

SUMMER 2026 - Volume 73, Number 2
WWW.AFHISTORY.ORG

Journal of the Air Force Historical Foundation



know the past

.....*Shape the Future*

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DeWITT S. COPP

A FEW GREAT CAPTAINS

It was known as the Army Air Corps from 1926-41, and it was in many ways a golden age. The technology of flight was advancing in great leaps, and it was glamorous. Aces of the World War, such as Eddie Rickenbacker and Frank Luke, were heroes still, and then there were the new faces—Charles Lindbergh, Jimmy Doolittle, Horace Hickam and the like. Also, in the Air Corps it was energetic and farsighted young officers who envisioned a new type of war that would be dependent on airpower. This vision was in direct contradiction to that of the ground officers who actually ran the army. Sparks flew.

Pete Copp tells this story with unusual verve and insight. His research was prodigious, and he speaks eloquently of the times—dominated by the bang of the Roaring Twenties and giving way to the kaboom of the Great Depression. It was a feast and famine environment for most of America, but for the Air Corps it was mostly famine. Technology nonetheless moved ahead as rickety biplanes of wood and fabric gave way to sleek monoplanes of metal. Speed went from the Wright brothers blistering 7 mph over the windy beach at Kitty Hawk to over 400 mph three decades later. Aircraft would dominate the world war soon to erupt.

As for people, Billy Mitchell cast a long shadow over the early years of this story, and his disciples carried on with those ideas afterwards: Hap Arnold, Carl Spaatz, Ira Eaker, Frank Andrews and even Ben Foulois—who was no friend of Mitchell's but who shared the same hopes for the air weapon. It is all here in this wonderful classic.



ISBN 0-939009-29-3



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DeWitt
S. Copp

A FEW GREAT CAPTAINS



A FEW GREAT CAPTAINS

DeWitt S. Copp

The Men and Events That Shaped the
Development of U.S. Air Power

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!



Order of Ceremony

AIR FORCE HISTORICAL FOUNDATION

AWARDS BANQUET 2026

1830-1930 SOCIAL HOUR

Welcome

Maj Gen John Barry, USAF Retired, Foundation Chair

Posting of the Colors (USAF Honor Guard)

National Anthem (USAF Band String Quartet)

Sponsor Recognition

Banquet Sponsor, General Atomics, Aeronautical Systems, Inc.

Lockheed Martin

Johnson Brothers

Snake's Predator Group

Symposium Sponsor: Air Force Association

Introduction of Distinguished Guests

Lt Col Dik Daso, USAF (Ret), Ph.D.

Executive Director, AFHF

AFHF President's Advisory Council

Mr. Ron Kaplan (Museums Liaison), Joe Burke (Space Advisor),

David Byrd (Media), Mike Devine (Student Awards),

Tobias Naegele (ASFM Editor), Bill Strandberg (JOAT),

Richard Wolf (JAFHF Editor), Paul "Abbie" Hoffman (Incoming JAFHF Editor),

Maj Teddy Givler (DFH, Space), David Anderson (MA, ANG Historian)

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Lt Col John Terino, USAF, Retired, Ph.D.
Lt Col Daniel Jackson, USAF, Ph.D.
Capt Jared "Swiss" Del Orfano, USAF

Office Manager: Mrs. Angela Bear

Special Recognition: 25 years as Office Manager for AFHF

Honoring our Service Heritage

Brig Gen Paul W Tibbets, IV, Grandson of legendary WW II Pilot, Brig Gen Paul W. Tibbets, Jr.
Robert B. Arnold, Grandson of General of the Air Force, Henry "Hap" Arnold and Donald Douglas
Jonna Doolittle Hoppes, Former AFHF Board President and Granddaughter of
Gen James H "Jimmy" Doolittle

Tonight's Table

The Summer Special Journal, *The Unmanned Edition*, 2026
(includes Program for Symposium and Banquet)
AFHF 2026 commemorative coin: *Always Looking Up*
Wine selection provided by Johnson Brothers
Celebrating 250 years of American Independence

AFHF Change of Command, Foundation Chair

Officiating: AFHF Board President, Mr. Robert B. Arnold
Outgoing, Maj Gen John Barry
Incoming, Gen James Slife

Dinner Service

Please charge your glasses, one with water and one with wine

We honor and remember :

Mrs. Natalie Crawford

Renowned Long-time Director of Project Air Force (RAND)

Maj John "Lucky" Luckadoo

Last surviving pilot of the "Bloody 100th" Bomb Group

Brig Gen Carl Reddel

Former Chair, USAFA Department of History

Mrs. Katy Flosi

Wife of retired CMSAF David Flosi

Astronaut Jim Lovell

Commander of the Apollo 13 mission

Lt Col Harry Stewart Jr.

Tuskegee Airman, Distinguished Flying Cross recipient, 332nd Fighter Group

Lt Col George E. Hardy

Last surviving member of the Tuskegee Airmen who
flew combat missions during WWII in Europe, Korea, and Vietnam

CMSgt Rod Stewart

Legendary Director of the USAFA Cadet Drum & Bugle Corps

Arnold Air Society Cadet 1st Lt Blake Buterbaugh

AFHF member and Det 157 AFROTC student

Lt Gen Robert “Bob” Beckel

USAFA 1959, 300-plus combat missions in Vietnam,
Thunderbird, Commandant of Cadets, 13th AF/CC

Gladys West

Mathematician at the U.S. Naval Weapons Laboratory
played a critical role in the development of GPS

Russell W. “Russ” Meyer, Jr.

NAHF Enshrinee and aviation pioneer

TOASTS:

With water

“To our members and family now departed”

With wine

“To the Foundation”

Special 509th BW Presentation

Col (Retired) Keith Butler, former 509th Bomb Wing Commander
and Mr. Rick Herter

Blessing and Meditation

DINNER IS SERVED

FIRST COURSE

Burrata and Heirloom tomato salad with Prosciutto

MAIN COURSE

*Herb-Crusted Organic Tenderloin and Black Garlic Chilean Sea Bass with Red Wine Jus
wild arugula, aged balsamic vinaigrette and mini French baguette
truffle mashed potatoes, roasted purple carrots, and sautéed French beans*

VEGAN VEGETARIAN OPTION

*Stuffed Roasted Baby Peppers filled with saffron risotto, and toasted
Almonds with Lemon Vinaigrette*

DESSERT

*Raspberry-Chocolate Marquise flourless Belgian chocolate cake
layered with mousse and fresh raspberries*

*Coffee and Tea Service gourmet roasted coffees and herbal teas
with cream, sugar and fresh cut lemons*

Wine selection

COMFORT BREAK

Guest Speakers

Dr. Jeremy Kinney, National Air and Space Museum

Associate Director of Research and Curatorial Affairs

General Ronald R. Fogleman, USAF Retired

15th Chief of Staff of the US Air Force from 1994 to 1997

Commanding General of the US Transportation Command from 1992 to 1994

2015 AFHF Spaatz Award Recipient

2023 AFHF President's Integrity First Medal

Recognition of AFHF Award Recipients

AFHF Student Awards

AFHF Literary Awards

Outstanding JAFHF Article

Major Korey F. "Bounce" Lantes

REFORPAC's Pacific Playbook: Survive, Surge, Sustain and Synchronize to Win—
JAFHF Fall 2025

Maj Korey F. Lantes is an experienced Air Force officer with 12 years of service as an Air Battle Manager. He is a Master AETC instructor and has served as an Instructor and Evaluator ABM on the E-8C JSTARS and at the ABM Schoolhouse. Maj Lantes has deployed to multiple theaters, including CENTCOM and PACOM, with over 750 combat hours supporting various operations. He is currently pursuing his Ph.D. in Military History through the Air Force Advanced Academic Degree program at Kansas State University.

AIRPOWER HISTORY BOOK PRIZE

For editorial excellence

John Andreas Olsen

Air Power Pioneers: From Billy Mitchell to Dave Deptula (NIP, 2023)

John Andreas Olsen is a professor at the Swedish Defence University, where he serves as Head of the Department of War Studies. He retired from the Royal Norwegian Air Force in 2025 with the rank of colonel after thirty-eight years of service. His final assignment was at NATO HQ in Brussels, where he led and contributed to NATO's Net Assessments and published Routledge Handbook of NATO for the Alliance's seventy-fifth anniversary.

Professor Olsen is a Non-Resident Senior Fellow of the Mitchell Institute for Aerospace Studies, Fellow of the Royal Swedish Academy of War Sciences, member of the RUSI Journal editorial board, and advisory board member of the U.S. Air University's *Æther: A Journal of Airpower and Spacepower*. Colonel Olsen's previous assignments include service as Norwegian Defence Attaché to the United Kingdom and Ireland; Director of Security Analyses in the Norwegian Ministry of Defence; Deputy Commander and Chief of the NATO Advisory Team at NATO Headquarters, Sarajevo; and Dean of the Norwegian Defence University College. Olsen is a graduate of the German Command and Staff College and has served both as liaison officer to the German Operational Command in Potsdam and as military assistant to the Norwegian Embassy in Berlin. He has a doctorate in history and international relations from De Montfort University, a master's degree in contemporary literature from the University of Warwick and a master's degree in English from the University of Trondheim.

CHAPTER AUTHOR AFHF MEMBERS

DICK HALLION, DIK DASO, RICHARD MULLER, PHIL MEILINGER,
BEN LAMBETH, JOHN ANDREAS OLSEN

SPACE HISTORY BOOK PRIZE

For editorial excellence

David C. Arnold

Space Force Pioneers: Trailblazers of the Sixth Branch (NIP 2025)

David Christopher Arnold is a prominent figure in the field of space leadership and strategy. He is the author of "Space Force Pioneers: Trailblazers of the Sixth Branch," a book that delves into the biographies of key space leaders who have made significant contributions to military space. Arnold's work is a valuable resource for understanding the evolution of the United States Space Force and the leadership styles of its pioneers. His expertise in space and missile strategy, along with his experience as a colonel in the U.S. Air Force, makes his contributions to the field of space leadership particularly noteworthy.

CHAPTER AUTHOR AFHF MEMBERS

RICK STURDEVANT, JOHN TERINO, DAVID ARNOLD, COL. MARGARET "MEG" MARTIN

AFHF President's Medal for Service:

AVIATION AND SPACE ARTIST, RICK HERTER

for Exceptionally Meritorious Contributions to the Foundation and Excellence in Artistic Documentation of Aviation History "Artifex in Perpetuum" 2026
Rick is hereby declared the AFHF "Air and Space Artist for Life"

Unit Awards

The **James H. "Jimmy" Doolittle Award** recognizes an active Air Force or Space Force unit for gallantry, determination, esprit de corps, and superior management of joint operations in accomplishing its mission under difficult and hazardous conditions in multiple conflicts.

The AFHF **Superior Air National Guard Unit Award** recognizes an ANG unit for gallantry, determination, esprit de corps, and superior management of joint operations in accomplishing its mission under difficult and hazardous conditions in multiple conflicts.

"JIMMY" DOOLITTLE AWARD

509th Bomb Wing, Whiteman AFB, MO



AIR NATIONAL GUARD AWARD

131st Bomb Wing, Whiteman AFB, MO



June 21, 2025, Operation MIDNIGHT HAMMER saw seven B-2 Spirit deliver an overnight strike on three Iranian nuclear facilities, the largest B-2 operational strike in U.S. history. In a timeline of just weeks, members of the 509th and 131st Bomb Wings turned strategic planning of an unprecedented operation into global execution.

"The success of this mission demonstrates the precision and potency of a combat-ready Air Force and strategic innovation," USAF Secretary Dr. Troy E. Meink said. "The warfighting capability of the Total Force Airmen and the B-2 Spirit was tested with the world watching, and Team Whiteman performed flawlessly."

Col Joshua Wiitala, current 509th Bomb Wing Commander

Col Matthew Howard, current 131st Bomb Wing Commander (Deputy Commander during OMH)

Special Presentation to the 509th Bomb Wing

Operation Midnight Hammer Painting by Mr. Rick Herter

Individual Awards

The **Gen Carl A. “Tooey” Spaatz Award** is given in recognition of an individual who has made significant contributions in their lifetime to the making of Air Force history.

Col James “Snake” Clark, USAF (Ret.), SES



Snake was born in Carney, New Jersey, is a 1973 graduate of the Catholic University of America Air Force Reserve Officer Training Corps (AFROTC) and who served as a USAF officer and F-4 pilot, retiring at the rank of colonel in 2001. He has been described as one of the most colorful, innovative, and risk-taking U.S. Air Force (USAF) warfighters in the service's 70-year history. He served in the Senior Executive Service. In a career spanning five decades, he enabled numerous tactical and strategic capabilities which shaped our modern-day USAF. His work includes building and standup of the Warrior Preparation Center (WPC) – the world's premier wargaming, modeling, and simulation center. Leading the USAF's first mission planning division, his implementation of a system program office and shrewd identification and canceling of systems that did not work led to operational success for its first use in support of Operation EL DORADO CANYON. His leadership as USAF Director of Intelligence, Surveillance and Reconnaissance (ISR) Modernization and Infrastructure capitalized on his skills as one of the Defense Department's leading experts in the fields of mission planning, commercial imagery, unmanned aerial vehicle (UAV) applications, computer modeling and simulations and as the inventor of EAGLE Vision. Snake forever changed airpower through his determined advocacy in the early stages of the Predator UAV/RPA platform. His efforts brought innovation that changed the calculus involved in combat operations for the USAF, sister services, allies, and perhaps our adversaries and competing powers. He is rightfully known as “The Godfather of the MQ-1 Predator.”

The **Gen John W. “Jay” Raymond Award** is given in recognition of an individual who has made significant contributions in their lifetime to the making of Air Force Space and Space Force history.



The Honorable Mike Rogers

Representative Rogers represents the third district of Alabama and has served as the Chairman of the House Armed Services Committee since January 2023. Prior to that, he served as the Ranking Member of the Committee from 2021 to 2023. Nationally, Rep. Rogers has built a reputation as a recognized leader on national security and a strong advocate for national defense. As Chairman of the Armed Services Committee, he works to ensure that our military is properly funded, that our warfighters have the resources and weapons they need to succeed on current and future battlefields, and that the military is focused on deterring and combating threats coming from China and our other adversaries. During his tenure on the House Armed Services Committee, Mike saw a need to realign our resources and efforts toward countering our adversaries in space. With bipartisan support in Congress, Mike initiated and oversaw the creation of the U.S. Space Force.

Concluding Words Air Force Historical Foundation Chair General James C. Slife



USAF Song

Off we go into the wild blue yonder,
Climbing high into the sun;
Here they come zooming to meet our thunder,
At 'em boys, give 'er the gun (give 'er the gun!)
Down we dive spouting our flame from under
Off with one helluva roar!
We live in fame or go down in flame, hey!
Nothing'll stop the U.S. Air Force!



USSF Song

We're the mighty watchful eye,
Guardians beyond the blue.
The invisible front line,
Warfighters brave and true.
Boldly reaching into space,
There's no limit to our sky.
Standing guard both night and day,
We're the Space Force from on high!

AFHF SYMPOSIUM and MUSEUMS CONFERENCE

AFHF SYMPOSIUM PANELS

AFA Headquarters, Pentagon City, 8 AM to 5 PM
1201 S. JOYCE STREET
C6, SECOND FLOOR
ARLINGTON, VA 22202

- 0800-0810 **Administration and Instructions**
Special Thanks to AFA for hosting the Symposium this year
- 0810-0835 **Keynote/Kickoff**
James “Snake” Clark, 2025 SPAATZ AWARD RECIPIENT
LEGACY OF THE PREDATOR
- 0845-0930 **The Early History of Unmanned Aircraft (1910-1975)**
Dik Daso, *The Early Days: Flying Bomb and Radio Dog to Vietnam*
Korey Lantes, *WW II and Early Remote Technology* (AFHF Article Award Recipient)
- 0940-1045 **Transitioning to CCA (2017-2027)**
Moderator: Capt. Jared “Swiss” DelOrfano
Lt Col Troy “Red” Barnes, Chief of Staff, 25th Attack Wing
- 1100-1200 **Unusual Unmanned Museum Objects**
Roger Connor, NASM, *Operation Crossroads HELLCAT*
Jakob Jones, Grissom Air Museum, *The D-21 Supersonic Unmanned Concepts*
- 1215-1300 **Working Lunch**
 So, You Want to be an Editor...
 Book Prize Recipients PLUS
Dik Daso, USAF, ed., *USAF: A Complete History*
John Andreas Olsen, ed. *Airpower Pioneers*
David Arnold, ed. *Space Force Pioneers*
Phil Meilinger, AFHF Publisher
- 1300-1420 **The Birth of the Unmanned Mindset--Early Modern UAVs**
 Mitchell Institute Participants
Lt Gen Dave Deptula, USAF (Ret) 2024 AFHF Spaatz Award Recipient
Maj Heather Penny, ANG (Ret)
- 1430-1530 **Desert Shield/Desert Storm 25 Years On**
Maj Gen John Barry, Foundation Chair
 (Former Military Assistant to Mr. Dick Cheney)
- 1545-1645 **Operation MIDNIGHT HAMMER and Beyond**
Col Joshua M. Pope, Commander, 509th Maintenance Group
Col (Retired) Keith Butler, former 509th Bomb Wing Commander
Col Matthew Howard, current 131st Bomb Wing Commander
 (131st Deputy Commander during OMH)
- 1650-1700 **Summary and Sendoff**

Participants

0810-0835 Keynote/Kickoff Address (James "Snake" Clark)

Colonel James G. "Snake" Clark, USAF (Ret)

"Snake" Clark has been described as one of the most colorful, innovative, and risk-taking U.S. Air Force (USAF) warfighters in the service's 70-year history. He served in the Senior Executive Service. In a career spanning five decades, he enabled numerous tactical and strategic capabilities which shaped our modern-day USAF. Snake forever changed airpower through his determined advocacy in the early stages of the Predator UAV/RPA platform. His efforts brought innovation that changed the calculus involved in combat operations for the USAF, sister services, allies, and perhaps our adversaries and competing powers. He is rightfully known as "The Godfather of the MQ-1 Predator."

Lt Col Dik Daso, USAF (Ret), PhD Dik Daso is the Executive Director of the Air Force Historical Foundation. He earned his B.S. from the USAF Academy in 1981 and his doctorate in history from the University of South Carolina in 1996. Daso flew T-38, RF-4C, and F-15 aircraft during his service. He was assigned to the Air Force Scientific Advisory Board during the visionary New World Vistas S&T study in 1995 and also held the position of Chief, Air Force Doctrine, as a member of the Air Staff in the Pentagon. Daso is former adjunct faculty in the department of history at the University of South Carolina where he taught a variety of courses that focus on the history of technology and science. He retired from the USAF in 2001 and then served at the Smithsonian National Air and Space Museum as the curator of modern military aircraft until retiring from that post in 2012.

Lt. Col. Korey F. Lantes, USAF Korey F. Lantes is an experienced Air Force officer with 12 years of service as an Air Battle Manager. He is a Master AETC instructor and has served as an Instructor and Evaluator ABM on the E-8C JSTARS and at the ABM Schoolhouse. Maj. Lantes has deployed to multiple theaters, including CENTCOM and PACOM, with over 750 combat hours supporting various operations. He is currently pursuing his Ph.D. in Military History through the Air Force Advanced Academic Degree program at Kansas State University.

Capt. Jared G. Del Orfano, USAF Jared Del Orfano is a U.S. Air Force captain with four years of experience as an MQ-9 remotely piloted aircraft pilot operating specialized mission aircraft and commanding flight crews to accomplish a variety of diverse mission sets. He currently serves as a full-time Ohio National Guard pilot. Jared reviews mission requirements, intelligence, and weather information to integrate remote-split operations around the globe. He instructs junior colleagues on aviation tactics, techniques, and procedures and coordinates professional development and a robust unit history program.

Lt. Col. Troy "Red" Barnes, Chief of Staff, 25th Attack Wing Lt Col Barnes is responsible to the Wing Commander for 11 distinct staff functions, providing intent, guidance, and direction to more than 62 members, including active duty, civil service personnel and government contractors. He coordinates, prioritizes, and communicates Wing Commander direction in support of 10 squadrons engaged in MQ-9 mission generation and global mission execution supporting Combatant Commander requirements. Lieutenant Colonel Barnes is a 2007 graduate of East Carolina University and was commissioned through the Reserve Officer Training Corps. He has a diverse background in logistics, contingency, operational, Air Staff, and Joint Staff assignments. He served as Deputy Movement Director for Headquarters, Combined Joint Special Operations Task Force-Afghanistan where he identified and planned for the sustainment and emergent aerial delivery needs of 58 Special Forces Teams. He has led as an MQ-9 Chief of Weapons and Tactics, a Group Executive Officer, the Chief of PACOM and Advanced RPA Strategy at Headquarters, United States Air Force, and Current Operations Action Officer on the Joint Staff. Prior to his current position Lieutenant Colonel Barnes was the Commander for the 20th Attack Squadron, Whiteman Air Force Base, Missouri.

Roger Connor, Ph.D. Roger Connor curates technical collections at the Smithsonian National Air and Space Museum, including vertical flight aircraft, remotely piloted and autonomous aircraft, and Army Aviation. He is lead curator for the museum's new World War I and World War II galleries.

Jakob Jones, Curator, Grissom Air Museum Jakob Jones currently serves as the curator for the Grissom Air Museum in Peru, Indiana. A life-long interest in history and military aviation pushed him to devote his time to preserving artifacts and retelling the stories of the US military. He would parlay this interest into his degrees, securing a Bachelors of Arts in Military History from American Military University and will receive his Masters of Arts in the same subject from AMU this spring. In addition to his work preserving the stories of military aviation during the Cold War era, Jones works to collect stories and histories of the men and women who served at the Bunker Hill and Grissom air bases.

Dr. David Christopher Arnold Dr. Arnold is Professor of National Security Strategy at National War College in Washington, DC. He earned his PhD from Auburn University, his MA from Colorado State University, and his BA from Purdue University, all in history. He is a retired USAF colonel who was a space and missile operations and staff officer for 25 years. He is the editor of *Space Force Pioneers: Trailblazers of the Sixth Branch* (Naval Institute Press, 2024), which won the 2025 Space History Book Prize from the Air Force Historical Foundation. His next book is *Engineering the Future: Maj Gen Osmond Ritland, Problem Solving, and the Challenges of Technical Leadership* (Air University Press, 2026). He has taught history at 7,258 feet, 750 miles north of the Arctic Circle, and in cyberspace.

John Andreas Olsen, editor, *Airpower Pioneers: From Billy Mitchell to Dave Deptula* (NIP, 2023) Col. John Andreas Olsen is recently retired from the Royal Norwegian Air Force. Professor Olsen has published a series of books on airpower strategy and defense policy, lectured worldwide, and received several awards for his writings. His latest books include *Airpower Reborn*, *Airpower Applied*, and *Routledge Handbook of Air Power*.

Col. Phillip S. Meilinger, USAF, Retired, Ph.D. Colonel Meilinger received a BS degree from the United States Air Force Academy, an MA degree from the University of Colorado, and obtained a PhD in military history from the University of Michigan. A command pilot, he has served as a C-130 aircraft commander and instructor pilot in both Europe and the Pacific. He was also assigned to the Doctrine Division of the Air Staff at the Pentagon. Meilinger was the director of military history and deputy department head at the Air Force Academy, a professor of strategy at the US Naval War College and was founder and first Dean of the School of Advanced Airpower Studies—now the School of Advanced Air and Space Studies. Colonel Meilinger was the 2023 recipient of AFHF's I.B. Holley Award.

Dee Gullickson, 509th Wing Historian Dee Gullickson is the Historian for the 509th Bomb Wing located at Whiteman Air Force Base, Missouri. She is responsible for preserving the institutional memory of the United States Air Force's only B-2A Spirit bomber wing by performing historical document collection, analysis and research. In addition, she provides historical research services to meet the needs of the wing's commanders and staffs and routinely gives presentations on the history and heritage of both the wing and Whiteman AFB. Ms. Gullickson retired from the Air Force after 23 years of active duty, serving in a variety of positions both stateside and during deployments in support of Operations SOUTHERN WATCH, ENDURING FREEDOM and INHERENT RESOLVE. She received both her Bachelor of Arts and Master of Arts in History from Old Dominion University in Norfolk, Virginia.

Col Joshua M. Pope, Commander of the 509th Maintenance Group, Whiteman AFB, Missouri. Colonel Pope is directly responsible for the morale, welfare, and well-being of more than 1,500 Airmen and their families assigned to three squadrons. Additionally, he directs all production, flightline, and backshop maintenance supporting 20 B-2A aircraft supporting four operational squadrons. Colonel Pope entered the Air Force in February 2000 through the Air Force Reserve Officer Training Corps at Saint Louis University. He has served as a Flight Commander and Operations Officer in various maintenance and operational squadrons. Additionally, he has served as a Professional Military Education Instructor, Course Director, and Wing Executive Officer. He has also held positions as a Squadron Commander and Deputy Group Commander. He has deployed supporting contingency operations as an Academic Program Manager, Operations Officer,

and Squadron Commander. Prior to his current position, Colonel Pope was Commander, 7th Maintenance Group, 7th Bomb Wing, Dyess Air Force Base, Texas.

Col (Retired) Keith Butler, former 509th Bomb Wing Commander Colonel Butler is a Senior Staff Coordinator at ENSCO Inc.'s Mission Systems Group and a retired United States Air Force Colonel with more than 30 years of distinguished leadership. A seasoned strategist and operational executive, he brings expertise in managing complex organizations, advising senior leaders, and executing high-value defense and intelligence initiatives. A command pilot with more than 2,100 flight hours, including over 230 combat hours in Bosnia, Iraq, and Afghanistan, Keith has flown the F-16, F-117, and B-2, among other aircraft. He is widely recognized for leadership excellence, earning multiple Legion of Merit and Meritorious Service Medals, the Truman Foundation's Silver Veteran's Medal (2024), and the National Aviation Hall of Fame's Spirit of Flight Award.

Col Matthew Howard, Commander, 131st Bomb Wing, Whiteman Air Force Base, Missouri Colonel Howard is the commander of the National Guard's only B-2 Spirit stealth bomber wing providing combat ready Airmen for both state and federal missions. He is additionally responsible for the Air National Guard's B-2 and T-38 Talon aircraft operations. Col Howard joined the Missouri Air National Guard in 2014 to fly the B-2 at Whiteman AFB, Missouri. While at Whiteman, he has deployed multiple times to the IndoPacific region, planned a B-2 Bomber Task Force (BTF) mission to the United Kingdom in March 2020, and led the B-2's first BTF mission to Iceland in August 2021. He has commanded at the squadron and group levels, both at home station and on deployment. Prior to his current position, Col Howard served as the 131st Deputy Commander, 131st Bomb Wing during OMH.

Lt Gen Dave Deptula, USAF (Ret) Dean of the Mitchell Institute of Aerospace Power Studies General Deptula was a principal author of the original Air Force White Paper "Global Reach—Global Power." In the early 1990s he was instrumental in the formation and development of the concept later known as "effects-based operations," having successfully applied it in building the attack plans for the Operation Desert Storm air campaign. He has been cited as having "... fostered the most significant change in the conduct of aerial warfare since Billy Mitchell...Deptula's framework influenced the successful air campaigns in Operations Allied Force, Iraqi Freedom, and Enduring Freedom. Today, joint targeting cells and Air Force doctrine reflect Deptula's theory of airpower and the changing nature of warfare."

Maj Heather Penney, ANG (Ret) Director of Studies and Research at the Mitchell Institute for Aerospace Studies. Major Penney worked over a decade in the defense industry focusing on defense budgets, supporting program execution, and capturing campaign management. She served in the Washington, DC Air National Guard flying F-16s and Gulfstream G-100s; she has also served in the Air Force Reserve in the National Military Command Center. She has also lectured extensively on subjects such as Air Force capabilities and force structure, organizational command and control, reforming the defense personnel system, and other defense policy issues to a broad number of organizations, universities, and military institutions. Penney received her undergraduate degree from Purdue University, majoring in English with a minor in Philosophy. She earned her MA in American Studies from Purdue University. She earned her wings at Euro-NATO Joint Jet Pilot Training (ENJJPT) at Sheppard AFB and qualified in the F-16C at the 149th FTW at Kelly ANGB. She has successfully completed numerous industry executive leadership courses and holds multiple aviation certifications.



Former USAF Chief of Staff, Gen Ron Fogleman, delivered an inspirational and timely Keynote address to the AFHF Annual Awards Banquet crowd of more than 170 guests and awardees at the Smithsonian National Air and Space Museum, Udvar-Hazy Center in Chantilly, VA. (Photos by Jeremy Norwood.)



Col. Joshua "Half" Wiitala, 509th BW Commander, accepts the AFHF General James H. "Jimmy" Doolittle Award for gallantry and intrepidity in combat. (Photos by Jeremy Norwood.)



Gen Jay Raymond, USSF (ret), and AFHF Spaatz Award recipient, present the inaugural General Jay Raymond Trophy for Lifetime Contributions to Space Force History to Chairman Mike Rogers. Chairman Rogers was instrumental in the creation of the legislation that established the USSF in 2019. (Photos by Jeremy Norwood.)



Former 509th BW Commander, Col. Keith Butler, USAF (ret), assists in the unveiling of "Slamming the Door Shut," depicting the Operation Midnight Hammer strikes in Iran in June 2025. The Artist, and 2026 recipient of the AFHF President's Medal for Superior Service to the Foundation, is Rick Herter. Rick is a lifelong aviation and space artist and now, "AFHF's Artist for Life." (Photos by Jeremy Norwood.)



Gen James Slife, the new AFHF Foundation Chairman, presents the inaugural Superior Air National Guard Unit Trophy to Col. Matthew "Stang" Howard, current 131st Bomb Wing Commander (131st Deputy Commander during OMH). The trophy features the ancient Greek sculpture, Winged Victory (Nike of Samothrace) which for thousands of years has symbolized courage and fearlessness in victory. (Photos by Jeremy Norwood.)



Four former AFHF General Carl A. "Tooey" Spaatz Award recipients welcome the newest Spaatz Award recipient, Col. James "Snake" Clark to the elite club. from left to right: Col. Clark, Gen Ron Fogleman, Gen "Speedy" Martin, Lt Gen Dave Deptula, and Gen Jay Raymond. (Photos by Jeremy Norwood.)

Journal of the Air Force Historical Foundation

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FRONT COVER: Rick Herter's *Taking The Shot*, depicts an MQ-1 Predator as it fires a Hellfire missile at a distant target.



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Journal of the Air Force Historical Foundation

The Journal of the
Air Force Historical Foundation
Summer 2026 Volume 73 Number 2

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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
P.O. Box 405
Mechanicsville, MD 20659
e-mail: airpowerhistory@yahoo.com
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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
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ADVERTISING

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

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

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Leadership's Message

What a privilege it is to accept a role as part of the Air Force Historical Foundation team! I have long felt a debt of gratitude to the Historical Foundation and to have the opportunity to whittle away at that debt is a real joy. My initial reaction when asked to write a 700-1000 word piece for the Journal as I join the team was to take the Ira Eaker approach. As many know, when General Eaker arrived in England to take command of the Eighth Air Force, reporters met him upon arrival and asked him what his priorities would be, when he planned to start bombing missions, and how he thought his force could impact the tide of the war. In what must be one of the greatest beginnings and endings of a press conference ever recorded, he replied, "we'll do more talking once we've done more fighting." And that was all he had to say about that! Regrettably, the Executive Director rejected my first draft which read, "we'll do more writing once we've done more board-membering." His response: "Nice, but you're short by 691-991 words. Try again."

My relationship with the AFHF goes back over three decades to my first Pentagon assignment as a captain in the first cohort of Air Force Interns. Our Chief, General Ron Fogleman, established this program to provide a handful of young officers with exposure to the Pentagon in order to develop broader perspectives which participants could take back to the field in subsequent assignments. Holding a master's degree in history from Duke University and having taught history at the Air Force Academy, General Fogleman was keen to ensure this cohort of captains learned something about Air Force history while assigned to the Pentagon. He directed the Air Staff History Support Office to develop a course in AirPower history and the fifty of us attended weekly seminars with assigned readings and guest lecturers who were subject matter experts in their fields. We also received a small starter library of books on AirPower history. It was magnificent! As it happened, young Captain Slife's interest in AirPower history was ignited by this course and, in particular, by the superb AFHF volume *A Few Great Captains*. From then on, I couldn't read enough about our history. Indeed, the perspective I gained by voracious reading—to include the Foundation's *AirPower History Journal*—changed the arc of my career and gave me useful insights into the problems I'd wrestle with for the next three decades in uniform. As it happens, there are no new problems; there are simply new contexts for old problems, and with enough reading, one can recognize the patterns.

As I join the team at the AFHF, I'm eager to learn more about how I can help continue to provide momentum to the trajectory we're on. The work done over the last several years has been impressive and I'm grateful not only for the trust implied in the board's request for me to join them, but also for the leadership of General Barry as he passes the proverbial guidon. In flying terms, it feels like a "Code 1 hot turn." Please thank JB when able for agreeing to serve as chairman for these last several years.

As I join the team, I don't have any "priorities" or "objectives" apart from helping accomplish those already established by the leadership of the foundation. Nevertheless, I do have a few interest areas where I'd like to explore whether there are opportunities for me to help. Foremost among them is to do my part to ensure the Foundation remains on a firm legal and financial footing for the years ahead. JB, Dik, and the entire Foundation leadership cohort has done excellent work in this regard, and I believe it's imperative for us to bequeath this precious entity to our successors in good health to ensure its continued relevance and contributions to our shared story.

Secondly—and perhaps not surprisingly, given my own experiences—I'd like to explore whether there are further opportunities to support the still-serving force and the Air Force history enterprise. Over the decades since I benefitted so greatly from the Air Force History office's investment in that group of young captains in the mid-1990s, the Air Force history enterprise...from wing-level history offices all the way up to the Air Staff history organization itself...has atrophied in terms of manpower and resourcing. When I became a MAJCOM commander and—later—the Vice Chief of Staff, I was stunned by how hollowed out it had become through the various nicks, cuts, and belt-tightening initiatives over the last 30 years. I wonder if there are ways the foundation can partner with the Air

Force Historian to support new research, improve the accessibility of existing research, and make relevant material available to those currently serving.

Finally, I know from my own experience as a member of the Air Commando Association (ACA) that there are treasure troves of broader Air Force history tucked away in various “tribal” organizations such as the ACA. The ACA publishes the absolutely first-rate *Air Commando Journal*, which features articles highlighting elements of the Air Force Special Operations community’s historical threads, from noteworthy operations or missions to organizational development over time. Meanwhile, there are dozens of ACA-like organizations scattered across our force, each capturing portions of our greater Air Force history. I wonder if there are ways the AFHF can increase our connective tissue with these various organizations to bring greater shared awareness and cohesiveness to the many tribes which make up our magnificent Air Force.

In sum, I’d simply say I’m “happy to be here; proud to serve.” I look forward to engaging with our membership in the months ahead.

Gen. James C. Slife, USAF (Ret.)
Chair, Air Force Historical Foundation

From the Editor

Our theme in this issue is the development and integration of unmanned aerospace vehicles into the U.S. Air Force. It’s a history that goes back further than many people are aware of.

This issue continues our process of providing a larger than normal issue for Summer, which in this case includes the Awards Banquet Program to lead off, the AFHF Symposium and Museums Conference Program following, and finally the normal Summer issue which begins on page 13. If you were unable to attend the events in May surrounding our two events, you can at least get a good idea of what transpired.

We have striven to provide contributions that contribute to general historical awareness while providing a lead-in to the UAV-centric content. We have included a couple of new and fascinating articles which are not directly space-focused, and a group of older articles which were primarily discussing UAV history. We have also included more than 40 book reviews.

The Leadership’s Message can be found on page 16. It’s worth the read. Don’t miss Upcoming Events on page 158. And the issue closes with the Mystery on page 160. Enjoy!

On a personal level, this is the last issue which I shall be able to claim as Editor. I am co-editing this issue with our new Editor, Paul “Abbie” Hoffman. Starting with the Fall issue, it’s his journal, and I will assist him. This journey began for me with the Fall issue of 1993, so it’s been 33 years of involvement in publishing this journal. I have, for the most part, enjoyed the ride, and I will continue to help where needed. I hope you will all support Paul as well as you supported me.

Richard I. Wolf, Outgoing Editor

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John A. Shaud 1933 - 2026



General John A. Shaud, long-time officer and supporter of the Air Force Historical Foundation passed away in March 2026. He retired in 1991 as chief of staff, Supreme Headquarters Allied Powers Europe, Mons, Belgium.

General Shaud was born in 1933 in Cleveland, where he graduated from Cleveland Heights High School. He graduated from West Point in 1956, and was commissioned as a second lieutenant in the Air Force. He received pilot wings upon graduation from training in August 1957. In December 1957 he was assigned to the 358th Bombardment Squadron, Davis-Monthan Air Force Base, Ariz., as a B-47 pilot. After completing B-52 combat crew training in May 1964, he was assigned to Wright-Patterson Air Force Base, Ohio, as an aircraft commander with the 17th Bombardment Wing.

Upon graduation from Air Command and Staff College in June 1967, General Shaud completed RF-4C qualification training and was assigned to the Southeast Asia theater of operations in January 1968. He served on the operations staff of the 388th Tactical Fighter Wing at Korat Royal Thai Air Force Base, Thailand, and later became an RF-4C flight commander with the 12th Tactical Reconnaissance Squadron at Tan Son Nhut Air Base, South Vietnam.

General Shaud returned to the United States and attended Ohio State University, where he received his doctorate in June 1971. He then was assigned to Maxwell Air Force Base, Ala., and served on the faculty of the Air Command and Staff College until entering the National War College in August 1973. After graduating in June 1974, the general was assigned to the 449th Bombardment Wing, Kincheloe Air Force Base, Mich., as deputy commander for operations. In April 1975 he became vice commander of the wing.

In January 1976 he was assigned to the Office of the Deputy Chief of Staff, Plans and Operations, Headquarters U.S. Air Force, Washington, D.C. During this tour of duty he served as chief, Strategic Division; deputy chief, Air Force Readiness Initiatives Group; and assistant deputy director for readiness development. In June 1978 General Shaud assumed command of the 92nd Bombardment Wing (Heavy) and, later, of the 47th Air Division, both at Fairchild Air Force Base, Wash.

General Shaud transferred to Minot Air Force Base, N.D., in August 1980 as commander of the 57th Air Division. As part of his responsibility, the general performed special missions as commander of the strategic projection force when directed by the commander in chief of Strategic Air Command.

In October 1981 General Shaud returned to Air Force headquarters, where he served as deputy director of plans and, later, director of plans in the Office of the Deputy Chief of Staff, Plans and Operations. He remained at the Pentagon as deputy chief of staff for personnel from September 1985 to August 1986. The general then became commander of Air Training Command with headquarters at Randolph Air Force Base, Texas. He became chief of staff, Supreme Headquarters Allied Powers Europe, Mons, Belgium in July 1988.

A command pilot with more than 5,600 flying hours, General Shaud has flown in more than 35 different types of aircraft, including the B-47, B-52, RF-4C, T-38 and C-21A, and has logged 251 combat hours in the RF-4C. His military decorations include the Distinguished Service Medal, Legion of Merit with oak leaf cluster, Distinguished Flying Cross, Meritorious Service Medal with oak leaf cluster, Air Medal with five oak leaf clusters, and Air Force Commendation Medal with oak leaf cluster.

He was promoted to general July 1, 1988, and retired June 30, 1991. In retirement General Shaud remained active in directing the Air Force Aid Society, serving as the Executive Director of the Air Force Association, and Director of the Air Force Research Institute. He served as acting Vice President of the Air Force Historical Foundation, in 1994, Vice President from 1995 to 2005, and was the First Vice President from 2006 to 2012. He was awarded the Carl A. "Tooe" Spaatz Award in 2013 by the Foundation.

General Shaud is survived by his wife Beverly Brockus Shaud, his children, Patricia Francis (Tom), James Shaud (Lola) and Katherine Tofigh (Navid).

Of Sounding Rockets and Reentry Vehicles



David K. Stumpf

Athena Standard launch July 14, 1966, White Sands Missile Range. (White Sands Missile Range Archive.)

Dr. Theodore von Karman, the leading aerodynamics expert of his time, described what he called “the reentry problem” at a symposium in Berkeley, California, in June 1956. Reentering the atmosphere at speeds of Mach 12 to 20 was “perhaps one of the most difficult problems one can imagine... a challenge to the best brains working in these domains of modern astrophysics.”¹

Engineers had the daunting task of determining which among four general categories of cooling systems for the surface of a reentry vehicle would be the solution: (a) radiant cooling via emittance from the vehicle surface; (b) solid heatsinks which would have sufficient mass to absorb the heat and protect the payload; (c) transpiration and film cooling which would cause heat removal by material phase change or (d) ablation which would allow heat dissipation via the many protective processes associated with surface removal.²

Equally daunting was the material science research to provide protection from reentry temperatures up to 12,000°F. Fortunately, hypersonic wind tunnels had been developed by the Germans during World War II; shock tubes were already in use for studying mechanisms of explosions; the light-gas gun had been developed in 1948 and the atmospheric entry simulator, developed in 1955, was available in the late 1950s on a larger scale suitable for reentry vehicle research.³

Laboratory testing provided initial evaluation of heat shield components, but the extreme conditions with relatively short exposure time for most of the tests necessitated flight testing.⁴ Sounding rocket solid propellant motors served as the basis for launch vehicles that filled the gap between laboratory sub-scale evaluation and expensive full-scale testing utilizing refurbished and modified surplus Atlas ICBMs. This article describes the X-17, Trailblazer, Athena, Sandia-Air Force Material Systems (SAMS), Material Screening Vehicle (MSV), Large Payload Test Vehicle (LPTV), and Fighter Launched Advanced Material Experiment (FLAME) programs.

X-17 Reentry Test Vehicle Program (1955-1957)

On January 24, 1955, Lockheed Aircraft Corporation (LAC) signed a contract with the Air Force Ballistic Missile Division to provide 25 flights of a reentry test vehicle (RTV). The RTV would be instrumented to provide temperature, pressure and acceleration data in real time. LAC would be responsible for the analysis of the results. The contract included a provision for LAC to construct and test developmental models of the RTV to assure the necessary performance goal of exposing subscale reentry vehicles to ICBM reentry conditions. The use of proven solid propellant motors and spin stabilization enabled rapid development and research capabilities when compared to full-scale ICBM vehicles using cryogenic propellants and inertial guidance.⁵

Launch Vehicle

The X-17 RTV full-scale specifications are given in Table 1. The test vehicle was developed in three phases. Phase 1, quarter-scale, was to verify (1) assumed aerodynamic characteristics (2) proper functioning of the system components, and (3) equipment design and requirements.

The Phase 1 vehicle had a live first stage with the second and third stages replaced by a non-separable wooden dummy. A three-flight sequence began on May 23, 1955 and ended on June 13, 1955.

Phase 2 verified the Phase 1 objectives with a half-scale vehicle. A three-flight sequence began on 23 June 1955 and ended on July 14, 1955.

Phase 3 used a seven-flight sequence of a full-scale vehicle to (1) demonstrate major performance characteristics, (2) determine by test behavior what problems might require particular emphasis in preparation for research testing, and (3) assist the resolution of design problems with both vehicles and ground equipment prior to the start of the research program (Figure 1).⁶

Research Program

The 24-flight research program began July 17, 1956 and ended March 21, 1957. The research flight profile is shown in Figure 2: (1) The first stage burned for 28 seconds and boosted the vehicle to 90,000 feet; (2) The vehicle then coasted to an altitude of 300,000 to 517,000 feet depending on trajectory elevation angle and the vehicle weight (10,452 to 10,650 pounds); (3) As the vehicle began its descent the four fins at the base of the first stage caused the vehicle to invert as it reentered the atmosphere; (4) At an altitude of between 70,000 to 90,000 feet, depending on the experiment, a pressure probe initiated a firing signal that separated the first stage and fired a squib that ignited the second stage which burned for 1.5 seconds, followed by a 0.7 second delay before third stage ignition, (5) The third stage burned for 1.5 seconds boosting the payload to a velocity between Mach 11.2 and Mach 14.5.

Though subscale reentry vehicle shapes were used, this was compensated for by making measurements at a lower altitude. This required application of hypersonic velocities and was achieved by the use of the second and

Table 1. X-17 Specifications (a)				
Stage	Motor	Thrust (lb)	Diameter (ft)	Length (ft)
1	Sergeant (XM-20)	50,000	31	20.1
2	3x Recruit (XM-19)	104,000	17	8.5
3	Recruit (XM-19E1)	35,950	9.7	11.1

(a) See Endnote 5, 565.

third stages driving the sub-scale models at high speed into the lower atmosphere. Reentry vehicle shapes included hemispherical, cubic paraboloid, AVCO blunt and GE blunt nose cones. The primary objectives of boundary layer transition and heat transfer information, high Mach number and high free stream Reynolds numbers for each of the reentry vehicle shapes were achieved on 18 of the 24 flights.⁷

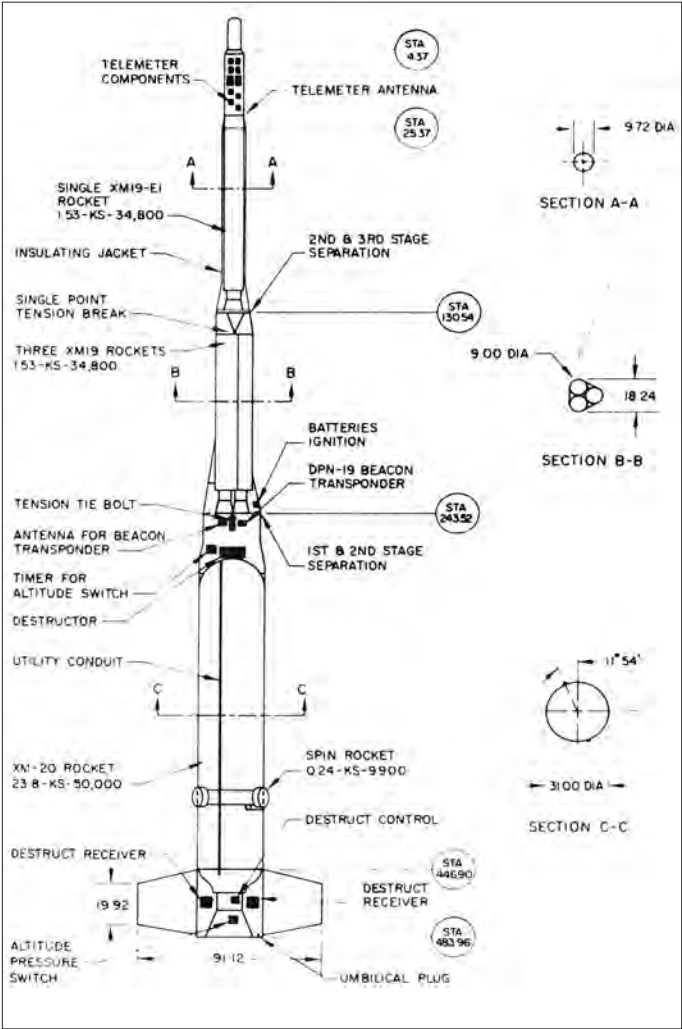


Figure 1. Lockheed X-17 Equipment Location. Endnote 4,2.

