyndwr*, to the establishment of permanent runways and hangars—is particularly strong, illustrating the adaptive ethos of German naval aviators in an environment of persistent climatic and material hardship.

Windau's operational role was far from peripheral. It served as a forward base for aerial reconnaissance over the Gulf of Riga and the Baltic islands, coordinated bombing runs on Russian supply depots and airfields, and hosted aircraft capable of torpedo attack—a mission set rarely emphasized in earlier literature. The inclusion of multiple after-action reports offers a rare glimpse into tactical planning and mission execution at the squadron level. These accounts, supported by mission maps and flight logs, convey the evolving reach and purpose of the Windau detachment which, by 1917, had become a reliable instrument of sea control and interdiction.

The 267 photographs and maps, many drawn from private collections and seldom-seen archives, are not mere embellishment—they serve as a primary evidentiary framework for understanding personnel, equipment, and deployment configurations. Of particular value are the 18 full-color aircraft profiles, which document the markings, paint schemes, and airframe modifications of key seaplane types operating from Windau. These include the Brandenburg W series, FF33 variants, and rare Rumpler floatplanes. For the aviation historian or modeler alike, this section alone justifies the book's reference utility.

Also notable is the rigor with which Schmeelke compiles the rosters of aviators, aircraft, and assigned landplanes, organized by type and serial number. These listings are more than taxonomic—they provide a granular picture of aircraft flow, attrition, and reassignment over time. Such material is essential for researchers tracking specific machines or reconstructing deployment histories and further situates *Windau* within the broader operational mosaic of the Marine-Flieger units.

The book's tone is appropriately restrained. Schmeelke avoids sensationalism or overreach, allowing the documents and photographic evidence to speak on their own terms. His collaboration with long-time naval aviation researchers such as Alexander Notopol and veterans such as Wolfram Eisenlohr lends the work additional credibility and depth.

In sum, *this* is a serious, documentary-rich monograph that restores this overlooked base to its proper place in the history of First World War naval aviation. It is essential reading for those studying German seaplane operations, the Baltic theatre, or the evolving intersection of aviation and maritime power in the early twentieth century.

Carl J. Bobrow, Quondam Alfred Verville Fellow, National Air and Space Museum

◆◆◆◆◆◆

Rise of the Mavericks: The U.S. Air Force Security Service and the Cold War, 1948-1979. By Philip C. Shackleford. Annapolis MD: Naval Institute Press, 2023. Diagrams. Photographs. Notes. Bibliography. Index. Pp. xxiv, 212. $34.95. ISBN: 978-1-68247-882-0

Shackleford, the library director for South Arkansas Community College, became interested in the USAF Security Service as a college student. On the way to earning master's degrees in history and library science, he wrote his theses on that organization. He has expanded that effort into this book. The Naval Institute Press published it as part of its Transforming War series.

Much of the Security Service's operations remain classified. Those who served in the Security Service generally have remained tight lipped about their experiences. Shackleford chose to closely examine the emergence of the Air Force's own electronic-intelligence capability after the creation of the Department of Defense in 1947.

The Air Force initially inherited former Army ground stations in assorted overseas locations. As might be expected, interservice rivalries prompted battles for controlling electronic intelligence. Several farsighted Air Force leaders realized that the Security Service needed to maintain its independence to provide timely operational intelligence. This conflict between national requirements and operational needs resulted in the Security Service establishing its headquarters in Texas rather than in the greater Washington DC area.

The Security Service's contributions to the success of Air Force operations in the Korean War as well as its support of Strategic Air Command reinforced its relatively independent status. At the time, the National Security Agency emerged as the clearinghouse for electronic intelligence. Air Force leaders insisted, however, that they required some independence to meet their needs.

Whereas the service initially focused on ground stations, airborne platforms became increasingly important by the middle 1950s. In fact, much of what has been written about the Security Service concerns the loss of aircraft during the Cold War. Shackleford notes the impact of the *US News and World Report* March 1993 cover story concerning peacetime aerial collection flights.

As they had in Korea, the Security Service assisted Air Force operations in Vietnam. Shackleford specifically mentions Operation *Bolo*. The 8th Tactical Fighter Wing, led by Robin Olds, ambushed North Vietnamese MiG–21 fighters through the use of an ambitious ruse. Using call signs and electronic devices, Olds' F–4 Phantoms appeared to enemy ground controllers as less-nimble F–105 Thunderchiefs. Security Service personnel on board a collection aircraft notified Olds as to the MiGs' location and intentions. With that advantage, Olds and his cohorts downed seven MiGs in 12 minutes.

Readers interested in Security Service operations will be disappointed. This book is best suited for leaders seeking a case study on how a smaller organization managed to maintain a degree of autonomy while under pressure from powerful competitors.