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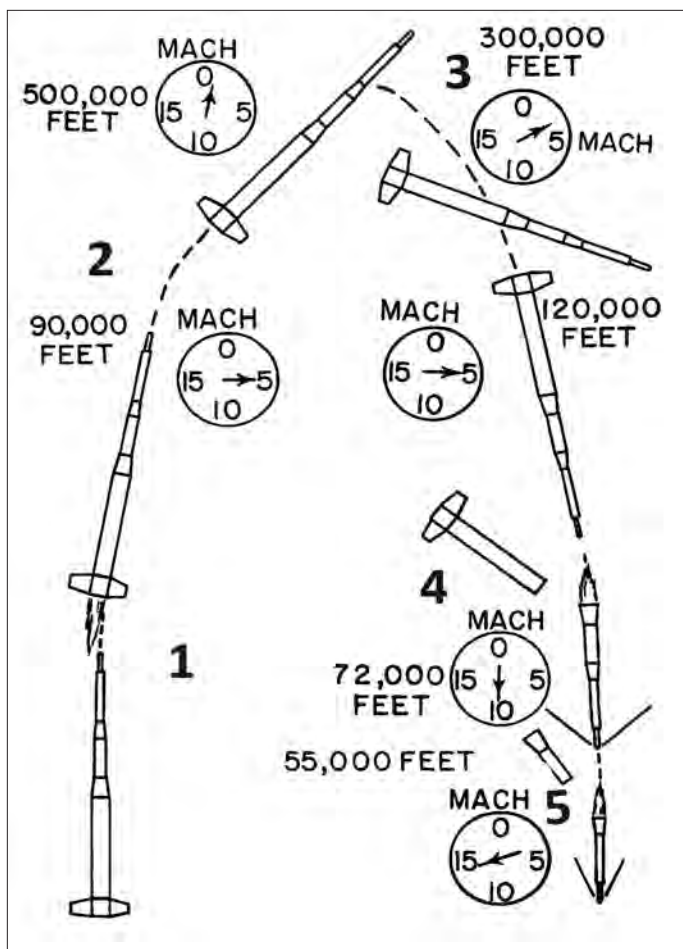


Figure 2. Typical X-17 Flight Profile. Endnote 5.

Trailblazer Program (1958-1973)

Trailblazer I (1958-1963)

The Trailblazer I program was a reentry physics project conducted by the Pilotless Aircraft Research Division (PARD) of the Langley Aeronautical Laboratory of the National Advisory Committee for Aeronautics (NACA), Langley Field, Virginia, and the Massachusetts Institute of Technology-Lincoln Laboratory. Robert R. Gilruth, Assistant Director at Langley, was a member of the Air Force Scientific Advisory Committee which was investigating how to obtain a better understanding of the radar signature of ICBM reentry vehicles as they reentered the atmosphere. Specifically, the question was how did the ionization of the air flowing around the reentry body affect accurate detection and discrimination by radar?

Meteor astronomers had been using radar and optical techniques to observe the ionized air in meteor trails. Long wavelength radar (30 MHz) could not detect the meteor itself. Frequencies of 200 MHz or greater detected the head echoes, radar reflection from the plasma directly in front of the meteor. PARD scientists proposed creating artificial meteors using iron pellets as well as reentry bodies, to develop relevant radar detection systems.⁸

The PARD solution was a simple, solid propellant launch vehicle similar in many respects to the earlier

Lockheed X-17. Both the X-17 and Trailblazer I flew a "piledriver" trajectory using the upper stages to accelerate the subscale reentry body back into the atmosphere at hypersonic speeds. The Trailblazer piledriver trajectory was directed back toward the launch point, simplifying optical and radar tracking.

Although the Trailblazer I vehicle had limited payload capabilities, approximately 2.2 pounds depending on the material being tested, the vehicle and operating costs were one fiftieth to one one-hundredth of the cost of an ICBM test. Additionally, the Trailblazer I flights took days to organize versus months for an Atlas test.⁹

Launch Vehicle

The Trailblazer I launch vehicle was composed of six stages (see Table 2). The first three served as the booster for the unique three-stage "velocity package" (Figure 3). The first three stages had fins canted at a slight angle to impart spin to stabilize the airframe attitude while still in the atmosphere. The fourth, fifth and sixth stages were inverted and housed within the velocity package airframe. The velocity package was boosted to 100,000 feet altitude and then coasted to approximately 400,000 feet altitude at which point the burnt-out third stage was released and the velocity package coasted to approximately 950,000 feet altitude and 100 miles down range. Unlike the X-17 upper stage, the velocity package motors were inverted (see Figure 4). They fired in quick succession on a piledriver trajectory. The reentry velocity of the sixth stage varied from 19,000 to 26,000 ft./s. depending on the reentry body material weight. This velocity was necessary to realistically simulate the phenomenon generated by the reentry of an ICBM payload.¹⁰

Table 2. Trailblazer I Specifications (a)

Stage	Motor	Thrust (lb)	Diameter (ft)	Length (ft)
1	Hercules Honest John (M6)	86,000	1.9	17.5
2	Hercules Nike (M5)	48,700	1.4	11.0
3	Thiokol (TX77)	47,000	1.25	15
Velocity Package				
4	T40	2,900	0.45	4.5
5	T55	4,630	0.45	4.9
6	Cygnus-5	550	0.4	0.41

(a) See Endnote 9, Gardner, 1.

Tracking Stations

The Trailblazer I flightpath paralleled the Virginia and North Carolina coasts. The piledriver maneuver brought the reentry trajectory back towards the launch site, enabling optical tracking stations at Eastville and Langley AFB, Virginia, and Coquina Beach, North Carolina, to record the optical signatures of the experimental

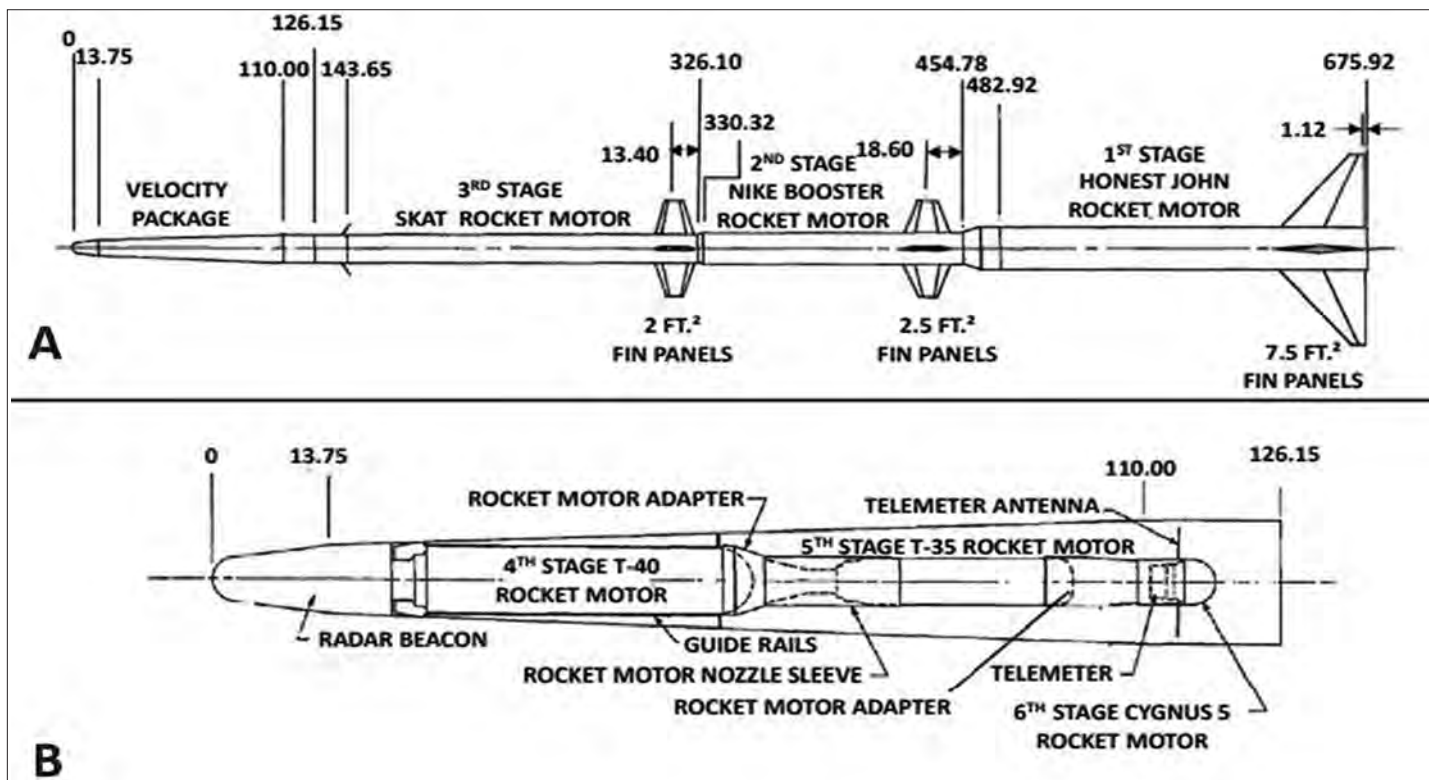


Figure 3. (A) Trailblazer I configuration; (B) Typical velocity package configuration. All station locations are in inches. Endnote 9, Gardner, 28.

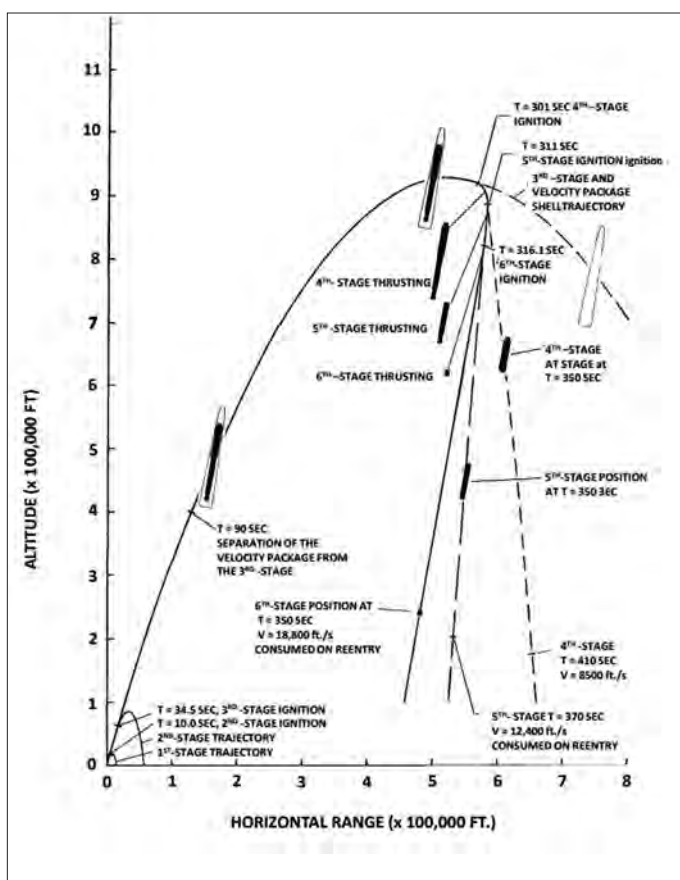


Figure 4. Typical Trailblazer I Flight Profile. Endnote 9, Gardner, 26.

heat shield materials. Radar tracking was accomplished using radars located at Arbuckle Neck, Virginia. All of the tracking stations were located within 100 miles of the point of reentry into the atmosphere (Figure 5).

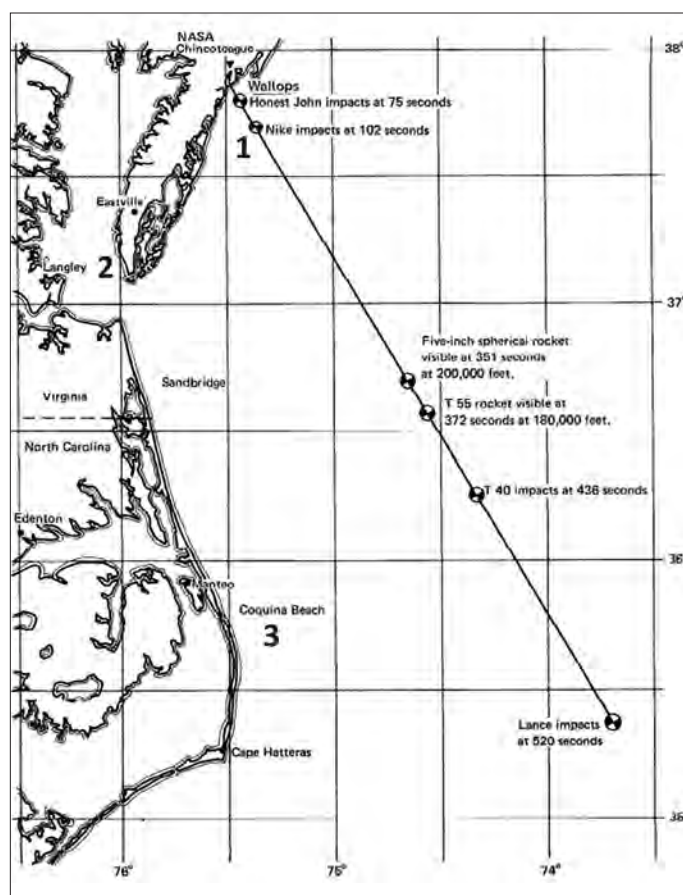


Figure 5. Trailblazer I Optical and Radar Tracking Station Locations: 1) Wallops Island, radar and optical, 2) Langley AFB, radar, 3) Coquina Beach, optical. Endnote 10, 679.

Reentry-Body Configuration

A spherical motor was chosen for the sixth stage. The spherical motor casing meant that radar returns were independent of the tracking aspect angle.^{11,12} In all of the flight tests, the empty case of the five-inch-diameter sixth-stage rocket motor served as the primary test object. The rocket case was manufactured out of the reentry test material except for the experiments using phenolic nylon and copper materials. The phenolic nylon material was bonded directly to the aluminum spherical motor case. The copper was positioned on a threaded stud on the front of the case. The payload weight was approximately 2.2 pounds. In the original design, a cylindrical housing containing a beacon transmitter was attached to the front of the spherical motor. After the first two flights, the cylinder was replaced with a toroidal transmitter which surrounded the sixth-stage rocket nozzle (Figure 6).

Research Program

The first flight test of the Trailblazer I vehicle took place on March 3, 1959. The first five stages operated as expected but the sixth exploded upon ignition. The sixth-stage motor problem was resolved with additional ground tests and the second launch, on 5 June 1959, was successful (Figure 7). Unfortunately, the next three attempts also failed due to instability problems but the accumulated telemetry was sufficient to identify the

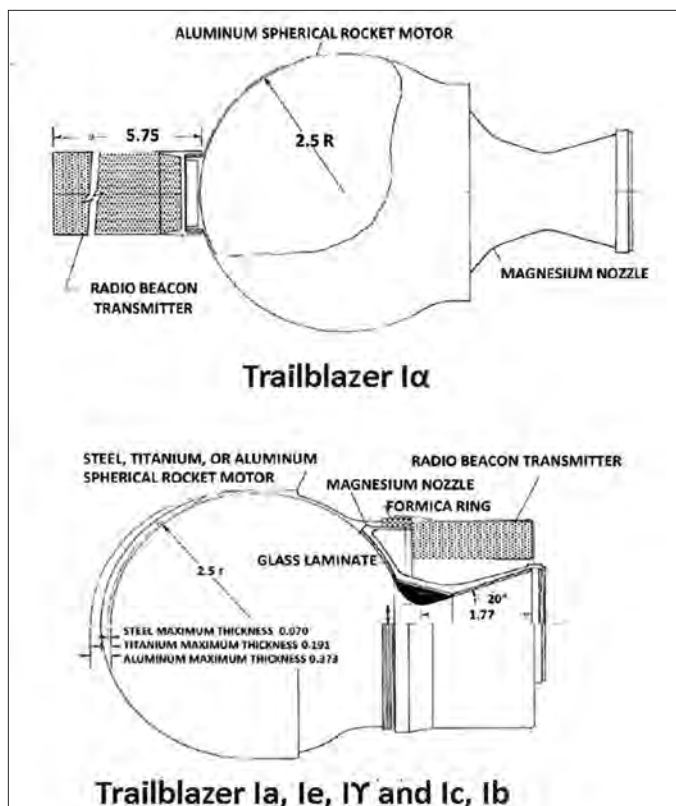


Figure 6. Trailblazer I Reentry Body Configurations. Upper: Trailblazer I α , thin aluminum case, spike radio beacon transmitter. Lower: Trailblazer Ia and Ie, steel case; Trailblazer IY and Ic, titanium case; Trailblazer Ib, thick aluminum case, all with a toroidal radio beacon transmitter. All dimensions are in inches. Endnote 9, 45.

Table 3. Trailblazer I Flight Test Summary (a)

Date	Flt	RV Shape	Reentry Body	Summary
1959				
Mar 3	I α	5" spherical rocket motor	thin wall aluminum	s1-5 successful; s6 exploded on ignition
Jun 5	I β	5" spherical rocket motor	thin wall aluminum	successful test
Dec 1	I γ	5" spherical rocket motor	heavy wall titanium	s3 instability prevented s4-6 ignition
1960				
Mar 29	Ia	5" spherical rocket motor	heavy wall steel	breakup at s5 ignition
Jun 26	Ib	5" spherical rocket motor	heavy wall aluminum	s6 failure
Aug 28	Ic	5" spherical rocket motor	heavy wall titanium	radar track lost
Aug 29	Id	5" spherical rocket motor	aluminum coated w/phenolic nylon	radar track lost
Oct 22	Ie	5" spherical rocket motor	heavy wall steel	successful test
1961				
Jan 17	If	5" spherical rocket motor	aluminum case w/copper shield	radar track lost
Apr 21	Ig	5" spherical rocket motor	aluminum case	artificial meteor track successful
May 18	Ih	5" spherical rocket motor	steel "j" case	radar track lost
Sep 16	Ii	5" spherical rocket motor	thick wall aluminum	successful test
1962				
Apr 2	Ij	5" spherical rocket motor	ablating phenolic nylon	successful test
Jul 27	Ik	8" sphere	8" aluminum case	successful test
1963				
Feb 16	Il	8" sphere	phenolic nylon	s5/s6 failed to ignite
Mar 23	Im	8" sphere	Avcoat II	successful test

(a) See Endnote 9, Deley, 14.

problems. The Trailblazer I flight test program ended on February 16, 1963 with 11 of 16 flights being partially or fully successful (Table 3). The Trailblazer I program.¹³

provided information on the behavior of different materials under the extreme aerodynamic heating condition of almost vertical reentry; but the most valuable contribution was as an aid to the development of special radars to detect and discriminate between reentry nose cones, as a part of a continuing antimissile program of the Department of Defense.

Bell Laboratory experiments with spheres flown as secondary payloads on ICBMs launched from Vandenberg AFB were the result of the Trailblazer I experiments.



Figure 7. Trailblazer Iβ undergoes final launch preparations on 4 June 1959. The next day was the first successful launch and flight in the Trailblazer I flight test program. *Author's Collection.*

Artificial Meteors

On April 21, 1961, a Trailblazer I launch vehicle successfully reentered a two-gram steel pellet at a velocity of 32,000 ft/s., the lower velocity range of natural meteors. This allowed for the first time the determination of the luminosity coefficient which related the deceleration and brightness of a meteor to its mass.¹⁴

Trailblazer II (1961-1973)

In January 1959, W. N. Gardner, the PARD engineer largely responsible for the Trailblazer I design, learned of the need for a launch vehicle system with an approximately 40-pound payload to continue the work begun with Trailblazer I. The result was Trailblazer II with a 15-inch spherical final stage rocket motor that, as with Trailblazer I, served as the reentry body payload in many of the experiments. Trailblazer II was designed to routinely achieve at least a 20,000 ft./s. reentry velocity to emulate the conditions of ICBM reentry vehicles.¹⁵

Launch Vehicle

The velocity package concept was continued but had two or three stages depending on the experiment (Table 4, Figure 8).¹⁶

Table 4. Trailblazer II Specifications (a)

Stage	Motor	Thrust (lb)	Diameter (ft)	Length (ft)
1	Thiokol Castor (XM33E8)	53,000	2.1	21.2
	2x Thiokol Recruit (XM19E1)	71,000 (total)	0.66	
2	Thiokol Skat (XM45)	45,000	1.5	16.6
3	Thiokol Altair (IX248A10)	3,000	1.5	8.3
Velocity Package				
4	Thiokol Cygnus 15	5,000 (b)	1.25	1.25
5	Cygnus 5	530 (c)	0.41	0.41
6	Cygnus 5	530 (d)	0.41	0.41

(a) See Endnote 16, 6; (b) Trailblazer IIa, four stages; (c) Trailblazer IIb, five stages; (d) Trailblazer IIc, six stages.

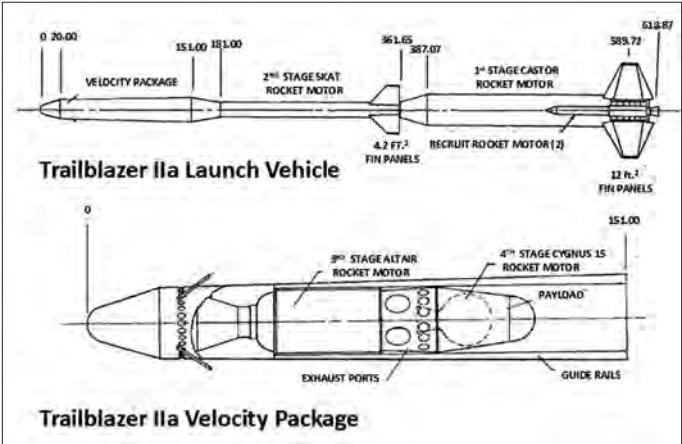


Figure 8. Upper: Trailblazer IIa Launch Vehicle; Lower: Trailblazer IIa velocity package. All station locations are in inches. *Endnote 16, 27.*

Trajectory

The trajectory was the same as that of Trailblazer I.

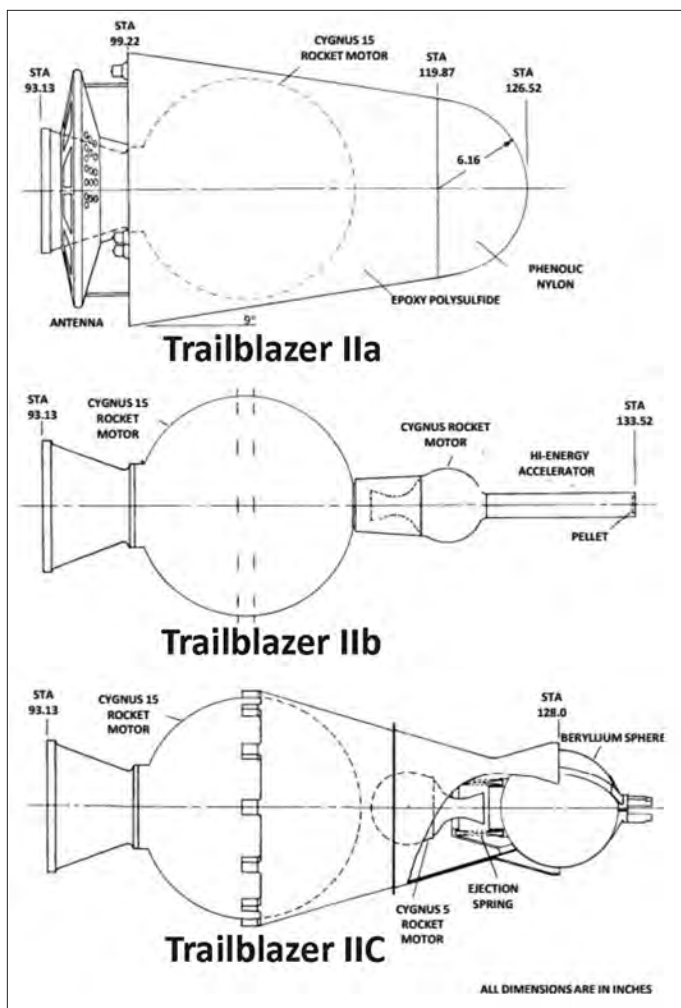


Figure 9. Trailblazer II Reentry Body Configurations. Trailblazer IIa utilized a 90 half-angle blunt-nosed reentry object; Trailblazer IIb had a 5.8-gram stainless-steel pellet as the primary reentry object, propelled by a Cygnus 15-inch diameter motor, Cygnus 5-inch diameter motor and a shaped charge accelerator; Trailblazer IIc had an eight-inch-diameter beryllium sphere as the primary reentry object, propelled by a Cygnus 15-inch motor and ejected by a spring. Endnote 16, 30.

Reentry Body

The nearly 20-fold increase in payload weight enabled installation of telemetry equipment in the reentry body as well as more realistic reentry body design (Figure 9).

Research Program

The Trailblazer II research program continued where the Trailblazer I left off, investigating VHF signal blackout during reentry, radar detection, and evaluation of heat shield materials.

Advanced Ballistic Reentry Systems Programs

Development of the Atlas and Titan I ICBMs was well underway when in March 1962 Gen. B. A. Schriever, AFSC Commander, advised Gen. C. E. Lemay, Air Force Chief of Staff, that:¹⁷

The scientific community and high levels of the Office of the Secretary of Defense were critical and concerned about the Air Force's apparent lack of urgency, vigor, and management attention to the ballistic missile penetration problem. In response to this criticism, Schriever recommended adopting a ballistic missile reentry system concept, under which the "attack element" of the missile system would be treated as "an entity which can be modified or replaced to meet a changing defense environment." The system approach would, according to Gen. Schriever, provide for the use of a broad technical base and permit the exploration of new ideas and methods at minimum cost.

On May 14, 1963, Advanced Ballistic Reentry Systems (ABRES), Program 627A, was established as a Defense Department/Advanced Research Project Agency (ARPA) joint-service program for reentry vehicle and penetration aids research, development, and testing.¹⁸ ABRES program objectives were "to develop an understanding of reentry phenomena and to establish the military worth and feasibility of advanced reentry concepts."¹⁹ The X-17 and Trailblazer programs had shown that flight tests utilizing sounding rockets correlated well with laboratory results. Now there was a need for a launch vehicle able to carry a much heavier payload while at the same time costing significantly less than flight tests using surplus ICBMs.

Athena Program (1964-1976)

The next step was the Athena program which built upon the investigations of reentry phenomena that had begun with the Air Force X-17 and Trailblazer programs. The new launch vehicle, with a 50-pound payload capacity, would continue heat shield material evaluation, sub-scale models of new reentry systems, and flight components of operational systems such as arming and fuzing devices. Additionally, specialized Athenas would serve as target vehicles to evaluate radars at White Sands Missile Range (WSMR) by testing full-sized penetration aids.²⁰

Athena Standard

On May 2, 1962, the Atlantic Research Corporation was awarded a 3.5-year, \$45 million Athena program contract as prime contractor, as well as assembly and test conductor. The contract was for 77 rockets. In February, 1966, and again in January 1967, Atlantic Research Corporation received contracts for an additional 36 Athena rockets, for a total of 149 launch vehicles.²¹

Unlike the X-17 and Trailblazer programs which were flown over the open ocean, the Athena program required a land-based launch area, launch abort impact area, as well as booster and payload impact areas. WSMR was selected on the basis of existing instrumentation and anticipated upgrading of the existing tracking radars. Tracking radars would be stationed at the

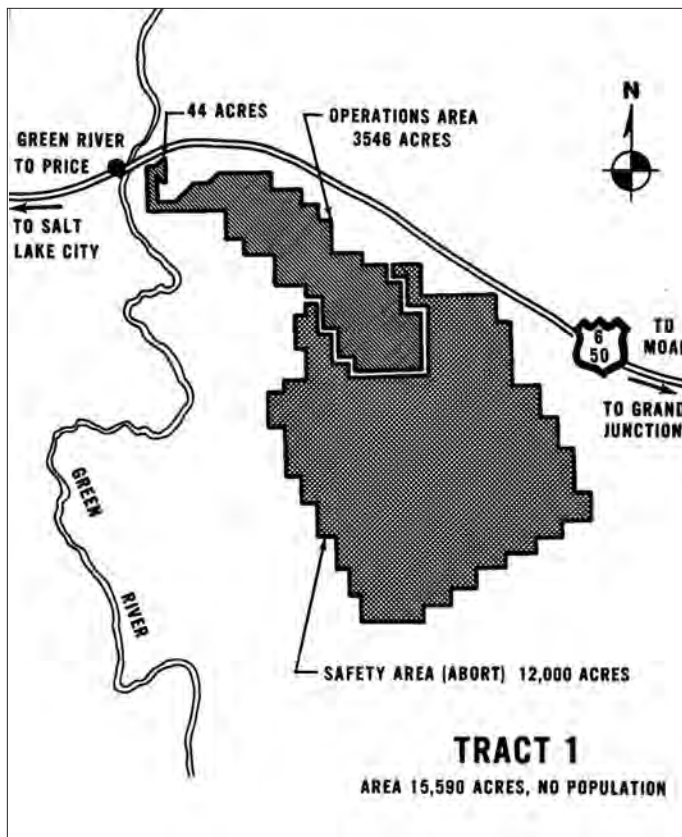


Figure 10. Tract 1. Operations And Safety Abort Areas. Endnote 19.

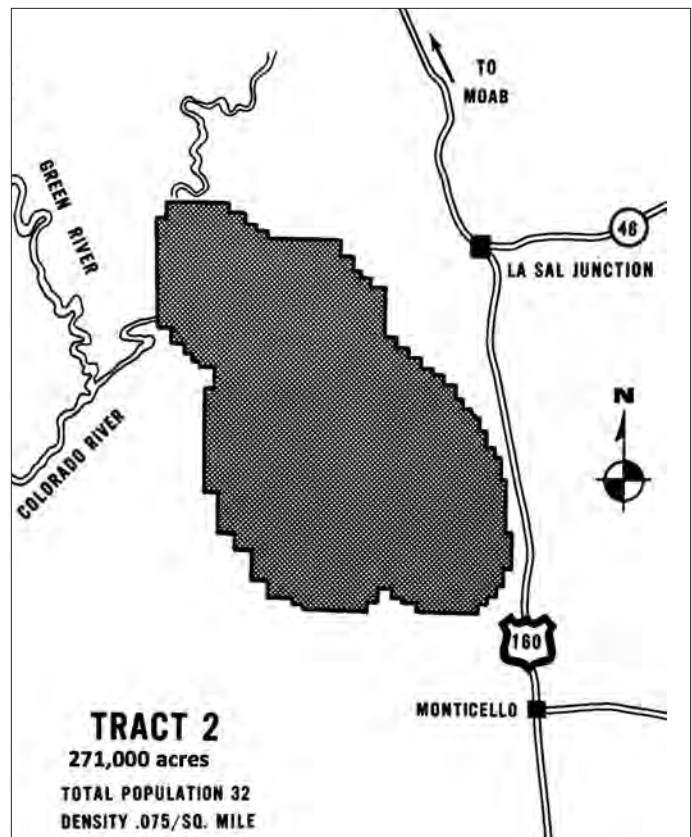


Figure 11. Tract 2. Low Angle Reentry Trajectory Booster Impact Area. Endnote 19.

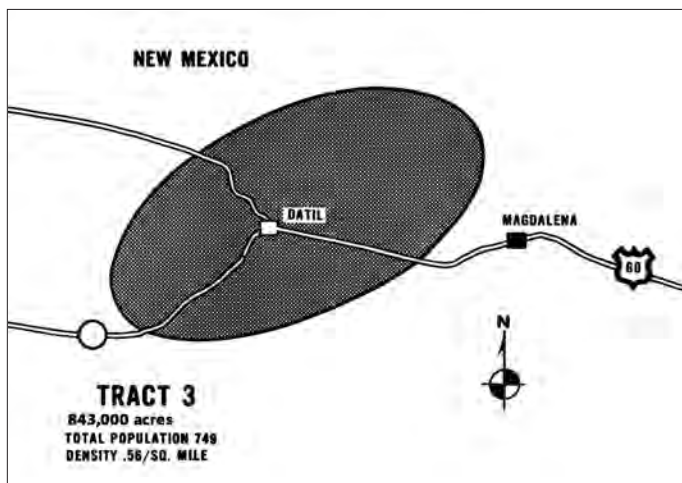


Figure 12. Tract 3. High Angle Reentry Trajectory Booster Impact Area. Endnote 19.

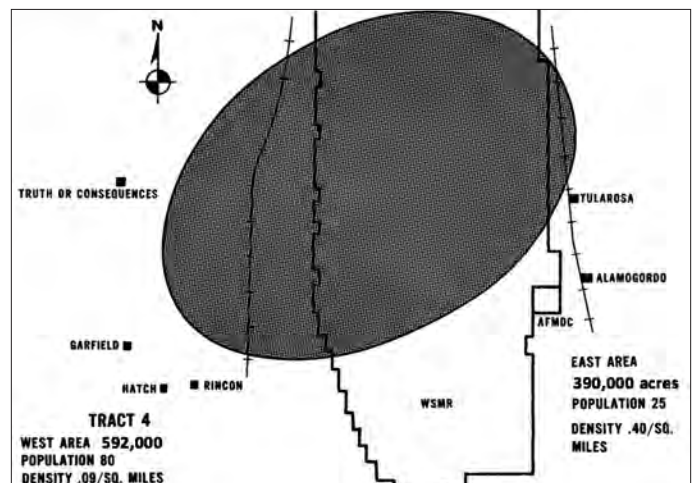


Figure 13. Tract 4. Third and Fourth Stage Impact Areas. Endnote 19.

launch site to perform flight safety surveillance, to provide acquisition data for range radars and to monitor performance during the boost-phase of the trajectory.²²

A total of 1,812,490 acres of co-use land was acquired, all southeast of Green River, Utah. Tract 1 was composed of an operations area (3,546 acres) and launch abort area (12,000 acres); Tract 2 was composed of 274,400 acres northwest of Monticello, Utah; Tract 3 (869,000 acres) was centered on the town of Datil, New Mexico; and Tract 4 (78,400 acres) encompassing WSMR. The land was sparsely populated, ranging from 0.11 persons per square mile in Tract 4 to 0.56 persons

per square mile in Tract 1. WSMR held the land under an exclusive use lease for a term of two years ending 30 June 1964 with an option to renew for successive years through June 30, 1968. All the land was acquired without condemnation proceedings (Figures 10,11,12,13).²³

Questions that needed to be answered at the beginning of the program included: What radar resolution would be required to distinguish between the third and fourth stages after third-stage separation? Would the payload be hidden by the flame plasma of the fourth stage retro rockets? To what extent would the hypersonic plasma sheath interfere with tracking capability?²⁴

Launch Vehicle

The Athena Standard Launch Vehicle (Athena Standard) first-stage was a Thiokol Castor (XM-33-E8) motor with two Thiokol Recruit (XM-19-E1) strap-on motors.²⁵

The velocity package consisted of the third and fourth stages with a 50-pound payload. The third stage was an Aerojet General 30KS8000. The fourth stage was a Hercules (BE-3) (see Table 5).²⁶ As was the case with X-17 and Trailblazer, all of the motors had been proven reliable in use with other programs, enabling rapid development of the Athena launch vehicle which was approximately 50 feet in length and weighed approximately 16,750 pounds (Figures 14-18).²⁷

The attitude control system was manufactured by Honeywell and was described as two gyroscopes in a Crab-orientation configuration, oriented such that the orthogonal yaw and pitch momentum vectors were rotated 45° from the vehicle axes. The output from the inner gimbal of the first gyroscope was used as the attitude reference of the pitch axis; the inner gimbal of the second gyroscope was used as the yaw axis reference. Roll attitude reference was defined by the outer gimbal of either of the gyros. In a more conventional attitude control configuration, the gyroscope spin vectors are in the same plane as the body coordinates of the vehicle.²⁸

Table 5. Athena Standard Specifications (a)

Stage	Motor	Thrust (lb)	Diameter (ft)	Length (ft)
1	Thiokol Castor (XM33E8)	45,400	2.6	21.2
	2x Thiokol Recruit (XM19E1)	48,000 (total)	0.8	8.0
2	Mod I: Thiokol (TX 261)	47,800	2.3	10.8
	Mod II: Hercules (X 259-A6)	20,700	2.3	12.7
3	Aerojet Alcor (23KS11000)	9,000	2.5	10.5
4	Hercules (BE3-A8)	5,700	2.5	4.5

(a) See Endnote 26.

Flight Path

The Athena Standard flight path required that the payload fly on a course no closer than 20 miles to the Stallion Site radar complex, side aspect, and impact at least 20 miles in front of the Ram Site complex, head-on aspect (Figure 19).²⁹

Optical signature measurements were collected by both aircraft and ground instrumentation. A ground optical signature measurement station collected and recorded data in the visible and infrared regions of the spectrum. Aircraft optical signature measurements in the ultraviolet, visible, and infrared portions of the spectrum were collected by the NC-121 TRAP-VI (Terminal Radiation Program) aircraft stationed at Holloman Air Force Base.³⁰

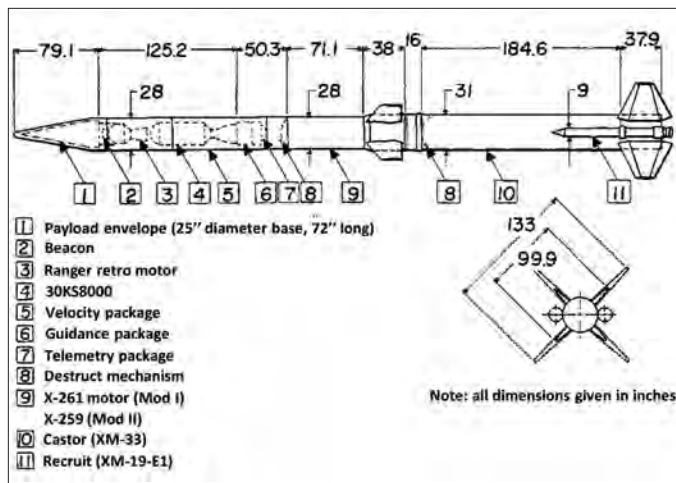


Figure 14. Athena Standard Launch Vehicle Specifications. Endnote 26.

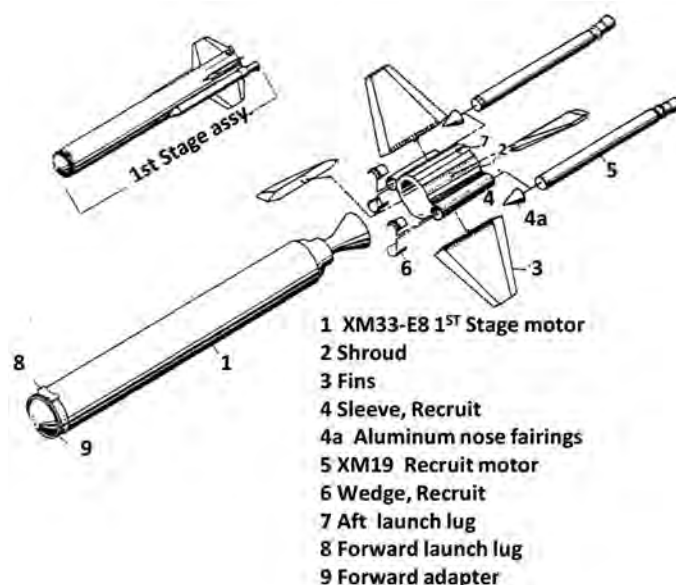


Figure 15. Athena Standard First Stage Assembly. Endnote 26.

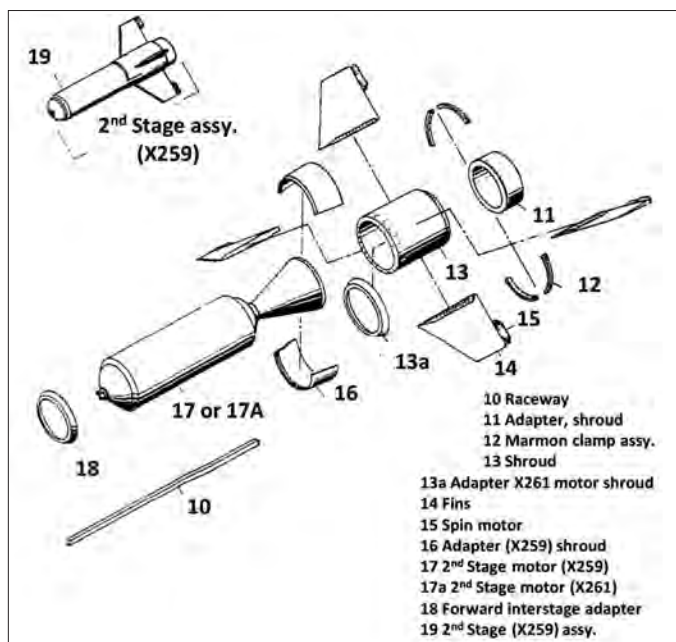


Figure 16. Athena Standard Second-Stage Assembly. Endnote 26.

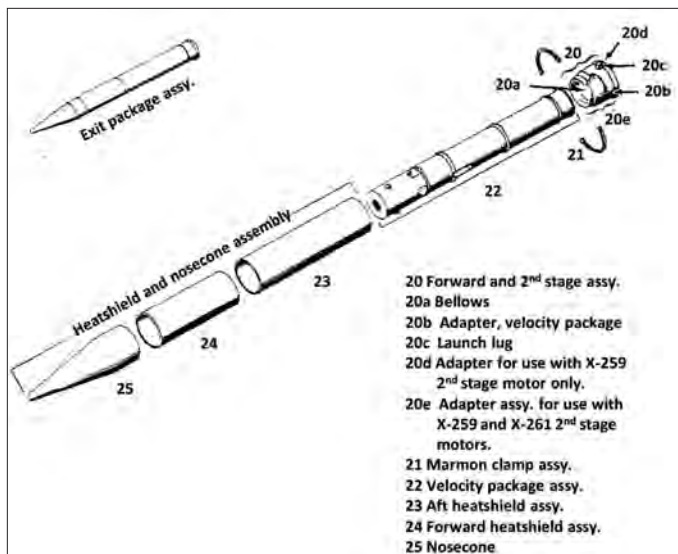


Figure 17. Athena Standard Velocity Package Exit Assembly. *Endnote 26.*

The Athena Standard was unguided and relied on spin stabilization. The booster's spin rockets, located on the trailing edges of the second-stage fins, ignited 0.015 seconds after clearing the launch rail and imparted a three revolutions per second spin that was sustained by slightly canting the first and second stage fins. Command-destroy devices were located in the forward sections of both the first and second stage motors.³¹

After approximately 40 seconds, the first stage motor burned out. First- and second-stage separation was achieved by atmospheric drag on the first stage. After a coast period which was determined by mission requirements, the second stage motor was ignited. At 300,000 feet altitude, the nose-cone heat shield was

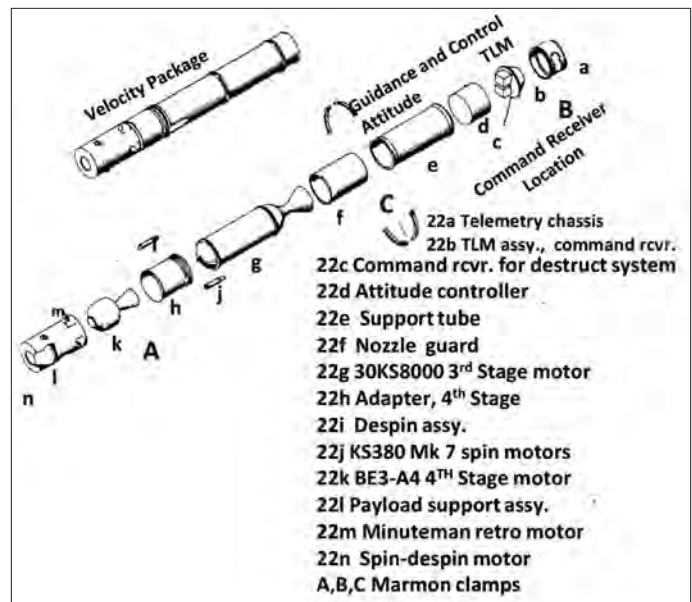


Figure 18. Athena Velocity Package Assembly. *Endnote 26.*

ejected by a set of springs, and the velocity package was ejected from the front end of the cylindrical heat shield.

A spin rate of three revolutions per second was maintained as the velocity package ejected from the heat shield. The velocity package was de-spun while the attitude controller simultaneously removed any residual pitch or yaw. The ground-command attitude controller oriented the velocity package to the appropriate reentry attitude. At this time ground-tracking provided position and velocity values for prediction of impact coordinates. The velocity package spin rate was set to five revolutions per second after the attitude-controller gas jets were deactivated. If the spin rate, body motions, impact predic-

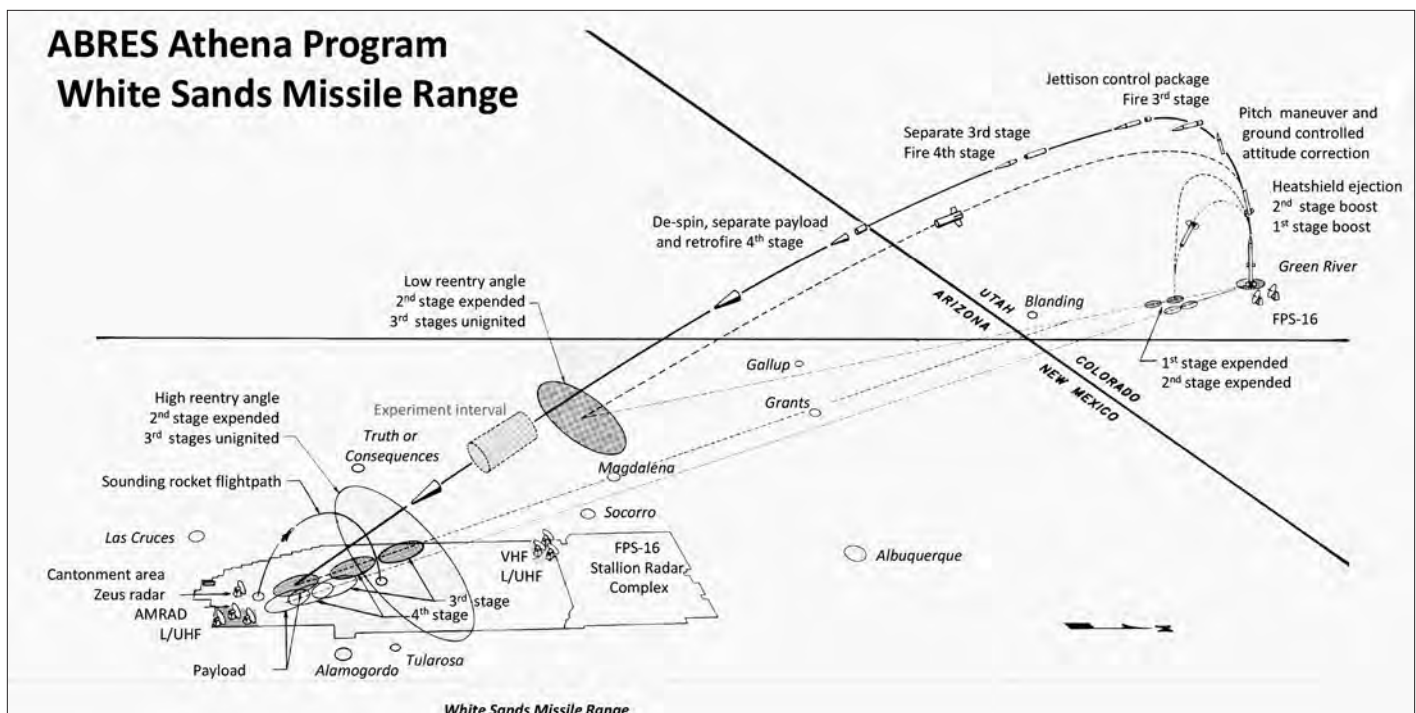


Figure 19. Athena Standard Flight Path from Green River to Impact at the White Sands Missile Range. *Endnote 19, 1*

tion, telemetry and attitude controller functions were acceptable, one more signal was sent activating a mechanical timer. The timer directed: (1) jettison of the guidance package, (2) third stage ignition, (3) third-stage separation, (4) fourth-stage motor ignition, and (5) reduction of the expended fourth stage spin rate. The payload was then ejected from the fourth stage and retro motors fired to move the spent fourth stage away from the payload. The payload was now at an altitude of approximately 250,000 feet with a velocity of 22,000 ft./s. There was no effort to retrieve the payload.³²

Research Programs

Athena Standard

The Athena Standard ABRES flight test program began on February 10, 1964 with the launch of Athena A001-01. This was an evaluation flight with dummy third and fourth stages. The rocket veered off course but was not destroyed because the calculated flightpath from radar data was over unpopulated land. The second stage and dummy third and fourth stages landed approximately 10 miles southeast of Durango, Colorado. Flight operations were suspended pending an investigation as to the cause of the deviation from the planned trajectory. Subsequent analysis indicated the cause was the premature ejection of the nose cone surrounding the reentry vehicle payload due to a junction box failure.³³

Flight operations resumed on May 28, 1964 with the successful launch of A002-A02 only to see the range safety officer destroy the rocket after 70 seconds when the radar track showed it about to leave the flight corridor. The post-flight investigation indicated the tracking data was incorrect.³⁴

Finally, on July 8, 1964, the program had its first successful launch and flight, Athena A003-B01. The dummy third and fourth stages impacted on target at WSMR. While this was still an evaluation flight the velocity package carried a subscale Titan II Mark VI reentry vehicle. Unfortunately, the next flight on September 28, 1964, C001-B02, was only a partial success when the ground-based trajectory computer canceled the third-stage ignition after sensing inverter malfunction. This was followed by another failure on October 4, 1964, D001-C01.³⁵

The first successful flight of a fully instrumented four-stage Athena Standard (C004-B05) took place on November 6, 1964. This was the first flight where the velocity package was used to drive the payload, a Mark 11 Mod B decoy, back into the atmosphere at 22,000 ft./s. as planned.³⁶

On November 28, 1964, high-altitude winds forced Athena Standard (C003-B04) out of the flight corridor and it was destroyed. With the successful launch and flight December 5, 1964 of Athena C002-B03, the Athena program ended the year on a positive note.³⁷

As shown in Table 6, the program hit its stride in 1966 with a 96% success rate. Between 1966 and 1969

there were 77 successful launches and flights with only eight failures. The Athena Standard program’s last launch was on 17 September 1971, a successful flight with a Sandia ABRES Material Systems Test payload. With a total of 130 flights, of which 107 were successful, the program made significant contributions to the development of the Mark I and Mark Ia chaff penetration aid system deployed on Minuteman II; hardening concepts used with the Mark 11C reentry vehicle; and design and development of the Navy’s Mark 2 and Mark 3 reentry bodies. The Air Force flew 92 missions, the Navy 30 and ARPA 8.³⁸

Table 6. Athena Standard Performance, 1964-1971 (a)				
Year	Success	Failures	Total Flights	% Success
1964	3	5	8	37
1965	18	9	27	66
1966	27	1	28	96
1967	27	3	30	90
1968	13	3	16	81
1969	10	1	11	90
1970	1	1	2	50
1971	8	0	8	100
total	107	23	130	82
(a) See Endnote 36, McDowell.				

HAVE SINEW

The original HAVE SINEW program was a two-flight evaluation of safety design alternatives for the radioisotope powered heat sources for thermal electric power generation in deep space probes. The Athena D payloads (Athena Standard was renamed Athena D) consisted of six radioisotopic heat sources and one dummy source, all which would be ejected as independent reentry bodies. Simulated nuclear fuel would be used and tracer amounts of tantalum 182 would be contained in each heat source to aid in detection *after* impact. HAVE SINEW-1 would “serve to verify the safety aspects of reentry from space of radioisotope heat sources for nuclear space programs commensurate with interagency safety requirements.” This included surviving land impact if a launch abort took place. HAVE SINEW-2 would serve to validate the selected design of the generator.³⁹

HAVE SINEW-1 was successfully flown on August 20, 1971. The six payload packages contained a total of nine radioactive gamma sources as an aid to recovery of the packages. Seven of the nine sources were quickly located. Of these, five were still attached to intact payload packages as expected; the other two were found detached from the third package. The remaining two sources were not found.⁴⁰ The results of HAVE SINEW-1 apparently were sufficient for design considerations as HAVE SINEW-2 was not flown.

**Sandia-Air Force Material Study (SAMS)
1969-1974**

The SAMS program began in 1969. The objective was to experimentally test the effects of precipitation and cloud particles, known as hydrometeors, impacting on various full-scale reentry vehicle materials by flying at high speed through storm cells and cloud environments. The test vehicles, either Terrier-Recruit, May 21, 1970 to April 8, 1974, 20 flights; or Talos-Terrier-Recruit (TATER), August 15, 1973 to April 25, 1976, 25 flights, were launched at an elevation of 30° and performed the impact erosion experiment during the ascent portion of their trajectory (Table 7). The instrumented payload, the nose tip and heat shield, were recovered using a parachute and floatation system. The Terrier-Recruit flights reached a speed of 8,800 ft./s. while the TATER flights reached a speed of 10,500 ft./s.⁴¹ A typical SAMS TATER reentry vehicle interior instrumentation arrangement is shown in Figure 20.

Table 7. Sandia-Air Force Material Study (a)

Launch Vehicle	# Tests	Nosetip Material	Heatshield
Terrier-Recruit	14	ATJS (graphite) ICCP (inverted chevron carbon phenolic) 3DCC (3-dimensional carbon-carbon)	CP (carbon phenolic) FWC (filament wound on-carbon GP (glass phenolic)
TATER	21	ATJS ICCP FWC GJNT (warm gas nose) TCNT (transpiration cooled nosetip) Tungsten/CP 3DCC 2DQP (2-dimensional quartz phenolic)	GP RMSPP (rub modified silica phenolic) SP (silica phenolic)

(a) See Endnote 43.

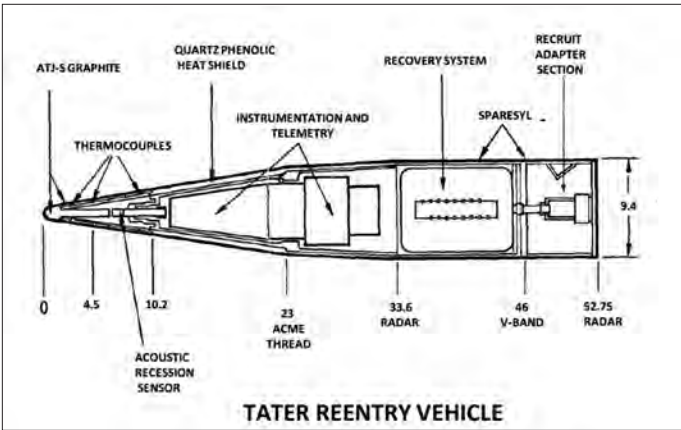


Figure 20. Inboard Profile of TATER Recovery Vehicle. Endnote 49, 5-9.

The SAMS program was also part of the Minuteman III Mark 12 reentry vehicle nose tip redesign effort. Four tungsten nose tips were designed, built, and flight tested on SAMS vehicles. Two of the nose tips were flown into

weather and two were flown in clear air. All four nose tips were recovered intact and analyzed with the result that “the monolithic tungsten sub tip should be replaced by a design, such as a segmented tungsten concept, that will enhance the thermal structural performance capability.”⁴² Additionally, given that ICBM reentry speed was on the order of 22,000 ft./s., the TATER launch vehicle experiments needed to be repeated at a higher reentry speed.⁴³

**Hydrometeor Erosion and Recession Tests
Systems (HEARTS) 1973-1975**

By the mid-1970s the Defense Nuclear Agency’s research into the effect inclement weather had on ICBM and IRBM reentry vehicle heat shields, specifically the nose tip and frustrum areas, required moving from the laboratory to an intermediate evaluation step prior to full-scale ICBM and IRBM flight programs. Hydrometeor refers to all of the liquid, solid, and mixed phases of condensed water existing in the atmosphere. It includes a spectrum of particle sizes from tiny ice crystals and cloud droplets through the various forms of snow, to the larger forms of liquid precipitation. The required weather conditions occurred most frequently along the Atlantic seaboard making Wallops Island an ideal location for the program. HEARTS and HEARTS II had as their primary objectives: (1) obtain experimental data for use in development and evaluation of mathematical rainfall erosion/ablation models; (2) verification of the tungsten sub tip redesign with monolithic or segmented tungsten.⁴⁴

There were six Athena C flights in the HEARTS program, with the first launch on December 12, 1973 and last launch on December 13, 1974, all successful. Each carried three instrumented payload vehicles to an impact point 300 nautical miles down range from the Wallops Flight Facility. Tungsten nose tips were flight-tested on HEARTS and HEARTS II reentry vehicles as an intermediate evaluation step prior to full-scale ICBM flights (Figures 21 and 22).

There were two flights in the HEARTS II program, January 20, 1975 (Athena C) and February 4, 1975 (Athena D). Both flights were successful.⁴⁵ Tungsten nose tips were also flown on the two HEARTS II reentry vehicles. Each nose tip was covered with a Teflon glove designed to burn through and expose the tungsten at an altitude of around 35,000 feet. Both flights reached reentry velocities of approximately 18,000 ft./s. The segmented tungsten sub tip was validated with these two flights.⁴⁶

A nose tip recovery system had been considered for the HEARTS and HEARTS II systems and tested with two prototype flights in 1974. One flight was successful and proved the overall concept of the mass jettison drogue (MJD) design. The MJD system was incorporated into a new project, the Fighter Launched Advanced Material Experiment (FLAME).

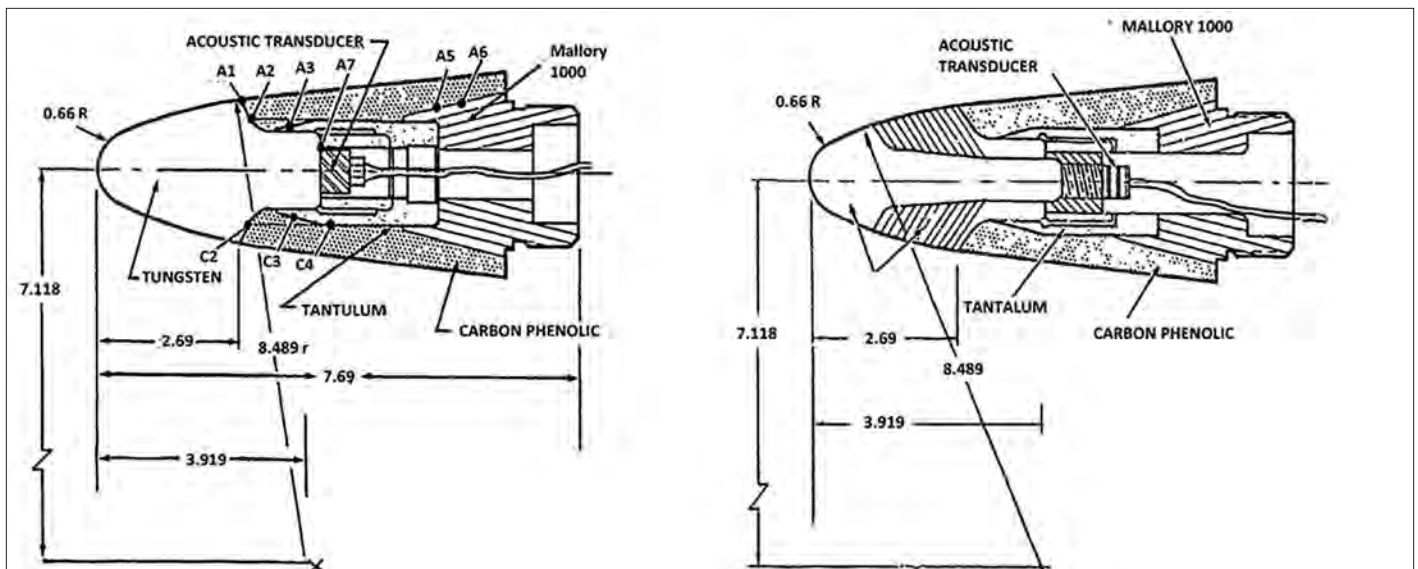


Figure 21. (Left) HEARTS II Monolithic tungsten nose tip flown on Vehicle 106 (Athena C), 20 January 1975; (right) HEARTS II segmented tungsten nose tip flown on Vehicle 112 (Athena D) 2 April 1975. Endnote 42.

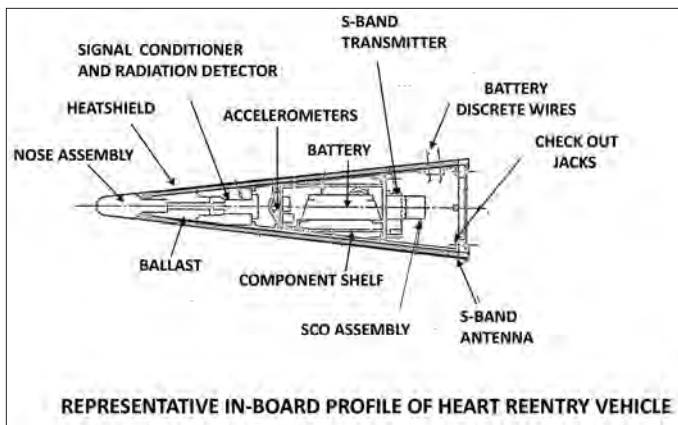


Figure 22. Representative Inboard Profile of HEARTS Reentry Vehicle. Endnote 42.

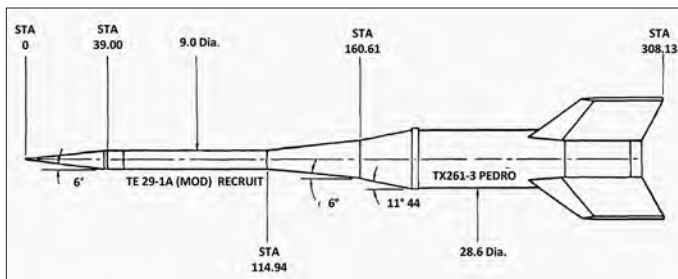


Figure 24. Outboard Profile of FLAME Launch Vehicle. Endnote 47, 11.

Fighter Launched Advanced Material Experiment (1972-1976)

In 1972, Prototype Development Associates, Inc., the prime contractor for the HEARTS program, began development of a novel solution to nose tip recovery, the MJD system (Figure 21 and 22). The reentry nose tip was mounted on a boom which was surrounded by the conical heat shield. At 15,000 feet altitude, linear charges split the heat shield into two sections which were ejected from the reentry vehicle. The increase in drag caused by this action slowed the reentry vehicle down to a speed where a para-

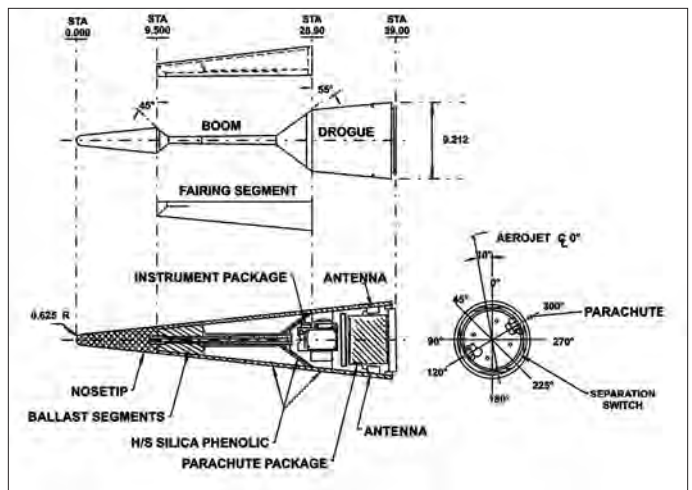


Figure 23. Inboard Profile of FLAME Recovery Vehicle. Endnote 47,14.

chute could be deployed and the recovery vehicle lowered to the earth or ocean depending on the flight profile (Figures 23, 24).⁴⁷



Figure 25. F-4JD Carrying a FLAME Test Vehicle. Endnote 47, 14.

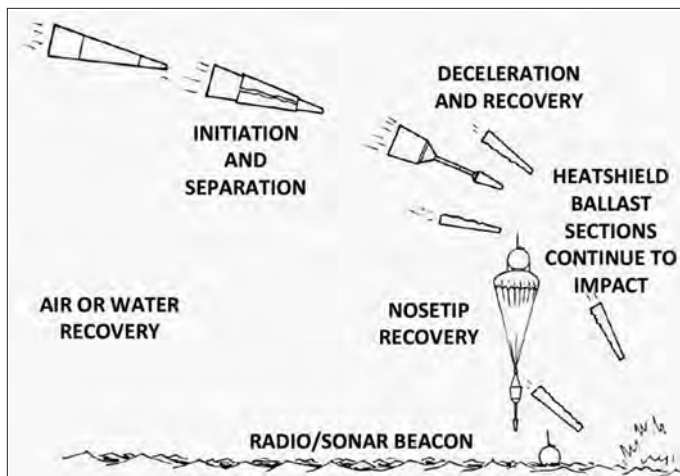


Figure 26. Mass Jettison Drogue Recovery Concept. Endnote 47, 11.

Booster Vehicle

The FLAME program replaced the first stage of the launch vehicle with an aircraft, simplifying and reducing launch costs considerably. The booster vehicle was a Pedro-Recruit, first and second stage respectively, with the MJD reentry vehicle and was carried on the centerline position of the Navy F-4JD (Figure 25).

FLAME Trajectory

The FLAME vehicle was released from the F-4JD after a Mach 1.4, high altitude pull-up maneuver. The booster vehicle coasted through apogee and when the vehicle reached a flightpath 13° below the horizontal, the first stage fired followed by second stage. This accelerated the reentry/recovery vehicle up to a maximum velocity of 13,200 ft./s at approximately 37,000 feet. The reentry/recovery vehicle then separated from the expended second stage at approximately 15,000 feet, linear charges fired to separate the heat shield and ballast from the recovery vehicle, resulting in a rapid deceleration due to large mass removal with a high drag result. The recovery vehicle consisted of the nose tip, electronics/instrumentation package, parachute, aft portion of the vehicle heat shield and, in case of water recovery, a flotation bag, location beacon and sonar pinger.

With removal of these center body sections, the exposed closed aft section of the vehicle containing the parachute and electronics package became a lightweight high-efficiency drogue connected to the nose tip section by a rigid structural member called the boom. The combined weight loss and drag increase resulted in a decrease in ballistic coefficient by a factor of over six. After approximately 20 seconds the vehicle approached a terminal velocity of approximately 650 ft./s. and the terminal recovery system was then deployed by mortar (Figures 26 and 27).⁴⁸

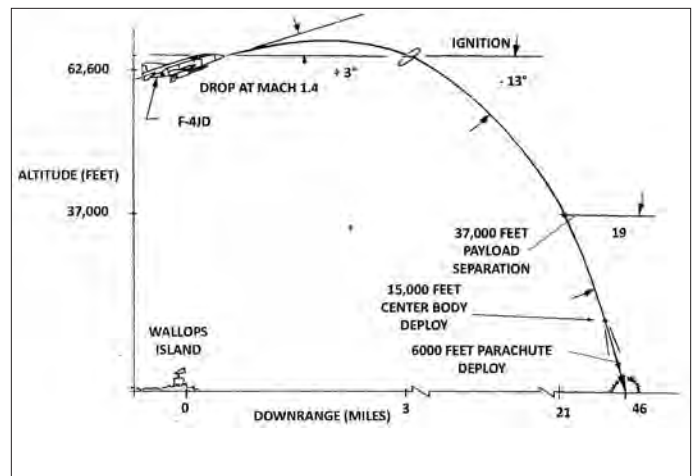


Figure 27. FLAME Flight Profile. Endnote 47, 15.

FLAME Flight Test Research Program

Eight FLAME vehicles were flown: two vehicles launched from Wallops Island and six at the Tonopah Test Range, Nevada, with only one success. The monolithic tungsten nose tip experiment flown on 3 June 1975 at Tonopah was recovered but the acoustic transducer sensor failed and recession data was not obtained. The flight was in clear weather so no further information on erosion caused by hydrometeors was obtained. The final report of the FLAME program recommended further research.⁴⁹

Material Screening Vehicle (MSV) 1975-1977

MSV was a continuation of the HEARTS program. The three-flight program used Athena D launch vehicles. The payloads were three miniature MSV reentry vehicles, simultaneously descending into weather systems over water approximately 75 nautical miles east of Wallops Island. First flight 2 April 1975, last flight 20 March 1977. All flights were successful.⁵⁰

Large Payload Test Vehicle 1964-1965

In May 1964, just three months after the errant flight of Athena Standard (A001-A01), the Air Force announced a new project, Super Athena (subsequently the name was changed to Large Payload Test Vehicle LPTV), which would have a payload capacity of 450 pounds and would use the Green River-to-WSMR flightpath.

Large Payload Test Vehicle

The LPTV would become the launch system for testing full-scale reentry vehicle payloads such as the proposed Minuteman Mark 12, 350-pound reentry vehicle, up to a maximum of 1,000 pounds at 22,000 ft./s.

More than 100 LPTV flights were contemplated. Experiment options included: verifying operational effectiveness with single full-scale reentry vehicles; multiple-payload systems trials; terminal sensing and

locating trials; recovery of material-test vehicle; research and development feasibility flight demonstrations. Mandatory flight performance for payload weights of 100 to 400 pounds would include: payload reentry angles of -14 to -50 degrees relative to the local geocentric horizontal at a reference test altitude of 300,000 feet; reentry velocities from 16,000 ft./s. to 25,000 ft./s. at the reference altitude of 300,000 feet. With the possibility of trajectory reaching from Mountain Home AFB to the WSMR impact areas, payload impact accuracy would have to be within one nautical mile, booster impact accuracy three nautical miles.⁵¹

On March 29, 1965, the Air Force announced that Martin-Denver had won a four-month, \$800,000 contract to evaluate options for improvements to Athena SLV. Four configurations were selected for further study: (1) First stage, Douglas Thor; second stage, a Minuteman second stage); (2) Three-stage solid propellant using a Minuteman first stage as the booster motor; (3) Cluster of Aerojet Algol or Thiokol Castor motors; (4) Minuteman with a fourth stage.⁵²

On May 30, 1965, Martin released the "Integration, Assembly and Checkout Plan for Large Payload Test Vehicle Program." The overland launch facility would be a Titan I Complex A, Mountain Home AFB, Idaho, converted into two IPTV launch facilities and associated support and control buildings (Figure 28). Impact would be at the WSMR facilities already in place. The launch vehicle would be a surplus Minuteman I with a modified Scout as the fourth stage.⁵³

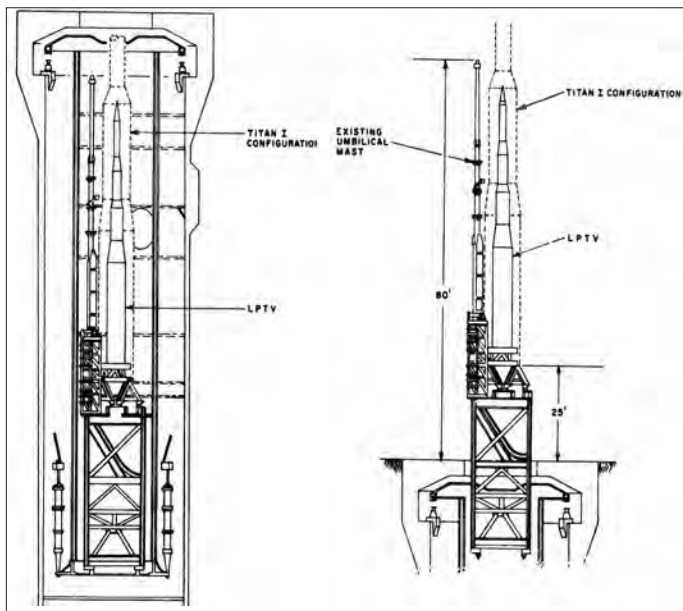


Figure 28. Titan I Silo Reconfigured to Support the Large Payload Test Vehicle Program. Endnote 53, 95-96.

The literature is not clear as to the demise of the IPTV program. It was replaced by an upgraded Athena, Athena H.⁵⁴

Athena H

Atlantic Research Corporation proposed an advanced version of Athena Standard with a payload of approximately 450 pounds to the Air Force in November, 1965. With this nearly tenfold increase in payload capacity, Athena H could be used with the proposed heavier reentry vehicles for the Minuteman program. In addition, the cost of Atlas launchers for ABRES experiments would increase once the Army stopped using them in 1970 as part of the Safeguard development program. Budget cuts due to the Vietnam War postponed further development of Athena H for three years. On August 23, 1968, Atlantic Research Corporation received a \$31,045,000 contract to build and launch 30 Athena H rockets.⁵⁵

Launch Vehicle and Flight Events

The Athena H rocket motor specifications are given in Table 8. The first stage booster consisted of either an Algol II-B or Castor IV solid propellant motor, augmented by four Recruit solid propellant motors which were retained during boosted flight. Atop each of the Recruit motors was a modified single wedge fin. These fins were designed to

Table 8. Athena H Specifications (a)

Stage	Motor	Thrust (lb)	Diameter (ft)	Length (ft)
1	Thiokol Castor IV	94,340	3.3	31.8
	Aerojet Algol II-B	70,700	3.3	31.8
	4x Thiokol Recruit (XM19E1)	97,000 (total)	0.8	8.0
2	Thiokol (TX-261)	47,800	2.3	12.7
3	Aerojet Alcor (23KS11000)	9,000	2.5	16.5

(a) See Endnote 56.

give minimum dispersion, adequate stability, and minimum roll damping at lift-off. Each fin had a wedge-shaped roll tab for roll augmentation (Figure 29).

The two spin motors were attached at approximately station 395 (Figure 29). After spin motor burn-out, the motors were ejected to reduce vehicle drag. After first stage burnout, the velocity package was separated and de-spun before the heat shield was released. The second stage was either a Hercules X-259 or Thiokol TX-261 solid propellant motor. This stage was attached to the first stage through an adapter section which contained the attitude controller. The attitude controller was released before second stage ignition. The third stage was a 23KS11000 motor. Eight retrograde motors were fitted to the third stage shroud. After the third stage was de-spun and the payload ejected, the retro motors were used to ensure the maximum separation distance between the terminal stage and reentering payload.⁵⁶

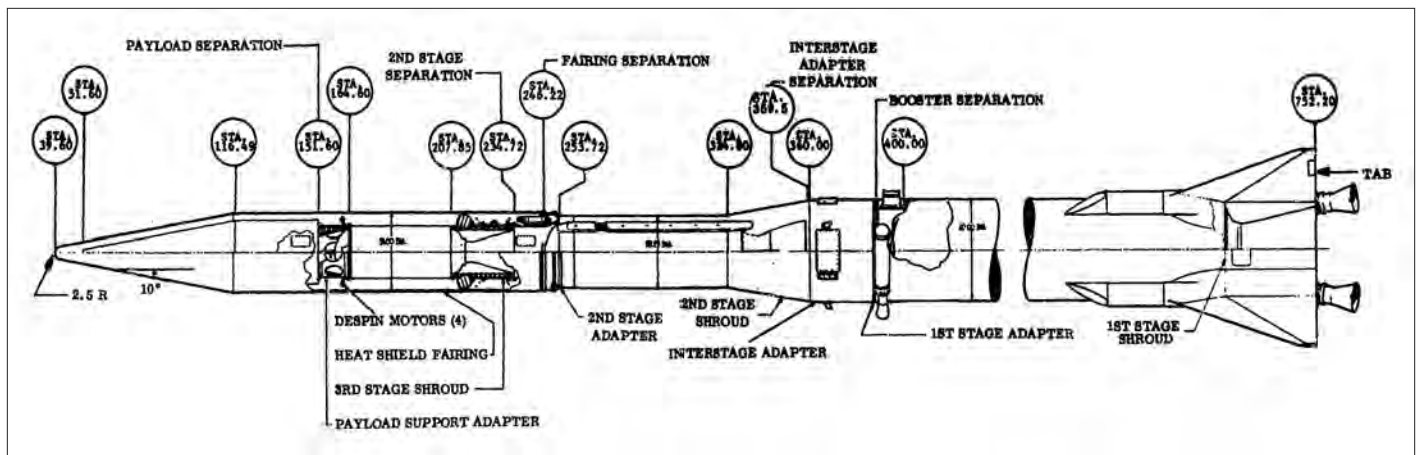


Figure 29. Athena H General Characteristics. Endnote 56, 18-19.

Research Programs

WSMR (1971-1973)

Athena H flight testing began on April 3, 1971 with the first of three research and development flights, launched from the Green River Launch Complex, all successful. Eight operational flights followed, also launched from the Green River Launch Complex, again all successful, ending on August 24, 1973. This flight testing evaluated a wide number of ABRES experimental reentry vehicle designs. When flight operations were moved to Wake Island, to support the HAVE MILL program, the Athena H assembly facilities were retained at

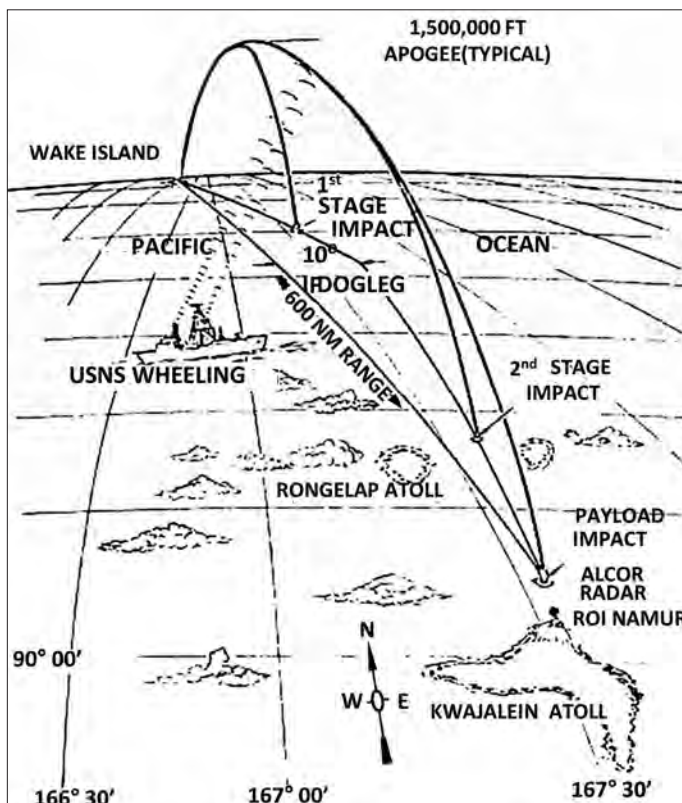


Figure 30. Project HAVE MILL Athena H Flight Profile and Sequence of Events. Endnote 58, 1892.

the Green River Launch Complex and the assembled rockets flown to Wake Island.⁵⁷

HAVE MILL, Wake Island (1972-1974)

On December 22, 1972, Celesco Industries, a subsidiary of Atlantic Research Corporation, received a \$6.5 million contract from the Space and Missile Systems Organization to construct an Athena H launch complex on Wake Island and then an additional \$14.8 million to build and launch 11 Athena H rockets in support of the HAVE MILL special targets program. The Army Advanced Ballistic Missile Defense Agency, the Navy Undersea Launched Ballistic Missile System and the Air Force ABRES program all had requirements for experimental payload delivery under ICBM and IRBM reentry conditions to the Kwajalein Atoll radar and optical instrumentation complex (Figure 30).⁵⁸

The HAVE MILL Athena H program flights began on February 13, 1974 and ended after seven successful flights on June 23, 1974.⁵⁹

Summary

At its inception in 1962, the ABRES program was faced with two major tasks. The first was to: develop scaling laws that would relate subscale reentry vehicle testing to full-scale IRBM and ICBM reentry vehicle velocities. If successful, this would allow screening reentry vehicle shapes and materials using laboratory-scale experiments followed by sounding rocket-type launch vehicles flight testing. By the end of 1965, the data collected from 34 Athena, 24 X-17, 15 Trailblazer I and 4 Trailblazer II flights enabled the development of scaling laws by comparing results from full-scale payloads using 17 surplus Atlas ICBMs flown from Vandenberg Air Force Base and Cape Canaveral (Minuteman IB ABRES flights did not begin until 1973).⁶⁰

The second major objective was investigation of new reentry techniques to reduce missile radar and optical signatures such that the enemy's defensive systems would fail to detect reentry vehicles, at least until it was too late. Here again, the use of the X-17; Trailblazer I and II, Athena Standard, C, D, H launch vehicles facilitated economical and flexible experimentation. ■

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The first Athena-H sounding rocket to be fired from the Utah Launch Complex, Green River, Utah, on its launcher before launch on January 7, 1971. (NASM)

“A hammer on a gigantic pistol being pulled back”: SAC, Nuclear Forces, and the Hungarian-Suez Crisis of 1956



SAC's workhorse during this time consisted of B-47 bombers capable of carrying Mk 15 and Mk 21 thermonuclear weapons. Operation ROAD BLOCK consisted of seventy-two B-47's launching from Barksdale AFB and Portsmouth (later Pease) AFB. Half of these aircraft were loaded with nuclear weapons. (U.S. National Archives)

Sean M. Maloney

We can prevent war only by letting potential enemies know what we can do, only by making a prospective war so horrible that they will seek other means of solving difficulties. But peace is our profession.

-Lt Gen Francis H. Griswold

interview with Nick Lamberto of the *Des Moines Register*,
November 17, 1957

I had this experience that stamped itself upon my memory during the Suez crisis in 1956...I went into the control room of the 8th Air Force to watch as symbols were moved across this gigantic map, and one after another the B-47s and B-52s were announced: combat ready, cruising aircraft ready for take-off. The tanker units were flown to the far bases, some of the B-47s also, until finally all the symbols were up and ready to start. It was like that, a hammer on a gigantic pistol being pulled back, and the end of the world, at most, a good part of it, was very, very near. It would have happened in the next few hours if they had ever gotten the order to go. I thought that was an impressive sight.

-George McFarland, SAC 1950-1958¹

We are conditioned to view Cold War nuclear crises through the lens of the gold standard, the dramatic Caribbean Crisis where the fate of the world hung by a thread in October 1962. But what happened when the United States and its President were confronted with an ambiguous Soviet threat coupled with ambiguous nuclear force signalling half a decade before the familiar Strangelovian trappings of the DEFCON system, the hot line, and airborne alert were in place?

The narrative of the 1956 crises is familiar to all of us. Egyptian leader Gamal Abdul Nasser flirts with both the United States and Soviet Union in what amounts to a grand souk negotiation for development and military aid, then nationalizes the Suez Canal prompting Great Britain, France, and Israel to collude in an invasion to topple the regime and restore control over that vital waterway. At the same time, Soviet leader Nikita Khrushchev, faced with the possibility of a collapsing Warsaw Pact after his anti-Stalinist 'secret speech' triggers dissent in the Soviet empire, cracks down on Hungary on the eve of the Anglo-French/Israeli operation in October 1956. He issues,

through Bulganin, a series of threats implying nuclear weapons use against Britain and France if they do not withdraw their forces. The Eisenhower administration refuses to support its allies and Canadian foreign minister Pearson supposedly invents UN peacekeeping to give the allies a way out of the situation. The French, British, and Israelis withdraw their forces and stability is returned to the Cold War system.

The existing literature depicting the Hungary and Suez crises, however, has virtually no detailed discussion of Soviet or American nuclear forces, their activities or the role they played in the lead up to and during the crises.² There is cursory mention of the vague Soviet rocket threats and that this was a grand bluff on Khrushchev's part that paid off spectacularly at the time but established a dangerous precedent that led to the Caribbean Crisis of 1962.³ Indeed the Hungarian-Suez Crisis barely makes it into Cold War-era analytical literature that attempted to address crisis signalling.⁴ The operational literature has only cursory, vague or inaccurate information.⁵ What has never been explained is this: in addition to other military activities mounted during the crises, why, exactly, did seventy two Strategic Air Command B-47 bombers loaded with nuclear weapons conduct a major operation in the Arctic at the height of the crises? Was this rogue activity on the part of SAC commander-in-chief General Curtis LeMay? Or was it part of something more sophisticated and precise directed by President Dwight D. Eisenhower in response to the activities of the Soviet nuclear forces? A new perspective based on newly-declassified intelligence and operational material confirms that the crisis extended into early December 1956 and that American and Soviet nuclear forces played a role in resolving it.

Preliminaries: February-August 1956

On February 2, 1956, twenty days before Soviet Premier Nikita Khrushchev made the "secret speech" denouncing Stalinism, the Soviet Union launched an R-5M (SS-3 SHYSTER) ballistic missile from Kapustin Yar missile test range. This particular R-5M was the first Soviet missile to carry a nuclear warhead, a modified RDS-4 gravity bomb, which detonated in the Aral Desert with a yield of less than a kiloton (the standard warhead for the R-5M when deployed later yielded 300 kt and later there was a 1 Mt version).⁶ There are no in-

dications that President Eisenhower was briefed on this test. His daily Current Intelligence Bulletin, which usually had sections on Soviet nuclear tests and other strategically-important exercises, has no mention of it and he was usually briefed on Soviet nuclear tests.⁷ To what extent the details of Op BAIKAL were known to the intelligence community in the West are unclear. The United States would not conduct a live full-up nuclear-tipped ballistic missile test until 1958, which put the Soviets ahead in this capability at this phase of the Cold War.

During the course of protracted public diplomacy over Nasser's "anti-colonial" endeavours in the Middle East in the spring of 1956, Khrushchev and Bulganin made a state visit to Great Britain in April. In a series of discussions, "Eden took the occasion to administer a heavy dose of British concerns over Soviet moves in the Middle East. He bore down heavily on the British need for a continuing flow of oil" and bluntly stated that they would "fight for it" if pushed into that corner.⁸ Khrushchev then casually threatened his hosts. "Eden, Lloyd, Macmillan, Butler and other British statemen. We told them frankly that we had rockets of various ranges."⁹ Indeed, the idea that the Soviets might introduce Korean War-style Communist "volunteers" for internationalist duty if Egypt were attacked by France and Britain was also mooted at this point.¹⁰ In essence, both threats were repeated as the crises took more acute form in November but the ability to carry out nuclear bombardment, specifically the use of nuclear-tipped missiles, was ambiguous to Western leaders. Indeed, the threats were extremely subtle and appear to have had no immediate deterrent effect on British action. This exchange was likely not crisis diplomacy and should perhaps be couched within Khrushchev's larger effort of the day to compete with the Western bloc in the developing, decolonizing Third World which was designed to "verify in practise whose system is better."¹¹

However, the view from the American Joint Chiefs of Staff at this time was focused on the expanding Arab-Israeli hostilities in the region. Chairman of the Joint Chiefs of Staff, Admiral Arthur Radford, informed the unified and specified commanders that "In view of the tense situation in the Middle East, the JCS have taken certain preparatory actions to improve readiness for military action."¹² This activity was to support a phased plan that had an escalating series of "deterrent actions to prevent hostilities" between the Arab states and Israel. These included alerting of forces; ostentatious deployment of naval and air forces to Middle East bases and at sea; the mass overflight of Israel and the Arab states by those aircraft while naval forces cruised off the coasts. The air intervention plan included Strategic Air Command (SAC): "These forces would gain control of the air, then warn both sides to ground their remaining aircraft and withdraw ground forces....If the warning were not heeded air attacks against the aggressor would be launched."¹³ The planning did not take into account possible Soviet intervention in the situation, nor Anglo-

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French intervention and was solely focused on the Middle East belligerents. There was no movement of forces in support of this contingency plan but it is indicative of how seriously the JCS viewed the situation earlier in 1956.

Another indicator of how serious the JCS viewed the situation was exercise GAS HOUSE, held in June 1956. At this point in history American nuclear weapons were owned by the Atomic Energy Commission, not the armed services. Weapons were stored in AEC-controlled National Stockpile Sites and Operational Storage Sites and, by mid-1956, increasingly in Special Service Facilities at SAC bomber bases (dubbed the “Bombs-on-Base” program). AEC Custodians held legal custody of the cores for the primaries of both atomic and thermonuclear weapons as well as the bomb casings and their pits. In the event of war, AEC Chairman Lewis Strauss had to release the special nuclear materials in consultation with the President of the United States. GAS HOUSE was a communications exercise between the JCS Joint War Room Annex, the Joint Coordination Center and the storage sites to test the communications network and the release procedures.¹⁴

Notably, SAC also conducted an exercise dubbed BIRDS EYE in July 1956 which involved the temporary deployment of five B-47 jet bombers and three KC-97 tankers to Adana Air Base in Turkey. BIRDS EYE was designed to familiarize the base with recovering B-47 aircraft after a strike against the Soviet Union had been made using nuclear weapons as part of the Emergency War Plan (EWP). BIRDS EYE was not designed as crisis signalling but it appears to have been a predecessor of the later BIG HORN rotational B-47 deployments which permitted SAC to strike targets deeper in the Soviet Union as part of the EWP in the event of war.¹⁵ If the Soviets knew about or were concerned about BIRDS EYE, they made no public mention of it.

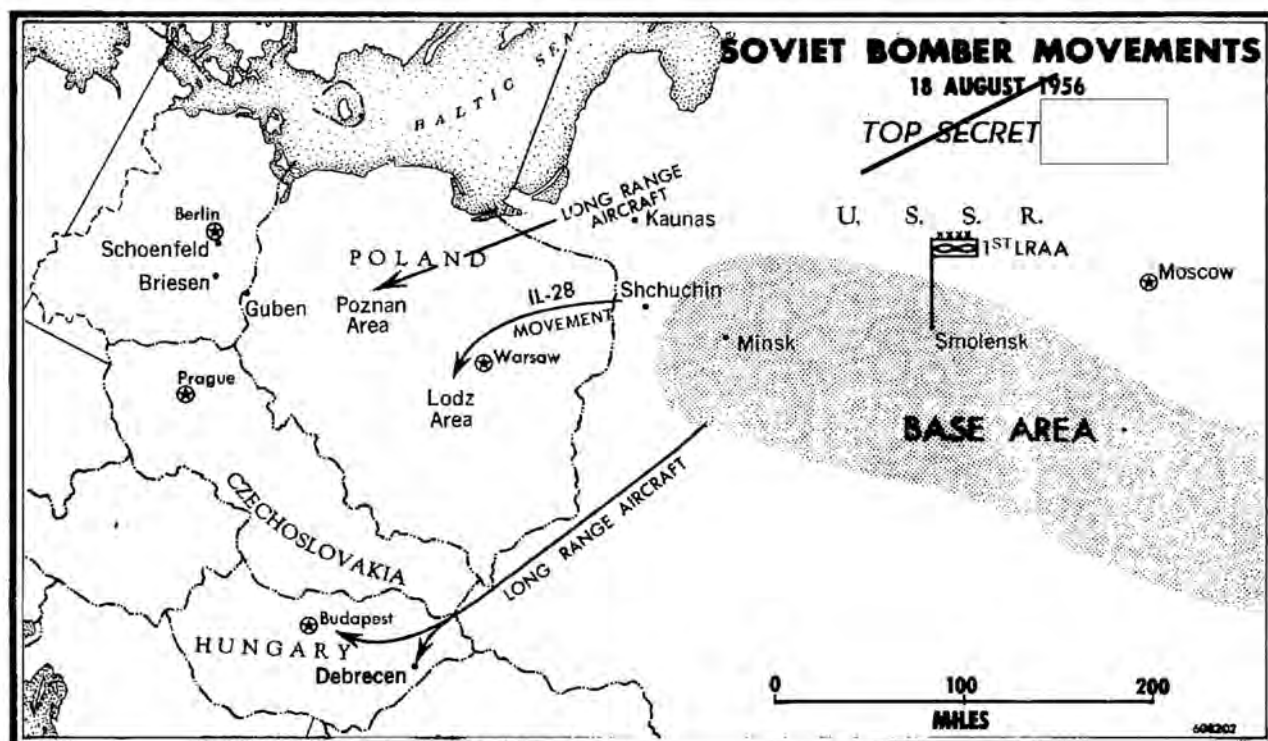
The crisis in the Middle East receded temporarily into the smoke-filled rooms of diplomacy for several months but Nasser's nationalization of the Suez Canal in July and the failure of Anglo-French-Egyptian diplomatic efforts afterwards prompted Admiral Radford to report to Secretary of Defense Charles Wilson that the JCS considered this move “to be so seriously detrimental to the United States and its allies from a military point of view as to require action.” At a subsequent National Security Council meeting, Chief of Naval Operations Admiral Arleigh Burke opined that “The JCS are of the view that Nasser must be broken.” Eisenhower, however, disagreed and instructed that all possible contingencies be studied. Out of this planning emerged preparations for non-combatant evacuation operations and sending a brigade to protect oil production in Dhahran.¹⁶ The possibility of Soviet intervention in the Middle East, however, emerged on 23 August with the failure of the London talks, which were aimed at gaining an amicable solution to the Canal's nationalization. Khrushchev lectured the French and British ambassadors in Moscow and warned them that “The Arabs will not stand alone” and repeated the threat to send “volunteers” in if there were a military intervention in the re-

gion.¹⁷ Eisenhower was seriously concerned with this threat and suspended all American peripheral “ferret” reconnaissance flights on August 25, to ensure there were no “incidents” that could aggravate the situation. These missions were permitted to gradually continue again six days later.¹⁸ The JCS, however, warned the unified and specified commands at the end of August that the “possibility exists that situation in Middle East could deteriorate rapidly.”¹⁹

Khrushchev and Crushing the Satellites: June-October 1956

It was in the fall of 1956 that Soviet issues in maintaining control of its eastern European colonies overlapped with the ongoing Middle East situation. Khrushchev's February 25 speech denouncing Stalin and his works produced substantially increased public dissent in Poland, Bulgaria, Hungary and Czechoslovakia in March. In June a demonstration in Poznan, Poland was crushed by the state with extreme violence and there were concerns on Khrushchev's part that the flow of cheap coal from Polish mines would be slowed which in turn would negatively affect the Soviet economy and its military buildup. Khrushchev was increasingly concerned that something similar was brewing in Hungary and dispatched Anastas Mikoyan to Budapest in July: his reports confirmed Khrushchev's fears that there was something existentially wrong with Soviet relations in Eastern Europe.²⁰ This put Khrushchev in the quandary of having to deal with not one, not two, but multiple crises at once, including unrest in the Soviet Union proper while the Suez situation bubbled away.²¹ At some point in July Defence Minister Marshal Georgy Zhukov was instructed to initiate contingency planning for Red Army interventions in Eastern Europe if the situation deteriorated.²²

This may or may not have accounted for the “unprecedented” large scale deployment of 60 medium bombers (either TU-4 or TU-16 or both) and 35 Il-28 light bombers to Hungary, Poland, and East Germany on the morning of August 18, 1956. The American intelligence apparatus detected unusual TU-4 bomber flights to East German bases on August 6, but the later move was so large it warranted briefing Eisenhower on the details.²³ All three aircraft types were nuclear-capable and had demonstrated that capability with live test drops of weapons yielding between 28 kt and 250 kt at the Semipalatinsk test site in 1954 and 1955. The American intelligence apparatus, however, was generally unable to distinguish between the nuclear-capable *Atomnyy* versions of the aircraft from the conventional versions because they were externally similar.²⁴ But if this was a signal then what was the message? And to whom was it directed? Was it to France and Britain to underscore the “volunteers” threat vis-à-vis the Middle East? Was it designed to overawe the Warsaw Pact nations and their leadership in a time of internal crisis? Was it to message NATO to stay out of Eastern European affairs? Indeed, SAC had been particularly concerned with the potential for a pre-emptive strike against B-47 bases in Great



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Figure 1. The deployment of 60 Soviet nuclear-capable medium bombers to forward bases in the Warsaw Pact in August 1956 was significant enough to brief President Eisenhower as they constituted a potential threat to SAC bases in the United Kingdom. Forward-based bombers in East Germany could also reach eastern North America with refuelling support. (CIA)

Britain going back to 1953 when Il-28s were deployed to East Germany and Soviet-occupied Austria. And the use of East German airfields expanded the range and variety of targets that refuelled TU-4 and TU-16s could reach in northeastern North America.²⁵ (Figure 1)

On September 7, 1956, Eisenhower's daily intelligence briefing noted that the entire Soviet armed forces had its leave cancelled. This was a massive undertaking given the gargantuan size of the Soviet armed forces and could only be understood as a preliminary move before mobilization. That, of course, greatly concerned NATO because of the possibility of an invasion of Western Europe was predicated on Soviet mobilization. But what did the leave cancellation mean? CIA analysis suggested that this move was deliberate signalling to the French and British over Suez.²⁶ There appears to have been no connection made between the leave cancellation and the deteriorating situation in Poland, where a combination of limited liberalization introduced in the summer and the trials of the Poznan revolutionaries in September acted like "a lightning rod for dissent."²⁷ At the same time, Khrushchev responded to developments in the Middle East. Increased Jordanian-Israeli tensions in September produced another ambiguous Soviet warning that Israel would face "serious consequences" if it continued to aggravate the situation.