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

◆◆◆◆◆◆

Bombs Away: A B–17 Pilot's "Small" Part in a Big War. By Hans P. Smith. Melbourne FL: HP Wordsmith Publishing, 2024. Photographs. Maps. Diagrams. Bibliography. Index. Pp. 247. $21.95 paperback. ISBN: 979-9920733-0-0

This is a biography of 1st Lt. Herbert W. Small, a B–17 pilot of the 544th BS, 384th BG, Eighth Air Force, whose bomber was shot down by flak on April 27, 1944. It is written by his great-nephew, who grew up hearing of Lt. Small from family members. Desiring to learn more of his great-uncle's service, selflessness, and sacrifice, Smith researched original sources and interviewed numerous family members, friends, and veterans to understand not only Small's service, but also the pre-World War II American society that shaped his motivations and values. In particular, Smith relates the international situation and American politics of the 1930s, the background of the B–17, the concept of strategic bombing, the Eighth Air Force, training, deployment, combat flying, flak, fighters, and life at the 384th's base of Grafton-Underwood.

A replacement for the group's heavy losses in the big aerial battles of late 1943, Small flew the first of 27 missions on November 16, 1943. He participated in the crucial operations of early 1944, when the Eighth Air Force broke the back of Luftwaffe resistance. On the fateful day, according to Freeman's *War Diary* (1990), the Eighth dispatched 476 bombers against V-1 sites around the Pas de Calais and Cherbourg. The 384th's assigned target was near Sottevast, France. Hit just after bombs away, Small's plane caught fire, banked out of formation, and dove into the ground. There were no survivors. His plane was one of only four losses the Eighth Air Force suffered that day. He is buried in the American Cemetery in Normandy.

Like Peter Usher's *Battle of Britain Spitfire Ace* (2024), similarly about an airman who did not return, *Small Part in a Big War* portrays the significant impact of Small's loss on his family, and by extension, all Gold Star families of World War II. Smith lets his sources tell the story, lending authenticity to his account. Extensive eyewitness quotes from 384th BG combat crew describe key aspects of the air war. The style is conversational and personable, with Smith often inserting himself into the narrative. This book is a great companion to Donald Miller's *Masters of the Air* (2006), about the personnel of the Eighth Air Force in World War II. The memoirs (*Screaming Eagle*, 1990) of Col. Dale O. Smith, who commanded the group while Small flew his missions, provide perspective. Decker (2005), Owens (1990), and Fayers-Hallin and Bland (1993) all exhaustively detail the wartime 384th.

Most of the photos are from private collections or bomb group memorial associations. They depict Small's childhood, life on the base, B–17s, bomber crews, and combat preparations. Maps and diagrams depict the base and the village of Grafton-Underwood. There is an organizational chart of the Eighth Air Force.

At least one passage seems to be cut off for space considerations, and a several photos appear twice. These are small matters, however. Smith's vivid depiction of his great-uncle's service will enable those with no prior knowledge of the air war over Europe to understand its human impact. This book is recommended reading.

Steven Agoratus, Hamilton NJ

◆◆◆◆◆◆

PROSPECTIVE REVIEWERS

Anyone who believes he or she is qualified to substantively assess books for the journal should contact our Book Review Editor for a list of books available and instructions. The Editor can be contacted at:

Col. Scott A. Willey, USAF (Ret.)
46994 Eaker St
Potomac Falls VA 20165
Tel. (703) 409-3381
e-mail: **scottlin.willey@gmail.com**

Compiled by
George W. Cully

January 8-11, 2026
The **American Historical Association** will hold its next annual meeting at the Hilton Chicago Hotel and the Palmer House in Chicago, Illinois. For registration and program details, see the Society's website at Annual Meeting - AHA.

March 11-13, 2026
The **American Astronautical Society** will offer its 63rd annual Goddard Space Science Symposium. For more details as they become available, see the Society's website at Goddard Space Science Symposium | American Astronautical Society.

March 26-29, 2026
The **Society for Military History** will offer its annual meeting in Arlington, Virginia. For more details as they become available, see the Society's website at 2026 Annual Meeting | The Society for Military History.

April 13-16, 2026
The **Space Foundation** will host its 41st annual Space Symposium at the Broadmoor Hotel in Colorado Springs, Colorado. It's billed as "the premier event uniting global space professionals from all sectors." For registration and a program of events, see the Foundation's website at 40th Space Symposium - Registration is now open!

April 16-19, 2026
The **Organization of American Historians** will hold its annual conference at the Philadelphia Marriott Downtown Hotel in Philadelphia, Pennsylvania. The theme of this year's gathering is "Re-thinking American History at 250." For further details, see the Organization's website at OAH | 2026 OAH Conference on American History.

July 13-16, 2026
The **History of Science Society** will co-host its 2026 meeting in partnership with the European Society for the History of Science. Their meeting is set to be held at the University of Edinburgh in Edinburgh, Scotland, and the conference theme will be "Shifting Perspectives: Plural Worlds, Contested Sciences." For further information, see the Society's website at 2025 HSS Annual Meeting - History of Science Society.