Khrushchev's primary problem, however, was Poland. Rehabilitated Polish leader, Wladyslaw Gomulka initiated a "Polacization" policy to reduce the Soviet security presence in the Polish secret police and the armed forces and possibly to remove Soviet divisions from Poland. Marshal Konstantin Rokossovsky, the Soviet-imposed defence minister, was dismissed and "concerned that Poland....might be about to break from the Warsaw Pact, Khrushchev decided to act."²⁹ On October 18, lead elements of between four to six Soviet armoured and mechanized divisions stationed in East Germany as part of the Group of Soviet Forces Germany opposite NATO, moved to assembly areas west of Stettin. All bridges over the Oder River were guarded by Soviet troops. The next day, Polish army and security forces went on alert as the two Poland-based Soviet divisions moved out of their barracks to assembly areas outside of Warsaw.³⁰ These land moves were accompanied by more than 20 Soviet warships appearing off Gdansk covered by air support.³¹ On October 19, a high-powered Soviet delegation consisting of Mikoyan, Molotov, and Marshals Zhukov and Ivan Konev arrived by plane to discuss matters with Gomulka. Despite the Soviet force moves, there were widespread demonstrations throughout the country. Somehow Gomulka was able to appease the Soviet delegation and Khrushchev ordered the

troops back to barracks on October 24. Another view is that “The Soviets were deterred by intelligence reports that significant numbers of Polish troops would [fight back] and unnerved by rumours of weapons being handed out in Warsaw factories.”³²

Right on the heels of the Polish situation came the initial stages of the Hungarian revolution. Anti-Soviet demonstrations escalated throughout October, fed off the situation in Poland and culminated in a mass demonstration in Budapest on October 23. By October 28, Zhukov deployed four Soviet divisions from Ukraine to Hungary, and preparations were made to move in additional divisions from Romania.³³ The American intelligence apparatus picked up on all of these moves and others that were of concern to NATO. Zhukov then increased the Soviet fighter strength of the 24th Air Army in East Germany by a whole MiG fighter division while at the same time withdrew a light bomber division and two ground attack divisions to the Soviet Union. This was assessed by CIA as “a reorganization....necessitated by a switch to nuclear warfare.”³⁴

From a NATO perspective these moves would have been of exceptional concern. The deployment of an additional four or more divisions to Hungary could have been used to outflank weak West German defences via Austria, for example. Preliminary steps towards mobilization, of course, are a prime indicator of war. The shifting of large numbers of potentially nuclear capable aircraft, however, was interesting and in contrast to the activities in August. It seemed that the new posture was designed to defend against a possible NATO strike while the ground divisions were temporarily engaged in Poland and Hungary and have the bombers out of the way inside the USSR to strike back instead of to pre-empt. Or was it to get them out of the way in case East Germany revolted as it had done in 1953, and potentially could following the events in Poland and Hungary? In the 1953 case all Soviet Il-28 units and their ground support were evacuated to the Soviet Union through Poland.³⁵

There were further indicators of concern. Communications intelligence detected “a resumption of Long Range Air Force operations in the Arctic [with] impending operations extending as far east as Cape Schmidt on the Chukotsk peninsula.”³⁶ This was strategically significant. Given the more limited range of Soviet bomber aircraft, they needed to move from their bases in the western Soviet Union and then stage from the Arctic and the eastern Soviet Union to reach North American targets. If they were preparing for operations in these isolated locations, that was a potential problem. Other intercepted communications confirmed that on two occasions Moscow-based M-4 BISON nuclear bombers conducted aerial-refuelled crossings of the entire Soviet land mass and back to Moscow, clearly demonstrating an intercontinental capability to whoever was paying attention, in this case the NSA.³⁷ To top it off, an intelligence source warned that Khrushchev planned to detonate a nuclear weapon as a message and that this “statement was made in connection with an exposition

on Soviet desire to ban atomic tests. He added that in the absence of an agreement to ban tests, the USSR had no choice but to continue its tests.”³⁸

On October 29, Israel attacked Egyptian forces in the Sinai. This prompted Khrushchev to assert publicly and vocally on October 31, that the United States was in collusion with Great Britain and France. There was no specific threat at this time and thus American moves remained limited. SAC mounted exercise BEAVERBROOK which deployed twelve B-36 heavy bombers to Adana, Turkey. They were followed by six C-124 transport aircraft from Evreux Air Base, France, two of which conducted a classified mission which probably involved the extraction of non-combatants or intelligence personnel somewhere in the conflict area on October 29.³⁹ The purpose of the B-36 deployment is unclear but was probably related to the summertime JCS contingency planning or flight training, though prepositioning B-36 in Turkey gave them deeper reach into the Soviet Union if the EWP were activated. At this point, these B-36 aircraft probably were not equipped with nuclear weapons on this deployment but SAC had the ability to move nuclear weapons from storage sites in the United States to forward-deployed aircraft in an emergency using its four Strategic Support Squadrons equipped with modified C-124 transport aircraft.

Then on October 31, there was an exchange of messages between LeMay and Chief of Staff US Air Force, General Nathan Twining. In the first, LeMay railed against instructions to modify forward-deployed SAC bombers with conventional bomb racks to support the Middle East contingency plans. He did so reluctantly “recognizing the reluctance of certain political and even military elements to consider atomic bombing, we could be forced to revert to archaic conventional techniques.” In this redacted Top Secret message, LeMay appears to suggest requesting immediate access to the national stockpile “to preclude such distorted views from catching hold and clouding realistic thinking.”⁴⁰ Twining firmly told LeMay no and to do what he was told: “It is considered essential that the air force achieve maximum flexibility for limited military actions such as those envisaged in CINCNELM’s OPLAN,”⁴¹ that is, conventional bombing. When he couldn’t gain movement on that issue, LeMay requested permission to disperse SAC tankers to overseas sites in case he had to implement the Emergency War Plan. Again Twining turned him down and told him to hold tight.⁴² Which LeMay did.

Drifting Towards the Abyss: November 1956

The initial deployment of Soviet forces into Hungary stimulated unrest throughout the country but the Hungarian government asserted they could handle it in their own. Consequently, Zhukov recommended that Soviet troops in Hungary should be withdrawn. Indeed, Khrushchev held a high-level meeting to examine how the Soviets “reduce its military and security presence in each of the socialist countries” to preserve the Warsaw Pact.⁴³ However, the revolutionary violence and partic-

ularly the growing number of brutal revenge killings directed specifically at the Hungarian secret police, the AVH, gave Khrushchev pause. By October 31, "The Soviet leader had barely slept for days. Budapest, was, he said, 'like a nail being driven into my head.'" The leaders in East Germany, Czechoslovakia, and Romania all expressed their alarm chorus-like to Khrushchev. Faced with the fact that the "instability in Hungary was threatening to spill over into the rest of its Eastern European empire" he changed his mind and ordered Zhukov to go back into Hungary.⁴⁴

After inviting the Hungarian military leadership to a meeting on November 3, KGB personnel arrested all of them. The following day, Marshal Konev issued the code-word THUNDER-444 initiating Operation WHILRLWIND. Soviet forces launched into Hungary and for the next 72 hours engaged in a pitched battle with Hungarian revolutionary forces.⁴⁵ While WHIRLWIND was in play, Franco-British forces launched Operation MUSKETEEER, the airborne and seaborne invasion of Egypt on November 5.

Several letters were delivered by Soviet ambassadors to France, Great Britain, Israel and the United States that day. These letters were followed up with a similar message on Radio Moscow. Dictated by Khrushchev but signed by Bulganin, the wording of the French and British messages implied that Soviet rocket forces would be employed if Op MUSKETEEER were not called off.⁴⁶

In what situation would Britain [or France] find herself if she were attacked by stronger states, possessing all types of modern destructive weapons?...Were rocket weapons used against Britain and France you would most probably, call off this barbarous action?...We are fully determined to crush the aggressors by the use of force and restore peace in the East.

What was Khrushchev's motive for making this threat? There are several views on this. The first is that the threat was in support of a larger Soviet strategy to use the situation in Egypt in an attempt to prevent the Middle Eastern countries from coalescing around the West in the larger Cold War game with the even larger purpose of weakening American influence globally.⁴⁷ A second was that, given the Soviet position in Eastern Europe and in the Middle East, "Without any real military options, Khrushchev believed he had no choice but to exploit Western fears of Soviet nuclear capabilities" to extricate himself from the situation.⁴⁸ A third is that Khrushchev was exhausted and desperate and saw this as a means to distract his opponents from exploiting Soviet weakness vis-à-vis his position in Europe. East Germany was the linchpin for Soviet domination in Europe. If it were plunged into revolution like Poland and Hungary the Soviet strategic position would be completely untenable.

Eisenhower immediately sought and received advice from State, CIA, and the JCS. Ambassador Chip Bohlen in Moscow opined that he didn't see "the Soviet Union

deliberately starting World War III and reference to atomic and hydrogen weapons in communication may be merely designed to enhance dramatic effect...."⁴⁹ Eisenhower met with a small group of officials and expressed his concern that "the Soviets, seeing their position and policy failing so badly that the satellites, are ready to take any wild adventure," that "the Soviets are scared and furious, and there is nothing more dangerous than a dictatorship in this state of mind. He referred to Hitler's last days in this connection" and he wanted a fuller analysis before he made any decisions.⁵⁰

CIA produced a Special Intelligence National Estimate the next day. Agency analysts firmly believed that the Soviets had objectives related to distracting the situation in the satellites, damaging "the interests and prestige of the UK and France and divide and weaken the Western Alliances" but wished "to avoid general war." The new missile system, which they credited with having an 800 nautical mile range, could only reach Britain and France if they were deployed forward to the satellites. "Air to surface missiles and probably submarine launched missiles are also within current Soviet capabilities and could pose a threat to all areas." That said, they did not "believe that the USSR would employ guided missiles with nuclear warheads in the Egyptian-Israeli conflict."⁵¹

The Joint Intelligence Committee disagreed with CIA, specifically on the Soviet potential to use other forms of airpower in the crisis.⁵² And this was valid criticism. The Soviets possessed at least 1300 TU-4 BULL bombers similar to the B-29, 300 TU-16 BADGER jet bombers, and hundreds of Il-28 light jet bombers. Though not all of these aircraft were *Atomnyy*, they had already drop tested nuclear weapons from all three types, and the TU-16 was capable of delivering 250 kt yield weapons. They had plans to stage these aircraft from Arctic bases against North America. Indeed, what the American intelligence apparatus did not know was that the 13th bomber division with its three regiments of TU-16 bombers and associated aerial tankers based at Poltava and Migorod in Ukraine were already standing ground alert with nuclear weapons. Indeed, almost all of the TU-16s thus far produced were *Atomnyy*.⁵³ Simply put, the Soviets did not need R-5M ballistic missiles to make good on nuclear threats. This was not covered in CIA's special national intelligence estimates, which generally played down the bomber threat.

Under Admiral Arthur Radford's leadership, the JCS recommended 13 activities to improve American readiness. These included increasing the alert state for Continental Air Defense Command and augment North American surveillance; load and sail two nuclear weapons-equipped aircraft carriers to the mid-Atlantic; deploy all anti-submarine forces and reconnaissance submarines; reinforce the Pacific with two other aircraft carriers; alert all strategic airlift; warn all American commands; station an air task force at Adana Air Base in Turkey; and deploy SAC's tankers to their forward bases. Eisenhower approved all of these measures except the SAC tanker deployment.⁵⁴ It is evident that

Eisenhower saw activation of SAC in any form as a signal or card to hold back in this poker game with Khrushchev.

The JCS message that went out to all commands on November 6 stated that the diplomatic notes indicated “at a minimum a very disturbed situation in Moscow and may indicate serious indent on the part of the Soviets. JCS considers situation requires special vigilance on your part...This is not intended to extend to a general alerting of your command.”⁵⁵ LeMay repeated the message to his subordinate commands and instructed them to review the Emergency War Plan in its variants. Ongoing flight training could continue as long as the bomber wings retained the ability to carry out the EWP.⁵⁶

This is where the written record gets murky. Eisenhower’s Current Intelligence Bulletin for November 7, remains partially redacted and it appears as though the JCS all of sudden altered the American military posture that day.⁵⁷ The reason for that may lay in a phone call between Eisenhower and Eden: “Eden...put a great deal of emphasis on the Russian threat, on NATO involvement, etc. he had, for instance, said that he had information that two unmistakably Russian planes had attacked UK air facilities, presumably in the Suez area.”⁵⁸ An RAF Canberra reconnaissance aircraft was, in fact, shot down over Syria and British air defence forces on Cyprus detected a “large unidentified jet...flying over Cyprus. The inference was that this was a Soviet aircraft with a performance superior to the MiG-15 or Il-28....The purpose of this visit is obscure but it could not have been for visual or photographic reconnaissance.”⁵⁹

Another reason may lay in CIA’s analysis as conveyed through Allen Dulles at the White House. A number of important points can be drawn from it. First, Dulles asserted that “The USSR is quite ready to help break down the cease-fire in the Suez area and turn to further trouble-making in the area, short of general war.” As part of these moves, “the USSR is also ready to make a show of force with naval units from the Black Sea.” Such a move would involve Turkey, a NATO member. Second, “Moscow is already giving strong covert support to extremist elements” in Syria, Jordan, and Iraq with the purpose of “supporting a leftist coup in Syria to gain a base there.” The expansion of the crisis throughout the rest of the Middle East could lead to something larger and more dangerous.⁶⁰

The commander of United States Air Forces in Europe (USAFE), General William H. Tunner, contacted General Nathan Twining to confirm that his readiness measures were acceptable given the present situation. Twining told him that he was “advised to exercise extreme caution with regard to your readiness measures to avoid unduly alarming other National authorities.”⁶¹ This likely related to moving the nuclear-tipped Matarador cruise missiles stationed in West Germany to a higher level of readiness as they played a crucial role in the overall Atomic Strike Plan supporting NATO and in turn the EWP itself.⁶² A currently unavailable JCS mes-

sage to LeMay dated November 7, entitled “Improve State of Readiness” was also sent.⁶³

The following day, November 8, USAF Operations contacted the State Department to request Canadian clearance for Operation ROAD BLOCK, a SAC operation that involved a large number of bomber aircraft that would operate in Canadian air space. The movement of nuclear weapons or components by air in or through Canadian airspace was subject to a highly classified agreement called the XYZ Procedures. Another operation, PINE GROVE, was tentatively scheduled for early January 1957.⁶⁴ The November 8 request involved the movement of 72 B-47 aircraft, “thirty of the B-47s will carry both nuclear components and non-nuclear; six will carry only nuclear.” PINE GROVE was projected to involve 180 B-47s with 69 of them carrying nuclear and non-nuclear components, and three carrying nuclear only. The ROAD BLOCK date for planning purposes was November 29-30, with an expected return date of December 3-5. There was no destination given to the State officials handling this. It is clear from the Air Force-State discussion that ROAD BLOCK was relatively open ended, that is, it was not the routine wing rotation to bases in the United Kingdom. It is equally clear that both the USAF and State did not want at this time to “give the impression of greatly heightened SAC activity.”⁶⁵ In effect the ROAD BLOCK and PINE GROVE request was a form of contingency request originating with SAC headquarters then passed to USAF Headquarters and not the other way around.⁶⁶ That is, USAF headquarters approved SAC’s request for the operations and State prepared the bureaucratic ground for it. Due to the operation’s size and geographical extent, LeMay had to have either come up with the plan himself, or it came from his staff and he approved it before sending it up the chain of command. The fact that the operation was approved by USAF headquarters demonstrates that USAF Chief of Staff General Nathan Twining was aware of ROAD BLOCK and PINE GROVE, the relationship between the two, and the purposes underpinning them.

The events of November 10, however, moved the crisis to a new level. Another Soviet threat to deploy “volunteers” to the region was received after British and French troop withdrawal deadlines were not met.⁶⁷ Communications intelligence picked up the movement of 25 Soviet transport aircraft from a base east of the Urals to Proskurov air base in Ukraine, the home station of a regiment belonging to the 39th Guards Airborne Corps.⁶⁸ The movement of significant transport resources to augment those already in Ukraine would have been of some concern. Were they to be used to augment Soviet operations in Eastern Europe, or used to intervene in the Middle East? Another indicator was the detection of the accelerated evacuation of Soviet dependents in East Germany.⁶⁹

The situation plateaued from November 10 to 13 and here we enter a period of documentary obscurity. U.S. State Department records depict White House dis-

cussions on the generalized concerns that the Soviets were fomenting a coup in Syria to use it as a base; the possibility that Nasser was dragging his heels on permitting the UN Emergency Force to deploy so that Soviet elements in the form of "volunteers" could get to Egypt first; and the larger issue of expanded Soviet influence in the region interfering with the Western oil supply.⁷⁰ The President's Current Intelligence Bulletin for November 10, reported that Soviet embassies in the Middle East were burning their files and evacuating dependents.⁷¹ Another issue of concern was the sudden mobilization of Israeli forces on November 11-12, in response to the Syrian situation.⁷² Throughout this period, however, American and other NATO naval forces made "multiple submarine contacts in the Atlantic, the Mediterranean, and the Black Sea." This was believed at the time to be one aspect of the larger alerting of the Soviet armed forces.⁷³

None of this explains, however, why on November 14, the JCS "in a decision cleared with the Secretary of Defense, directed the Chief of Staff of the USAF to place SAC in a state of increased readiness and deploy tanker aircraft to Labrador, Newfoundland, and Greenland."⁷⁴ The SAC staff at USAF headquarters also submitted a request for a specific increased readiness measure that remains classified but had "verbal approval of the Chairman of the JCS." SAC was told that "No airlift beyond SAC resources can be made available for this purpose" though the headquarters took action to notify an entity that also remains classified.⁷⁵ Though the documents have not been declassified, their titles are: "Dispersal and Custody of Atomic Weapons" and "Emergency Transfer of AEC weapons to the DOD."⁷⁶ So by November 15, 1956 the deployment of nuclear weapons was clearly under consideration and Secretary of Defense Charles Wilson was knowledgeable of that course of action as it evolved.

Two Soviet events likely contributed to the decision to do so. On November 18, Eisenhower was briefed that the previous day the Soviets detonated a 900 kt thermonuclear weapon at the Semipalatinsk test site and then announced they had done so after the fact.⁷⁷ Was a signal? It was a single shot held outside of the usual Soviet test period which tended to be from August to September. The previous test series, which consisted of four shots and concluded with a 900 kt shot, wrapped up back on September 9.⁷⁸ Khrushchev announced internally back in late October he planned to do this singular shot. And the previous test series had not been announced or commented upon at the time or after. The second event involved communications intelligence that Tiksi airfield in the Soviet Union was reporting to its higher headquarters that it was serviceable and capable of taking TU-4, TU-16, M-4 and TU-95 aircraft. Eisenhower was also briefed on this.⁷⁹ Tiksi airfield is located mid-way along the Soviet Union's Arctic coast and was a staging airfield that allowed bomber aircraft the ability to hit targets in North America.

It is equally possible that developments between Syria and NATO ally Turkey also played a role. Eisen-

hower was briefed on November 18, that a rightist coup in Syria was thwarted by pro-Soviet leftists. At the same time, the Turkish armed forces cancelled its leave, brought its forces on the Syrian border to an increased state of readiness, deployed additional armoured forces to the Syrian border, and put the entire air force on standby alert.⁸⁰ This new tense stand off involved Turkish air force Sabre reconnaissance aircraft overflying Syria looking for Soviet aircraft after the Soviets offered military personnel to Syria for training and technical support. Indeed, Eisenhower was warned that Turkey had plans to warn the Soviets not to "establish a base in Syria." While the Americans expressed concern that the Turks might invade Syria, the Soviet propaganda apparatus shrilly claimed there was a British-French-Israeli plan to invade from the south.⁸¹

What were the cumulative effects of these developments on Eisenhower? He says absolutely nothing about them in his memoirs and does not even discuss events after November 11.⁸² Yet on November 17, SAC sent a message to Air Material Command regarding increased readiness levels.⁸³ Air Material Command was responsible for the 3079th Aviation Depot Group, the U.S. Air Force nuclear weapons storage and maintenance formation whose purpose was "to receive weapons from the AEC for training exercises, manoeuvres, execution of the EWP or as directed by higher authority."⁸⁴ Then on November 19, SAC asked the U.S. Air Force to request authority for the dispersal of nuclear weapons.⁸⁵ The use of the word "dispersal" is important. This related to Presidential authorization to provide the JCS's unified and specified commanders with a specific number of weapons for a particular purpose, not just the spreading of nuclear weapons around to various sites to prevent generating concentrated targets.⁸⁶

The actions and activities of November 19 vis-à-vis American nuclear forces were likely related to the movements of Soviet nuclear forces. The American and Canadian communications intelligence collection system was in high gear covering the Arctic approaches throughout the crisis with its perfectly positioned station at Alert, North West Territories and one of its primary targets was the Soviet long-range direction finding (DF) network. On November 19-20, surveillance of that network produced something disturbing. The first were the DF communications reporting on a single TU-95 BEAR long range bomber as it departed Uzin, Ukraine and flew a "14 hour round-robin flight" from there to a point north of Franz Josef Land in the Arctic, over to Novaya Zemlya, and back to Uzin. The aircraft was tracked by the DF network for the whole flight. This flight, however, demonstrated that it could reach North American targets over the Arctic unrefuelled and strongly suggests this was a signal from the Soviet leadership. Eisenhower was briefed on the event on November 21.⁸⁷ (Figure 2)

But that was not all. During the same period November 19-20, communications from another aerial event were intercepted. The same Soviet DF network reported on more than 20 aircraft flying from Moscow to

Novaya Zemlya. When the aircraft passed the 80th Parallel north of Franz Josef Land, the DF network stopped their reports for the rest of bombers' flight. The analysts noted that "The length of the flight suggests that the aircraft were medium or heavy bombers rather than transports."⁸⁸ Post-Cold War Russian sources note that these were Tu-95 BEAR bombers, and they flew all the way to the North Pole and back.⁸⁹ Again, Eisenhower was informed on the progress of the flight. No Soviet bombers were based at the Moscow airfields with the exception of a handful being used for tests at Ramenskoye. The analysts noted that "Although long-range bombers have been observed in isolated flights above the 80th parallel since March, this is the first time aircraft are known to have operated in the area in strength."⁹⁰ Notably, the bases on Franz Joseph Land permitted the shorter-ranged TU-16s to stage against targets, especially SAC targets in Northern Canada, or to stage from ice runways at the three Soviet drift ice stations to reach targets in the United States.⁹¹ This Soviet flight was an even clearer signal. Having it originate from Moscow rather than Ukraine and then having it apparently disappear electronically over the Arctic was subtle and sophisticated all at once.

The Nuclear Dimensions of Operation ROAD BLOCK: November 1956

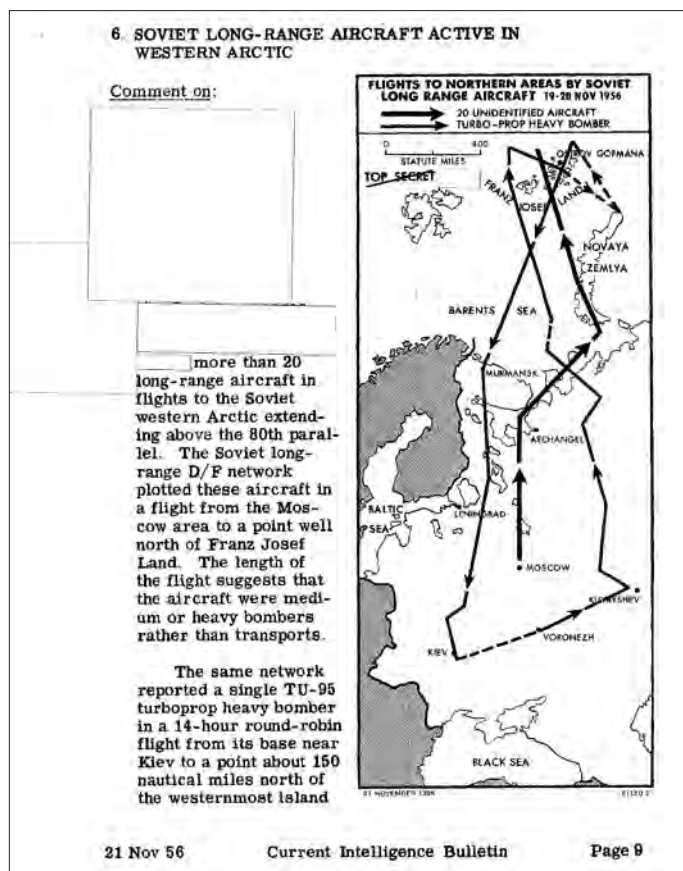


Figure 2. On November 19-20, 1956, SIGINT detected a flight of 20 Soviet strategic bombers flying from Moscow to the Arctic. The intelligence apparatus lost track of them when they stopped communicating in the vicinity of Franz Joseph Land (CIA).

Having been given the go ahead by the operations staff at the USAF, Burke Elbrick of the State Department met with Canadian ambassador A.D.P. Heeney on November 19, and briefed him on ROAD BLOCK, specifically the nuclear component of the operation. No destination for the aircraft was given, but this did not appear to have deterred Heeney who referred the matter to Ottawa. On November 23, overflight clearance was given. Internal State discussion on ROAD BLOCK noted that "such large operations apparently constituted a change from past practise" and there was "the possibility that Soviet intelligence was sufficiently good to permit them to be aware of these operations with the possibility of reactions on their part." Given the large numbers of aircraft involved, "Mr Murphy...told me that he would see that the President was made aware of these...operations."⁹²

Despite having high level access to the President, Robert D. Murphy, Deputy Undersecretary of State of Political Affairs was likely not read-in on the specifics of how nuclear weapons were handled between the AEC, JCS, the USAF and the President as these were some of the closest-held secrets in the U.S. Government at the time. As noted earlier, both atomic and thermonuclear weapons employed cores that were inserted into pits, that is, the implosion system. The cores remained in AEC custody, though the bomb casings containing the pits and in the case of thermonuclear weapons, secondaries, could shift to the custody of the U.S. Air Force under certain conditions. The formal process in 1951 was that the JCS requested that "complete weapons or nuclear cores" for be transferred to DOD. Then the President and the Secretary of Defense met with a special National Security Council committee where the President "gave appropriate instructions" to the AEC Chairman and Secretary of Defense. In practice, the President consulted directly with the AEC Chairman and it appears as though both men had to agree to the proposition before it could move forward regardless of whether the transfer was for training, deployment, or emergency use.⁹³ When Eisenhower took over, a more sophisticated system was established for emergency authorization involving an authenticated conference call that included the AEC Chairman, Lewis Strauss, the Secretary of Defense and the Joint Chiefs. Automated messages requesting and authorizing the transfer of nuclear weapons between the AEC and DOD, and finally a separate message from the President authorizing nuclear weapons use were employed. This process was for emergency use and did not address the release of components for manoeuvres short of war.⁹⁴

In 1955 capsules for high-yield weapons could only be transferred "in accordance with [a] Presidential Directive Implementing the Emergency Transfer Plan." Even then, "No active capsule will be inserted into any high yield weapon under AEC custody except with the expressed approval of the AEC custodian and in the custodian's presence." As for the casings, "components other than capsules containing [special nuclear material] will remain stored in AEC-controlled structures and accom-

panied by AEC custodians” except when the President implemented the Emergency Transfer Plan or when the casing was being used by on-base personnel inspection, maintenance, modification or readiness exercises.⁹⁵

After several tests in 1956, Eisenhower approved an AEC-DOD memo of understanding whereby the AEC could transfer custody of casings and cores to DOD without higher authority under specific conditions. Those conditions were if Defense Emergency or Air Defense Readiness Red or Yellow were declared. Defense Emergency, which explicit criteria that had to be met before it was called, could be declared by any of the CinC’s, including CinCSAC.⁹⁶ This included “a major attack by a member of the Sino-Soviet Bloc is made upon [US or allied forces] overseas” or the United States and “is confirmed either by the commander [of a JCS command] or by higher authority” or if a “condition of Air Defense Readiness or Air Defense Emergency is declared by CINCCONAD or CINCNORAD or higher authority.”⁹⁷

In 1957 another arrangement was implemented between AEC, Air Material Command, SAC, and the Armed Forces Special Weapons Project. A number of weapons were designated to be dispersed to SAC immediately “upon the declaration of ‘Dispersal Emergency’ or ‘SAC Alert’ by Commander-in-Chief SAC. This eliminated the requirement for AEC authority for release of weapons during periods of tension or emergency.”⁹⁸ In other words, that arrangement was not in effect in 1956, so AEC still had to authorize the custody change during the period of tension known as the Hungarian-Suez crises.

Thus if the AEC had to authorize the custody transfer of nuclear weapons for ROAD BLOCK, who authorized the it to do so if there was no Defense Emergency or Air Defense Readiness situation? It appears as though the AEC did, in fact, have the authority to transfer bomb casings and cores for atomic weapons and thermonuclear casings without cores to DOD for manoeuvre purposes on demand without specific Presidential authorization, with the thermonuclear primary cores remaining in AEC custody subject to the President authorizing nuclear weapons use.

The JCS message to LeMay on November 7, to improve readiness and the November 14 authorization for the JCS to increase readiness which led to ROAD BLOCK were approved by the Secretary of Defense, but there is no available primary or secondary source making the link from the Secretary of Defense to Eisenhower. That said, we must conclude the following. The Chairman of the Joint Chiefs of Staff and the Chief of Staff US Air Force were aware of ROAD BLOCK. The State Department and the Canadian government were aware of ROAD BLOCK and Murphy told his staff he would make the President aware of the operation. The Secretary of Defense had approved the JCS request to increase SAC readiness, which included ROAD BLOCK. All of these entities were aware the manoeuvre involved a large number of nuclear weapons. The AEC transferred the weapons and weapons components to DOD,

so the AEC was obviously aware of ROAD BLOCK. Is it really logical to suggest that President Eisenhower was completely unaware of ROAD BLOCK?

Collaterally, this technical and procedural digression provides insight into the role of Curtis LeMay, a man accused by journalists, politicians, political advisors, and historians of overreaching his authority to dangerous levels so beautifully mocked in the film *Dr. Strangelove*.⁹⁹ ROAD BLOCK and the other SAC activities during the crisis were not rogue operations by any stretch of the imagination and there is no indication that responsible civilian authorities were not informed of these specific SAC activities. Yes, LeMay leaned forward and yes, LeMay disagreed with many on how airpower should be employed. But he remained obedient to both military and civilian authority during this crisis.

Climax: SAC Operations, November-December 1956

The day after the Soviet Arctic bomber flights, a mini-Berlin crisis presented itself. In this case “five of the seven regularly scheduled Allied military trains passing between Berlin and West Germany were subjected to unusual controls and delays by Soviet authorities. Three American, one British, and one French train were detained in train sheds where an unusual number of armed Soviet soldiers were on hand.”¹⁰⁰ The movement of these troop trains back and forth to West Berlin were a regular event guaranteed under treaty. The idea that a mere Soviet colonel who was the acting commandant for Berlin acted on his own initiative to openly interfere with West Berlin transit arrangements on this scale beggars belief. The harassment continued throughout late November.¹⁰¹ And again, these events were not mentioned in Eisenhower’s 1965 memoir, *Waging Peace*, or Khrushchev’s memoir *Khrushchev Remembers*.

There was significant and varying SAC activity at this time but the question is, how much of it was signalling in response to the increasingly complex crisis environment and, if so, by whom and for what purpose? SAC conducted pre-Emergency War Plan reconnaissance operations in November and December 1956. A pair of RB-47 reconnaissance aircraft deployed to Incirlik, Turkey on November 24, for a special project operation dubbed SAM SPADE, involved “high priority unprogrammed missions.”¹⁰² SAM SPADE probably was designed so that SAC could update the Soviet air defence’s electronic order of battle in the Caucasus and Black Sea regions in the event the Emergency War Plan was implemented. This was ferreting as opposed to signalling. Similarly, SAC also conducted Operation POWER HOUSE out of Thule Air Base from mid-November to December 15. POWER HOUSE involved five RB-47 from the 26th and 55th Strategic Reconnaissance Wings and 37 KC-97 tankers from two separate squadrons. These aircraft were collectively “conducting classified reconnaissance missions as directed by SAC Headquarters.”¹⁰³ They were likely collecting on the Soviet air defence electronic order of battle in case the EWP

had to be activated. The numbers of ferreting aircraft appears to have been deliberately kept small. Earlier in March- through May 1956, SAC conducted Project HOME RUN, which involved the sustained probing of the Soviet air defence system with pairs of RB-47s followed by the mass overflight of Eastern Siberia with six aircraft.¹⁰⁴ The POWER HOUSE flights were much more limited, less intrusive and likely did not constitute crisis signalling.

That cannot be said about Operation QUICK KICK. QUICK KICK started off as a SAC public relations exercise in response to media criticism of the reliability of the newly-deployed B-52 Stratofortress bombers in the summer and fall of 1956. To disprove the critics, LeMay wanted several flights of B-52s were to conduct simultaneous endurance missions using aerial refueling to Japan, North Africa, the United Kingdom, and Hawaii. The fact that the Soviets also would be taking notes was not purely coincidental to QUICK KICK. That said, the game suddenly changed in November when the units engaging in planning QUICK KICK were instructed by SAC Headquarters to alter the operation. The missions that were flown by the B-52s on November 24, had rather different flight plans.¹⁰⁵ (Figure 3)

Eight B-52s from the 93rd Bomb Wing departed Castle AFB, California, refueled over Lockbourne AFB in Ohio, and then four returned to Castle. The other four passed Chicago, and turned northeast towards a point east of Loring AFB, Maine over New Brunswick, Canada. They then flew to Thule Air Base, Greenland, where a simulated bomb run was made followed by a second aerial refuelling. From there, “two B-52s continued their flight over the North Pole,” then turned southwest to Elmendorf AFB, Alaska where a third aerial refuelling took place, then to Abilene, Texas for a fourth refueling. The aircraft split and landed at Baltimore international airport and Loring AFB, Maine. Four more B-52s from the 42nd Bombardment Wing at Loring AFB, Maine also took off on a route that took them over the North Pole to a point near Franz Joseph Land, then to Elmendorf Alaska, down the west coast then over the Florida and back to Loring on November 25.¹⁰⁶ Of note, this route is similar to that used by B-52s of the CHROME DOME Airborne Alert Force in the 1960s. Route maps from 1956 clearly show that the aircraft were at the top of the world on November 24-25. Were these B-52s carrying nuclear weapons? The situation suggests they were not. There was no XYZ clearance requested for them so they could operate in Canadian air space.

But why send in QUICK KICK before ROAD BLOCK when its 72 B-47s were about to start a mass flight into the north? This was probably LeMay’s crafty opportunism. QUICK KICK served multiple concurrent objectives and there may have been one more. The Soviet intelligence apparatus at this time included GRU detachments stationed on Soviet drift ice stations in the Arctic, in addition to stations at Franz Josef Land and in the Soviet Union proper. One such station, “North Pole 4,” had drifted past the North Pole throughout 1956

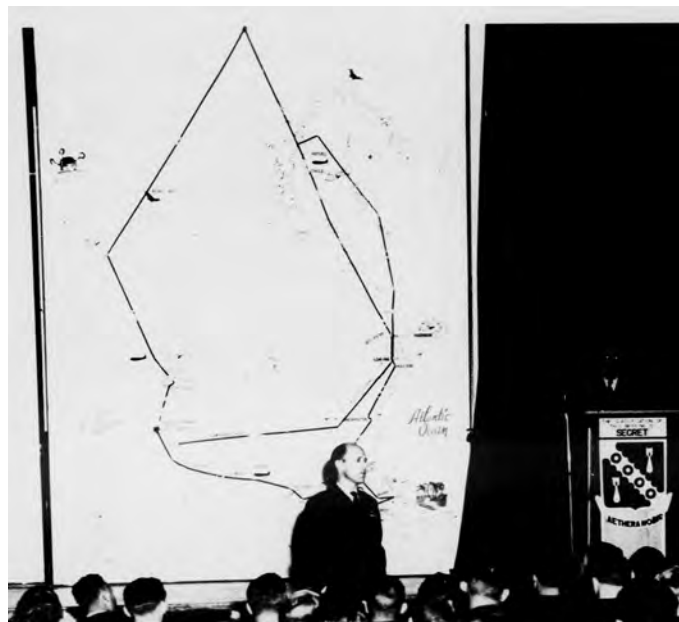


Figure 3. Operation QUICK KICK involved a force of B-52's that flew into the Arctic inside the detection envelope of Soviet detection stations located on drift ice stations near the North Pole. This photo depicts the QUICK KICK flight track provided during a classified briefing given to the 42nd Bombardment Wing (Heavy) in November 1956. (U.S. Air Force, *History of the 42nd Bomb Wing (H)*).

and was on a trajectory towards Greenland. Initially established to investigate DEW Line emissions, “American strategic aviation flights” became a top priority target. The drift stations also had early warning radar systems and these had been photographed by the Royal Canadian Air Force. LeMay knew about the Soviet intelligence collections stations, specifically the one at Ostrov Rudolfa in Franz Joseph Land, because they had been photographed by SAC aircraft during Project HOME RUN earlier in 1956.¹⁰⁷ In areas the Soviet Arctic stations’ sensors could not reach, there were the ubiquitous Soviet “trawlers” ready to scoop up any transmissions or emissions from American aircraft and track them by radar.¹⁰⁸ If ROAD BLOCK was a signal, it would have been a good idea to ensure the Soviets were listening first and QUICK KICK was a means to do so.

With the ‘Polyarki GRU’ now paying attention, ROAD BLOCK commenced on November 29, with the departure of 72 B-47 aircraft. The units selected for the operation were the 100th Bombardment Wing (Medium) at the still under construction Portsmouth Air Force Base in New Hampshire; and the 301st Bombardment Wing (Medium) at Barksdale, Louisiana.¹⁰⁹ The 100th Bomb Wing conducted the operation without weapons: it was a brand-new formation and their Special Service Facility was not completed yet. As the wing was not fully integrated into the Emergency War Plan, SAC could afford to use it for a signalling operation like ROAD BLOCK while more experienced units remained on ground alert. The 301st, on the other hand, was stationed right next to the AEC National Stockpile Site Bossier Base. Bossier Base consisted of over 60 nuclear weapons storage ‘igloos’ and had a special loading ramp

between the storage base and the main runway to facilitate rapid aircraft loading. The 301st B-47s were loaded with casings and pits for either Mk 15s (1.8 to 3.8 megatons), Mk 21s (18 megatons), or both, and possibly a handful of complete improved Mk 6 atomic weapons (variable yield up to 180 kt) that could be flown with their cores in.¹¹⁰ As there was no Presidential direction to do so, no cores were loaded into the thermonuclear primaries. This begs the question. Why were nuclear weapons without their cores being flown on ROAD BLOCK? At this point in the Cold War B-47 crews rarely had the opportunity to fly with a nuclear weapon on board. The weight of the weapon alters the flight characteristics of the aircraft and the more comfortable a crew is with those characteristics, the more effective they would be in the event they had to execute their Emergency War Orders. The operation also permitted a test of mass load techniques from Bossier Base, which, incidentally, were found deficient and changed in 1957.¹¹¹

The 301st Bombardment Wing's 30-plus B-47s departed Barksdale, flew northeast to a point over the Atlantic where they were refuelled by KC-97 tankers. (Figure 3) Normally, a single KC-97 squadron, in this case, the 55th Air Refuelling Squadron, was based at Ernest Harmon Air Base in Newfoundland. Three other KC-97 refuelling squadrons—the 99th, 91st, and 98th—arrived between November 15 and 16, prior to ROAD BLOCK.¹¹² Additional tankers were likely stationed at Goose and Thule. (Figure 4)

A second refuelling took place near Greenland where the force turned northwest “to a geographic point near the Arctic Circle.” At this point the aircraft were between 32,000 and 40,000 feet, and thus more readily detectable by Soviet systems. The flight broke up into cells of four aircraft each and proceeded southwest over Canada, “to make simulated bomb runs as we penetrated the border and hit selected targets in the U.S.”¹¹³ The 100th Bombardment Wing's flight path is unavailable at this time but its 30-plus B-47s probably conducted a similar manoeuvre.

The Soviet surveillance apparatus would essentially have seen a steady stream of B-47s proceeding parade-like in the direction of the North Pole from the Labrador Sea-Greenland area and then altering course over the Davis Strait to head south over Canada. A manoeuvre on this scale, 72 aircraft, had never been done before and it would have been as unprecedented to the Soviet analysts as much as the Soviet bomber flight on November 19-20, was to American analysts. Unfortunately, one of the 301st B-47s had a mechanical failure and crashed near Ray Lake, Ontario killing three of its four crew members. A massive joint Canadian-American search and rescue effort was launched to recover the downed pilot, Major Robert Slane, the remains of 2nd Lt's Richard Martin, Donald Petty, and 1st Lt Max Workman, and what was left of B-47 serial number 523360.¹¹⁴

So how do we know that Khrushchev received the message? Nothing appears in his memoirs, nor in the lost Khrushchev tapes, nor in his son's memoir.¹¹⁵ That

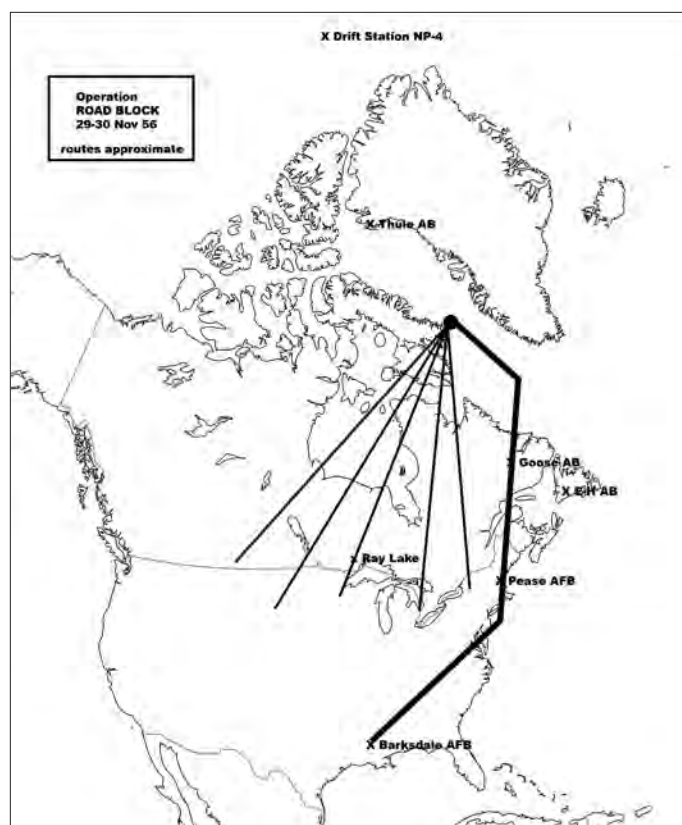


Figure 4. Operation ROAD BLOCK route map.

said there were no further Soviet aerial demonstrations, small or large, reported in December 1956 or January 1957: the next BISON aerial refuelling exercise did not take place until late February 1957.¹¹⁶ Nuclear detonations at Semipalatinsk did not resume until the March-April 1957 test series, and the largest device tested only yielded 680 kilotons.¹¹⁷ There were no more demands to pass naval forces through the Dardanelles. The Soviet airborne forces concentrating in Ukraine did not deploy. There was episodic but unsystematic small scale harassment of Berlin access routes.

What we do know on the American side is that on December 3, United States Air Force Headquarters authorized SAC to “redeploy tanker squadrons from advanced bases to home bases on 14 Dec subject to review of the international situation about 10 December. The foregoing prompted primarily by requirements to resume operation training and improve overall readiness posture and is not interpreted as reflecting a relaxed international situation.”¹¹⁸ On December 8, the JCS ordered SAC to “revert to normal readiness and training.”¹¹⁹ The POWER HOUSE reconnaissance operations wrapped up on December 15.¹²⁰ Eisenhower did, however, authorize the use of atomic weapons for air defence operations on December 14.¹²¹ PINE GROVE, the planned follow-on to ROAD BLOCK using an astonishing 180 B-47s, was cancelled. In other words, Eisenhower was convinced that the message had been received and the American posture deliberately shifted from signalling to strictly defence. There are some clues as to why this was so. One lies in the December 1, 1956 Current Intelligence Bul-

letin. The pattern of Soviet harassment directed at Western military movements in and out of Berlin abruptly changed. A U.S. Army truck convoy transiting from West Germany to Berlin cleared the Marienborn checkpoint in East Germany but was stopped temporarily at the Berlin end. A Soviet lieutenant colonel demanded to inspect the vehicles. The convoy commander predictably refused. The convoy proceeded after the Soviet officer verbally admonished the convoy commander.¹²² The December 7 Current Intelligence Bulletin noted that "Tensions over the Suez Canal Problem have been reduced as a result of the announced intention of the British and French to withdraw their troops."¹²³

Recapitulation

What does it all mean? The Hungary-Suez crisis extended into late November 1956 as opposed to the accepted denouement established in the historiography which is usually early to mid-November, and during that time there was a period of intense signalling between the superpowers using nuclear forces. The movements of Soviet and American nuclear forces were deliberately used by both sides as signalling devices to indicate their concerns over courses of action during the crisis period (One must recall these actions occurred during the pre-"Hot Line" years). The whole situation shifted from ambiguous Soviet nuclear threats against Britain and France to an escalating series of Soviet military activities directed at the United States to remind the Americans that the Soviet Union had clout and their diplomatic actions needed to be taken seriously. These moves were met with an overwhelming American response that demonstrated qualitative and quantitative nuclear force superiority. Soviet action in the wake of that demonstration was to disengage and return to pre-crisis levels of activity almost immediately after the final American demonstration.

What of Khrushchev and signalling? The rocket threat in the Bulganin letters is almost as casual or impulsive as it is ambiguous. The movements of Soviet nuclear forces and their accompanying threats correlating to the slow Anglo-French progress on withdrawal come across as impatient, demanding, and petulant, that is, reflective of Khrushchev's personality when he was under stress. The 900 kt detonation on November 17, seems almost impulsive. Yet the Soviet bomber flights of November 18, and the Berlin corridor harassment are subtle and calculated, almost as if another was directing events, possibly even Zhukov. And what did Khrushchev gain with his signalling methods? The Anglo-French force withdrew, but it would have anyway. Eisenhower did not support the Anglo-French Suez enterprise and took steps to express his displeasure to his allies and that is what they responded to, not the rocket threat.¹²⁴ If Khrushchev believed there was specific American meddling in the Eastern European situation, meddling that warranted a nuclear threat, there is no discussion of it anywhere. NATO was not postured to intervene in

Eastern Europe, NATO had no intention on intervening in Eastern Europe at this time, so it wasn't being deterred by Soviet activities or threats. Indeed, Soviet military movements in Eastern Europe were alarming and potentially destabilizing. Berlin corridor harassment is easier to explain: Khrushchev reportedly said that "Berlin is the testicles of the West. Every time I want the West to scream, I squeeze on Berlin." There is, however, no adequate explanation for the large-scale Long Range Air Force exercise in the Arctic on November 19-20, or what the Soviets hoped to achieve with it. It appears as though Khrushchev calmed down (or perhaps got more sleep) and started moving chess pieces again after fits of impulsivity. The most likely scenario was that it was a test to see how far the Eisenhower and the United States would go to respond to more blatant military activity and thus establish a notional red line. Indeed, the recent alarming Russian military movements around Ukraine in March 2021 seem to be designed for exactly the same purpose, to test the adversary's leadership and their limits to see how much room to manoeuvre there is in other spheres of competition. The calculated, overwhelming American response that the November 19-20, exercise and the nuclear test established that red line...which Khrushchev would proceed to push again and again until Cuba in 1962.