September 16-19, 2026
The **National Council on Public History** will cohost its annual meeting with the American Association for State and Local History at the Rhode Island Convention Center in Providence, Rhode Island. The theme of this year's meeting will be "The Work of Revolution." For more information as it becomes available, see the Council's website at 2026 Annual Meeting | National Council on Public History.

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: warty0001@gmail.com

Guidelines for Contributors—We seek quality articles—based on sound scholarship, perceptive analysis, and/or firsthand experience—which are well-written and attractively illustrated. If a manuscript is under consideration by another publication, the author should clearly indicate this at the time of submission. Manuscripts should be prepared according to the Chicago Manual of Style (University of Chicago Press). Use civilian dates (month, day, year) and either footnotes or endnotes may be used. Because submissions are evaluated anonymously, the author's name should appear only on the title page. Authors should provide on a separate page brief biographical details, to include institutional or professional affiliation and recent publications, for inclusion in the printed article. Pages, including those containing illustrations, diagrams or tables, should be numbered consecutively. Any figures and tables must be clearly produced ready for photographic reproduction. The source should be given below the table. Notes should be numbered consecutively through the article with a raised numeral corresponding to the list of notes placed at the end. Submissions may be submitted either by mail or via email. Email is generally the norm. While Microsoft Word is the most common, any word processor may be used. Do not "Track Changes." Photographic illustrations are greatly appreciated. There is no restriction on the file format used. There is no standard length for articles, but 4,500-5,500 words is a general guide. Manuscripts and editorial correspondence should be sent to Richard Wolf, Editor, c/o Air Power History, 70 Shannon Way, Upton, MA 01568, e-mail: airpowerhistory@yahoo.com.

Answer: Corporal Vernon L. Burge became the first enlisted aviator in the U.S. Army on June 14, 1912 by passing the Federation Aeronautique International (FAI) test and receiving Aviation Certificate 154. Burge began his military career in 1907 as a mechanic with the U.S. Army Signal Corps, the branch responsible for early aviation activities. In 1910, he served as the mechanic on the Signal Corps first airplane. While serving in the Philippines in 1912, Burge received flight instruction from Lieutenant Frank P. Lahm and successfully soloed in a Wright Model B aircraft. When the War Department learned that an enlisted man had been trained to fly, it initially objected, stating that "It is not the policy of the War Department to train enlisted men in flying aeroplanes ..." In July 1914, Congress would authorize the training of enlisted pilots in 1914. Burge was commissioned in 1917. Burge continued his career in aviation and eventually retired in 1942 as a Colonel after logging 4,667 hours and 55 minutes of flight time.

Use the following links to learn more.

Vernon Burge:
https://media.defense.gov/2013/Nov/26/2001329858/-1/-1/0/AFD-131126-045.pdf
Early Army Aviation by Col V. L. Burge:
https://media.defense.gov/2013/Nov/22/2001329868/-1/-1/0/burge%20early%20history.pdf
Enlisted Aviators:
https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/3488780/stripes-and-wings-enlisted-pilots/
The Philippine Air School:
https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/197511/philippine-air-school/

New History Mystery

by Dan Simonsen

This Issue's Quiz:

Question: In the early years of U.S. military aviation, both officers and enlisted men were trained to fly. At that time, what would later become the U.S. Air Force began as part of the U.S. Army Signal Corps, responsible for military communications and early flight operations. While flying was primarily an officer's role, over 4,000 enlisted earned their pilot wings. With over 4,000 enlisted pilots, someone has to be the first. Who was the U.S. Army's enlisted pilot?

Air Force *Historical* Foundation
P.O. Box 405
Mechanicsville, MD 20659

To: Air Force *Historical* Foundation
P.O. Box 405
Mechanicsville, MD 20659

Visit Us Online at:
www.afhistory.org

Know the Past,
Shape
the Future

AIR FORCE HISTORICAL FOUNDATION MEMBERSHIP FORM

NAME____________________ PHONE ________________ E-MAIL________________

STREET ADDRESS ____________________ CITY________________ STATE______ ZIP______

❑ **Associate Membership ($30/year) (on-line magazine access)** (Visit our Web site at www.afhistory.org)

❑ **Sustaining Membership ($50/year)**

❑ **Gift Membership ($50/year)**

❑ **President's Circle ($1,000) Benefactor ($500) Patron ($250) or Contributor ($100)**

GIFT FOR (NAME)____________________

ADDRESS ____________________

CITY________________ STATE______ ZIP______

* Non-US recipients please add $10.00 for postage (See Web site for additional membership options)

❑ **Check enclosed, payable in US Funds to Air Force *Historical* Foundation**

❑ **Please charge my credit card (VISA/MasterCard/Discover)**

CARD NUMBER: ____________________ EXPIRATION DATE: ________

SIGNATURE: ____________________ DATE: ________

Send form, along with your remittance to:
Air Force *Historical* Foundation
P.O. Box 405
Mechanicsville, MD 20659