The crucial role of communications intelligence and how it was presented and handled by Eisenhower is notable. Without it, Soviet signalling would, perhaps, have been much coarser or subject to misinterpretation. This COMINT material was presented in such a way that Eisenhower could interpret its meaning for himself. These were not "canned" assessments by Agency analysts. Making the direct connection between that intelligence and specifically how he used it, however, is more murky as not everything was written down. Eisenhower's thought processes on these matters went to the grave with him so we are left to infer how this mechanism operated. That said, the correlations between information and action are not gratuitous and there is a convergence of evidence that rests within tolerable and logical norms. Eisenhower's careful yet resolute responses during the crisis ensured that the American position was not compromised, particularly when it came to Khrushchev's flirtation with nuclear-backed diplomacy.

Then there are the pressing matters of civil-military relations and command and control. General Curtis LeMay was not a rogue actor during the course of events: one could legitimately argue that Nathan Twining had him firmly under control. Strategic Air Command activities were consonant with the crisis situation and were in no means overly provocative in that aggressive, active ferreting did not take place, nor did SAC aircraft overfly the Soviet Union. There is no evidence that LeMay attempted to provoke war at any stage of the crisis. Indeed, he could not because the nuclear weapons stockpile was not configured to do so and the force was not on a "hair trigger." The vast majority of the American aircraft engaged in signalling were incapable of de-

livering a weapon that would detonate with a nuclear yield in any event. Civilian control over American nuclear forces was evident, especially at the AEC-DOD level regarding stockpile controls and release. The JCS was also demonstrably responsive to civilian control throughout the crisis. At no point did Admiral Arthur Radford or others push anything resembling preventive war. Of note, and for comparative purposes, the deliberate use of the SAC Airborne Alert Force during the Cuban Missile Crisis of 1962 to signal Khrushchev and facilitate a resolution to that crisis may have had its origins in the events of 1956, specifically the ROAD BLOCK and PINE GROVE operations that employed the presence of increased numbers of SAC bomber aircraft in the Arctic to demonstrate capability to the Soviet leadership in Moscow.¹²⁵

Of equal interest is the contrast between John Foster Dulles's declaratory Massive Retaliation policy and

the more flexible response-like moves recommended by the JCS and made by the United States during the crisis. Initial JCS planning in the Middle East region had an escalating series of deterrent actions, then conventional bombing. The debate between Twining and LeMay on the use of SAC aircraft for conventional operations and possibly the BEAVERBROOK B-36 deployment underscore the fact that there was contention on the issue, but recognition at the JCS level and ultimately by LeMay that conventional activities or nuclear activities short of mass nuclear weapons use were desirable in crisis situations. Perhaps American nuclear weapons policy in the 1950s was more flexible than we have previously understood. In the final measure, we should consider the possibility that the final stages of the Hungary-Suez crisis were resolved in the freezing air of the Arctic and not in the smoke-filled rooms of the United Nations in New York. ■

NOTES

1. Association for Diplomatic Studies and Training, Foreign Affairs Oral History Project, interview with George McFarland, 2 Aug 99.
2. See for example David A. Nichols, *Eisenhower 1956: The President's Year of Crisis Suez and the Brink of War* (New York: Simon and Schuster, 2011); Dwight D. Eisenhower, *Waging Peace: The White House Years, a Personal Account 1956-1961* (New York: Doubleday Books, 1965); Keith Kyle, *Suez* (New York: St. Martin's Press, 1991); Terrence Robertson, *Suez: The Inside Story of the Suez Conspiracy* (New York: Atheneum Books, 1965); Selwyn Lloyd, *Suez 1956: A Personal Account* (New York: Mayflower books, 1978); Chester L. Cooper, *The Lion's Last Roar: Suez, 1956* (New York: Harper and Row, 1978); Stephen Z. Freiburger, *Dawn Over Suez: The Rise of American Power in the Middle East 1953-1957* (Chicago: Ivan R. Dee, 1992); Evan Thomas, *Ike's Bluff: President Eisenhower's Secret Battle to Save the World* (New York: Little, Brown and Co., 2012). None of these works reference the use of nuclear forces for signalling during the 1956 crises other than the Bulganin letters.
3. See Aleksandr Fursenko and Timothy Naftali, *Khrushchev's Cold War: The Inside Story of an American Adversary* (New York: W.W. Norton, 2005) and Vladislav Zubok and Constantine Pleshakov, *Inside the Kremlin's Cold War: From Stalin to Khrushchev* (Cambridge: Harvard University Press, 1996).
4. See for example, Stephen S. Kaplan, *Diplomacy of Power: Soviet Armed Forces as a Political Instrument* (Washington DC: The Brookings Institution, 1981); Barry M. Blechman and Stephen S. Kaplan, *Force Without War: U.S. Armed Forces as a Political Instrument* (Washington DC: The Brookings Institution, 1978); Francis Fukuyama, *Soviet Threats to Intervene in the Middle East 1956-1973* (Santa Monica: Rand Corporation, 1980).
5. David A. Anderton, *Strategic Air Command* (London: Ian Allen, 1975), 51-52; Norman Polmar (ed) *Strategic Air Command: People, Aircraft, and Missiles* (Annapolis: Nautical and Aviation Publishing, 1979), 45.
6. A.I. Aidin and S.A. Zelentsov, "Warming up the Nuclear Force for forging a Nuclear Sword," a conference paper from the Second Public National Forum-Dialogue Atomic Energy Society, St. Petersburg, 21-22 April 2008. As Aidin and Zelentsov make clear, the 80 kt yield that features in so many Soviet publications was "populist action."
7. CIA Research Search Tool [hereafter CREST], CIA Office of Current Intelligence, "Current Intelligence Bulletin [hereafter

- CIB] 2 Feb 56"; "CIB, 3 Feb 56"; "CIB, 4 Feb 56"; "CIB, 5 Feb 56."
8. Cooper, *The Lion's Last Roar*, 87. Another version of events is depicted in Robertson, *Suez: The Inside Story of the Suez Conspiracy*, 91, where Robertson depicts the Soviet delegation recognizing "the logic" of the British position but not threatening them.
9. Nikita Khrushchev, *Khrushchev Remembers*, trans. by Strobe Talbott (London; Andre Deutsche, 1971), 435. Khrushchev is disingenuous in his memoir. On page 405 he goes out of his way to explain that "We certainly didn't mean to threaten anyone" after a previous interchange during a state dinner where he was asked about Soviet ballistic missile ranges.
10. Kyle, *Suez*, 105.
11. Fursenko and Naftali, *Khrushchev's Cold War*, 57.
12. Library of Congress Manuscript Division (hereafter LCMD) LeMay Papers, box B-203, message JCS to LeMay, 18 Apr 56.
13. Kenneth W. Condit, *History of the Joint Chiefs of Staff Volume VI: The Joint Chiefs of Staff and National Policy, 1955-1956* (Washington DC: Historical Office of the Joint Staff, 1998) p. 169-170.
14. FOIA USAF "History of the 3079th Aviation Depot Group, January 1956-June 1956."
15. FOIA USAF "History of Detachment 10 TUSLOG 7216th Air Base Squadron, 1 July 1956 to 31 December 1956"; see also Sean M. Maloney, *Emergency War Plan: The American Doomsday Machine, 1945-1960* (Lincoln: Potomac Books, 2021).
16. Condit, *JCS 1955-56*, 178-83.
17. Fursenko and Naftali, *Khrushchev's Cold War*, 105-6.
18. LCMD LeMay Papers, box B-203, message JCS to unified and specified commanders, 31 Aug 56.
19. LCMD LeMay Papers, box B-203, message JCS to unified and specified commanders, 31 Aug 56.
20. Simon Hall, *1956: The World in Revolt* (London; Pegasus Books, 2015). Hall's work, which is to a significant part derived from newly-opened information from the former Soviet regimes, captures this situation in some detail in chapters 5, 9, and 10.
21. There were also protests in Lithuania. See CIA CREST "CIB 15 Nov 56" and "CIB 13 Dec 56."
22. Fursenko and Naftali, *Khrushchev's Cold War*, 122-3.
23. CIA CREST, "CIB 21 Aug 56."
24. Serafim Mikhailovich Kulikov, *Aviation and Nuclear Tests*, (Moscow: TsNIIatominform, 1998), 13-14, 42-43, 49, 61-64; Maloney, *Emergency War Plan*, 43-79.
25. Maloney, *Emergency War Plan*, 95-97.
26. CIA CREST, "CIB 7 Sep 56."
27. Hall, *1956*, 276.

28. CIA CREST, "CIB 30 Sep 56."
29. Hall, 1956, 279.
30. CIA CREST: Information Report "Survey of Recent Events, 18 December 1956."
31. Hall, 1956, 280.
32. Hall, 1956, 286-287.
33. CIA CREST: Information Report "Survey of Recent Events, 18 December 1956."
34. CIA CREST: Information Report "Survey of Recent Events, 18 December 1956."
35. Maloney, *Emergency War Plan*, 95-97.
36. CIA CREST, "CIB 18 Nov 56."
37. CIA CREST, "CIB 6 Oct 56"; CIA CREST, "CIB 17 Feb 57."
38. CIA CREST, "CIB 27 Oct 56." The analysts believed that the test would occur "on the periphery of the Barents Sea" that is, the Novaya Zemlya nuclear test site as opposed to Semipalatinsk in Kazakhstan.
39. USAF FOIA "History of Detachment 10 TUSLOG 7216th Air Base Squadron, 1 July 1956 to 31 December 1956."
40. LCMD Twining Papers, box 101, message CinCSAC to COFS USAF, 31 Oct 56.
41. LCMD Twining Papers, box 101, message COFS USAF to CINCSAC, 31 Oct 56.
42. LCMD Twining Papers, box 101, message CinCSAC to COFS USAF, 31 Oct 56.
43. Fursenko and Naftali, *Khrushchev's Cold War*, 128.
44. Hall, 1956, 343-349.
45. Hall, 1956, 343-499.
46. Kyle, *Suez*, 456-457.
47. Vladislav Zubok and Constantine Pleshakov, *Inside the Kremlin's Cold War: From Stalin to Khrushchev* (Cambridge: Harvard University Press, 1996), 190-191.
48. Fursenko and Naftali, *Khrushchev's Cold War*, 33.
49. *Foreign Relations of the United States, 1955-1957*, Volume XVI Suez Crisis July 26-December 1956 (Washington DC: GPO, 1990) [hereafter *FRUS*], message Bohlen to Department of State, 5 Nov 56, p. 995
50. *FRUS* Suez Crisis, memo of conference, 5 Nov 56, 1000.
51. *FRUS* Suez Crisis, "SNIE 11-9-56, "Sino-Soviet Intentions in the Suez Crisis," 6 Nov 56, 1018-1019.
52. Condit, *JCS 1955-56*, 182-183.
53. Yefrim Gordon, *Soviet Strategic Aviation in the Cold War* (Manchester: Hikoki Publications, 2009), 51-2; Yefrim Gordon et al., *Tupolev TU-16: Versatile Cold War Bomber* (Atglen: Schiffer Publishing, 2017), 70.
54. Condit, *JCS 1955-56*, 189-90.
55. LCMD LeMay Papers box B-203, message JCS to all CINCs, 6 Nov 56.
56. LCMD LeMay Papers, box B-203, message CINCSAC to numbered air forces, 6 Nov 56.
57. CIA CREST "CIB 7 Nov 56."
58. *FRUS* Suez Crisis, memo "Acting Secretary's Talk with the President," 7 Nov 56, 1047. Note that in the 7 November CIB there were reports of Syria that relocated Egyptian MiG-15 fighters allegedly shot down a pair of British Canberra reconnaissance aircraft. In reality, Syrian Meteor fighters intercepted an RAF Canberra reconnaissance flight transiting from Iraq to Cyprus and shot the aircraft down; Brian Cull et al., *Wings Over Suez* (London: Grub Street, 1996), 336-337.
59. Cull et al., *Wings Over Suez*, 338. Cull discounts the possibility this was a U-2 overflight.
60. CIA CREST, Letter Dulles to Higgs, "Status Report on the Near East given by the Director at the White House to a bipartisan Congressional Group, 9 November 1956." The Turkish government later denied that there was a Soviet request for naval force movement through the Dardanelles. See CIA CREST "CIB 10 Nov 56."
61. LCMD Twining Papers, box 101, message COSAF to CINCSAC, 7 Nov 56.
62. Maloney, *Emergency War Plan*, 156; Richard Boverie, "First USAF Missile Alert?" *Association of Air Force Missilers Newsletter* 13, no. 4 (December 2005): 1-2.
63. LCMD LeMay Papers, box B-205. The title was found in a list of Top Secret document control numbers. The message itself does not appear to be in the LeMay Papers, nor the Twining Papers.
64. Sean Maloney, *Learning to Love the Bomb: Canada's Nuclear Weapons During the Cold War* (Lincoln: Potomac Books, 2007), 52-53.
65. USNARA RG 59, box 3219, memo "Canadian XZY Procedures-Operations ROADBLOCK and PINEGROVE," 8 Nov 56.
66. SAC operation code names in the 1950s and early 1960s had a pattern in that they consisted of two easily pronounceable one-syllable words, usually but not always nouns: HARD ROCK, PINE GROVE, STEEL TRAP, SWITCH BLADE, GLASS BRICK. In contrast, non-SAC USAF code names at this time were generally singular like JUDO or SKYHAWK, or multisyllabic, ie: BUCKSKIN RIDER, PALACE LIGHTNING.
67. Condit, *JCS 1955-56*, 190-1.
68. CIA CREST "CIB 10 Nov 56."
69. CIA CREST "CIB 12 Nov 56."
70. *FRUS* Suez Crisis, 1101-1123.
71. CIA CREST "CIB 10 Nov 56."
72. CIA CREST "CIB 14 Nov 56."
73. CIA CREST "CIB 16 Nov 56."
74. Condit, *JCS 1955-56*, 190-1.
75. LCMD LeMay Papers, box B-203, message HQ USAF to CINCSAC.
76. LCMD LeMay Papers, box B-205. The title was found in a list of Top Secret document control numbers. The messages themselves do not appear to be in the LeMay Papers, nor in the Twining Papers.
77. CIA CREST "CIB 18 Nov 56."
78. Podvig, *Russian Strategic Nuclear Forces*, 487-488.
79. CIA CREST "CIB 18 Nov 56."
80. CIA CREST "CIB 18 Nov 56."
81. CIA CREST "CIB 24 Nov 56," CIA CREST "CIB 25 Nov 56."
82. See Eisenhower, *Waging Peace*, Ch III.
83. LCMD LeMay Papers, box B-205. The title was found in a list of dated Top Secret document control numbers.
84. FOIA USAF "History of the 3079th Aviation Depot Group, January 1956-June 1956."
85. LCMD LeMay Papers, box B-205. The title was found in a list of Top Secret document control numbers.
86. Generally, there was an "annual atomic weapons dispersal authority issues by the Joint Chiefs of Staff to commanders of unified and specified commands." LCMD Twining Papers, box 112, memo for SECDEF, "Withdrawal of DOD Memorandum, 29 Mar 60." See also FOIA DOD Office of the Assistant to the Secretary of Defense (Atomic Energy), "History of the Custody and Deployment of Nuclear Weapons July 1945 Through September 1977", specifically, "The numbers of weapons to be transferred were to be directed by the President in separate actions from time to time."
87. CIA CREST "CIB 21 Nov 56." Uzin airfield was known to be a TU-95 base by the intelligence apparatus at the time.
88. CIA CREST "CIB 21 Nov 56."
89. "Long Range Flights of Military Aviation," *Polar Mail* 4 March 2012, [https://www.litres.ru/book/v-i-saperov/sovetskaya-dalnyaya-aviaciya-v-gody-holodnoy-voyny-68885253/chitat-onlayn/?page=3](http://www.polarpost.ru/forum/viewtopic.php?f=16&t=2479&hilit=%D0%BB%D0%B5%D0%B2%D0%B0%D0%BD%D0%B5%D0%B2%D1%81%D0%BA%D0%B8%D0%B9&start=0; V.I. Saperov, Soviet Long-Range Aviation During the Cold War, (Moscow: Veche Publications, 2023); excerpt on Tu-95 operations at <a href=)
90. CIA CREST "CIB 21 Nov 56." Ramenskoye air base was known to the intelligence apparatus as a Soviet research and development facility.

91. Sean M. Maloney, "Arctic Sky Spies: The Director's Cut," *Canadian Military Journal* 9, no. 1 (2008), <http://www.journal.forces.gc.ca/vo9/no1/11-maloney-eng.asp>; Gordon, *Soviet Strategic Aviation in the Cold War*, 75-82.
92. USNARA RG 59, box 3219, memo, "Canada-Overflight," 19 Nov 56; "Operation ROADBLOCK and Operation PINE-GROVE," 20 Nov 56.
93. Roger M. Anders (ed), *Forging the Atomic Shield: Excerpts from the Office Diary of Gordon E. Dean* (Chapel Hill: UNC Press, 1987), 135, 137-138.
94. USNARA RG 218 CCS 354.2 US (4-12-57) (22 Apr 57) "Results Obtained from Ex DODEP, 12 April 1957"; US Navy Operational Archive, Strategic Plans Division Box 315 file A-5, Op ALERT message traffic.
95. FOIA DOD Office of the Assistant to the Secretary of Defense (Atomic Energy), "History of the Custody and Deployment of Nuclear Weapons July 1945 Through September 1977."
96. FOIA DOD Office of the Assistant to the Secretary of Defense (Atomic Energy), "History of the Custody and Deployment of Nuclear Weapons July 1945 Through September 1977."
97. LCMD Twining Papers, box 110, "Proposed Revision to Atomic Energy Commission-Department of Defense Memorandum of Understanding for the Transfer of Atomic Weapons." Note that the proposal references the 1956 version of the MOU regarding Defense Emergency and its criteria.
98. FOIA USAF "History of the 3079th Aviation Depot Group, January 1957-June 1957."
99. As discussed in the author's *Deconstructing Dr. Strangelove: The Secret History of Nuclear War Films* (Lincoln: Potomac Books, 2020) chapters 2 and 3.
100. CIA CREST "CIB 22 Nov 56."
101. CIA CREST "CIB 27 Nov 56."
102. FOIA USAF "History of TUSLOG Det 10 (7216th Air Base Squadron) July-December 1956."
103. FOIA USAF "History of the 6607th Air Base Wing, January-March 1957."
104. Robert S. Hopkins III, *Spyflights and Overflights: US Strategic Aerial Reconnaissance, Volume 1 1945-1960* (Manchester: Hikoki Publications, 2016), 110.
105. FOIA USAF "History of the Strategic Air Command 1 July-31 December 1956 Volume I."
106. FOIA USAF "History of the Strategic Air Command 1 July-31 December 1956 Volume I"; FOIA USAF "History of the 42nd Bombardment Wing, Heavy, 1 November-31 December 1956."
107. Fradkov Boltunov, *Golden Ear of Military Intelligence*, (Moscow: Veche EAN publishing, 2014), 91-92; Public Archive of Canada (PAC) MG 32 b1a Vol. 11 file 15-90, memo Chief of the Air Staff to Minister of National Defence, "RCAF Reconnaissance Mission," 2 Sep 58; CIA CREST PIR "Franz Joseph Land," 15 Aug 58. Assuming Soviet radar on the drift ice stations operated at less than 3 MHz frequency, the radar was capable of refracting off the ionosphere under certain conditions and could detect aircraft at distances beyond line of sight.
108. The Soviet trawlers started operating off the Canadian coast in 1954. A study examining the development of Soviet Trawler capabilities noted that they carried out "COMINT functions involving the intercepting and recording of radar and radio communications...including on the spot analysis of tactical methods and procedures...[and] are known to be specially fitted out for electronic intercept functions of a wide variety."
- See Directorate of History and Heritage (DHH) File 79/246 Folder 29, VCNS to CCoS, "The Threat Posed by the Soviet Fishing Fleet, 15 Jan 53."
109. Tom Hildreth, "Pease Air Force Base: The Stratojet Years," <http://www.tomhildrethphotos.com/AIRCRAFT/AIRPORTS/Pease.html>
110. See FOIA USAF "History of the 4th Air Division, April 1957." Though the weapons types have been redacted from this document, the remaining language, "capsule installation", "capsule containers", "trap door plug", "guide tube during capsule preparation", "spreading the E-1 ring" around the "capsule and trap door plug", exhortation to "never handle the core charges with bare hands" and that crews with use rubber surgical gloves "when performing capsule insertions" clearly indicates that the base was equipped with non-sealed pit thermonuclear weapons that required in-flight insertion of the core. Only two such weapon types were allocated for USAF B-47 service at this time, the Mk 15 and Mk 21. See Maloney, *Emergency War Plan*, 115.
111. FOIA USAF "History of the 4th Air Division, April 1957."
112. FOIA USAF "History of the Ernest Harmon Air Force Base APO 864, New York, NY, 1 July-31 Dec 45."
113. See Robert M. Slane, *Journey to Freedom and Beyond* (Bloomington: Trafford Publishing 2004).
114. I am indebted to Katerina Feisthauer and Christine Green for bringing the details of the Ray Lake B-47 crash and the SAR effort to my attention when they were conducting research into it for a class project. Interestingly, the B-47 crash does not appear on the BROKEN ARROW nuclear accident lists. See Michael H. Maggelet and James C. Oskins, *Broken Arrow: The Declassified History of U.S. Nuclear Weapons Accidents* (Lulu Press, 2007).
115. Khrushchev, *Khrushchev Remembers*; Jerrold Schecter and Vyacheslav V. Luckov (eds) *Khrushchev Remembers: The Glasnost Tapes* (London: Little, Brown and Co, 1990); Sergei Khrushchev, *Khrushchev on Khrushchev: An Inside Account of the Man and His Era* (London: Little, Brown and Co, 1990).
116. CIA CREST "CIB, 17 Feb 57."
117. Podvig, *Russian Strategic Nuclear Forces*, 487-488.
118. LCMD LeMay Papers, box B-203, message HQ USAF to SAC, 3 Dec 56.
119. LCMD LeMay Papers, box B-203, message HQ USAF to SAC, 8 Dec 56.
120. FOIA USAF "History of the 6607th Air Base Wing, January-March 1957."
121. LCMD LeMay Papers, box B-203, message HQ USAF to CINCCONAD, 14 Dec 56.
122. CIA CREST "CIB, 1 Dec 56."
123. CIA CREST "CIB, 7 Dec 56."
124. Nichols captures this in *Eisenhower 1956*, 262-263. Cooper, *The Lion's Last Roar*, 200 notes the British and French relaxed attitude during a CIA briefing that asserted that the missile threat was chimeric.
125. See Maloney, *Deconstructing Dr. Strangelove*, chap 5 for details. CinCSAC General Thomas Power openly threatened the bald Khrushchev in public speeches, ensured that there was substantial public information about the low-level flight capabilities of and training conducted by the B-52 and B-58 force, and SAC Airborne Alert movements in the Arctic were code-named CHROME DOME. The Airborne Alert Force used routes similar to those used by QUICK KICK in 1956.

NOEL PARRISH: TRAINER OF THE FIRST BLACK U.S. MILITARY PILOTS



Maj. James A. Ellison returns the salute of Mac Ross of Dayton, Ohio, as he passes down the line during review of the first class of Tuskegee cadets; flight line at U.S. Army Air Corps basic and advanced flying school, Tuskegee, Alabama, 1941. (Public Domain; <https://commons.wikimedia.org/w/index.php?curid=3347330>)

Daniel Haulman

Many falsehoods have circulated about the legendary Tuskegee Airmen since their World War II combat as the first black U.S. military pilots. One of the most common of the falsehoods is the claim that the military flying training program at Tuskegee was designed to fail. The story of Colonel Noel Parrish, who commanded Tuskegee Army Air Field and its flying schools during most of World War II, refutes that myth. Parrish was a white officer fully committed to the success of the Tuskegee Airmen, and they recognized that fact. The Tuskegee Airmen Incorporated, an organization founded by the Tuskegee Airmen veterans, annually presents one of its members its most prestigious award, which is named after Noel F. Parrish.¹

Noel Parrish was a Southerner, born in Kentucky in 1909, the eldest of four children of a Disciples of Christ minister and his wife. When Noel was about seven years old, the family moved to Auburn, Georgia, where his father taught at Southeastern Christian College. When Noel was twelve, his family moved again, this time to Cullman, Alabama, where his father served as a preacher at a small church. Noel attended high school in Cullman, where he graduated at the age of only fourteen. While growing up in Alabama, Noel Parrish was surrounded by the racism of his time and place, but he was also exposed to the values of Jesus Christ expressed in the Gospels about which his father preached.²

About that time, the family moved again, this time to Houston, Texas, where both his father and uncle served as preachers in small churches. In 1924, Noel entered Rice Institute as a student. He was quite liberal at the time, organizing a Christian Endeavor Society at his church and urging the passage of resolutions against war and segregation. His father and uncle encouraged him not to antagonize their congregations. In 1928, Noel graduated from Rice Institute with a degree in history. At first, he wanted to be a teacher, and started graduate school at Rice for that purpose. He practice taught at Sam Houston High School in downtown Houston, the same school where Lyndon Baines Johnson did his practice teaching a year later. At nineteen, Noel Parrish was not much older than his students, and when requested a job as a regular teacher there, the principal told him he was “too young.”³

The Great Depression started in 1929, and Parrish began looking for a job. He was briefly hired as a timekeeper at a local steel foundry but that company failed. Noel then worked in the accounting office of Texas Company, but that company lost business, and could not afford to keep him on the payroll. Parrish went to San Francisco, California, still looking for work. He finally found a job by enlisting in the U.S. Army.⁴

The Army was good for Noel. Not only did it give him food, clothing, shelter, and an income, but it also allowed him to become more physically fit. He had always been very skinny, and his service with the 11th Cavalry in Mon-



Brig. Gen. Noel F. Parrish, (pictured as a junior officer.) (USAF Photo.)

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terey, beginning in 1930, allowed him to gain more than thirty pounds of muscle. He needed to be physically fit for his next goal: to become a U.S. Army pilot.⁵

After his application for flight training was accepted, Parrish went to March Field, California, for primary flight school, where he flew a PT-1 biplane and landed and took off on grass. After four months at March, Noel moved to Randolph Field, Texas, where he had four months of basic flight training. His final four months of advanced flight training took place at Kelly Field, Texas, which, like Randolph, was in the San Antonio area. Only about half of the cadets who entered the three phases of military flight training graduated from the advanced phase, and Noel was happy to receive a one-year Reserve commission as a second lieutenant. He was first stationed at Fort Crockett, Texas, in Galveston, and served with the 13th Attack Squadron.⁶

After only a year as an officer, Noel's Reserve commission expired. He wanted to remain in the Army and continue to fly, but the only way he could do that, in those pre-war days of military austerity and depression, was to reenlist as a private again, and become an enlisted pilot. He was stationed first at the Air Corps Technical School at Chanute Field, Illinois in 1933, and the next year he was reassigned to the 1st Air Transport Squadron at Patterson Field near Dayton, Ohio, where he tested new transport aircraft such as the DC-1.⁷

Not satisfied as an enlisted man, having been an officer, Parrish applied for a regular commission, and, because of his credentials, he received it, in July 1935. He was assigned to his old unit, the 13th Attack Squadron, which by then had moved to Barksdale Field, Louisiana. The next year he married his sweetheart.⁸

In 1938, Noel Parrish became a flight instructor at Randolph Field, Texas, the same field where he had his basic flight training, but he taught primary phase flight training there. By then he was a first lieutenant. The next year he moved again, this time to an Air Corps Flying School at Glenview, Illinois. While serving there, between 1939 and mid-1941, Parrish came into contact with Cornelius Coffey and Willa Brown, who ran a flying school for black civilian pilots on the west side of Chicago.⁹ At the time, Chicago was the second largest city in America, and had a thriving black population. It had also become the center of black aviation in America, although none of the pilots were military.

The same years that Noel Parrish was at Glenview, World War II was breaking out and growing in Europe. Hitler's Germany took over most of Europe between 1939 and 1941, even invading the Soviet Union, and reaching the gates of Leningrad and Moscow, while Imperial Japan took over large parts of China and southeastern Asia. While the United States resisted the temptation to intervene on the side of the British Empire, Roosevelt pushed for greater defense spending, and increasing funding became available for the Air Corps, which was reorganized in the Army Air Forces. As the need for military pilots increased, military flying schools sprang up all over the country, largely replacing the



Brig. Gen. Noel F. Parrish, (pictured as a Lt. Col.) (Photo courtesy of the Lone Star Flight Museum.)

civilian flying schools that preceded them. Blacks interested in aviation demanded to be trained as well, because they also wanted to be military pilots.¹⁰

By 1941, the Franklin D. Roosevelt administration had decided to begin training black military pilots, as part of a 1940 campaign promise. On March 22, 1941, the War Department constituted and activated the 99th Pursuit Squadron (later redesignated as the 99th Fighter Squadron) at Chanute Field, Illinois.¹¹ It was destined to become the first black flying unit, but for almost a year it had no pilots. The War Department decided its pilots would be trained at Tuskegee rather than Chicago. Not only was there another good civilian pilot training school at Tuskegee Institute, but central Alabama had good flying weather in all seasons. It also had the prestige of nearby Tuskegee Institute, the most famous black institution of higher learning in the nation. Moreover, it was in a segregated part of the country, and the Army insisted that the black flying training to be segregated, since the black flying unit would also be segregated. The War Department opposed the idea that white enlisted men would ever serve under black officers.¹²

During that crucial year of 1941, a primary flight school was built at Moton Field, north of Tuskegee, and a basic and advanced flight school at a much larger field eventually called Tuskegee Army Air Field, which was miles northwest of that. Moton Field was owned by Tuskegee Institute, but it would operate the primary flight school under contract with the Army Air Forces. Charles Alfred Anderson, or “Chief” Anderson, became the head civilian flight instructor there, because of his experience at the civilian pilot training facility at another airfield owned by Tuskegee Institute. The Army



Tuskegee Army Air Field in 1943. (USAAF photo.)

Air Forces needed a pilot officer to be military commander at Moton Field. It naturally turned to Noel Parrish, an experienced military flight instructor who had some associations with black aviation leaders and pilots in Chicago. While Parrish did not seek the position at Tuskegee, he accepted it willingly. In the summer of 1941, Noel moved to Maxwell Field, Alabama, and once the primary flight school opened in Tuskegee, he moved to Moton Field to become its military commander. He served under the command of Major James Ellison, who was headquartered at the much larger Tuskegee Army Air Field, which would handle the subsequent basic and advanced flight training. Unlike Moton Field, Tuskegee Army Air Field was a U.S. Army rather than a Tuskegee Institute facility. It was much larger than Moton Field, and had paved runways and more advanced aircraft.

Parrish arrived at Tuskegee Institute as the construction of the primary flight school at Moton Field was completed at the end of August. The Army Air Forces provided funding for the school, and provided its equipment, supplies, and aircraft. Most of the aircraft were PT-13 and PT-17 biplanes, which were essentially the same aircraft type with different engines. There were no paved runways at the primary flight school. A lieutenant and later a captain, Parrish was the highest U.S. Army officer at the field, but he had a staff of other white officers. The flight school at Moton Field was very unusual, being the only one in the country providing primary flight training for African Americans. At Moton Field, Parrish worked not only with black flying school cadets, but also with civilian flight instructors. Parrish and the black flight instructors and flying training cadets got along well.

After primary flight training at Moton Field, the first class of cadets moved on to basic and advanced flight training the much larger Tuskegee Army Air Field, and Major Parrish moved with them, to become the Director of Training. During the same month, December 1941, the United States entered World War II. Tuskegee Army Air Field was much larger than Moton Field. It had four long intersecting paved runways, three large double hangars, and abundant housing facilities.



Tuskegee Class 42-H. (Photo courtesy of CAFRiseAbove.org.)

There were BT-13 airplanes for basic flying training, AT-6 aircraft for advanced flying training, and P-40s for transition training. Eventually the field would also train twin-engine pilots, first with AT-10 airplanes, and later with B-25s.

Nine days after Parrish transferred to Tuskegee Army Air Field to become Director of Training there, Col. Frederick V. H. Kimble became the new commander of the base and the flying school there, succeeding Major James Ellison. Parrish, later promoted to major, worked as Director of Training at Tuskegee Army Air Field for a little over a year, from December 1941 to December 1942. During that time, racial incidents sometimes erupted in the area, especially when black cadets and military personnel entered the segregated town of Tuskegee. Kimble restricted most of the black personnel to the base, and ordered that black military police, when they entered the town, not be armed. Kimble also segregated facilities on the field, making sure the dining hall had separate wings for black and white personnel, hoping that a segregation on base policy would remind the men of the segregation policy in Tuskegee. Parrish opposed some of these decisions, and even wrote an article, using the pseudonym Frank Lambert, in defense of the black cadets at Tuskegee Army Air Field. People became aware of Parrish's more liberal views without knowing they belonged to the Director of Training at Tuskegee Army Air Field.

It is possible that continuing racial tension at the base and in Tuskegee, coupled with continued criticism

of the segregated program in the Black press, persuaded the War Department to reassign Kimble. Whatever the reason, on December 26, the day after Christmas, 1942, Major Parrish became commander of the basic and advanced flying school at Tuskegee Army Air Field, succeeding Kimble as base commander. Many of the black personnel there welcomed the new commander, partly because he seemed more tolerant and less racist than his predecessor. They hoped for a relaxation of segregation on the base, and he eventually fulfilled those hopes.

At Tuskegee Army Air Field, Parrish faced many difficulties besides the racial animosity engendered by Colonel Kimble. By later 1942 and early 1943, the base was tremendously overcrowded because it not only housed black cadets in the basic and advanced phases of flight training, and their instructors, and all the personnel maintaining the huge facility, but it was also home of the 99th Pursuit Squadron, renamed the 99th Fighter Squadron, which had moved from Chanute Field, Illinois to Tuskegee and which absorbed the first black military pilots to graduate from the advanced flight training. Tuskegee Army Air Field had also become home to three other black fighter squadrons, the 100th, 301st, and 302nd, and the 332nd Fighter Group to which they were assigned. The base was bursting at the seams, and the trained black pilots wondered when they would ever have a chance to deploy overseas and enter combat, to show off their flying skills.



Tuskegee Class 43-A. (Photo courtesy of CAFRiseAbove.org.)

Tensions eased in the spring of 1943 when the 99th Fighter Squadron, which had received its first pilots a full year earlier, finally deployed for overseas duty. Around the same time, the 332nd Fighter Group and its three fighter squadrons moved to Selfridge Field, Michigan. Newly trained black military pilots who graduated from advanced flight training at Tuskegee Army Air Field thereafter deployed to Selfridge Field, and, after the 332nd Fighter Group also deployed overseas, at the beginning to 1944, to Walterboro in South Carolina, a replacement pilot facility. Eventually the twin-engine graduates of advanced flight training at Tuskegee Army Air Field deployed to Selfridge, where the 332nd Fighter Group had been, to serve with the newly activated 477th Bombardment Group and its four squadrons.

The reduction of crowding at the base was not the only reason tensions eased at Tuskegee Army Air Field while Parrish was commander there. New facilities opened that furnished more opportunities for recreation and sports, since those opportunities could not be provided in the little segregated town of Tuskegee to the south. Among the new facilities were a Service Club, a swimming pool, and an amphitheater. Parrish sup-

ported the development of a 16-piece orchestra on the base, which was called "Wings of Rhythm." Parrish also succeeded in getting many famous black entertainers and sports heroes to visit Tuskegee Army Air Field and put on shows there. Two of the most famous among them were Joe Louis (Barrow), the heavyweight champion of the world, and Lena Horne, the famous black singer and actress.

Parrish also reduced the segregation that his predecessor had enforced on the base. Eventually the only segregated facility left was the dining hall, which had a black wing and a white wing, with the kitchen in the middle. When black officers entered the side that had been reserved for white officers, and demanded service there, Parrish allowed them to enter and use it, effectively ending segregation on the base. He immediately became less popular among the white officers on the base, many of whom stopped eating at the dining hall. None of the white officers lived on base, but in the town of Tuskegee or nearby Auburn. On the other hand, by allowing integration of the base facilities, Parrish became much more popular among the black personnel on the base. He was the only white officer to join the Serv-



Roger C. Bill Terry (center) at Tuskegee Army Air Field, December 1944. (Photo courtesy of CAFRiseAbove.org.)

ice Club, which functioned as the Officer's Club. The white officers did not have their own club. When some of the white flight instructors requested transfers, Parrish facilitated the arrival of black pilots with combat experience from overseas to take their places, although they never outnumbered the white flight instructors at Tuskegee Army Air Field.

Parrish went to great lengths to meet with officials of Tuskegee and Macon County to assure them that just because Tuskegee Army Air Field was integrated, segregation would not be affected beyond the base. Most of the black officers and enlisted men and flying cadets at Moton Field and Tuskegee stayed away from the town of Tuskegee, except for Tuskegee Institute, which was reserved for blacks anyway.

Parrish also met often with representatives of the War Department and what was called the "Black Press" to assure them that the training of black pilots for the Army Air Forces was succeeding. Newspapers such as the *Pittsburgh Courier* and the *Chicago Defender*, whose writers initially condemned the War Department for requiring segregated flight training at Tuskegee, warmed to the training of the black pilots who achieved success in combat overseas. If the newspapers celebrated the black airmen in combat, they had to give some of the credit to their training at Tuskegee. While the "Black

Press" remained critical of the high washout rates, the editors had to admit that the pilots who completed the advanced flight training at Tuskegee Army Air Field, under Parrish's leadership, were superbly trained and equipped to excel.

When Colonel Parrish was commander of flight training at Tuskegee Army Air Field, he often had difficulty securing positive decisions through normal chains of command. He made numerous trips to the Pentagon to break through the bureaucracy, and complained that "every promotion, every assignment, nearly every decision, had a black and white side to it that we had to consider as well as the purely military side and the side of efficiency." He did not regard his Tuskegee assignment as a temporary exile from regular service, and used his position not to benefit himself so much as the cadets whose training he was charged to facilitate. Unlike his predecessor Kimble, who was paternalistic and skeptical of blacks and their ability to fly, Parrish looked for ways to improve morale on base by eliminating much of the segregation his predecessor had directed in an effort to preserve the peace. In August 1944, Parrish addressed white Rotary Club chapters in Tallahassee and Tuskegee to explain a recent order he was implementing regarding recreational facilities on base. He knew that his integration of base facilities was not the norm in the



Col. Noel F. Parrish (center) flanked by Col. Benjamin O. Davis, Jr. (right) and Col. Davis's father Brig. Gen. Benjamin O. Davis, Sr. (USAAF photo.)

surrounding area, but he was able to bridge some of the gaps between higher military headquarters and local communities and between whites and blacks. Morale under him improved partly because he was a peace-maker without sacrificing the need for progress.¹³ Major General George E. Stratemeyer, Chief of the Air Staff, directed that Air Corps bases desegregate official assemblies and toilet and messing facilities, and that blacks be placed in administrative posts at Tuskegee. Colonel Parrish implemented Stratemeyer's policy without alienating the surrounding communities, which enforced local segregation outside of the base.¹⁴

During the course of the war, the Tuskegee Airmen pilots who had trained at Parrish's school shot down 112 enemy airplanes. They flew 179 bomber escort missions between early June 1944 and the end of April 1945, and lost bombers on only 7 of those missions. A total of 27 bombers under Tuskegee Airmen escort were shot down by enemy airplanes, but the average number lost by the other fighter groups in the Fifteenth Air Force was 46. The Tuskegee Airmen lost significantly fewer bombers than the other fighter groups with which they served, and while most of the credit goes to Colonel Benjamin O. Davis, Jr. commander of the 332nd Fighter Group, some of it must also go to the white officers who trained the black pilots at Tuskegee Army Air Field under Parrish.

Partly because of Parrish's successes at Tuskegee Army Air Field, he was promoted again, first to lieutenant colonel in 1942, and then to colonel in early 1943. He was interested in the success of those who had graduated from flying training at his school, and kept up with their combat exploits. He became close friends with Colonel Davis, who visited Tuskegee again after having trained there. While Parrish commanded Tuskegee Army Air Field, Davis visited him and brought along his father, Brig. Gen. Benjamin O. Davis, Sr., who was the first and then only black general in the U.S. Army.

The War Department, conscious of the attention that Tuskegee got as the only flight training school for black military pilots during World War II, often sent important leaders to visit the field and its commander. Among the distinguished visitors Colonel Parrish hosted were Truman Gibson, civilian aide to the Secretary of War; Lt. Gen. Bardon K. Yount, commander of the Army Air Forces Eastern Flying Command, and Maj. Gen. Ralph Cousins, commander of the Army Air Forces Western Flying Command.

Colonel Parrish earned respect from the black cadets and officers with whom he worked. One black pilot noted that if a white had to command the base, Parrish was the best one. While he did not force white officers to live on the base or to join the integrated Offi-



Tuskegee officers posing with their base commander Noel F. Parrish (4th from left) and unidentified man. (Schomburg Center for Research in Black Culture, Photographs and Prints Division, The New York Public Library. "Tuskegee officers posing with their base commander Noel F. Parrish (4th from left) and unidentified man" New York Public Library Digital Collections..)

cers' Club, he joined the club, and became its only white member. Black newspapers sometimes published Parrish speeches on base, and commented positively.¹⁵

An ugly racial incident erupted at Freeman Field, Indiana, when the predominantly black 477th Bombardment Group was training there. Its pilots had been trained at Tuskegee Army Air Field under Noel Parrish. At Freeman Field, they had another commander, Col. Robert Selway, who insisted that facilities at his base remain segregated. Refusal of more than 100 black officers to go along with the base segregation policy resulted in their arrest. The arrestees were eventually exonerated, and Selway was reassigned to another organization. Colonel Benjamin O. Davis, Jr. became the new commander of the group. The contrast between Selway and Parrish in handling the challenge of segregation was evident. Parrish's more lenient policy eventually won the day.

At least five Tuskegee Airmen pilots wrote autobiographies after World War II, and all of them agreed on their assessment of Colonel Noel Parrish. Among those Tuskegee Airmen were Colonel Benjamin O. Davis, Jr., Colonel Harold Brown, Lieutenant Colonel Charles Dryden, Lieutenant Colonel Alexander Jefferson, and Lieutenant Colonel Harry T. Stewart, Jr. Tuskegee Airman pilot Colonel (later, Brigadier General) Charles McGee did not write an autobiography, but his daughter wrote a biography of him, in which she conveyed McGee's impressions of Parrish. All six of these Tuskegee Airmen pilots went through basic and advanced flight training at Tuskegee Army Air Field when Colonel Noel Parrish was commander of the field and the leader of the flying schools there.

Benjamin O. Davis, Jr. was the most famous Tuskegee Airman of all, having commanded the 99th Fighter Squadron and the 332nd Fighter Group in combat overseas, and having commanded the 477th Composite Group in the United States. He also became the commander of the first black wing, the 332nd Fighter Wing, before integration of the Air Force in 1949, and went on to become the first black general in the United States Air Force. Davis wrote that Parrish "won the respect and liking of many blacks" and that he was "eager to understand blacks and treat them on an equal, man-to-man basis." According to Davis, Parrish left the black cadets "with the feeling that he understood their problems and was sympathetic to them." In his book, General Davis recognized that Parrish had allowed the integration of the Tuskegee Army Air Field restaurant, despite the protests of other white officers. After Davis returned from leading the black combat units overseas, Parrish invited him to visit Tuskegee Army Air Field, where Davis himself had trained under Parrish, and speak at the airfield's fourth anniversary celebration.¹⁶

Harold H. Brown was another Tuskegee Airman who wrote an autobiography that included his impressions of Noel F. Parrish as commander of Tuskegee Army Air Field. Brown wrote that Parrish had improved conditions for black cadets at the base, since he had replaced previous racist commanders more intent on enforcing segregation on base than on the success of their flight training. He wrote "nearly all of the Tuskegee Airmen were very fond of Colonel Parrish and had a great deal of respect for him because of the dramatic changes he made once he was in command." Brown also ex-



Tuskegee Airmen Class 44-K-SE. (Photo courtesy of CAFRiseAbove.org.)

pressed appreciation for some of the white flight instructors that worked under Parrish at Tuskegee Army Air Field, and thought, like Parrish, they clearly had his best interests at heart.”¹⁷

One of the most memorable autobiographies of a Tuskegee Airman pilot was that of Charles W. Dryden, a member of the 99th Fighter Squadron who went overseas and fought in the Mediterranean Theater of Operations in 1943. Like Davis and Brown, Dryden remembered Parrish as a white officer who encouraged the first black military pilots to succeed. When he learned a lower-ranking white officer had penalized some of the cadets for a minor infraction, he told them he was pulling for them and wanted them to “stick it out.” He told them “Don’t give up.” Dryden noted that “all along the way to the top,” Parrish had been a “friendly, enthusiastic supporter” of the black flight training who was “sensitive to the needs, aspirations, and obstacles faced” by the black airmen. In Dryden’s words, Parrish “used his position as best he could to make sure that we succeeded in spite of the Jim Crow policies” of the service and the surrounding communities in Alabama. Because of Parrish’s support of black pilots in the Army, he was branded by some of the many white racists as a “nigger lover.” When the 99th Fighter Squadron departed Tuskegee for deployment to North Africa, Dryden remembered him going to the train station and saying goodbye, wishing them “Godspeed,” and complimenting their black commander for the “decorum and discipline of the officer and enlisted men of the 99th.” After Dryden returned from combat overseas, and prepared to get married in Tuskegee, Colonel Parrish invited him to visit his headquarters and “interrupted

his busy schedule” to take Dryden and his father on a tour of the base in his staff car. He also lent a staff car to Dryden so that he could better prepare for the marriage to one of the base nurses. When an MP stopped Dryden for speeding on base, and found out Dryden was the driver, he let him go, because he knew Parrish had made special arrangements to help Dryden prepare for his wedding. In his autobiography, Dryden listed some of the white friends he had in his career, and included Noel F. Parrish.¹⁸

Alexander Jefferson was one of the Tuskegee Airmen pilots who went down over enemy territory, after his plane was hit, and became a prisoner of war in Germany. Like some of the other Tuskegee Airmen, he wrote an autobiography that praised Noel Parrish. Jefferson noted that Parrish “was determined that we should succeed” and that “standards for us were every bit as high as for the white pilots he had previously trained.” He went on to say that “anything less would get us killed.” Parrish was “quite willing to wash out anyone who did not perform up to his high expectations. Above all, he tried to stand up for us when many of his superiors wanted us to fail.”¹⁹

Lieutenant Colonel Harry T. Stewart Jr. is another Tuskegee Airman fighter pilot who remembered Colonel Noel Parrish, commander of Tuskegee Army Air Field when Stewart trained there. In his autobiography, which he wrote with Philip Handleman as coauthor, Stewart noted that “Colonel Parrish was revered by cadets both for his insistence on high standards and for his evenhandedness. Without him at the helm, the program might have failed.” Stewart flew combat missions in red-tailed P-51s over Europe in 1945, and became one



332nd FG Commander, Col. Benjamin O. Davis, Jr., (left) and Edward C. Gleed, Group Operations Officer, scan the skies over the airfield at Ramitelli, Italy. (Library of Congress Photo.)

of the Tuskegee Airmen pilots on the team that won the conventional aircraft category (propeller aircraft category) in the first United States Air Force gunnery meet at Las Vegas Air Force Base in 1949.²⁰

One of the most famous of the Tuskegee Airmen pilots is Brigadier General Charles McGee, who was granted honorary promotion to that rank in December 2019, the same month he turned 100 years old. McGee served as a fighter pilot in three wars, accumulating a total of 409 fighter missions. Only two other Air Force pilots are known to have flown more combat missions in the same three wars. McGee's daughter wrote his biography, including McGee's memories of Noel Parrish. Like the other Tuskegee Airmen pilots mentioned above, McGee remembered Parrish improving conditions for black personnel at Tuskegee Army Air Field, after he succeeded the previous more racist commander of the base. McGee thought Parrish was thoughtful and fair, which led him to implement "practices to improve the quality of life for blacks at Tuskegee." McGee's biography quotes Parrish as telling deploying black pilots "you are fighting men now... Your future, good or bad, will depend largely on how determined you are not to give satisfaction to those who would like to see you fail." The McGee biography contains words from a report Parrish submitted to the War Department: "Whether we dislike or like Negroes and whether they like or dislike us, under the Constitution of the United States, which we are all sworn to uphold, they are citizens of the United States, having the same rights and privileges of other citizens and entitled to the same applications and protection of the laws." Like Davis, Brown, Dryden, Jefferson, and Stewart, McGee was a Tuskegee Airman combat pilot who recog-

nized the fairness of Noel Parrish and his interest in the success of the first black military pilots. Charles McGee was the first of the Tuskegee Airmen to receive the prestigious "Noel F. Parrish" award given by members of the Tuskegee Airmen Incorporated to recognize original Tuskegee Airmen for their contributions.

World War II ended in Europe in May 1945 and in the Pacific in August, vastly reducing the demand for pilots, including black pilots. In 1946, the last black cadets graduated from advanced flight training at Tuskegee Army Air Field, and in 1947, the base closed permanently. In the meantime, Colonel Parrish was reassigned to Air University, where he became a student at the Air Command and Staff School (later, Air Command and Staff College). In May, 1947, he submitted a thesis called "The Segregation of Negroes in the Army Air Forces," in which he expressed some of what he learned from having commanded the base and school where almost a thousand black U.S. military pilots trained during World War II, and from other many other sources regarding race and racial testing, by both white and black authors. In his thesis, he condemned racial segregation as having no rational basis, and ridiculed its inefficiency. He noted that many of the Tuskegee Airmen themselves were of mixed race, and that testing showed no inherent white superiority over blacks in terms of intelligence or flying aptitude. He provided examples of black cadets who scored better than white cadets at other bases, and argued that persons should be judged as individuals. Racial stereotypes were not valid.²¹ His thesis was published before the founding of the Air Force as a separate service from the Army, which occurred in September of the same year.



Tuskegee Class 45-A-SE.(USAAF Photo.)

Parrish moved on to Air University's Air War College, where he authored another thesis called "The Elimination of Waste in the Education of Air Force Officers." Unlike his 1947 thesis for Air Command and Staff School, Parrish's 1948 Air War College thesis said nothing about the black pilots Parrish had trained at Tuskegee during World War II, but reflected his interest in improving the education of officers in the new independent Air Force, without reference to race.²²

From the Army, the new service inherited a host of bases, personnel, aircraft and units, including flying squadrons and groups. The new service needed experienced officers at the Pentagon, and that is where Colonel Parrish was assigned after graduating from the Air War College. He moved to Washington, D.C. in 1948, where he served first as Deputy Secretary of the Air Staff at Air Force Headquarters, and then, in 1951 was reassigned as Special Assistant to the Vice Chief of Staff. During the time Parrish was at Air Force headquarters, President Harry S. Truman issued his famous Executive Order 9981, which mandated the desegregation of all the military services. While I have found no evidence that Truman's issuance of the order was a direct result of the Tuskegee Airmen experience, or of Colonel Parrish's thesis, there is evidence that many Air Force leaders at the time agreed with him that segregation had to go. Among them was the first Secretary of the Air Force, Stuart Symington, who might have become aware of Parrish's integration preferences while both of them served at the Pentagon. Even before the Tuskegee Airmen began their training at Tuskegee, the National Association for the Advancement of Colored People had urged that their training as pilots in American military service be integrated with that of the white cadets, and

the Air Force was already doing that after the closing of Tuskegee Army Air Field in 1947.

After President Eisenhower became President in 1953, Parrish's career took another turn. Eisenhower had been the military commander of the North Atlantic Treaty Organization, and he wanted the United States to continue furnishing leadership for the new alliance. In 1954, Noel Parrish was promoted to brigadier general rank and assigned as Air Deputy, North Atlantic Treaty Organization (NATO) Defense College in Paris, France. Two years later, Parrish became Deputy Director, Military Assistance Division, United States European Command, also headquartered in Paris. While Eisenhower was still in office, Parrish returned to the Pentagon in 1958 to serve as Assistant to the Deputy Chief of Staff, Plans and Programs.

During the 1960 campaign for President, Senator John F. Kennedy charged that the Eisenhower administration had allowed the Soviet Union to build up more intercontinental ballistic missiles than the United States, and that he would correct this "missile gap." Kennedy also called for a shift in military policy away from the Air Force and its strategic bombers and more toward a "flexible response" policy that would increase the relative importance of surface U.S. Army and Navy forces. Parrish had defended Eisenhower's older policy, and for that reason, became, among some other Air Force officers, persona non grata after Kennedy moved into the White House. Parrish left the Pentagon, never to return.²³

In 1961, Parrish was reassigned to Air University at Maxwell Air Force Base in Alabama, where he became Director, Research Studies Institute. While there he led a program in which historical studies were re-

searched, written, and published. He retired from the Air Force in 1964, after serving his last three military years back in Alabama, the state where he had commanded the school where the Tuskegee Airmen learned to fly military airplanes.

While Noel Parrish's military career was over, he continued to further his own education, earning a Master of Arts degree from Rice University in 1966 and then a Doctor of Philosophy in history degree from the same university in 1968. He served as a professor of military history at Trinity University in San Antonio, Texas from 1969 to 1975, and, from 1976 to 1977, as a visiting professor at the Air War College at Maxwell Air Force Base, back in Alabama one more time. In 1979, Dr. Parrish retired from Trinity University. Eight years later, he died at Perry Point, Maryland.

Parrish's private life is more obscure than his public service. He was married more than once, and his last wife became a regular attendee of annual Tuskegee Airmen Incorporated national conventions. She presented the Noel F. Parrish award, which was given to one Tuskegee Airman each year in recognition of outstanding service.

More than any other white man, Noel Parrish was instrumental in the success of the Tuskegee Airmen. Black officers who led the Tuskegee Airmen squadrons and groups, both in the United States and overseas, need to receive all the credit they are due, but to Noel Parrish should go some of the Tuskegee Airmen success,

because they trained under him. In fact, all the black combat pilots received their training under his leadership. Without him, the Tuskegee Airmen might not have been as successful as they were. As long as the Tuskegee Airmen are remembered, Noel Parrish should be remembered, too. ■

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Pro Pilot Bias Syndrome: Remotely Piloted Aircraft's Failure to Takeoff Post Vietnam



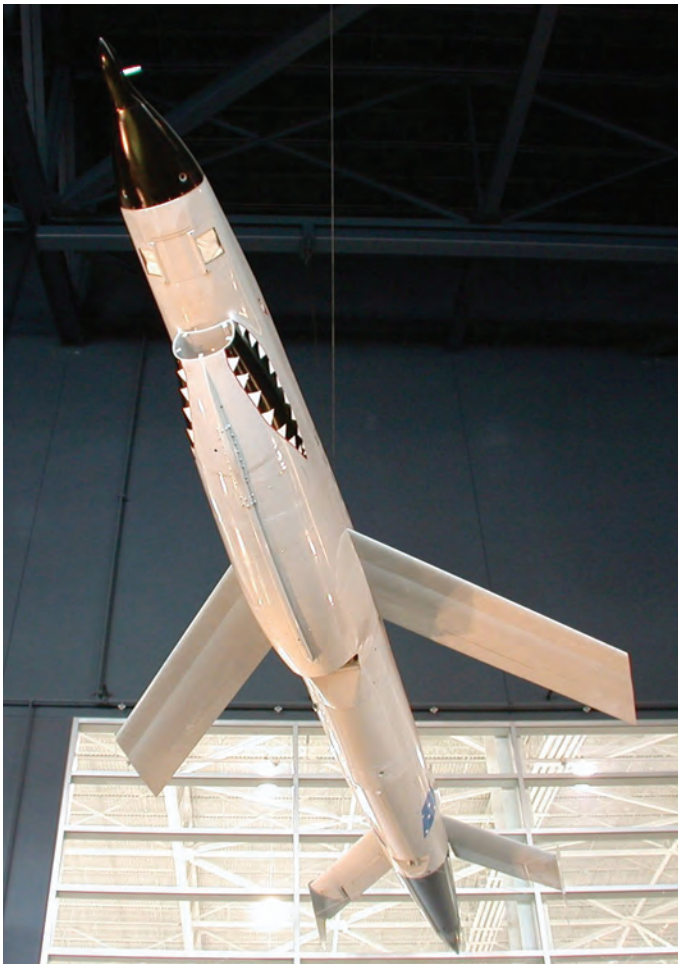
A U.S. Navy Lockheed DC-130A Hercules (BuNo 158228) from Composite Squadron VC-3 in flight in 1976, carrying subsonic Teledyne Ryan BQM-34S Firebee drones.

Don Strawbridge

The Global War on Terror was ubiquitous with drone warfare. The United States Air Force (USAF) used remotely piloted aircraft with impunity because the United States held complete air supremacy and technological superiority over disorganized and entirely ground-based militant groups. The first time a drone employed munitions in combat was in 2001. However, it was far from the first time the USAF used drones in combat. USAF drone history traces its roots back the Vietnam War, when airmen modified target drones to carry reconnaissance cameras. These drones proved their worth in the intelligence, surveillance, and reconnaissance (ISR) role gathering valuable photographs of bombing damage assessment, and signals intelligence of enemy surface to air missiles (SAMs). Yet despite these successes in Vietnam, USAF drone usage almost completely stopped after the war. The Air Force's failure to build on the success of the Lightning Bug after the Vietnam War came because of post-war reorganization and draw-downs, complex acquisitions processes, and an irrational desire for piloted aircraft. These factors halted drone development and usage for 25 years. It was not until the RQ-1 Predator began to see action in the 1990s that drones would return to the Air Force inventory.

In the late 1950s, early concepts of drones and their potential began circulating. However, the 1960 Soviet Union's downing of a CIA-flown U-2 piloted by Gary Powers proved to be a watershed moment in USAF drone development.¹ Following Powers's dramatic public trial and conviction for espionage within the Soviet Union, President Eisenhower vowed to never again let a pilot be shot down over the USSR. This came at a critical time, as the United States had no other method of surveillance behind the Iron Curtain during an election year.² The National Reconnaissance Office (NRO), a secretive organization meant to centralize intelligence gathering, thus had to figure out another means of safely flying over the USSR without risking a pilot. One of these proposed methods was Project Red Wagon, a purpose-built unmanned aerial vehicle (UAV) designed for reconnaissance. However, Red Wagon faced an expensive bill of \$70 million. Although Air Force leadership supported Red Wagon, in 1960 the Department of Defense decided to allocate the Red Wagon funding to the Oxcart program instead, which was the development of the A-12 aircraft. This program competed with the Corona spy satellite for dollars.³ This marked the first example of the struggle for resources between manned aircraft, drones, and satellites.

Since large scale funding attempts reached a dead end, the NRO turned into a more subtle means of funding: Big Safari. The office, located at Wright-Patterson AFB, specialized in modifications of existing airframes. Rather than paying for an expensive purpose-built frame like Red Wagon, Big Safari simply funded the modification of the Q-2C Firebee target drones into reconnaissance ones for less than \$1,500,000. These small target drones were designed to



Ryan Model 147 "Lightning Bug" reconnaissance drone at Strategic Air & Space Museum, Nebraska. (Official photo via Wikimedia.)

be cheap methods of training enemy fighters. The drones weighed only 2500 lbs. on takeoff, with a wingspan of 12.9 feet. The normal operation for these drones was to fly as if they were a much larger bomber, with an electronic device inside recording nearby missile explosions as hits or kills. Once the mission was over, the drones would ditch into the sea, to be recovered by helicopter, refurbished, then flown again.⁴ The modified drones, designated Ryan Model 147A "Fire Fly", replaced the electronic hit counter with a camera and doubled the wingspan. These new drones were faster, and entered service on February 1962, after only 91 days in development.⁵ The Fireflies launched from a specially designed DC-130 Hercules.

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They flew a preprogrammed flight path, based on internal navigation systems over suspected enemy areas, for a variety of missions. After their flight, the drones returned for pickup via a modified CH-3 helicopter, ideally without endangering pilots at any point of the mission.

Because the NRO could not fly the drones themselves, they needed to convince Air Force generals and pilots to support the drone program. Yet the NRO struggled to find an initial customer for the new drone. The generals were hesitant to allocate resources since money given towards planes that flew themselves was money pulled from manned airframes. Finally, a last-minute meeting between the NRO's briefing team and Strategic Air Command's (SAC) Director of Operations led to SAC accepting the drone program with plans for reconnaissance over the Soviet Union.⁶ However, the first opportunity for combat flights came much closer to home. The Cuban Missile Crisis sparked a need for photoreconnaissance over a highly contested and politically tense area. It seemed like the perfect opportunity to prove the usefulness of the Fireflies. However, the Chief of Staff of the Air Force, General Curtis LeMay, personally ordered the planned flight cancelled over fears of alerting the Soviet Union to the new top secret technology possessed by the Air Force.⁷ Instead, the drones would see their first test over China.

In 1963, the Air Force redesignated the drones to the AQM-34 "Lightning Bug" due to concerns over classification. Shortly after in 1964, the Gulf of Tonkin incident increased the United States involvement in Vietnam. With growing numbers of American troops in Vietnam, concerns grew over the possible intervention of Communist China, similar to its entry into the Korean War against the United States. The 4080th Strategic Reconnaissance Wing deployed with Lightning Bugs to Kadena Air Base, on Okinawa, to gather intelligence on Chinese strength and its burgeoning nuclear program. The drones would fly under the Nationalist Chinese flag, giving the United States plausible deniability.⁸ The nature of the unmanned craft offered political advantages. The first Lightning Bug shot down by the Chinese generated little outrage, and even the Soviets failed to object. This was much preferred to the dramatic incident Gary Powers caused with his U-2 crash and subsequent trial within the Soviet Union.⁹

With the war in Vietnam heating up, the 4080th Strategic Wing redeployed to Bien Hoa Air Base in South Vietnam, with the Lightning Bugs flying large numbers of reconnaissance sorties at low altitudes. In 1965, 33 of the 63 discovered SAM sites came from Lightning Bug sorties.¹⁰ The Vietnam War saw a large variety of roles performed by the Lightning Bugs. Some gathered valuable signal intelligence on enemy SAM sites, sending it back to the DC-130 via a rudimentary data link before the enemy missiles shot it down. Others carried powerful cameras, taking photographs of potential enemy locations or previously bombed targets in battle damage assessments (BDA) over Southeast Asia. Some could drop leaflets over the enemy, and some contained a live feed TV camera broadcasting to the DC-130 mothership off



An AQM-34L hangs at the National Museum of the U.S. Air Force. The AQM-34L remotely piloted aircraft flew low-level photo-reconnaissance missions over North Vietnam. The AQM-34 series was developed from the unmanned BQM-34A target aircraft. The AQM-34L on display flew more than 30 missions over North Vietnam. This AQM-34L's nickname, M.R. Ling, was a pun on the last name of Lt. Col. Edwin Emerling, who was involved with its early combat missions. (NMUSAF/LaRock)

the coast of Vietnam.¹¹ This diverse set of missions proved the versatility and economics of the airframe. Though not perfect, the Air Force regarded Lightning Bug operations as generally successful in Vietnam. Some were even able to assist in downing enemy aircraft, as MiG fighters sent to intercept were shot down by wayward SAMs intended for the modified target drones.¹² However, there were two specific missions that demonstrated the value and potential of remotely piloted aircraft.

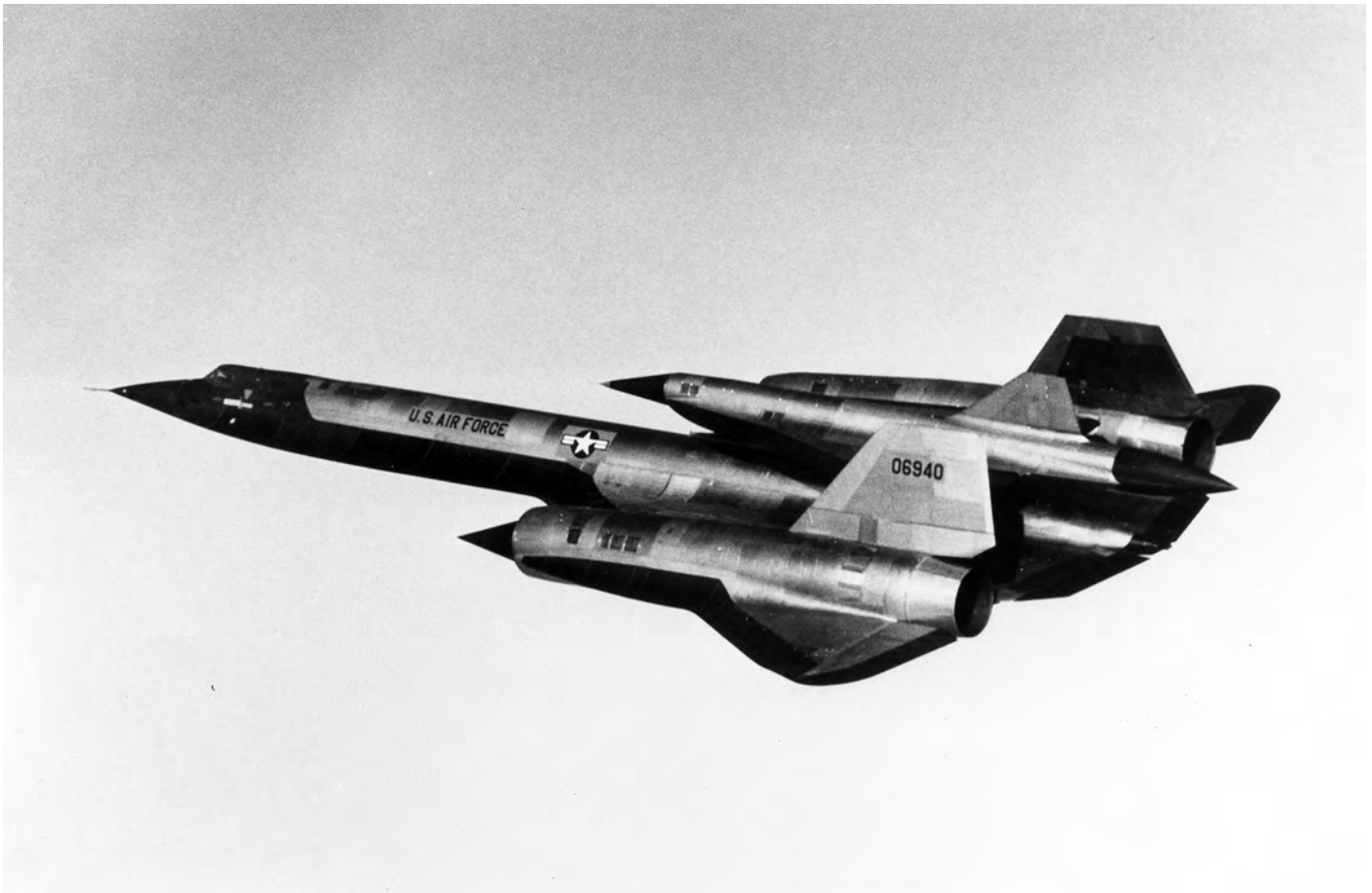
The first was the success of Project UNITED EFFORT. For this mission, the Air Force modified existing Ryan Model 147s to collect radar signals and then sent into air defenses, beaming data back to loitering mother-ships flying at a safe distance. The sixth mission flown by the 4080th Strategic Reconnaissance Wing on February 13, 1966 finally captured the SAMs fusing signal, the most critical piece of intel for successful jamming.¹³ Another drone carrying jamming devices derived from that signal intelligence managed to evade ten missiles, which confirmed the accuracy of the data.¹⁴ The project director deemed the mission as the most significant in electronic reconnaissance since the Second World War, and the Secretary of the Air Force claimed that the intel from the SA-2 paid for the entire drone program by itself.¹⁵ The radar information recovered during that operation was still used during the Gulf War several years later in electronic countermeasures on USAF aircraft.¹⁶

The second major contribution of the 147s was battle damage assessment during Operation Linebacker II. The monsoon season, with its heavy cloud cover, prevented most reconnaissance aircraft from capturing photos

under the clouds. SAC turned to a low-flying version of the Lightning Bugs to photograph valuable BDA photos over North Vietnam. The drones performed so well in the low altitude ISR role they quickly prompted an investment in a better camera and a new production model, the 147S variant.¹⁷ In 1972, low level drone sorties were so reliable that Lightning Bugs flew 93 percent of BDA missions for Operation Linebacker II in December of 1972. 7th Air Force Commander John Vogt Jr. asserted "I know of no other way we could have obtained the information we needed ... [during] the intensive combat activity of the December period."¹⁸

Despite these contributions, the drones were not without their flaws. The technology was inaccurate enough, as the internal guidance systems could not always prevent the drones from being off target by miles. Additionally, the results came at extraordinary costs in money and manpower. Despite no-onboard pilot, each sortie required a DC-130 mothership and a CH-3 recovery team, with adequate protection for both, which cost thousands of dollars. Teledyne-Ryan manufactured over 1000 Lightning Bugs, of which around 200 were lost, costing the Air Force \$1.1 billion dollars, making it the most expensive UAV operation in history by FY2010.¹⁹ Throughout the entire war, 28 different variants of the drones flew 3435 operational sorties, providing miles of film photographs.²⁰

Even with the end of the Vietnam War, the central problem of Cold War reconnaissance remained: How could the United States safely collect intelligence over the Soviet Union? Spy satellites, manned aircraft, and UAVs



The D-21 was originally designed to be launched at supersonic speed from the back of an M-21 carrier aircraft (the M-21 was a modification of the A-12 design). In July 1966, a D-21 collided with its M-21 after release, destroying both and resulting in the death of one of the M-21's two crew members. No further "piggyback" launches were attempted. (U.S. Air Force photo)

continued to vie for budgets and missions in the 1970s, but unmanned aircraft could never breakthrough like the Lightning Bug did. The NRO's seemingly unlimited supply of money with little oversight tended to create expensive and complex UAVs, which did not suit the practical realities of the Cold War era militaries.²¹ The only exception to this was with the Lightning Bug, and thus it should not be surprising that it was the only UAV program that excelled during the Cold War. This did not stop the NRO from funding other attempts at ISR UAVs during the 1970s. One ambitious program was the D-21 Tagboard, an expensive unmanned aircraft launched from the SR-71 Blackbird and meant to spy on the Chinese nuclear program. All D-21 prototypes crashed with no recovery of intelligence and the program was cancelled after President Richard Nixon opened diplomatic relations with Communist China.²² After a clear maturation of satellite technology, the NRO, which had funded Big Safari's Ryan Model 147 modifications, completely divested from drones and its manned reconnaissance operations as well, handing both unmanned and manned assets over to TAC in 1976.²³ This made the NRO an entirely satellite focused organization and ended the endless pool of money for Big Safari. Now all UAV development had to acquire funds from the "white" world of conventional acquisitions.²⁴

Tactical Air Command (TAC) had observed the photos captured with the Lightning Bugs and decided that drones could play a role in tactical reconnaissance as well. TAC established the 11th Tactical Drone Squadron in 1972 and took advantage of post-war drawdowns to absorb SAC's drones and drone support aircraft. Now that TAC had the drones, they needed to find a mission for them. However, without an active war, short-range reconnaissance was no longer in high demand. Instead, reconnaissance needs shifted to Europe and the ever-present threat of the Soviet Union. The weather patterns in Europe, combined with congested skies meant there was no room for drones in the United States main area of concern after Vietnam. Without a proper role, funding issues once again killed the drones' chances, as TAC felt pressures from F-15 and F-16 costs and decided to eliminate the drone program on April 1, 1979.²⁵

With the NRO, SAC, and TAC having decided drones were no longer worth the expense, the United States no longer had any unmanned ISR. However, Israel saw an opportunity for drone employment following their experiences with Egypt's Soviet-supplied SA-2 and SA-3 SAMs, which eroded air assets and placed pilots at risk. In 1970, the Israeli Air Force signed a contract with Tele-dyne-Ryan for another UAV to serve as a decoy. Israel used the BQM-74 Chukar drones to suppress enemy air



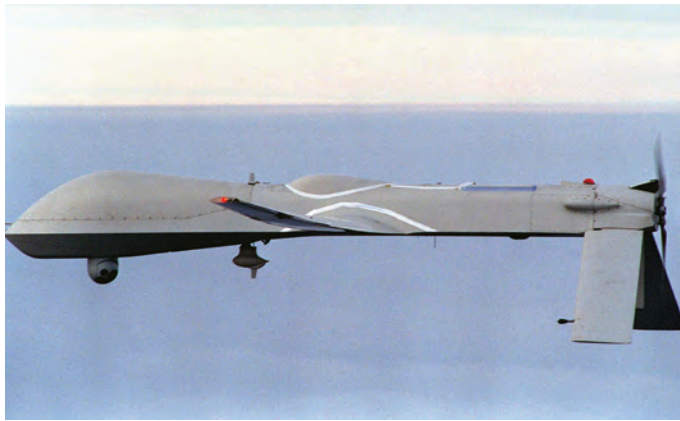
A BQM-74 Chukar target drone launched from the ship's flight deck and acted as a "hostile" anti-ship missile during a training exercise. (*United States Navy photo by Ensign Lyn Niemeyer.*)

defenses during the 1973 Yom Kippur War and again in the 1982 Bekka Valley Strike. Massed Chukar drones appear to be an enemy formation, forcing the Egyptians to turn on their air defense radars, which the Israelis quickly located and destroyed. Two to four drones could destroy up to 25 enemy missiles.²⁶ The United States repeated these tactics against Baghdad during the beginning of the 1991 Gulf War.²⁷ Despite success from close United States Allies in 1973, in 1974, Congress decided to curtail UAV development funding from over eight million to only five million dollars because the Air Force had squandered millions in UAV development that it ultimately never used.²⁸

It is clear that United States UAV efforts had fallen from sight in the years between 1979 and 1991. However, the Air Force continued to entertain developmental contracts yet faced stiff competition and institutional inefficiencies within conventional acquisitions process in a peacetime military.²⁹ High budget developmental concepts such as Compass Arrow, an expensive long-range reconnaissance platform, or the BGM-34A, B, and C models, designed as a strike version of the Lightning Bug, could not justify the enormous costs against subpar performance compared to manned platforms.³⁰ The most common problem that frustrated post-Vietnam UAV development was cost overruns. A persistence myth of affordability perpetuated around UAVs, despite obvious

examples of unrealistic expectations. As an example, a technologically simpler cruise missile came at a price tag of around \$1 million, but the RAND Corporation predicted a cost of only \$200,000 for a more complex attack UAV.³¹ Lack of interservice cooperation exacerbated cost inefficiencies. Services attempted to separately develop UAVs without sharing breakthroughs or budgets.³² The Comptroller General, in a report to Congress on DOD UAVs, also claimed that drones offered a cheaper solution to manned aircraft, as well as claiming that technological developments were not a barrier to further UAV use.³³ This was not the case. Even with advancements in microprocessors, electronic countermeasures could still render the drones useless, and internal navigation systems were still not accurate enough to warrant more trust in unmanned guidance.³⁴ The lack of operational UAVs during the 1970s and 1980s shows that for a peacetime military, the advanced technological developments required for the ambitious drone projects were simply too expensive.

The Comptroller General's report reveals that the simplest reason for the lack of UAVs post-Vietnam was reluctance to replace a manned aircraft with an unmanned one. This "pro pilot bias" frequently was given for why UAVs did not see wider support in the DOD. Career opportunities for drone pilots were limited and the systems were drab.³⁵ The report also states a contributing factor as the lack of knowledge surrounding Lightning



RQ-1 Predator Unmanned Aerial Vehicle (UAV) flies on a simulated Navy aerial reconnaissance flight near the aircraft carrier USS Carl Vinson (CVN 70) off the coast of southern California on Dec. 5, 1995. (USN photo.)

Bug Operations in Vietnam, as at the time those missions were classified.³⁶ Despite this, the report proves that UAVs were rated strongly on core Air Force missions such as decoys, harassment, electronic warfare, and surveillance/reconnaissance.³⁷ This showed that marketing was not the problem, again pointing towards pro pilot bias as the main reason for lack of further investments. The CEO of Teledyne-Ryan answered simply when asked about the difficulty in selling UAVs to the Air Force: “The customers all wear wings.” There was no desire from pilots to invest in pilotless planes.³⁸

Thus, the Air Force moved on without UAVs. The planned uses from the 1970s switched to other aircraft. The Air Force found that integrating the planned support roles for drones was cheaper and simpler than investing in UAVs. Stealth technology, symbolized by the F-117A Nighthawk, minimized risk to the pilot during strikes.³⁹ Electronic jamming pods mounted directly to planes removed the need for a whole separate UAV to carry out electronic warfare.⁴⁰ The reliable U-2 received a synthetic aperture radar, which saw through clouds from high altitudes, removing the need for the niche, low-altitude high-speed Lightning Bug.

Ultimately, the Air Force failed in investing in the future of UAV technology during the 1970s and 1980s. The Air Force held unrealistic expectations, entertained unrealistic proposals, and allowed an environment of general apathy towards unmanned operations which in turn did little to advance drone technology, despite potential benefits in Cold War missions. However, that did not stop overall technological development, and when unmanned aircraft technology matured and grew more affordable, UAVs quickly thrived in their increased roles within the Air Force. ■

“The views expressed in this article are those of the author and do not necessarily reflect the official policy or position of the United States Air Force Academy, the Air Force, the Department of Defense, or the U.S. Government.” USAFA-DF-2025-762

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The USAF and Unmanned Aerospace Vehicles



Northrop-Grumman RQ-4 Global Hawk.

Dik Daso

In the 2026 Special Summer Edition of the *Journal of the Air Force Historical Foundation*, we focus on legacy articles related to the evolution of unmanned military and space flight. Leading the lineup is a 2017 piece by the late AFHF historian, John Kries. John describes how the AFHF was created and what it was designed to do in relation to the USAF and Air University. The article gives us all some important background on the Foundation's early days and demonstrates how close to AFHF's initial charter we remain today. It reminds us all to "Know the Past."

The series of articles related to the history of unmanned aircraft begins with a summary of Army unmanned efforts that began in WW I and expanded during WW II with the drive and encouragement of Henry H. "Hap" Arnold and his staff. The late Jacob Neufeld's piece is an excellent introduction to the birth of the technology that today is taken for granted and is ubiquitous in modern warfare.

A brief vignette describing a test flight of the 1918 "Kettering Bug." The 'FB' or "Liberty Eagle" demonstrates a common issue with early test programs designed by a team of now famous engineers for use on the front lines during WW I—they did not work very well. Then Colonel Henry Arnold (later better known as "Hap") was the War Department project officer for the Army's earliest functional unmanned aerial weapon.

Next are excerpts from an excellent thesis presented to the Faculty of the U.S. Army Command and General Staff College by Maj. Bishane Whitmore—*Evolution of Unmanned Aerial Warfare: A Historical Look at Remote Airpower*. Selections from the thesis fill in the story of the evolution of unmanned flight in the USAF.

The next two articles describe unmanned operations in conflict. First, is the examination of Israel's use of UAVs in regional conflicts in the 1970s and 80s. The second is the personal story of the birth of the Predator (#3034) as an offensive weapon in Afghanistan in 2011. The AFHF recipient of the Gen. Carl "Tooey" Spaatz Award this year, Snake Clark's telling of the story is a lesson in innovation and bold leadership.

While it might be assumed that unmanned space flight is a given, the function of space is similar to the function of unmanned aircraft. In most cases, the satellite is launched and functions are controlled from the ground, like UAVs. But the role that space plays in the successful operation of airpower is essential and often neglected. Donald J. Kutyna's article examining Space Systems in the Persian Gulf War, is a terrific summary of what these "unmanned" programs provide to the atmospheric forces.

Also included is the unique story of "satellite snatching" by USAF C-119 aircraft. This ingenious method of satellite recovery was only the first step in future "drone catching" as in Whitmore's example of CH-3C helicopters recovering Lightning Bug drones during Vietnam.

We are thankful to our newly anointed "AFHF Artist for Life." Rick Herter is the recipient of the President's Medal for Exceptional Service to the Foundation for his contributions to the *Journal* and generosity with his Predator artwork published as the cover of this Special Edition.

The History of the Air Force Historical Foundation: An Extract



John Kreis

Two supporters of the Foundation, Gen. Carl A. "Tooey" Spaatz (left) and Gen. Laurence S. Kuter (right) flank Air Chief Marshal Sir Arthur Tedder in 1943.

The Air Force Historical Foundation originated after World War II from an informal group of senior officers, friends in many cases since the 1920s, who met from time to time to play poker or at other social functions. General Carl Spaatz and Lt. Gen. Ira Eaker were key proponents of an organization to preserve and promote the history and heritage of the new United States Air Force and of aviation in general. Both men were icons who had the respect, stature, and reputation necessary to support an organization created to promote awareness of air power history. One person influential in forming the concept for the Foundation was Lt. Col. Arthur J. Larsen, slated to become librarian at a new Air Force Academy, if one were ever to be organized. Larsen recognized that some impetus from outside the Air Force was needed in conjunction with the Service's own efforts if the history of air power were to be developed as a distinct academic discipline useful for the Air Force.

Early in the 1950s, Larsen wrote several staff studies recommending creation of an independent but quasi-official Air Force Historical Foundation similar to the Naval Historical Foundation; one model Larsen used was the relationship between the federal government and the Smithsonian Institution. At the time, the Air Force had no historian or history office, and whatever historical work was done took place at the Air University at Maxwell AFB, Alabama. The Air University staff, however, had much to do, and had to use their limited resources to prepare teaching materials from scratch for the Service schools there. At the middle of the Twentieth Century, after a decades-long struggle to gain independence and develop aviation technology, their new Service was under attack. Of particular concern were the post-war budget battles with the other Services and restrictions placed upon the use of air power in the Korean conflict. Casting about for an intellectual basis for defending the potential of air power, these men found that there was almost no literature examining and recording the Army Air Forces' accomplishments during the European and Pacific wars. There were no published works on air operations or air warfare available for use by the Service schools at Maxwell AFB; Craven's and Cate's seven volume *The Army Air Forces in World War II* was not published until 1955. So desperate for material were the developers of the new Air Force ROTC program that they had to write and mimeograph by hand the teaching material for instructors at the various detachments, or locate outside contractors to prepare textbooks.

Sensitive particularly to the attacks on the concept of strategic bombing, which most of these men had been instrumental in developing during the 1930s, and carrying into operational execution during the recent war, Spaatz, Eaker, and their colleagues set out to start an organization that could fill some of the historical requirements that the Service needed. Two early supporters were Lt. Gen. Laurence S. Kuter, the Air Force's Director of Personnel, and Maj. Gen.



Gen. William F. McKee, who helped guide approval through the Air Council.

William F. McKee, Assistant Vice Chief of Staff, General Kuter, as Acting Chairman of the Air Council, guided the approval action for the Foundation through the Council, where it was approved on December 2, 1952. Kuter and McKee then met with the Chief of Staff, General Hoyt S. Vandenberg, explaining to him the need for such a Foundation and of the Air Council's action. General Vandenberg approved the establishment of the Air Force Historical Foundation on January 5, 1953. In establishing the Foundation, General Vandenberg clearly intended it to be a quasi-official, integral part of his new Service, and an agency that could provide material support in defining the Air Force's mission and organization in the absence of a formal history function in the Service. These tasks applied

John F. Kreis, a retired U.S. Air Force officer, is a historian and military and defense analyst as well as a Senior Fellow of the Air Force Historical Foundation. He holds a B.A. in economics from Willamette University, Salem, Oregon, and an M.A. in medieval history from the University of Delaware. He is the author of Air Warfare and Air Base Air Defense, 1914-1973, as well as numerous articles on air power history and operations in addition to being the General Editor for Piercing the Fog: Intelligence and Army Air Forces Operations in World War II. This is an extract from a history of the Foundation that Mr. Kreis is completing.

particularly to the need for some organization that could promote the USAF's interests in public and in ways that the Service itself could not.

The Foundation was incorporated in the District of Columbia. Specifically, the purpose was to supplement the official Air Force programs for commemoration of its history and outstanding members. There was to be a close relationship between the Foundation and the historical activities at the Air University.

Article II of the Constitution of the Foundation adopted on May 27, 1953 said that the Foundation was to be:

[A]n independent, incorporated body, existing by and with the sanction of law as a non-profit organization, [it] shall be intimately associated with, and will at all times coordinate its program with the United States Air Force.

The close association between the Air Force and the Foundation can be seen in the committee of active duty and retired Air Force personnel that General Vandenberg appointed to prepare the constitution and articles of incorporation: General (Ret.) Carl Spaatz, Maj. Gen. (Ret.) H. Conger Pratt, and Brig. Gen. (Ret.) T. DeWitt Milling.

The group completed its work by May 27, 1953, and twenty-four original Trustees were appointed. The constitution specified that the most recently retired CSAF would be the *ex-officio* president of the Foundation, and this was General Spaatz, who served until June 30, 1953 when General Vandenberg took over. On Vandenberg's untimely death in 1954, the Trustees elected Maj. Gen. Benjamin D. Foulois to the post, which he held for twelve years. Foulois had been Chief of Air Service, American Expeditionary Forces in France during World War I; later he was Chief of the Air Corps from 1931 to 1935. Foulois was very close to Carl Spaatz and Lt. Gen. Ira Eaker, both of whom had worked with him during the 1920s and 1930s.

The other original officers of the Foundation were First Vice President Lt. Gen. (Ret.) Idwal Edwards, Second Vice President C. R. Smith, Third Vice President Gill Robb Wilson, and Treasurer Maj. Gen. (Ret.) St. Clair Streett. The Foundation's first Secretary was the Assistant Vice Chief of Staff, Maj. Gen. Robert W. Burns, who also served as the Air Force project officer. By the end of the first year, the Foundation had 2,000 members, with 300 contributing military organizations, and General Burns had raised \$35,000.

The Foundation moved its headquarters to Maxwell AFB in September, and hired a salaried administrator, Brig. Gen. Hume Peabody (Ret.), as Executive Director. At the same time, and in line with the Air Force's charter of the Foundation, the Commander of Air University became the Foundation's *ex-officio* secretary. Peabody was succeeded in short order by Maj. Gen. (Ret.) Orvil A. Anderson, who had been relieved as Commander of AU by President Harry Truman after making some rather inflammatory remarks about how air power was not being used in the war in Korea in 1950. ■

Early Experimental Guided Missiles





Jacob Neufeld

(Overleaf) The JB-10 on its trailer.

(Right) Lt. Col. Henry H. "Hap" Arnold.

THE AVIATION SECTION OF THE SIGNAL CORPS FIRST BECAME INVOLVED WITH MISSILES SHORTLY BEFORE AMERICA'S ENTRY INTO WORLD WAR I WHEN IT SPONSORED CHARLES F. KETTERING'S RESEARCH ON A REMOTELY CONTROLLED AIRCRAFT



The Aviation Section of the Signal Corps* first became involved with missiles shortly before America's entry into World War I when it sponsored Charles F. Kettering's research on a remotely controlled aircraft dubbed the "Bug." A renowned engineer, Kettering collaborated on the project with several associates, including Orville Wright, Elmer A. Sperry, Edwin S. Votey, and Childe H. Wills. Also called a flying bomb, an

Excerpted from Jacob Neufeld's *The Development of Ballistic Missiles in the United States Air Force, 1945-1960* (Washington, D.C.: Office of Air Force History, 1990), pages 8 to 13, this essay aims to provide background to more advanced laser-guided bombs and laser guns.

* Established on August 1, 1907, the Aeronautical Division (Signal Corps) became the Aviation Section (Signal Corps) on July 18, 1914. The Air Service was created in May 1918.

aerial torpedo, and Project Liberty Eagle, the small craft was built by the Dayton Metal Products Company. It performed well enough after several test flights for the Air Service to order 100 of the pilotless aircraft in October 1918. Col. Henry H. "Hap" Arnold, another of those involved in the project, wanted to persuade Gen. John J. Pershing, Commander of the American Expeditionary Forces, to organize tactical missile units in Europe. Unfortunately for missile enthusiasts, Arnold became ill and before he could see General Pershing the war had ended. With the cessation of hostilities, production was canceled and the project abandoned. The Navy, which had started a similar program in 1916, continued its research until about 1919, but then it too scrapped the work.¹

In 1923, the Chief of the Air Service Engineering Division at McCook Field, Ohio, recommended adapting radio controls to the aerial torpedo and the following year obtained support for the

Jacob "Jack" Neufeld is the editor of Air Power History and a consultant. Before his retirement from federal civil service in 2006, he was Director of the Air Force Historical Studies Office. During his forty-year career, he held virtually every senior position in the Office of Air Force History from staff historian to branch chief to senior historian to general editor. From 1992 to 1994, he was the Director of the Center for Air Force History. Neufeld earned BA and MA degrees in history at New York University and did doctoral studies at the University of Massachusetts, Amherst. Commissioned in the U.S. Army, he served with the Corps of Engineers from 1964-1966. He has written and edited numerous works in military history and the history of technology, including Development of Ballistic Missiles in the United States Air Force, 1945-1960. He also wrote several biographical studies of General Bernard A. Schriever, the "father of the USAF missiles and space programs." Neufeld was an adjunct professor of history at the University of Maryland, Montgomery (Md.) College, and American Military University.



The Kettering Aerial Torpedo, on display at the National Museum of the U.S. Air Force.

DESPITE SUCH SIGNAL ACHIEVEMENTS AS PRESET FLIGHTS TO A DISTANCE OF 30 MILES AND RADIO-CONTROLLED FLIGHTS OF UP TO 90 MILES, THE PROJECT WAS CANCELED A SECOND TIME FOR A LACK OF FUNDS



project. Despite such signal achievements as preset flights to a distance of 30 miles and radio-controlled flights of up to 90 miles, the project was canceled a second time for a lack of funds. It was revived in 1928, as part of a scheme to adapt remote control and guidance, with various-sized bombs, to commercial aircraft and to file the data for future reference in the event of war. After a promising start,

however, the effort foundered in 1932 and then lay dormant until the eve of World War II.

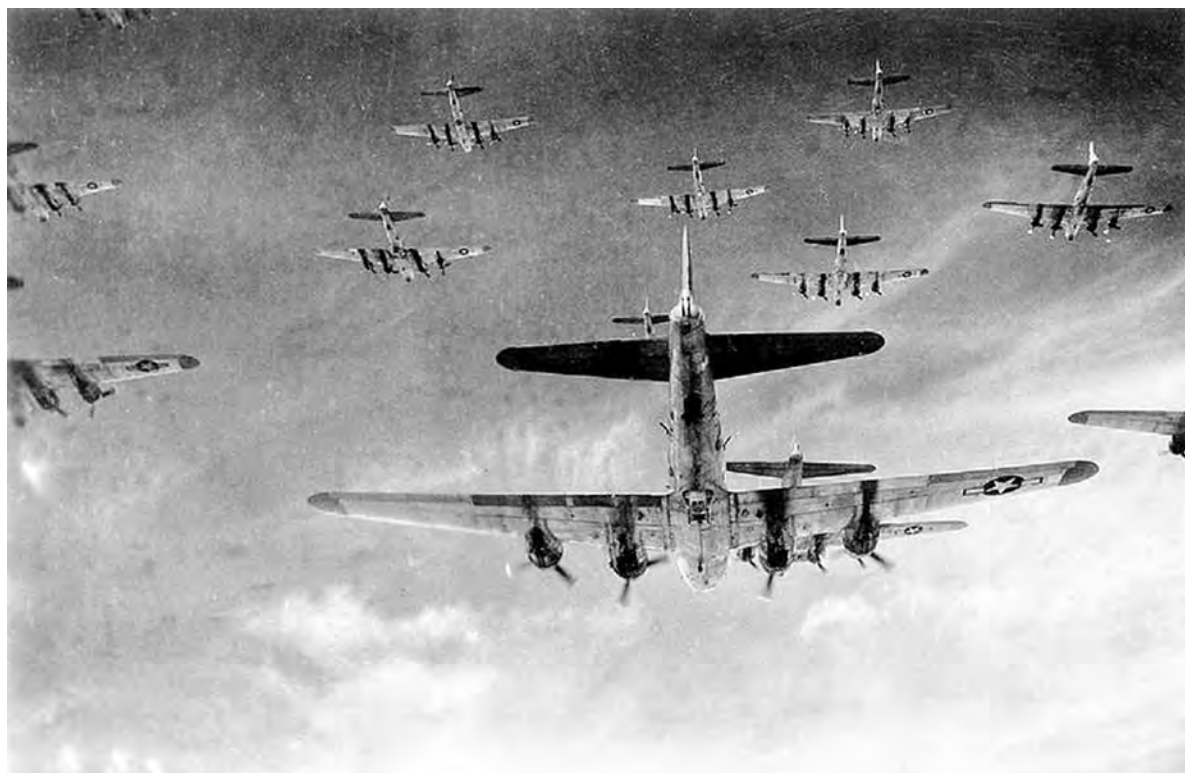
Interest was next renewed with the August 1937 demonstration of a completely automatic radio-controlled flight and landing of an aircraft.[†] This event prompted Maj. Gen. Oscar Westover, Chief of the Air Corps,[‡] to establish a requirement for an unmanned aircraft with a range between 20 and 50 miles, carrying 200 to 300 pounds of explosives and capable of striking a two square-mile target. A design competition was initiated in April 1939, but failed to elicit an acceptable proposal. Nonetheless, the effort resumed in February 1940, with even more demanding specifications for the aircraft to fly up to 100 miles and strike within one-half mile of a target.

This phase culminated in April 1941, when Charles Kettering, now a General Motors Corporation executive, won a contract to fabricate ten aerial torpedoes. Designated as Guided Missile A-1 (GMA-1), or "controllable bomb, power-driven," the project was supervised by Col. George V. Holloman, Chief of Air Materiel Command's Special Weapons Unit at Wright Field, Ohio.²

[†] Capt. George V. Holloman, Capt. Carl J. Crane, and Raymond K. Stout developed the automatic landing system and flew aboard the test aircraft on its historic flight.

[‡] The Air Corps was established on July 2, 1926.

B-17s like these, although war-weary and obsolete were used as remote-control bombs.



A MORE PROMISING APPROACH, BEGUN IN 1944, INVOLVED THE USE OF OBSOLETE B-17 AND B-24 AIRCRAFT AS POWER-DRIVEN BOMBS, NICKNAMED WAR WEARY

The new Bug was expected to carry between 2,000 and 4,000 pounds of explosives over a pre-selected 20-mile range and then dive into its target. The Special Weapons Unit grappled with the requirement for about two years without appreciable success and was especially stymied by the craft's inaccuracy. Moreover, during the course of the war, the Bug's capabilities in terms of speed, range, and bomb load seemed increasingly inadequate as the capabilities of standard combat aircraft increased. Consequently, in August 1943, the AAF** considered other small, power-driven pilotless aircraft for special bombing missions, including the Fleetwings XQB-1 and XQB-2 and the Fairchild XQB-3. But these conventional aircraft also proved inadequate because they were expensive, needed clear visibility, fighter protection, and highly skilled crews.³

A more promising approach, begun in 1944, involved the use of obsolete B-17 and B-24 aircraft as power-driven bombs. Nicknamed War Weary, the project employed a large number of these aircraft. On a typical mission, the pilot would take off in an airplane laden with about 20,000 pounds of explosives, set a course, and then bail out. (Navy Lt. Joseph P. Kennedy, Jr., President John F. Kennedy's older brother, died on such a mission when the bomb load exploded prematurely.) War Weary aircraft carried a predetermined fuel load to stop the engines over the target. The bombers could also be controlled by accompanying "director" aircraft or from the ground. Like the Bug, these experimental aircraft were beset by serious problems in accuracy and therefore proved most useful against large area targets.⁴

** The AAF was created on June 20, 1941.

Another category of missiles developed during the war included the air-launched glide bombs (GB), which had numerical designations from 1 to 15. Interest in these weapons stemmed from the work done by the British, and from General Arnold's 1941 directive to the AAF to develop them. The glide bombs were simply standard 1,000-, 2,000-, and 4,000-pound bombs fitted with wings and gyrostabilizers. The GB-1, for example, was a general-purpose bomb to which was attached a simple monoplane structure, including a wing assembly with twin booms extending rearward to a horizontal surface with two square fins and a movable elevator. Most glide bombs were preset on a course and could not be controlled after being released from their aircraft.

Although these missiles experienced problems in achieving acceptable accuracies, the AAF was determined to prepare them for combat. The effort began in October 1942, and by the end of 1943 the GB-1 and its B-17 launch aircraft were declared ready. The initial combat mission, however, was not flown until March 25, 1944, when a squadron of 58 B-17s, each carrying two GB-1s, attacked Cologne. Fewer than half the bombs hit their intended targets, and the Eighth Air Force, noting that manned bombers could do better, gave up on the project. At war's end the AAF had 200 glide bombs in storage, but did not plan any further research with them.⁵

A variant of the GB series was the air-launched glide torpedo, which involved the AAF and Navy in a dispute over which service should develop it. The AAF also experimented with the radio-controlled and television-guided GB-8 missile. While the AAF encountered accuracy problems with the GB-8, the Navy used a similar missile, called the Bat, with some success. The AAF also experimented with a



The VB-1 Azon.

**THE AAF
ALSO EXPER-
IMENTED
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LARGER
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AND RADIO-
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...WITH
GENERALLY
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ING RESULTS**

larger bomb, the television- and radio-guided GB-4. Between July and September 1944, the GB-4 was launched against German U-boat pens at Le Havre, France, with generally disappointing results.⁶

Another category, called high-angle or vertical bombs (VB series), also consisted of standard-size bombs equipped with special controls. Developed by the National Defense Research Committee, the apparatus was mounted in a square-shaped tail at the rear of the bomb. Also included on the tail were a flare, radio receiver, antenna, gyrostabilizer, and rudders. Launched from B-17 aircraft, the vertical bombs were controlled through part of their earthward dive by the bombardier. The most useful of these weapons-and the only one used in combat in more than experimental quantity-was the Azon (VB-1) missile. Azon (short for azimuth only) was a 1,000-pounder that could be controlled to the right and left of a target and, therefore, effective in attacking roads, tunnels, bridges, and railways. The first Azon model appeared in 1943, and 150 of the missiles were initially ordered for testing. Test results proved so encouraging that the AAF placed quantity orders for the missile.

In early 1944, a specially trained squadron attached to the Fifteenth Air Force in Italy unveiled the VB-1 in attacking the Brenner Pass and river locks on the Danube. Despite some early successes, Azon performed erratically in subsequent missions and saw only limited action in Europe during the

balance of the war. The weapon proved more successful, however, in the China-Burma-India Theater. In 1944 and 1945 the 7th Bombardment Group used Azon missiles to destroy nearly all of the bridges in Japanese-held Burma. During a two-month period, ten Azon-equipped B-17s destroyed 27 bridges with an expenditure of 459 missiles and had direct hits with 10 to 15 percent of the weapons⁷. At the end of the war there were 12,000 Azons on hand and another 10,000 on order. Nonetheless, the AAF abandoned Azon when it achieved better test results with more technologically advanced vertical bombs.⁸

Even as the AAF flew the Azon, the Massachusetts Institute of Technology (MIT) was devising a more advanced missile called the Razon (for range and azimuth). This 2,000-pound vertical bomb entered development in 1942, but was not ready for combat before the war ended. At that time the service had a stockpile of 3,000 Razon bombs.* Other bombs in the VB series included the Felix (VB-6), a heat-seeking missile, and the Roc, a television-guided bomb with radio-controlled variants. The AAF also fitted television guidance to the 12,000-pound British Tallboy bomb; called the VB-13, it was used to attack German submarine pens.⁹

The most important category of pilotless aircraft developed by the AAF during the Second World War was the jet-propelled missile. In July 1944, one month after Germany began launching its V-1 Buzz Bombs against England, Materiel Command obtained parts of the weapon from the battlefields and within two weeks succeeded in copying the V-1's pulse jet engine. By September 8, less than sixty days after they had begun, Wright Field and Republic Aviation engineers had produced a copy of the German V-1 for testing.

Although the V-1 had caused a sensation when it was first launched by the Germans, the AAF and Royal Air Force (RAF) quickly learned to master the missile with their fighter aircraft and antiaircraft guns. Gen. Carl A. Spaatz, Commanding General of the United States Strategic Air Forces in Europe, and Gen. Ira C. Eaker, Commanding General, Mediterranean Allied Air Forces, foresaw "no immediate requirement for the use of pilotless aircraft."¹⁰ Dr. Vannevar Bush, Director of the Office of Scientific Research and Development, also opposed developing an American version of the V-1, because he considered it uneconomical. Among those favoring development were General Arnold and Robert A. Lovett, the Assistant Secretary of War for Air. Lovett believed that the AAF should match the enemy, if only to counter the V-1's potential for damage.¹¹

* In 1946 the Air Proving Ground Command at Eglin Field, Florida, ran extensive tests on Razon, contemplating using the missile aboard all-weather bombers. Nothing materialized, however, until the Korean War, when the Far East Air Forces ordered and used the Tarzon, a Tallboy-Razon combination. [Mary R. Self, *History of the Development of Guided Missiles, 1946-1950* (Wright-Patterson AFB, Dec 1951), pp 32-34.]

BY AUGUST 1945 THE AAF HAD TEST-LAUNCHED MORE THAN 200 OF THE MISSILES AND BY MID-SEPTEMBER, ... HAD ACCEPTED 1,391 JB-2s



The JB-2 in flight.



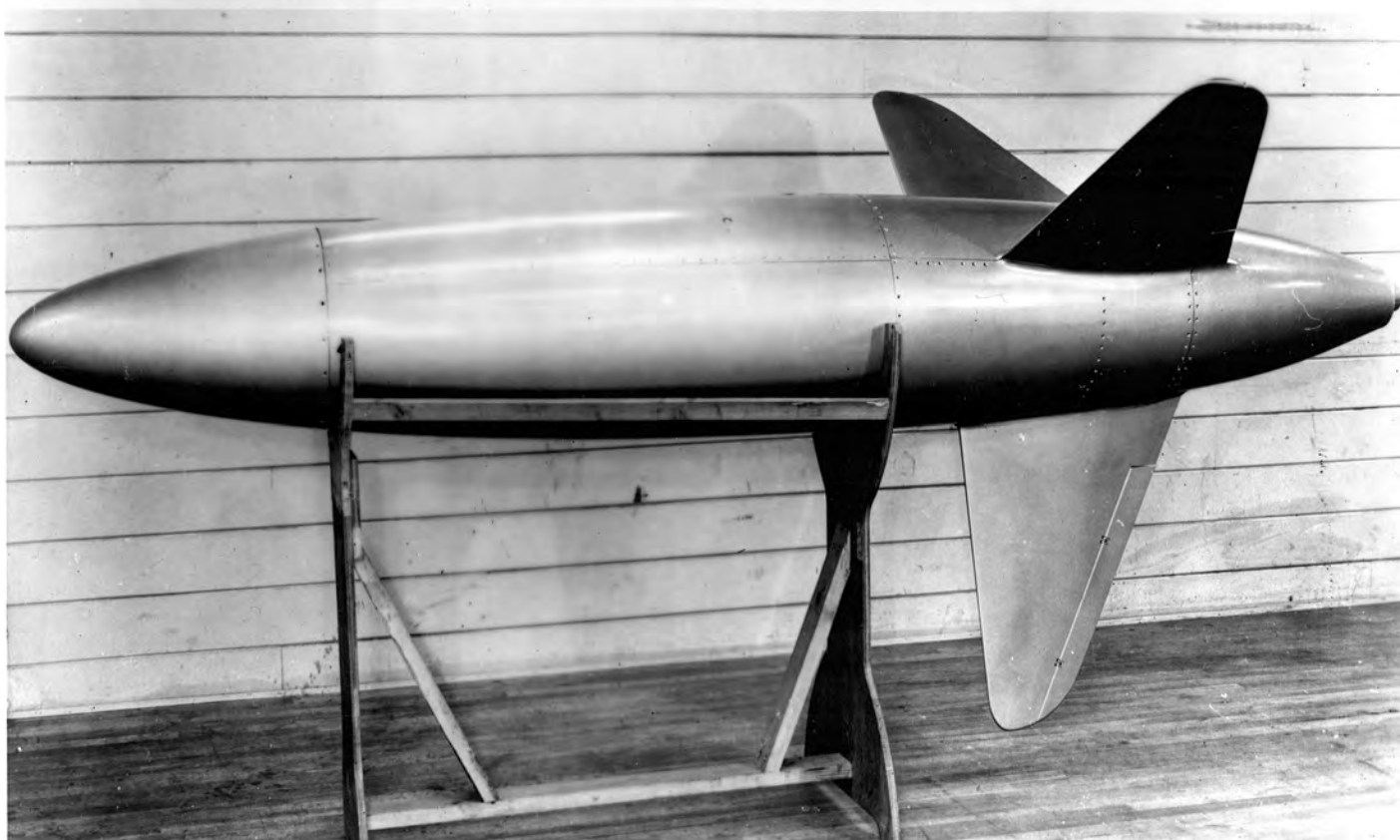
Called the JB-2 (for jet bomb), the American copy of the V-1 experienced launch difficulties and problems with inferior components and unreliable autopilots, but the AAF was satisfied enough to

order the missile into mass production. Lt. Gen. Barney M. Giles, AAF Chief of Air Staff, wanted to produce JB-2s in sufficient quantity to permit launching 500 missiles per day by February 1945. The War Department General Staff approved JB-2 production at a reduced level of 5,000 missiles. After applying a number of general improvements, the AAF contracted with the Ford Motor Company for the engine and the Willys Overland Company for the airframe.

Although the JB-2 was not ready in time for employment against its inventors,* the AAF made good use of the missile in testing and training of personnel. By August 1945 the AAF had test-launched more than 200 of the missiles and by mid-September, when the contracts were terminated, had accepted 1,391 JB-2s. Development continued until 1946, when emphasis shifted to the Snark and Navaho missiles.¹²

Besides copying the V-1, the AAF also contracted with Northrop Aircraft to develop a new jet-propelled missile called the JB-1. This was a flying wing structure beset by shortcomings similar to those of the V-1, including low speed, small payload, limited range, and poor accuracy. First launched in December 1944, the JB-1 encountered an incompatibility problem between its airframe and engine.

* Shortly after the end of the war in Europe, the War Department considered launching German V-1 and V-2 missiles against Japan. [Ltr, Gen Marshall to Gen Eisenhower, no subj, May 6, 1945. RG 341, AAG File (TS), NA.]



The JB-3.

This difficulty led to several modifications and a redesignation as the JB-10. The new version, however, proved little better than the original, and the service dropped the project altogether in March 1946.

In addition to the JB-10, only the JB-3 air-to-air missile remained under development at the end of the war. Research on the JB-3 was performed by Hughes Aircraft and the National Advisory Committee for Aeronautics.¹³ ■

NOTES

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The Liberty Eagle—The First Army Unmanned Aerial Vehicle



Historic Kettering Aerial Torpedo "Bug" image. In 1917 Charles F. Kettering of Dayton, Ohio, invented the unmanned Kettering Aerial Torpedo, nicknamed the "Bug." Launched from a four-wheeled dolly that ran down a portable track, the Bug's system of internal pre-set pneumatic and electrical controls stabilized and guided it toward a target. (Ken LaRock/NMUSAF)

Dik Daso

An eager crowd of Army brass was seated in grand stands at a secluded airfield near Dayton. They were to witness the flight test of a new weapon—a tiny, pilotless, biplane which had the potential to strike the enemy by air without danger to pilots or soldiers. As the miniature craft lifted into the air the development team began to smile and those in attendance began to wonder how this new missile could be used in fighting the Great War which was devouring Europe. Just then, the aircraft pivoted off its course, swooped and dove, and then headed straight toward the reviewing stands. Fortunately, it crashed landed a few hundred feet from the invited guests—much to the embarrassment of the once-confident development team.

One of the disheartened developers was Colonel Henry H. Arnold, Deputy Director of the Aviation Division of the Signal Corps. Arnold's task force of civilian scientists and military project managers had produced the Army's first guided missile. It was called the Liberty Eagle but unofficially was referred to as "FB," which stood for flying bomb, and the "Kettering Bug," after the principal designer.

The unpowered machine was a beautiful wood-crafted, mini-biplane. Early versions had been crafted from paper maché. It housed a two-stroke, Ford engine and carried a 225 pound warhead. The Bug had no wheels and was launched from a wagon-like contraption which ran on a long section of portable track. The engine was cranked at one end of the track which was pointed directly at the intended target. When the engine was fully revved, the mechanical counter was engaged and the Bug was released. When it reached flying speed, it lifted off and flew straight ahead toward the target, climbing to a preset altitude which was controlled by a supersensitive aneroid barometer. When the Bug reached its altitude, the barometer sent signals to small flight controls which were moved by a system of cranks and a bellows from a player piano for altitude control. A gyro helped maintain the stability of the craft, the barometer helped maintain altitude, but only the design of the wings assured directional stability. Kettering designed the Bug to fly straight ahead until a mechanical counter had sensed a calculated number of engine rotations required to carry the weapon to the intended target. When the preset number of revolutions was reached, a cam fell into place and the wings folded. The Bug pointed to the ground, looking much like a diving falcon swooping down on its prey. Unfortunately, the Bug was not as deadly, nor as fast, as a falcon. After the first ill-fated test, lateral controls were added which rectified the instability problem caused by over-dependence upon the dihedral—the slightly upward angle of the wing—for lateral stability.

On the Liberty Eagle team were Orville Wright; Elmer Sperry—who spearheaded the Navy's aerial torpedo project a few months earlier; Robert Millikan—soon to be president of Caltech and a future Nobel Laureate; and Charles "Boss" Kettering—the primary engineer. Most test flights were accomplished at a remote test field in the Florida panhandle on



The Liberty Eagle Team. (Photo courtesy of NMUSAF)

the wide open sand dunes which existed in that day. As important as the development of the machine was the cultivation of the members of the team, particularly Millikan, who would play a crucial scientific role for the air arm in the 1930s and again during the Second World War. Arnold never forgot his experiences in production, administration, scientific experimentation, or testing. Nor did he forget the men who had helped design and build the missile.

Col. Arnold was sent to Europe with the device in an effort to persuade Gen. John J. Pershing to use it in the waning days of WW I. Despite several setbacks, Arnold finally made it to the Western Front during November 1918, only a few days before the armistice went into effect. Because the weather was so terrible, however, the Army's secret weapon flew no combat missions. The project, along with most other weapons projects, was terminated shortly thereafter. But the idea of the Liberty Eagle project was not eliminated forever.

Dik Daso serves as the Executive Director of the Air Force Historical Foundation. As the senior administrator for the Foundation, he is responsible for day-to-day operations and support for the Executive staff, members, and corporate partners. Daso taught at the University of South Carolina where his courses focused on the history of technology and science. Lt. Col. Daso retired from the USAF in 2001 and then served at the Smithsonian National Air and Space Museum as the curator of modern military aircraft until retiring from that post in 2012. Daso flew T-38, RF-4C, and F-15 aircraft during his service. He was assigned to the Air Force Scientific Advisory Board during the visionary New World Vistas S&T study in 1995 and also held the position of Chief, Air Force Doctrine, as a member of the Air Staff in the Pentagon. He earned his B.S. from the USAF Academy in 1981 and his doctorate in history from the University of South Carolina in 1996. He has authored several books and contributed chapters including, U.S. Air Force: A Complete History (Hugh Lauter Levin Associates, Inc., 2006), Doolittle: Aerospace Visionary (Brassey's US, 2003), and Hap Arnold and the Evolution of American Airpower (Smithsonian Institution Press, 2001.)



Tinkering with the Liberty Eagle. (Photo courtesy of NMUSAF)

The McCook Field Radio Laboratory was established in 1919, and one of its greatest achievements was the development of the radio beacon navigational system. This system allowed pilots to navigate at night or in bad weather based on radio signals transmitted from stations on the ground to the air. The McCook Field "radio dog" was a radio-controlled car that resembled a small tank and was controlled from the air. Although it was little more than a novelty, the principles learned from it were valuable in the development of radio-controlled unmanned aircraft and guided missiles. The Radio Laboratory tested this little tank out by driving it around downtown Dayton during busy traffic in 1923. It should not surprise anyone that combining technology used in the Bug and combining it with that of the radio dog would eventually lead to programs pursued in WW II.

In the fall of 1939, Arnold wrote his old friend Charles Kettering, now vice-president of General Motors, wanting to develop glide bombs to be used in the event of war. Arnold wanted a device that could be used by the hundreds which might keep his pilots away from enemy flak barrages. Even though strategic airpower doctrine centered on precision, daylight, high-altitude bombing, Arnold was willing to sacrifice some level of bombing accuracy to minimize potential danger to his airmen. Initially, Arnold considered reviving the Bug. About fifty were in storage from the First World War and a mass production plan already existed. The idea was finally dropped in 1942 because of the weapon's relatively short 200-mile range.

Today's Air Force depends upon the technology of precision guided munitions which have their roots in the Liberty Eagle, developed and tested during the First World War. ■



The Radio Dog. (Photo courtesy of NMUSAF)

Air Force UAS Development During the Cold War



A pair of jets, one of which is a drone, wait for takeoff. The pilotless QF-80 in the foreground will be flown off the runway by a remote control station at the side of the runway. In the picture is the elevator controller and not seen is a rudder controller who operates a similar control box that keeps the aircraft lined up with the center of the runway. The director aircraft (background) will assume control during the climb out of the pattern.

Bishane A. Whitmore

The Second World War's abrupt end with the use of two atomic bombs on the Japanese cities of Hiroshima and Nagasaki pulled back the curtain to a new and destructive way of war.¹ Despite the Japanese surrendering aboard the battleship USS *Missouri*, many Americans questioned how much longer the United States would sacrifice lives and resources for overseas wars. The Soviet Union had emerged victorious against Germany, but at a cost of nearly 25 million Soviet military and civilian lives.² The major world powers were once again being required to pick up the pieces of large-scale conflicts. The aftermath, however, led to the uneasy time in American history known as "the Cold War," a time during which the United States and the Soviet Union directly competed for hegemony. The power struggle formed on many fronts including: the political, economic, military, and even technological. However, the sentiment of lives being put at risk echoed throughout the Cold War period.

In the United States, the new president, Harry Truman, hoped for some type of peace with the Soviet Union. He offered to extend the Marshall Plan, which gave supplies and aid to European nations as a show of goodwill, modernization, and economic prosperity. The Soviets refused, since they viewed the plan as a sign of weakness and prying by the Americans.³

Militarily, the United States had expanded at exponential rates to deal with the German and Japanese threats. Although the military created bases and facilities at an expeditious rate during World War II, the military found itself questioning the appropriate peacetime force structure and fiscal basis. Arnold commanded the Army Air Forces with proven and experienced officers under his lead, such as Generals Carl "Tooe" Spaatz, Ira Eaker, Lauris Norstad, and Hoyt Vandenberg.⁴

The Army Air Forces established a postwar goal of expanding to 550,000 personnel, 70 groups of varying aircraft types, 27 Air National Guard groups, and 34 reserve groups. The Army had a limited budget so growth in the AAF meant sacrifices in other ground unit capabilities. According to one airpower historian, the goal of 70 groups was appropriate for peacetime but woefully inadequate for a time of war. The number was decided based on what was essential for global demands and in preparation for the next war. Postwar demobilization after the Japanese surrender restricted military budgets and, ultimately, technological development including in what eventually became the U.S. Air Force.⁵

Fiscal challenges have reverberated throughout U.S. military history, not just that of the U.S. Air Force. The reduction in military funding during interwar periods has routinely led to the inability to fully harness technological advancements. The capability requirements are not as pronounced during peacetime, but during conventional peer or near-peer enemy conflicts, the lack in systems development becomes painfully obvious.

The highest levels of government held discussions about an independent Air Force; the Navy, in particular—which sought continued fiscal relevance—did not want a separate service for airpower. In 1945, President Truman stated: “Airpower has been developed to a point where its responsibilities are equal to those of land and sea power, and its contribution to our strategic planning is great. Parity for airpower can be achieved in one department or in three, but not two. As between one department and three, the former is infinitely more preferred.”⁶

The Declaration of Policy of the National Security Act of 1947 provided for the establishment of the Air Force as a separate and distinct branch of the military. Its creation provided consistent oversight and authorities for Air Force leadership, starting on the official creation date of September 18, 1947. W. Stuart Symington was the first secretary of the Air Force, and the first chief of staff was General Spaatz. Agreements between the Air Force and Army, such as the Joint Army and Air Force Adjustment Regulation 5-10-1, dictated that the Army could operate fixed-wing aircraft of less than 2,500 pounds and rotary aircraft weighing less than 4,000 pounds.⁷ The Air Force branching off into a separate service was important for many reasons relating to unmanned aircraft development. Not only did it provide advocacy and an independent financial pot to pull from but it also added an avenue for continued work in UAS technology. This proved especially true now that there was a branch of the service whose sole purpose was to find ways to create and maintain air superiority.

In 1948, President Truman and Secretary of Defense James Forrestal gave the Air Force responsibility for providing “close combat and logistical support to the Army, to include airlift, support, resupply of airborne operations, aerial photography, tactical reconnaissance, and interdiction of enemy land power and communication.”⁸ Unmanned aircraft in the late 1940s into the early 1950s had transformed from quasi-cruise missiles to target decoys, with the possibility for aerial reconnaissance. Aerial reconnaissance, first seen in World War I at conflicts such as the first Battle at the Marne and the Battle of the Somme, proved its capacity to develop target sets and intelligence to manipulate the battlefield. To create appropriate reconnaissance drones, their navigational accuracy needed to be enhanced and the aircraft that carried the surveillance payloads needed to be reusable.⁹

Major Bishane A. Whitmore wrote this Masters Thesis while studying at the U.S. Army Command and General Staff College. This represents the second half of the thesis. Some minor editing and re-formatting has been carried out for publishing. Originally titled Evolution of Unmanned Aerial Warfare: A Historical Look at Remote Airpower—A Case Study in Innovation, it was presented to the faculty in 2016.

Rise of the Drone Group

A little-known piece of military history involves the existence of the 3205th Drone Group. The unit’s mission was to provide drone aircraft as targets for all branches of the military. Established on June 1, 1951, the group grew to include six subordinate squadrons, the 3205th Drone Squadron, the 3205th Maintenance and Supply Squadron, the 3215th Drone Squadron, and the 3205th Air Base Squadron were all located at Duke Field (Auxiliary No. 3), Eglin Air Force Base, Florida. The 3225th Drone Squadron was located at Holloman Air Force Base, New Mexico, and the 3235th Drone Group was located at Point Mugu, California.¹⁰

The 3205th Drone Group flew a mixture of QB-17 drones called “Roughnecks” and QF-80 drones. It maintained approximately 60 QB-17s and six QF-80 aircraft. The letter “Q” designated the unmanned versions of aircraft. Although the group’s flying-hour program authorized 8,700 hours of flight time every six months, the unit sometimes went upward of 8,910 hours. One of the unit’s major issues was maintenance and the procurement of parts. Aircraft availability rates hovered around 77 percent due to the failure to acquire appropriate parts on time.¹¹

Basic QB-17 operations required four pilots: the airborne remote control or beeper pilot; his chauffeur, the director pilot; and two ground control pilots, known as a “rudder” controller and an “elevator” controller. Additionally, each mission consisted of 15 additional pilots and 18 enlisted professionals as support, and two pilot controllers for the radar control station to ensure safety and accuracy. In essence, one unmanned mission required four pilots and 33 support personnel for support.¹² The notion of the time was that “pilotless” aircraft produced manpower savings, yet in most cases, they were more manpower intensive than manned aircraft.

Manning levels for the 3205th Drone Group fluctuated based on standard manpower rotations but routinely were not filled to authorized requirements. On June 30, 1954, the group had 144 officers authorized to 127 assigned (88 percent) and 1,003 enlisted airmen authorized to 1,070 assigned (94 percent). While the overall officer manning appeared sufficient, qualified QB-17 drone pilot manpower hovered as low as 77 percent.¹³ The 11-percent drop revealed the unique training requirements and time necessary to qualify the drone pilots.

Finally, another important note about the squadron was the morale of its airmen, which was not tied directly to operations as many, particularly the enlisted cadre, saw value in their work. However, morale was poor for the first enlistees, who were so discontent with service life that few planned to reenlist. The cause of their unhappiness came from the perceived poor locations, lack of amenities on base, and poor infrastructure in the cities in which they lived. Leadership attempted to boost morale and well-being by building new barracks and more activity facilities but, in the end, most airmen disliked Duke Field for social situations.¹⁴



A QB-17 executing a remote landing. The rudder controller in the foreground guides the plane over the middle of the runway. The binoculars are needed to watch the drone as it is braked to a full stop further down the runway.

The Cold War

The concern of nuclear warfare during the Cold War created a need for military preparation. As long as an exchange of nuclear weapons was possible, the requirement for aircraft to be flown into the residual radiation existed. In 1946, manned flight tests proved that radiation sickness was unavoidable, despite the pilots wearing lead-lined flight suits and aircraft being washed upon landing. The Air Force looked to unmanned technology as a safety measure to eliminate risk to personnel. The Air Force sought to keep people safe from the radiological threat by reinvigorating the rudimentary successes of radio-controlled QB-17s.¹⁵

During the 1950s, the necessity of limiting the scale of war required the United States to use weapons for desired and scaled effects, rather than for annihilation. Atomic weapons became less of an advantage and more of a shield, as conventional rearmament became a priority. The issue with conventional weapons was cost, and senior leaders were looking for systems that provided more “bang for the buck.”¹⁶ To be successful, the Air Force had to stay creative and enhance its tactical and operational effectiveness through reconnaissance.

Of all of the branches, the Air Force’s work with UAS technology had the most lasting effects during the Cold War. Multiple types of UASs were introduced with differing focuses. McDonnell Douglas built one design, called the GAM-72 Quail, as a decoy drone in 1961. The Quail was launched from a B-52, was jet powered, and was intended to confuse the Soviet integrated air defense system.¹⁷ As Soviet Surface-to-Air Missile (SAM) systems advanced, the goal of the Quail was to saturate the integrated air defense system to increase the survivability of the ingressive bomber force. At the peak of its inventory, the Air Force had 492 Quails but they steadily became obsolete as Soviet radar technology increased to a point that it could easily identify the differences between decoys and actual bombers.¹⁸

Compared to decoys, drones were a longer-lasting and viable option as reconnaissance platforms. In 1948, Ryan Aeronautical Company developed a target drone called the Q-2 “Firebee.” The refocusing of the drone’s mission from target drone to reconnaissance drone took nearly 10 years. In 1958, Ryan Aeronautical Company developed the Q-2C Firebee, which was the first drone developed specifically for reconnaissance missions. The Firebee’s J69-T-19 turbojet engine enabled an operating ceiling of 60,000 feet and a range of 800 miles.¹⁹

The threat of the Cold War piqued interest and the development of a more capable Firebee. The United States focused on reaching deeper into the heartland of the Soviet Union to gather intelligence on its military strength and atomic weapons development. More than one issue arose from those criteria. First, the Firebee required a range of nearly 2,000 miles to reach the heartland of the Soviet Union.²⁰ The second issue was the radar signature of the Firebee. Since these unmanned aircraft were developed as decoys, the radar signature was intentionally large to ensure radar acquisition by the Soviets. Now that the Firebee’s mission was changing to reconnaissance, the radar signature was a liability. The developers of the Firebee reduced the signature by adding radar-absorbing material to the sides of the aircraft, changing the intake, and using non-conductive aircraft nose paint. This initial investment into the Firebee’s reconnaissance capabilities proved beneficial; however, as the Cold War continued the Air Force saw a rollercoaster of advancement and obstruction that caused fragmented development progression.

Major “Powers” Face-Off—The Cold War Heats Up

The Air Force, for the most part, lost interest in unmanned aviation technology after the Korean War. Demand for reconnaissance, on the other hand, was at an all-time high due to the fear of Soviet nuclear development. The concern for the Soviets’ new capability spurred the development of the U-2 high-altitude reconnaissance aircraft. Starting on July 4, 1954, the U-2, piloted by the Central Intelligence Agency (CIA), gave the United States the capability to fly over Soviet airspace with impunity. Soviet displeasure led to the country’s development of the SA-2 radar-guided SAM.²¹ The Air Force realized the risk of U-2 operations, and the Air Staff reconnaissance chief inquired about the Q-2C Firebee drone as a possible reconnaissance replacement if needed. By mid-April 1960, the Air Staff was pushing a strategic drone project that led to greater interest in unmanned technology.²² The UAS resurgence began on May 1, 1960, when the Soviet Union shot down an American U-2. Francis Gary Powers was piloting the aircraft and was captured soon after the downing.²³ The Powers incident caused political embarrassment and affected U.S.-Soviet treaty negotiations at the Paris Summit between President Dwight Eisenhower and Premier of the Soviet Union Nikita Khrushchev.²⁴

The United States secretly awarded Ryan Aeronautical Company a contract for its Q-2 Firebee target drone for reconnaissance eight days after Powers’ capture. Flight

tests soon began but were quickly blocked a few weeks later due to the political prioritization of Department of Defense funds. Senior leaders wanted to acquire the new SR-71 spy plane because it was capable of Mach 3 speeds and able to fly at altitudes no Soviet surface-to-air mission could reach. Senior leaders felt that the Boeing SR-71 supersonic reconnaissance aircraft was better suited to fit the service's needs at the time.²⁵ In 1960, the Air Force sent the Secretary of Defense a \$1 million plan for the development of unmanned aircraft, but it stalled as President John F. Kennedy's administration was entering the White House.²⁶

The Air Force finally awarded Ryan Aeronautical the contract in February 1962, which correlated with the "Big Safari" program to modify four Q-2C Firebees and call them special purpose aircraft. Big Safari was a contracting and procurement organization meant to streamline the acquisition process.²⁷ The company was meant for highly classified and quick-reaction aircraft modifications. Big Safari's programs had little oversight or paperwork. Big Safari and Ryan Aeronautical modified the Q-2C special purpose aircraft by adding an improved onboard camera. This variation was called the Ryan 147 "Fire Fly." The test flight included round-trip missions from Holloman Air Force Base, New Mexico, to slightly west of the Great Salt Lake in Utah after being air launched from a C-130.²⁸ The Fire Fly proved that a pilotless aircraft could have a quality camera outfitted and that it could perform required reconnaissance up to expectations.

Meanwhile, on October 27, 1962, one day before the end of the Cuban Missile Crisis, another U-2 was shot down over Cuba, killing the pilot.²⁹ The strategic dangers and ramifications of people being captured or, as in this case, killed highlighted to the Air Force the need to embark on surveillance drone projects.³⁰ The use of unmanned aircraft never seemed able to build on its momentum due to political intervention or poorly prioritized asset development. The reason the political influence and faulty prioritization are important is because they led to a lack of adequate fielded capabilities in required quantities at the onset of conflict future conflicts, or wars.

The next task for the Fire Fly was survivability. How could an unmanned aircraft last in a non-permissive environment, particularly against fighter aircraft? The aircraft was reconfigured as a target and employed against four F-106 Delta Darts, each loaded with four air-to-air missiles. The four aircraft fired all of their missiles at the 147A but failed to hit the target from a rear aspect position, proving the promising future of the small-signature, speedy, and stealth-enhanced Fire Fly.³¹ The successful trials bolstered the argument that the aircraft could be extremely beneficial in various combat situations. The success of these tests validated the aircraft's worthiness and led to further contracts requiring Ryan Aeronautics to build nine more Fire Fly variants, which had a wing span 27 feet longer than earlier models, a fuselage that was four-feet longer, and an operating altitude of 62,500 feet.³²

Unfortunately, not everyone saw positives to the program, and the commander of Tactical Air Command stated



Fire Fly ready to launch from DC-130. (Source: Thomas P. Erhard, *Air Force UAV's: The Secret History* (Arlington, VA: Mitchell Institute Press, 2010), 5.)

that he "wanted no part of unmanned aircraft." The Fire Fly's developers shipped the concept to numerous Air Force agencies until the Strategic Air Command Director of Operations, Major General William H. "Butch" Blanchard, recognized their value and accepted putting them under his command. In July 1963, the first drone reconnaissance unit in the Air Force became operational as members of the 4080th Strategic Reconnaissance Wing. In 1964, the Air Force tested further models such as B, C, D, and E; however, sentiments like those of the Tactical Air Command commander were pervasive, and many individuals in the Air Force resisted the use of drones for fear of replacement or a lack of confidence in the technology.³³ Continuing the legacy of the 3025th, the Strategic Reconnaissance Wing revealed how its value was on the rise, despite an aversion to what unmanned aircraft represented for the future of the Air Force.

The Cuban Missile Crisis

The U-2 discovery of a nuclear missile facility and SAM locations in Cuba on October 14, 1962 led to opportunity for the UAS community.³⁴ The SA-2 Guideline Missile threat was considered a high priority; this was the moment during which the Fire Fly could prove its merit. Dr. Joseph V. Charyk, undersecretary of the Air Force and national reconnaissance chief, advocated strongly for the use of the Fire Fly to do reconnaissance over Cuba. Just before conducting the mission, it was aborted at the last minute out of fear that the Soviets might find out about the secret Fire Fly project and its capabilities.³⁵ Despite the potential for war, the United States did not use its UAS technology, which might have revealed the value and potential of the system as an asymmetric advantage.

One ever-increasing challenge was the cost of the systems. Some improvement programs cost the government \$13 million, or \$86 million in fiscal year 2010 dollars, which equated to \$12.3 million dollars per aircraft in



Fire Fly in Flight. (Source: Thomas P. Ehrhard, *Air Force UAV's: The Secret History* (Arlington, VA: Mitchell Institute Press, 2010), 7.)

today's conversion. One of the Air Force's avenues for developing of UAS technology was through joint ventures with the CIA. The capture of CIA operative pilots and the sensitive nature of such captures necessitated that the CIA heavily look into unmanned technology. Additionally, the joint Air Force–CIA venture proved beneficial for both parties, because the Air Force provided aviation experts and the CIA offered a budget that allowed for riskier development designs and practices. Finally, the Cold War and the requirement to gather intelligence over vast areas allowed for public acceptance of UASs as well.³⁶ The intelligence community appreciated the technology for what UASs afforded it: close to the same reward but less risk.

The tug of war between technological revolution and man's demand for relevance in manned aircraft became a common theme during the Cold War and throughout UAS history. The concerns over robotic replacements for humans only grow as technology develops exponentially. The Air Force's challenge, from 1960 until today, is finding the balance in sharing the burden of relevance with all stakeholders. This is a telling glimpse into the mindset of why the use of unmanned aircraft continued to be constrained despite glaring operational demonstrations of success. The advancements in technology and modifications proved valuable for subsequent conflicts, namely, Vietnam.

Vietnam and Post-Vietnam

Until the conflict in Afghanistan, Vietnam was the longest war in US history. Similar to the power struggle between the United States and the Soviet Union during the Cold War, the political interests in Vietnam revolved around containing communism. In their expansionist efforts, the French claimed Vietnam as a colony in 1887, seeking oil and rubber from the region.³⁷ One major factor that led to American involvement in Vietnam was the First Indochina War (1946–1954) between France and Vietnam. After the French experienced a humiliating defeat at Dien Bien Phu in 1954, negotiations resulted in the Geneva

Agreements of July 21, 1954, which divided Vietnam at the 17th parallel. North Vietnam was led by Ho Chi Minh and the communist government, while South Vietnam was led by President Ngo Dinh Diem. North Vietnamese aggression and influence seeped into South Vietnam through North Vietnamese forces as well as South Vietnamese guerillas and conventional forces known as the Viet Cong.³⁸ As a whole, the Vietnam War lasted from November 1, 1955 through April 30, 1975; however, the signing of an economic and military aid treaty between the United States and South Vietnam resulted in overt US involvement starting in 1961.

The American strategy going into Vietnam was based on an amalgamation of political, economic, and military measures to defeat the insurgency by eliminating the unrest and discontent. Indecisiveness existed in how the military, particularly its ground forces, should prosecute the war. This uncertainty left General William Westmoreland, commander of Military Assistance Command, Vietnam, with little choice but to rely on airpower and covert operations to interdict Viet Cong external operational and logistical lifelines.³⁹ The unconventional counterinsurgency environment presented by Vietnam and Southeast Asia resulted in the military employing a variety of resources. What began as foreign aid missions grew to include aircraft, support equipment, and manpower.

Aerial reconnaissance was at a premium for intelligence professionals working in the theater. Photographs captured numerous high-value systems such as the Soviet heat-seeking air-to-air missiles loaded on Mikoyan-i-Gurevich-21 (MiG-21) aircraft that were airborne over North Vietnam and pictures revealing optical tracking capabilities that fed acquisition data to SAM systems.⁴⁰ The reconnaissance photos were especially valuable for commanders to gain a situational understanding of the battlefield, defensive orders of battle, and possible enemy vulnerabilities. Drones were one of the most valuable assets in collecting reconnaissance photos during the Vietnam War. To maintain secrecy, drone reconnaissance programs held multiple code names, such as Blue Spring, Bumble Bug, Bumpy Action, and finally, in February 1970, Buffalo Hunter.

The Lightning Bugs Swarm

In the early 1960s, the United States continued to maintain basic Model 147 Firebees in its inventory. The Air Force realized it needed improved versions of the Firebee to compensate for possible demands and varieties of mission sets. This led to the development of the Ryan 147 "Lightning Bug," which was a variation of the Firebee used during the Cold War. Lightning Bugs entered the Pacific theater before the U.S. intervention in the Vietnam conflict. Lightning Bugs became the aircraft of choice after the People's Liberation Army Air Force shot down multiple CIA U-2 aircraft.⁴¹ The first Lightning Bug missions flew over China on August 20, 1964.⁴² However, as the U.S. military's focus began to pivot from China to Vietnam, so too did the direction of Lightning Bug assets, which began seeing action over North Vietnam in late 1965. The Lightning

Bugs gave developers the ability to create niche variations quickly to overcome specific threats or challenges. For example, the weather and cloud coverage in the area spurred the creation of a low-altitude variant. Low-altitude operations increased the survivability of the drone, as chances to engage them were limited. The rapid development process and tempo of UASs was beneficial and not easily replicated in manned aircraft.⁴³

President Lyndon Johnson had concerns of possible Chinese involvement in the war, mirroring their participation in Korea. The president authorized Lightning Bug reconnaissance usage over Southern China and allowed basing at Kadena Air Force Base in Okinawa. These missions were named BLUE SPRINGS. Their base of operations was transferred to Bien Hoa Air Base in South Vietnam in October 1964. As Lightning Bugs flew into China, the Chinese shot down numerous drones. This benefited them twofold: first, the downed aircraft provided the Chinese with enough material and examples to potentially reverse engineer the technology. Second, the downed aircraft were put on public display in an effort to embarrass the American government. However, much to China's dismay, due to a lack of human casualties or captured pilots being paraded in front of cameras, the press in the United States ignored the story and propaganda.⁴⁴

Lightning Bug Variants

The different variants of Lightning Bugs were not just capability demonstrators, but also a testament to focused American ingenuity. Vietnam proved to be a pivotal time for UAS growth. The platforms were robust and easily modified into variants with various missions. The Air Force saw 23 versions of the Lightning Bug created, most with unique specialties. Their downside, similar to UASs in the current-day inventory, is that they were not line-replaceable modifications, so each one was held for certain types of missions, which limited flexibility.⁴⁵

As mentioned, a low-altitude variation of the Lightning Bug was created that was capable of flying at 1,000 feet AGL and above at speeds of 500–540 knots. This provided the military with reconnaissance capability below the weather as well as below some of the thresholds of the certain ground-launched missile parameters. One variant was fitted with chaff dispensers and active jamming systems. This type proved beneficial in forcing the enemy to expend missiles, while keeping manned aircraft safe. Another variant was created for carrying propaganda leaflets, which allowed for psychological campaigns to augment the air and ground efforts.⁴⁶ Other versions included night capability with strobe flashes to illuminate the target area, as well as signals intelligence (SIGINT) and electronic anti-radar jamming versions.⁴⁷ Some aircraft saw the outfit of air-to-ground missile launchers, which included AGM-65 Maverick and Stubby Hobo TV-guided missiles and 250- and 500-pound general-purpose bombs.⁴⁸ The creation of multiple variations showed the flexibility of UASs and created a demand for them in Southeast Asia. Lightning Bugs proved capable of executing missions that manned aircraft



Lightning Bug over Vietnam. (Source: Ian G. Shaw, "The Rise of the Predator Empire: Tracing the History of U.S. Drones," *Understanding Empire*, 2014, accessed 25 August 2015, <https://understandingempire.wordpress.com/2014/08/a-brief-history-of-u-s-drones/>.)

could not due to risk and survivability. However, one major issue with the Lightning Bug was retrieving the collected reconnaissance photos.

Mid-Air Retrieval System (MARS)

The Vietnam War saw UASs perform reconnaissance in large quantities, but each mission was relatively complex, based on their launch, execution, and recovery. Before 1966, the Lightning Bugs were air-launched from man-piloted DC-130 aircraft. These cargo aircraft were specifically configured to carry, launch, monitor, and if necessary, control the drones on the reconnaissance missions. In essence, it was an aircraft launching an aircraft. A DC-130 was capable of carrying four drones: however, the standard was two drones, one primary and one backup. The DC-130s were usually launched in pairs so that there was launch redundancy. In addition to the standard C-130 flight crew—pilot, copilot, navigator, and flight engineer—the DC-130s had two launch control officers, an airborne recovery control officer, and a radar technician who monitored the Microwave Command Guidance System, which provided line-of-sight acquisition, identification, tracking, and control of the drones from launch until recovery.⁴⁹

Normally, the drone crew inputted waypoints into the Lightning Bug so that it flew a preprogrammed mission.⁵⁰ Along the mission, the navigation system kept the aircraft on its path and the camera system took photos of desired targets or areas of interest. A drone's flight time was typically 55 minutes in length and covered 430 nautical miles. In total, the drones cost approximately \$200,000 each, including navigation systems and cameras.⁵¹ When the drone completed its reconnaissance mission, it flew to a predetermined point for recovery, deployed a parachute, and floated to the ground. A second DC-130 retrieved the drone from the recovery site, removed and packaged the film, put it onboard a courier jet, and flew the film to Offutt Air Force Base, Nebraska, for interpretation, due to limited in-theater processing.⁵² Chute landings proved ineffective be-

Table 1. Model 147s in Vietnam

Ryan Model	Military Model	Length	Wing Span	Thrust (lbs.)	Mission	Operational Period	Number Launched	% Return
A		27'	13'	1700	Fire Fly - first demo drone	Apr 62-Aug 62		
B		27'	27'	1700	Lightning Bug - first big-wing high-altitude day photo bird	Aug 64-Dec 65	78	61.5%
C		27'	15'	1700	Training, low altitude tests	Oct 65		
D		27'	15'	1700	From C, electronic intel	Aug 65	2	
E		27'	27'	1700	From B, high-altitude electronic intel	Oct 65-Feb 66	4	
F		27'	27'	1700	From B, high-altitude electronic intel	Jul 66		
G		29'	27'	1920	Longer B with larger engine	Oct 65-Aug 67	83	54.2%
H	AQM-34N	30'	32'	1920	High-altitude photo; more range	Mar 67-Jul 71	138	63.8%
I		29'	27'	1920	First low-altitude day photo	Mar 66-Nov 67	94	64.9%
N		23'	13'	1700	Expendable decoy	Mar 66-Jun 66	9	0.0%
NX		23'	13'		Decoy and medium-altitude day photo	Nov 66-Jun 67	13	46.2%
NP		28'	15'	1700	Interim low-altitude day photo	Jun 67-Sep 67	19	63.2%
NRE		28'	13'	1700	From NP, first night photo	May 67-Sep 67	7	42.9%
NQ		23'	13'	1700	Low-altitude NX, hand-controlled	May 68-Dec 68	66	86.4%
NA/NC	AQM-34G	26'	15'	1700	Chaff and electronic-countermeasures	Aug 68-Sep 71		
NC	AQM-34H	26'	15'	1700	Leaflet dropping	Jul 72-Dec 72	29	89.7%
NC(M1)	AQM-34J	26'	15'	1700	Interim low-altitude day photo and training			
S/SA		29'	13'	1920	Low-altitude day photo	Dec 67-May 68	90	63.3%
SB		29'	13'	1920	Improved SA low-altitude	Mar 68-Jan 69	159	76.1%
SRE	AQM-34K	29'	13'	1920	From SB, night photo	Nov 68-Oct 69	44	72.7%
SC	AQM-34L	29'	13'	1920	Low-altitude workhouse	Jan 69-Jun 73	1651	87.2%
SC/TV	AQM-34L/TV	29'	13'	1920	From SC, with real-time TV	Jun 72-	121	93.4%
SD	AQM-34M	29'	13'	1920	Low-altitude photo, real-time data	Jun 74-Apr 75	183	97.3%
SDL	AQM-34M(L)	29'	13'	1920	From SD, with Loran navigation	Aug 72	121	90.9%
SK		29'	15'		Navy operation from aircraft carrier	Nov 69-Jun 70		
T	AQM-34P	30'	32'	2800	Larger engine; high-altitude day photo	Apr 69-Sep 70	28	78.6%
TE	AQM-34Q	30'	32'	2800	High-altitude; real time communications intel	Feb 70-Jun 73	268	91.4%
TF	AQM-34R	30'	32'	2800	Improved long-range TE	Feb 73-Jun 75	216	96.8%

cause early versions landed over South Vietnam— sometimes in a rice paddy, in the jungle, in the ocean off of Da Nang, or in hostile territory. Additionally, landings usually resulted in damage to the drone and the film on the aircraft. The military sought a new method of recovery to preserve the intelligence.

In 1966, developers created another component that increased the effectiveness of drone reconnaissance by increasing the survivability of the coveted collected photos. This led to the Mid-Air Retrieval System (MARS), which was one of the most creative aspects of the Lightning Bug. The H-model became the first MARS-capable Lightning



CH-3C Helicopters used by the 100th Strategic Reconnaissance Wing to recover drones in mid-air.

Bug, which eliminated damage to the drone and the onboard film during landings. The MARS consisted of the drone and a CH-3H Little Jolly helicopter, later to be replaced by a CH-53 helicopter.⁵³ To avoid damage from hard landings, saltwater contamination, or just losing the drone, the Lightning Bugs were plucked from midair by a CH-3C helicopter after the parachute opened. The aircrew manipulated two 20-foot-long hydraulically operated poles and an array of three hooks. The helicopter crew snagged the parachute's cords and, with a winch that fed 1,000 feet of steel cable out of a reinforced hole in the helicopter's floor, reeled the 2,000-pound drone into a position about 20 feet underneath the helicopter. Once collected, the helicopter delivered the drone to a recovery zone.⁵⁴ Despite its complexity, MARS proved to be an achievement in innovative recovery methodology. Out of 2,745 attempted recoveries, 2,655 were successful, for a nearly 97 percent success rate.⁵⁵ After the drone was brought back to base, the onboard still-photo film cartridge then had to be flown out of Vietnam for development and analysis, with photos of interest flown back later.⁵⁶ Unfortunately, the process sometimes took days to go round-trip.

Operational Effectiveness

The inventiveness of MARS and the assortment of drones provided during Vietnam required extensive manpower and financial resources to enable these operations. Launching a Lightning Bug required a cargo aircraft, the drone, and a helicopter for retrieval. This resource draw demanded that the benefits of the program be extensive enough to validate the continued use of the systems. Vietnam proved to be the coming-out party for UAS in the U.S. Air Force and a turning point in how drones were employed. The operational tempo of the drone program was far-reaching, and it proved to be a major influence in the conflict. In the decade from 1964 to 1974, 1,016 Lightning Bugs flew 3,435 sorties over China, North Vietnam, and North Korea—equating to nearly a sortie per day. Specifically in Vietnam, drones accounted for nearly half of the total missions. The Fairchild 415Y low-altitude camera on the Lightning Bug was advanced enough to provide usable 120-nautical-mile strips of imagery in three-nautical-mile



Drone Hanging from its Parachute as it Floats Downward.

swaths that resolved objects as small as six inches.⁵⁷ The Lightning Bugs recovered over 100,000 feet of film for intelligence exploitation.⁵⁸ These successes in high-volume reconnaissance were acknowledged by senior leaders. On June 17, 1983, retired General John Vogt, who previously held the positions of Seventh Air Force Commander and Deputy Commander Military Assistance Command, Vietnam stated, "I am a great believer in drones. I used drones in a reconnaissance role very effectively."⁵⁹

Another operational success in Vietnam was that the first UASs were employed as SIGINT and suppression of enemy air defense platforms. Unmanned aircraft were ideal for these roles in Southeast Asia because the preponderance of missions required exposure to enemy threats with the possibility of engagement. Due to the range and number of key radar systems in Vietnam, U.S. commanders needed aircraft to get within the radar's line-of-sight to gather data on those radars' operating parameters. Manned aircraft encountered difficulty in overcoming radar systems deployed in a point defense because of the intelligence collection challenge they created. As the American people began to question the validity of U.S. involvement, minimizing casualties was an important component for maintaining national will in the conflict. UAS removed the risk to pilots in the areas where radar systems tracked and engaged aircraft.⁶⁰

One mission uniquely suited to drones was SIGINT acquisition of SAM sites. The relatively new danger SA-2s presented required that all aircraft operate at standoff distances that were inadequate to execute appropriate reconnaissance, according to for Air Force and Army leaders.



The Helicopter's Retrieval Hooks have Caught the Parachute Executing the MARS Process.

The Lightning Bug was the right tool for the problem. The Lightning Bug E-model was equipped with an active radar-enhancing device to ensure that the SA-2 Fan Song fire control and tracking radar detected the aircraft. On February 13, 1966, the Lightning Bug made history when it detected the command-link signal from the Fan Song E radar system and transmitted the data before the aircraft was destroyed. This was a pivotal moment in the Vietnam War because it provided military leaders with the two uplink channels used to control the SA-2 missile. The uplink channels gave the military the ability to either jam or manipulate the command signals so that the missiles missed their targets. More importantly, the information enabled the development of safety measures for manned aircraft. The uplink channels spurred development of radar warning receiver technology on manned aircraft so pilots would know when the SA-2 command link became active and an engagement was imminent, giving them time for appropriate defensive maneuvers.⁶¹

In 1965, North Vietnam introduced high-altitude SA-2s, forcing manned American U-2 reconnaissance aircraft to fly standoff missions, during which they took reconnaissance photos outside of the missile's engagement zone. Once again proving its worth, the Lightning Bug took over most of the high-risk penetration flights into North Vietnamese airspace to reduce unnecessary risk.⁶² The drones



Photograph Showing the Drone's Low-altitude Photographic Capability of a B-52 Crash Site with People Surrounding the Debris

were also credited with the losses of numerous enemy MiG fighter aircraft, which either crashed by trying to intercept the drones or were hit by SAMs that missed the drones during missile engagements. Interestingly, one drone earned "ace" status because it was involved in the loss of five North Vietnamese fighters. The unmanned aircraft also proved to be far more resilient than anyone expected. The anticipated life expectancy of a Lightning Bug in combat over Vietnam was only 2.5 sorties, but they ultimately averaged 7.3 missions. The record was set by an S-model called "Tom Cat," which flew 68 sorties before being lost on September 25, 1974.⁶³

The Lightning Bug program was not without its issues. During the war, 544 drones were lost, a third of which were due to mechanical issues that led to crashes or unsalvageable failures. SA-2 Guideline missiles, fighter aircraft, or anti-aircraft artillery shot down the remaining two thirds.⁶⁴ Early on, the Air Force struggled with ensuring that missions went according to plan. Some drones made mysterious turns while in flight and never returned; one failed to switch to remote control for landing and flew past the recovery zone before running out of fuel. Even when everything did go right, the Lightning Bugs often sustained considerable damage upon landing.⁶⁵

As the Vietnam War ended, the successes of the UAS program were evident. One of the main contributing factors was the fleet of leftover Firebee drones and equipment that were still serviceable as Vietnam began. This translated (with little major innovation) into the Lightning Bug program cutting down on development time and speeding up operator training, organizational growth, and tactical employment.

Post-Vietnam: 432d Tactical Drone Group

The rapid development and deployment of UAS technology left the Air Force behind the power curve when

meeting training requirements. The reconnaissance drones entered production just prior to the escalation of the war; therefore, the Air Force had limited time to train personnel before placing them in theater. The second problem had to do with the outlook of Air Force personnel regarding career progression within the UAS community. Many reconnaissance aviators believed, perhaps correctly, that working in a drone unit instead of a U-2 unit would stall their careers. In an attempt to rectify this, the Air Force eventually created an airborne missile-maintenance squadron, which put Lightning Bug units on the same organizational level as the U-2 units.⁶⁶ Unmanned aircraft also saw a shift in naming from UAS to RPV to highlight the pilot aspect of the system.⁶⁷ However, programs are only as good as the leaders who push them, and when senior-level acceptance for RPVs was still noncommittal, this indifference reverberated throughout the lower echelons.⁶⁸

Activated on July 1, 1976, the mission of the 432d Tactical Drone Group (432 TDG) was to maintain capability to deploy the reconnaissance drone force (as directed by the Commander-in-Chief of Readiness Command) to any theater; this involved conducting reconnaissance drone operations and any conduct necessary training or testing to reach initial operational capability. A byproduct of the unit was the creation of an environment of inclusion and self-worth among pilots who felt negatively affected by the drone assignment. The unit was located as a tenant unit of 355th Fighter Training Wing (355 FTW) but was subordinate to the 12th Air Force.⁶⁹ The group consisted of the 432d Drone Maintenance Squadron (432 DMS), 432d Organizational Maintenance Squadron (432 OMS), 11th Tactical Drone Squadron (11 TDS), 22d Tactical Drone Squadron (22 TDS), and 432d Headquarters Squadron (432 HSS).

The 432 TDG leadership encompassed a melting pot of aeronautical specialties. At the end of 1976, the aircraft flown by the group included nine DC-130A/E Hercules and RC-130A aircraft, nine CH-3E Jolly Green helicopters (MARS modified), and 45 AQM-34 Lightning Bugs of various versions (L, M, and V). Even after the Vietnam War ended, the unit continued to develop the systems.⁷⁰

While the group found successes in Vietnam because of the intense involvement of its aircraft, one of the major issues it faced was manpower. In contrast to the previous 3205th Drone Group, the 432 TDG had relatively good manpower numbers on paper. For example, in December 1976, the group was authorized 708 officers, airmen, and civilians, and it was assigned 777 (110 percent). The more glaring issue related to ensuring that personnel were qualified and combat-ready. The training was specialized and traditional pilots required considerable training time to effectively operate the UASs. The unique nature of the drone group meant there was not a pool of Air Force members who could transition easily into the jobs. The UAS offered a capability that the enemy had difficulty countering, but it also created a stovepipe in training and manning. Due to long assignments with the program, the 432 TDG lost large portions of its experienced personnel in an effort to balance careers and mission. While this is normal in most

career fields, the UAS community failed to establish career paths for its pilots, enlisted operators, and mechanics.⁷¹ By losing experienced personnel, and receiving inexperienced people, the overall skill level decreased. The group had to train the new arrivals and still maintain a high sortie rate. This left the group in the precarious position of not having an experienced aircrew to train those without proficiency.⁷²

The ad hoc methodology of developing the UAS organization without first creating a foundational career model affected the overall efficiency and morale of the airmen. These challenges were also seen in the early MQ-1 Predator years, when people were brought from manned aircraft units and had no established career paths. This was exacerbated by community's substandard views of unmanned aircraft relative to manned aircraft. Without strong leadership and planned measures to ensure that operators had the same opportunities as others in the Air Force, the UAS program found itself fighting external wars amidst internal conflict. As the Air Force struggled to find a place for drones within its culture, the civilian sector was embracing the technology with open arms.

The Fight for Legitimacy

The divisiveness of the Vietnam War created a societal acceptance of unmanned aircraft that stimulated the civilian population's imagination. On November 16, 1970, Aviation Week & Space Technology devoted an entire issue to the topic. The numerous articles expressed people's intrigue regarding the notion of unmanned flight and forecast definite possibilities on multiple fronts of development. In the military, the use of unmanned aircraft prompted new ideas and reexamination of previously overlooked and discarded concepts.⁷³ Military and civilian developers always worked closely on UAS projects. The lack of development and investment post-Vietnam allowed many civilian companies to catch up.

On June 5, 1971, Air Force General John D. Ryan stated, "drones have demonstrated an excellent potential for use in tactical reconnaissance and electronic warfare. Although the austere budget situation has had an adverse effect on the tactical drone program, actions pointed toward your needs are underway and will continue to be given full support."⁷⁴ This perspective, coming from the Air Force chief of staff, illustrated the back-and-forth nature of drone support in the Air Force hierarchy. The capability was desired because it enhanced operations, but it was always met with budget constraints that limited its full realization.

By 1973, an article in Aviation Week and Space Technology stated, "Ironically, it was the military that first sparked major industry interest in the UAS concept . . . but currently, the military is providing inertia preventing major progress in this field at the pace that technology now permits." The article explained how the United States had the advantage in the UAS field and that, if exploited wisely, the country could see great leaps in potential and remain one step ahead of opposition.⁷⁵ This is important—civilians saw the asymmetric benefits UASs provided and

realized the fragility of the country's advantage within the technological domain.

During the mid-1970s, new ideas flourished in UAS command and control. These included concepts such as ground-control stations that were equipped so one pilot could fly multiple RPVs, autonomous aircraft that only required human intervention from target acquisition to weapon delivery, and new recovery techniques.⁷⁶ These revolutionary concepts were only realized decades later due to the lack of investment post-Vietnam. Did civilians see more potential in unmanned aircraft than the Air Force did? While the Air Force realized the potential of UASs, the Department of Defense constrained budgets limited development and active research. Additionally, the lack of a war meant that there was no longer a necessity for the systems to fill capability gaps. The end of the military involvement in Vietnam was not the end of the Lightning Bug. While the war had created dynamic RPV technologies, the United States engulfed itself in post-war introspection and the focus shifted back toward the Cold War and operations in Europe.⁷⁷

A commander in Vietnam and Europe, General Vogt stated in an interview, "I decided that the drone would be extremely useful in Europe, so the first thing I did when I arrived over there was say, 'I want the drones I had earmarked for my use in Vietnam. Let's bring them over, and we'll base them in England'."⁷⁸ General Vogt also discussed how he had expected the Air Force to be extremely involved in the drone business by devoting resources to research. However, he realized that the underlying stagnation created competing interests revolving around the development of the F-15 and required combat against the institutional reluctance to change. The perception that the program was driving pilots out of the cockpit was not palatable for most Air Force senior leaders, leading to an under-exploitation of UAS capability.

The battle for relevance and culture still loomed behind the scenes as Vietnam drew down and another inter-war period began. The Air Force's internal conflict of capability demand and its aircrew culture were at odds, but without a war and a voice of advocacy, the unmanned aircraft community made little progress in developing either a career path for rated officers or a sense of identity. The Air Force's need to have a person in the loop resulted in repression of one of its greatest capabilities. UASs were not perfect; however, during these times of lull, the Air Force could have pressed for greater development and technological refinement. The numerous UAS successes in Vietnam were soon forgotten or willfully ignored. The suppression of enemy air defenses role taken from the UASs and given to manned aircraft due to the role's perceived glamour. The battle for relevance was not just between branches of the military but within the Air Force itself. Unmanned aircraft provided a way to determine the technological capabilities of enemy weapons and to test counter-measures, all without risking the life of the pilot.⁷⁹ The Air Force was willing to accept risk in manned platforms doing suppression of enemy air defenses without assistance from UASs. Unmanned aircraft were once again

at an impasse, and development stalled until the Gulf War of 1990.

Conclusions and Recommendations

The research for this thesis highlighted pioneering efforts by early Army Air Corps, Army Air Forces, and later Air Force development of unmanned aircraft. Beginning with the use of balloons, kites, and the Aerodrome No. 5, exploiting the air domain became a way to gain military advantage. The development progressed to the initial concept of a long-range, weaponized platform in the Kettering Bug, which was never used but spurred the imagination of aeronautical engineers and military alike. The pressures of the German V-1 threat inspired American inventions such as the OQ-2 Radioplane as a target platform, and Operation Aphrodite, an AAF attempt to reduce risk. Two important themes during the Cold War were the rise of organizations dedicated to drone development and the aversion of senior leaders toward unmanned technology. Finally, the Lightning Bug had various impacts on operations in Vietnam using reconnaissance, suppression of enemy air defenses, and other roles.

Evaluating the Research Questions

The purpose of the research questions provided the foundation and framework for analysis. The primary research question pertained to how the U.S. Air Force and predecessors used unmanned aircraft in major conflicts from World War II (1939-1945) to Vietnam (1961-1973). This study showed the ebb and flow of demand for unmanned aircraft in times of war and peace. Two key points of emphasis are, first, that the capabilities each UAS version generated contributed to the systems' evolutionary, not revolutionary, process—from concept to target to reconnaissance to, ultimately, strike platforms. The research also illustrated the influence technological advancements have on tactical, operational, and strategic aims. Secondly, UASs transformed from capability demonstrators to force multipliers. The common threads over the decades of UAS development show three main uses of UASs: to advance the technological narrative, to mitigate risk, and to fill capability gaps.

UASs have been important to advancing the technological narrative within airpower. Unmanned airpower has hinged on continuous technological developments to improve anti-air defense systems, gather intelligence, or enable the gaining and maintaining of air superiority. Unmanned systems were required to promote innovative aeronautical thinking and to push new ideas into the realm of the possible. Manned aircraft developments advanced the aerodynamic platforms used for UAS, while UAS pushed developers to find new ways for manned aircraft to provide the same capabilities as unmanned aircraft and enhance certain electromagnetic spectrum upgrades. For example, in Vietnam, the Lightning Bug launched from a DC-130 and recovered via helicopters and the MARS showed advancements for all of the aircraft communities

to stretch the limits of their typical operational skillsets and inventiveness. One benefit to advancing the technological narrative was the reduction in risk to aircrew.

Second, UASs were tools to mitigate risk. The ability to keep the pilot out of harm's way and the relative expendability of UASs provided peace of mind and strategic impact. During the Cold War, downed pilots became a liability and unmanned aircraft offered a new way to exploit the reconnaissance without a loss of personnel. UASs could also collect information on SAMs, leading to the creation of radar warning receivers that helped manned pilots be aware of and avoid threats in hostile territory. Ultimately, senior decision makers did not want to continue to accept the losses of people when an unmanned aircraft could do the same job. In the 21st century, this risk mitigation has advanced to the point where people no longer need to be in the theater of operations. Current RPA developed by taking advantage of the system's greatest strength, the capability to extend the distance between person and aircraft. The systems require a smaller footprint of personnel to forward deploy, keeping the majority of aircrew in the US. What began as hundreds of feet has transformed to thousands of miles of connectivity and near-instantaneous feedback, placing fewer aircrew in danger overseas.

Third, UASs filled capability gaps. From the initial concept, unmanned aircraft were a tool to fill a need the air forces of the time were unable to satisfy. The Kettering Bug, for example, could provide the ability to strike from a long distance. The OQ-2 Radioplane provided targets to hone gunner fire, a skill that was lacking but needed due to the V-1, V-2, and enemy aircraft threats. The Firebee and Lightning Bug, outfitted with cameras, filled the need for intelligence photography in non-permissive environments. The Lightning Bug also provided SIGINT and other capabilities where needed. Along with the primary question, the secondary questions looked at the wider scope of influence of UASs.

The secondary research questions were significant in understanding UAS usage by putting them into context. UASs were not isolated entities. Internal and external factors shaped their progression and modern-day status. One of the secondary questions was whether or not there was a thread of missed opportunities in the development of UAS technology, politically or fiscally, that led to underdevelopment of unmanned systems and programs. The secondary research question revealed a theme of long-term underdevelopment of UAS capabilities beginning in the 1940s. The Kettering Bug was a glimpse into what the systems could be and never came to completion.

The most detrimental moments were during the interwar periods where reductions in defense spending forced prioritization of research projects and many leaders focused on the short term rather than the long-term strategic potential of UASs. Additionally, technology developed at a slow pace, which inevitably made scientists recreate processes and products. Still, today's capabilities are currently not as developed as they might have been. Lieutenant Commander Delmar Fahrney realized in the 1940s

the potential for weaponized UASs as attack platforms, but the Japanese attack on Pearl Harbor, caused reallocation of resources and Fahrney's ideas never gained momentum. UASs were ultimately weaponized in Vietnam; however, the continuity did not last and it took another 30 years to weaponize them permanently in the early 2000s. This is exemplified when the RQ-1 was outfitted with hellfire missiles and renamed the MQ-1 Predator.⁸⁰

Additional secondary questions included the following: What were the sentiments of manned aircraft pilots regarding UASs? Was there generalized acceptance of these technologies or an internal aversion to a concept that threatened the aviator status quo? While the data shows that these questions warrant further research, this thesis revealed distinct biases. Traditional pilots and senior leaders were unwilling to accept what UASs could deliver and meant for aviation. Unmanned aircraft could mean a dramatic culture shift, challenging pilots' sense of belonging, worth, and legitimacy.

The tertiary questions focused on what programs improved the capabilities of the operators and what type of doctrine or training programs developed UAS crews to standardize operations and ensure proficiency. Institutionalization came from the development of multiple UAS squadrons and groups that focused on the training and development of operators and systems. While many traditional pilots did not accept the transition to flying UASs, Air Force leadership created organizations that operated like any other flying unit. Capabilities may have been different, but standards and evaluations, training, scheduling, and tactics shops were all incorporated into the units to ensure quality operators.

Conclusions

This paper tells a cautionary tale about UASs and future technologies regarding institutional progress and innovation. It shows how technology drove the change in aerial warfare despite the fact that, in 2003, the Lightning Bug saw its last combat missions over the Gulf with a total of five involved in opening salvos of the Second Gulf War.⁸¹

UASs regressed from the forefront of military minds, but never completely disappeared. To retain the most qualified individuals, leadership needs to look at how it treats its people in technical jobs. Despite the misconception that unmanned aircraft created a manpower savings because there was not a person in the plane, they actually required more personnel to support flight operations.

Third, the Air Force must be mindful of how it views risk and balancing that with its sense of culture. UASs are about preventing risk to manned aircraft and keeping people out of harm's way. This explains the continued pressure regarding personnel in manned aircraft and the slow progression of unmanned aviation dominance into fighters, bombers, and mobility aircraft. While this may finally be changing, senior leaders routinely valued the culture of the Air Force above capabilities and risk aversion.

The UAS narrative is a cautionary tale of innovation. As new and advanced technologies are developed, the De-

partment of Defense must be prepared to accept and integrate tools that enhance effectiveness. Cyberspace is one realm where the Department of Defense needs to stay ahead. The Department of Defense must have advocates for new capabilities that challenge the status quo. While the crux of the issue is the “man in the loop” mentality, the Air Force’s love-hate relationship with unmanned aircraft must come to a head. In some ways, the Air Force has hindered its own progress and air superiority due to a failure to recognize the value of unmanned systems. The tipping point came when costs had dropped and technology advanced to a stage when military forces became so dependent on the information and capabilities UAVs provided that there was no turning back. Lastly, the Air Force and military as a whole must be mindful of the stagnation peacetime brings to development. The stressors of war breed innovation while the complacencies of peace stifle it.

Recommendations

UASs can be analyzed in a variety of ways; however, the most succinct and encompassing way to make recommendations is through the Army’s DOTMLPF framework. DOTMLPF refers to doctrine, organization, training, material, leadership and education, personnel, and facilities. These recommendations are made by synthesizing the research and extrapolating lessons learned that could help the RPA communities of the future. “Ignorance of the history of unmanned aviation is costing us, the casual taxpayer and UAV developer alike, time and resources by retreading old ground. If this can help to prevent reinventing the wheel then it would have service its purpose.”⁸²

Doctrine

Doctrine is a fundamental source of standardized thinking and institutional legitimacy for the services. Historically, it has rarely included unmanned aircraft. UAS doctrine has developed in recent years through organizations such as the Air Land Sea Application Center that created multi-service tactics, techniques, and procedures regarding UAS. It is important to understand how UAS at all levels can enhance deep, close, and security missions. Tactics, techniques, and procedures need to be doctrinally codified.

Organization

The organization is an important part of the UAS construct because it adds validity to the systems. While two aviation groups were created during the Cold War and Vietnam, an entire wing was created in 2008 because of the insatiable demand for RPA. Organizationally, UAS units were modeled after traditional manned pilot units; however, the Air Force must view them as different. While there is some carryover of best practices, the inherent command and control of UAS create unique organizational structures. Air Force leadership must be open-minded enough to recognize and accommodate those differences, to maintain a high level of mission effectiveness.

Training

Training is always a difficult requirement to meet. UAS organizations struggled with maintaining currencies in the various mission sets for which they are responsible. This paper recommends in-depth analysis of training in UASs’ unique nature and complexities. The Lightning Bug had 23 variants; many of those pilots had to train in and remain current in multiple versions. The ease of creating new types of UASs is a strength as well as a weakness because it forces unmanned aircraft aviators to learn more than one type of aircraft. While some of the UAS variants are similar, some have substantial hardware differences that affect flying characteristics.

Material

Material is the driving force behind DOTMLPF and, in the case of UASs, behind development despite institutional reluctance. They provided a capability that met a requirement. As UASs or RPA continue to improve, they must be created with a modular mentality. Variations are simply line-replaceable units that can be pulled on and off of the aircraft. The variations during Vietnam proved that single-capability aircraft stifle overall flexibility. UASs need to be created in a fashion that is agile and universal.

Leadership and Education

Leadership is reviewed through the Kotter model of organizational change. The following eight-stage process shows how leadership can create change in an institution. This is an important concept because UASs were a change in operations and culture and the failure in acceptance came from poor change practices in the organization.

1. Establish a sense of urgency.
2. Create a guiding coalition.
3. Develop a vision and strategy.
4. Communicate the change vision.
5. Empower broad-based action.
6. Generate short-term wins.
7. Consolidate gains and produce more change.
8. Anchor new approaches in the culture.⁸³

The cultural change failure regarding UAS during the 20th century revolved around leadership, mainly the lack of an advocate and voice of reason to promote capabilities and benefits, like Colonel Billy Mitchell did during the inception of manned aircraft. Change failed to occur because of a failure in the first two steps of the Kotter model. First, often there was not a sense of urgency to develop unmanned aircraft; as mentioned, during interwar periods they were often prioritized low on the hierarchy of organizational needs. However, during times of war in which capability gaps were created, there was a sense of urgency to develop UAS, which resulted in the variants of Vietnam. Unfortunately, the programs also lacked a guiding coalition. Not enough senior leaders were on board with the

technology to execute the broad, sweeping changes required to stay on the leading edge of UAS technology. Never getting past the first two steps meant never reaching later steps.

Ironically, the technology proved so beneficial that, even without good urgency or guiding coalitions, UASs leaped to step six in which small, successful wins were attained, whether the execution of the mission or a development of innovation, in various pre-21st century conflicts. This kept UASs in the inventory and led to their continued use despite institutional reluctance. Leaders must be mindful of how they prioritize UASs in the future. The sense of urgency must remain during times of peace and war. The other issue is that, over the past 100 years, no senior leaders have been adequately involved in UAS programs. In the 21st century, that is changing as more UAS leaders are making the rank of general officer; however, in the past the lack of community knowledge has hindered any true DoD-level backing.

Personnel

One of the most important aspects of the DOTMLPF process is the personnel. The stigma of being a UAS pilot or operator had effects in the 1970s and still does today. The Air Force, through leadership, must ensure that promotions are fair for everyone. The UAS communities cannot function as the “stepchildren” of the aviation community. Additionally, senior leaders must understand and translate the role UAS will play in the future. They are additional capabilities to add complexities to the enemy’s battle calculus. As the technology continues to grow and mature, motivated and quality personnel need to be recruited to ensure that the UAS community can meet demand and head into the future of unmanned warfare.

Facilities

Facilities have always been an issue for UAS because of the sensitive nature of the aircraft classification and the search for operating airspace in which to train. RPA aviators today experience the same challenges of locations and facilities with amenities as the members of the 3205th Drone Group in 1951. The importance of facilities cannot be underestimated because of the morale factor they provide. The Air Force needs to learn the lessons of the past and pick locations good for family life, especially since modern-day UAS can be placed almost anywhere with very few limitations.

Areas for Further Research

This examination of unmanned aircraft throughout history has revealed numerous areas for future research. While the topic is of great interest to the public and seems likely to remain so, research needs to build a wider-ranging body of literature, not just talk about what an aircraft is

and look at the new and interesting concepts regarding the systems. This is important, since the systems are still relatively new and future researchers will look back to make links from what is written about now.

The first area for research is UAV doctrine and usage during the Gulf War. UAV doctrine is still in its infancy, but analysis of doctrine used at the drone groups or squadrons may be beneficial for understanding many connections to how UAVs were used in that time. The importance of UAVs echoes from the time before the Gulf War and taking the thread of use, opportunity, and doctrine development may shed light on important information.

The second area for future study involves the human factors involved with UAVs. Throughout history, these systems have been used out of necessity, with little consideration for physiological factors. Often the ground control stations from which pilots fly are not ergonomic or comfortable. Scrutinizing how human factors have evolved for UAS pilots and how the stresses, morale, and operations tempo have affected UAS operators in comparison to manned aircraft could reveal interesting information.

A third line of inquiry might be civilian and commercial progress and development in the UAV arena, specifically how and why it surpassed the military. One glaring reason is the profitable nature of maintaining research compared to the military. The military has too many cyclic changes to keep pace and too many divested interests. However, dissecting the civilian perspective on UAV advancement and marrying it to how it has affected military progress is important. Also, a critical vulnerability for the military is the chance that for-profit civilian organizations someday sell their weapons to another country. The fourth area for further research is the impact of the scenario if all Air Force aircraft became unmanned and how this might affect the culture of the Air Force. Although hypothetical, it looks at the psychology of the service. Aircrew have a notion that they are irreplaceable and unmanned aircraft personnel are not trying to replace all manned aircraft; however, at some point in the future, this may become a real possibility. Understanding what the psyche is and could be may help to provide organization-level realization. Many military jobs have been replaced due to technology and manned planes could become a thing of the past.

The fifth area for further research is an investigation of UASs as a revolution in military affairs. The technological age is a military revolution based on the capabilities it provides. The computer, Internet, and GPS, to name a few technologies, have altered how the military wages, commands, controls, and institutes the instruments of power, be they diplomatic, informational, military, and economic. Technology has altered war. A sub-area for examination is the development of the ground control systems, simplex and duplex signals, and other capabilities that enabled UAS to fly over long distances. Unmanned aircraft provide new ways of considering time, space, and purpose. The ability of an RPA to kill people from thousands of miles away gives the U.S. military a distinct advantage worthy of research.⁸⁴ ■

1. Peter Paret, Gordon Alexander Craig, and Felix Gilbert, eds., *Makers of Modern Strategy: From Machiavelli to the Nuclear Age* (Princeton, NJ: Princeton University Press, 1986), 779.
2. Geoffrey Parker, ed., *The Cambridge Illustrated History of Warfare: The Triumph of the West* (Cambridge, UK: Cambridge University Press, 1995), 340-341.
3. Parker, 341.
4. Walter J. Boyne, *Beyond the Wild Blue: A History of the United States Air Force, 1947-2007*, 2nd ed. (New York: Thomas Dunne Books/St. Martin, 2007), 24.
5. *Ibid.*, 26.
6. Boyne, 30.
7. Blom, 22.
8. *Ibid.*, 22.
9. Laurence R. Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles* (Reston, VA: American Institute of Aeronautics and Astronautics, 2004), 1.
10. Wayne Hammack, Unit History of the 3205th Drone Group: Jan 54 through Jun 54, Box K-GP-TEST-3205-HI (January-June 1954)-KP-GP-TEST-3205-HI (January-June 1955), File K-GP-TET-3205-HI (Drone), January-June 1954: 1, Air Force Historical Research Agency, Maxwell Air Force Base, AL. While the day of inception was 1 June 1951, the unit was originally called the 3200th Drone Group until 1 December 1951 when it was redesignated the 3205th Drone Group.
11. *Ibid.*
12. Lt. Col. Walter C. Cannon, Briefing, USAF Drone Program Operations, 10 June 1954, Box K-GP-TEST-3205-HI (January-June 1954)-KP-GP-TEST-3205-HI (January-June 1955), File K-GP-TET-3205-HI (Drone), January-June 1954, Air Force Historical Research Agency, Maxwell Air Force Base, AL.
13. Hammack.
14. *Ibid.* Of note, this mirrors the challenges of remotely piloted aircraft operators in the 21st-century. Maj Bishane Whitmore, in his capacity working for the wing headquarters at Creech Air Force Base, the hub of RPA operations in 2014, took a survey showing 70 percent of first-term officers were planning on getting out of the military because of conditions. Their main reasons were location, amenities, and lack of occupational growth opportunities. The same types of issues were seen in the mid-1950s.
15. Newcome, 71. Residual radiation was a concern for aircrew. Some U.S. pilots flew data-gathering missions over Bikini Atoll in the Pacific immediately after the nuclear tests in 1946. The radiation effects revealed the "dirty" aspects of nuclear weapons and the dire need for unmanned options.
16. Paret et al., 738-740. The NSC-68 was a key document during the 1950s that recognized the advantage that the hydrogen bomb provided; however, this advantage diminished as the Soviets developed their own nuclear weapons. The document discussed that the main option for the president was to build combat capability and conventional forces.
17. Steve Zaloga, *Unmanned Aerial Vehicles: Robotic Air Warfare, 1917-2007* (Oxford: Osprey Publishing, 2008), 11.
18. Dave Sloggett, *Drone Warfare: The Development of Unmanned Aerial Conflict* (New York: Skyhorse Publishing, 2015), 74-75.
19. John D. Blom, *Unmanned Aerial Systems: A Historical Perspective* (Fort Leavenworth, KS: Combat Studies Institute Press, 2010), 55.
20. Blom, 55-56. The Firebee needed a new engine and increased fuel capacity to increase the range by 1,200 miles. Additionally, the wings needed to be larger to support those improvements.
21. Thomas P. Ehrhard, *Air Force UAVs: The Secret History*. Arlington, VA: Mitchell Institute Press, 2010. Accessed 21 September 2015. <http://aviationweek.com/site-files/aviationweek.com/files/uploads/2015/05/1970-%20UAVs%20in%20the%20Vietnam%20War.pdf>, 6.
22. *Ibid.*
23. Richard Whittle, *Predator: the Secret Origins of the Drone Revolution* (New York: Picador, 2015), 21.
24. Ehrhard, 6.
25. Whittle, 21.
26. Blom, 56.
27. The sped up acquisition and development process used by Big Safari is called "rapid prototyping" today.
28. Ehrhard, 6.
29. Whittle, 21.
30. Newcome, 71-72.
31. Blom, 55. The data points collected laid the framework for future development, as UASs became more capable leading into the late 1990s and early 2000s.
32. *Ibid.*
33. *Ibid.*, 56-58.
34. Ehrhard, 7-8.
35. *Ibid.*, 8.
36. *Ibid.*, 5.
37. Richard Stewart, *The U.S. Army Campaigns of the Vietnam War: Deeping Involvement 1945-1965* (Washington, DC: Center of Military History, 2012), 5-7.
38. HistoryNet, "Vietnam War: Facts, Information and Articles about the Vietnam War," accessed 6 January 2016, <http://www.historynet.com/vietnam-war>.
39. Andrew J. Birtle, *U.S. Army Counterinsurgency and Contingency Operations Doctrine, 1942-1976* (Washington, DC: Center of Military History, U.S. Army, 2006), 362-363.
40. Paul W. Elder, Project CHECO Southeast Asia Report. Buffalo Hunter 1970-1972. Hickam AFB, HI: Pacific Air Forces CHECO Division, 1973. Accessed 3 October 2015. <http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA486697>, xi.
41. Zaloga, *Unmanned Aerial Vehicles*, 12. The Lightning Bug was extremely beneficial for aerial reconnaissance but operated poorly during the monsoon months of November through March as most targets were obscured by clouds.
42. Newcome, 83.
43. Zaloga, *Unmanned Aerial Vehicles*, 12.
44. Sloggett, 80-81.
45. Line replaceable modifications refer to new hardware or software that provides a specific capability. This capability can be added to the aircraft when a specific mission requires it and removed for other flights, which provides an aircraft fleet the greatest flexibility.
46. Sloggett, 80-87. The low-altitude version of the Lightning Bug normally flew at 500-540 knots but could go upwards of 590 knots if needed.
47. Zaloga, *Unmanned Aerial Vehicles*, 14.
48. Newcome, 83.
49. Elder, 6.
50. Newcome, 84. For missions over China, the DC-130s took off from Kadena Air Force Base at dawn, launched the drone off to China at noon on its two-to-three hour preprogrammed mission (no en route corrections were made), and then returned to Kadena. Meanwhile, the drone returned over Taiwan, where it deployed a parachute over a predesignated location, and a second C-130 flew it back to Kadena that evening.
51. Elder, 4-6. The \$200,000 price per drone in 1966 equates to approximately \$1,460,000 in 2016.
52. Newcome, 84.
53. Zaloga, *Unmanned Aerial Vehicles*, 14.
54. Ann Rogers and John Hill, *Unmanned: Drone Warfare and Global Security* (New York: Pluto Press, 2014.), 22.
55. Sloggett, 81.
56. Rogers and Hill, 22. Future generations of UASs tried to

overcome the delayed timeline in recovering. As technology developed, the capability to transmit full-motion video decreased the time-space gap, increasing the speed of commander decision cycles.

57. Rogers and Hill, 22. According to Paul W. Elder, the camera loaded on the low-altitude variant was a Fairchild 415Y (still picture, rotary prism, moving film, and panoramic type) designed specifically for the low drone. It provided 180 degrees of lateral coverage transverse to the flight path (i.e., horizon-to-horizon) when the drone flew straight and level. Carrying 1,800 feet of 70-millimeter film at 1,500 feet of altitude, the camera was capable of 120 nautical miles of continuous longitudinal (along-track) photographic coverage with 60 percent frame overlap. The usable lateral coverage (swath width) was three nautical miles from 1,500 feet and one to two nautical miles from 500 feet. The nadir resolution of the camera, which had a three-inch focal length, was an optimum six inches at 1,500 feet and one foot at 1,000 feet. Elder, 3.

58. Newcome, 86.

59. Richard H. Kohn and Joseph P. Harahan, eds., "Air Interdiction in World War II, Korea, and Vietnam: An Interview with Gen. Earle E. Partridge, Gen. Jacob E. Smart, and Gen. John W. Vogt, Jr." USAF Warrior Studies. (Office of Air Force History, Washington, DC, September, 1986), 88.

60. Sloggett, 81-82.

61. Sloggett, 82-83.

62. Newsome, 83.

63. Zaloga, *Unmanned Aerial Vehicles*, 14-15. "Ace" status within the Air Force has always been culturally important. To achieve it, traditionally, a person has to shoot down five enemy aircraft. During Vietnam, only five U.S. aviators earned ace status from their work strictly in Vietnam. Two were pilots, and three were weapon systems officers (Air Force) or radar intercept officers (Navy). Robin Olds earned his third ace in Vietnam, but only four of his overall 16 kills were in Vietnam; the rest were in World War II.

64. Zaloga, *Unmanned Aerial Vehicles*, 14. Lightning Bug use fluctuated during its employment in Vietnam. Notable increases in UASs flights occurred during the Tet Offensive on 30 January 1968 and during Operation Linebacker in 1972.

65. Blom, 58.

66. Blom, 62. This was an important conundrum for the Air Force to address because the pilots' beliefs resulted in decreased morale in drone units. Pilots who were sent to those units felt as though their careers were over or assumed that they were at the bottom of the pack when compared to their peers.

67. Newcome, 85.

68. One significant event in October 1965 helped the perceptions of UAS. In a joint U-2/RB-47/Lighting Bug mission, the drone purposely drew SA-2 fire while the U-2 and RB-47 stood aside to record and report on the intercept tactic used. That cooperation for a common cause—plus the visual impact of watching what a SAM could do to an aircraft—helped convert reconnaissance pilots.

69. MSgt Vincent L. Daubenspeck, Report. History of the 432d Tactical Drone Group: Davis Monthan Air Force Base Arizona, 1 October–31 December 1976, Box K- GP-RCN-432-HI (October–December 1976) – K-GP-RCN-432-HI (January–June 1977), File K-GP-RCN-432-HI (1 October 1976–31 December 1976): 1-1, Air Force Historical Research Agency, Maxwell Air Force Base, AL.

70. *Ibid.*, 4-2.

71. The lack of a career path decreased morale in the units because it accentuated the destructive effect that UAS assignments had on traditional pilots. This issue also surfaced in the RPA community of the 21st century. The lack of career path and development led to many people leaving the military because their careers were stifled.

72. Daubenspeck, 2-1.

73. Barry Miller, "Unmanned Aircraft Gain Favor, *Aviation Week and Space Technology* 7, no. 4 (November 1970): 67.

74. Gen John D. Ryan, Memorandum, Tactical Drones, 5 June 1971, Box

168.7041-41 (May 1971)–168.7041-54 (July 1972), Air Force Historical Research Agency, Maxwell Air Force Base, AL.

75. Robert Hotz, "The Promise of RPVs," *Aviation Week and Space Technology* (January 1973): 7.

76. The ground-control station is a box where the pilot or operator sits when flying the aircraft. In modern-day RPA employment, the ground-control station is called a "cockpit" to indicate that it is where the pilots sit to fly the aircraft.

77. Sloggett, 87.

78. Kohn and Harahan, 88.

79. Blom, 61.

80. RQ-1 stands for R = "Reconnaissance," Q = "Unmanned" first version, which changed to M = "Multi-role." The change happened soon after 11 September 2001, when senior military leaders realized these long-duration aircraft needed the capability to strike time-sensitive targets if necessary.

81. Sloggett, 87-88.

82. Newcome, V.

83. John P. Kotter, *Leading Change* (Boston, MA: Harvard Business Review Press, 2012), 23.

84. Rogers and Hill, 144-146.



A U.S. Air Force Ryan BQM-34A Firebee drone. (SSgt. Daniel C. Perez, USAF)

Unmanned Aircraft in Israeli Air Operations

by John F. Kreis

Because unmanned aerial vehicles (UAV or drones) are able to carry out several types of missions in high threat areas, to operate surreptitiously, or to avoid the difficulties attendant upon the capture by one country of the pilot of another country's intruding airplane, they have received a good deal of military attention recently. Despite the interest, these aircraft are not new to combat; their earliest development dates to 1917. (see Kettering "Bug" on the cover.)

The U.S. Air Force flew thousands of unmanned reconnaissance sorties over North Vietnam and China during the Southeast Asian War. With strong links to the American UAV development community, Israel purchased American built UAVs, used them cleverly against her foes, and then produced its own series of pilotless airplanes. The most recent Israeli use was during the Beka'a Valley fighting in 1982, where UAVs provided crucial electronic and combat intelligence to support both the air and ground forces. For an extended period before the fighting, the Israel Defense Force (IDF) used unmanned aerial reconnaissance to study potential opponents.

True to Israel's traditional practices of secrecy and disinformation, however, its officials have made few public disclosures on their methods of deception and operations leading up to and during the 1982 clash with Syria. Israel's success in 1982 raises again the question of whether technology or tactics and preparation are most important in warfare. This article is an exploration of the subject, taken from a review of open, unofficial literature. The sources are diverse, and not always verifiable. The conclusions are necessarily tentative, are solely those of the author, and are cautiously offered in the hope that they may help improve the understanding of the uses of unmanned aircraft in modern war.¹

Israeli Use of UAVs Pre-1982

The Israeli use of unmanned air vehicles in combat was not new in 1982, but reached a high point in conflict with the Syrians that year. Earlier, the Israeli Air Force (IAF) had used UAVs both for reconnaissance and as decoys since the early 1970s. It is possible that the Israelis used UAVs as attack aircraft during the October War of 1973. The first Israeli use of unmanned aircraft in combat took place after the August 1970 cease fire that ended the 18-month War of Attrition between Egypt and Israel. The terms of that agreement, brokered by the United States and Soviet Union had restricted the IAF's ability to carry

out long range manned flights over Arab territories. In its need for intelligence about its enemies, Israel turned to unmanned aerial reconnaissance. To carry out the information gathering, Israel employed Teledyne-Ryan FIREBEEs as well as a number of Northrop CHUKAR aerial targets also in her inventory. The Israeli government has not disclosed the frequency of such flights, their precise purpose and nature, or the full extent of their accomplishments, but there seems little doubt of their existence.²

During the 1973 October War, the Israelis took initially heavy aerial losses attributable to dense enemy AA gun and surface-to-air missile (SAM) defenses. To reduce the losses, the IAF's commander, General Benjamin Peled, hit upon the idea of using UAVs as a way of breaking through the Egyptian defenses along the Suez Canal. Peled sent a number of these unmanned air vehicles toward Egyptian radars as decoys, arrayed as if they were manned aircraft intending to attack. Fighter bombers followed, their pilots ready to strike once the defenders disclosed their locations by turning on their gun or missile fire control radars, or had fired their missiles at the wrong targets. Apparently, to further confuse the radar operators, the decoy aircraft also discharged chaff on their run toward the Egyptians.

While fighting with Egypt, Peled combined unmanned decoy aircraft, chaff, electronic countermeasures, and varying approach patterns and times with the firing of large numbers of SHRIKE antiradiation missiles at SAM radars. It is possible that the Israelis armed some of their FIREBEEs with SHRIKES, using the unmanned weapons to make attacks on the radar sites that would otherwise have been enormously hazardous for pilots. Peled's tactic was to use enough antiradiation weapons to force his enemy to shut down a given area's radar operation. Once this was accomplished, he then attacked the vulnerable SAMs and AA guns themselves. One FIREBEE is reputed to have drawn the fire of 32 missiles and returned to its home base intact. If true, that was a most impressive cost/benefit ratio.³

After the 1973 war and evidently as a derivative of the Israeli success, the U.S. Air Force experimented with FIREBEEs armed with both SHRIKES and electro-optically guided bombs. Simultaneously, the Americans began development of a series of small UAVs called PRAEIRE and CALERE that were to carry television and laser target designation equipment (the PRAEIRE), and a forward looking infrared imaging instrument and a laser designator

Unmanned Aircraft in Israeli Air Operations



The Israeli Scout aircraft in flight. Note the underbody blister housing the television camera. The UAVs used in 1982 resembled this late model, but lacked the antenna for updated command and control data link. The SCOUTs that overflew the Beka'a Valley used a very simple data link, subsequently changed to avoid jamming and attempts to take over the aircraft by enemy units. Scout is retrieved in a net. (IAI photos)

(CALERE). Israel, too, completed early feasibility studies of small unmanned air vehicles. The unmanned American FIREBEE weapon received the designations BGM-34A/B and C. The Americans soon abandoned the experimental attack FIREBEE project, but pursued the design of the smaller unmanned aircraft to the AQUILA project that ran until 1988, as well as other developmental and operational UAVs.

Mini-RPVs

During the same period, Israel continued its interest in remotely piloted reconnaissance and attack weapons, adding the use of so-called mini-RPVs in the late 1970s. The United States authorized sale of several PRAEIRE IIBs to Israel in 1977. Those sales probably included the imaging and target designation technology, the application of which was the purpose of the American developmental effort.⁴

Tadiran, Ltd., of Israel first flew its MASTIFF Mk I mini-RPV about 1978. The aircraft's wingspan was 13 feet 9 1/2 inches; its overall length 8 feet 6 1/4 inches. The MASTIFF had a very low radar signature. An improved version, the Mk II, went into production about 1980; it too had low radar and infrared signatures. The Mk II could carry a television camera or a forward looking infrared (FLIR) unit, and various electronic packages; its data link could transmit information or video images from southern Lebanon and southwestern Syria. A slightly larger craft, Mazlat's SCOUT, came into production about the same time as the MASTIFF Mk II. The SCOUT carried a television camera or FLIR in a belly blister, allowing 360 degree surveillance. SCOUT had a low radar signature due to its small size, fiberglass wings and tailbooms, and inward

canted tail fins and rudders. Like the MASTIFF, SCOUT could transmit from southern Lebanon and southwestern Syria to its control station. The video transmission distances, while seemingly short, were adequate for the surveillance needed by the IDF. The first active roles for the small UAVs seems to have been border control and counter-PLO operations.⁵

In April 1981, Syria moved three SA-6 missile batteries into Lebanon's Beka'a Valley. With anti-aircraft missiles so near its borders, and posing a threat to air operations over Lebanon, the Israeli government decided to destroy them in an attack set for April 30. On the 30th, however, heavy clouds obscured the target, forcing a delay. Then, on May 1st, the United States intervened diplomatically, seeking to defuse the volatile situation, and attaining a temporary respite. That Israel had been fully prepared to reveal its new SAM suppression tactics at that early stage, however, indicated the severity with which she viewed the situation. The delay in Israel's preemptive strike allowed her to continue surveillance while practicing and refining tactics.⁶

A string of reports of Israeli losses of unmanned air vehicles emerged in the world's press as tensions along the Lebanese-Syrian-Israeli border continued. The first account appeared in the New York Times, datelined Syria, May 15, 1981; it noted that Syrian SA-6 missiles had downed an Israeli drone, apparently one of three aircraft flying near each other. The UAV was not specifically identified, but the description of "stubby wings," and a 4-foot long tail section parachuting to earth implied not a mini-RPV, such as MASTIFF or SCOUT, but a FIREBEE or CHUKAR, both of which used a parachute recovery system. The Syrian employment of a high speed (mach 2.8) SA-6 with its radar guidance

Unmanned Aircraft in Israeli Air Operations

system and minimum engagement distance of four kilometers indicates they were after a target they probably believed to be much larger than a SCOUT or MASTIFF. After the May 15 incident, and as an apparent warning to Syria, Israel's Prime Minister, Menachem Begin, stated publicly that the Syrian missiles in Lebanon posed "a danger to our national security."⁷

A later New York Times article, datelined Jerusalem, May 26, 1981, reported that the Syrians had shot down another drone, and that Israel had acknowledged the loss of three unmanned reconnaissance vehicles to Syria. As before, the Israelis refused to disclose the type of aircraft lost. Then, on January 30, 1982, Flight International magazine reported that the Israeli Ministry of Defense (MoD) confirmed the loss of a total of five drones. The article went on to relate that Syrian missiles had shot down at least one small propeller driven aircraft while an Israeli RF-4 followed at high altitude, probably (although not so stated by the Israelis) to record fire control and ECM data. Later that year, tensions between Israel and Syria boiled over as Israel launched its Operation Peace for Galilee, hoping to drive the PLO from its Lebanese base.⁸

UAVs in Lebanon

The actual Israeli invasion of South Lebanon began on June 6. From the start, unmanned aerial reconnaissance craft sent critical intelligence information to the ground commanders. It was not until the 8th that the Syrians entered the fighting, with air battles starting on the 9th. The Israel Defense Force probably anticipated for some time the inevitability of a fight with Syria under such circumstances. The Israelis seem to have structured the UAV flights as an 18-month long series of tests to provoke and to evaluate Syrian reactions and practices, and to form a basis for wartime countermeasures.

In the 1982 incursion, Israel intended the fighting to be limited to Lebanon if possible. With Syria as a combatant, the extensive Syrian air defenses combined with the government's decision not to attack Syrian airfields posed a problem for the IAF, which for years believed that air superiority was best achieved by destruction of its enemy on the ground at its bases. Israeli air commanders historically have intended that active air defense be outside of Israel, not over the small and potentially vulnerable country itself. By 1982, the high speed of both sides' aircraft, the very small combat area, dense SAM dispositions in eastern Lebanon and Syria, and Israel's warfighting doctrine combined to create a very difficult problem for the IDF: how to quickly reduce Syrian air defenses and give the IAF its sought after air superiority.⁹

After grappling with the heavy defenses and hardened airfields during the 1973 October War, Israel had sought an alternative warfighting philosophy. The Israelis found their new approach in two parts, both of which

enrolled the use of UAVs. First, the IAF mapped the Syrian ground defense's locations, practices, and electronic profiles and vulnerabilities for several months. Second, from the very beginning of fighting, small Israeli UAVs orbited over Syrian forces in Lebanon and over Syrian airfields. From the airfields, the small aircraft transmitted video reports of aircraft take-offs. With that information, the IAF's airborne controllers stood ready to direct fighter pilots toward the kill.¹⁰

Israeli warfighting has always made use of surprise, guile, or innovative tactics such as the 1973 use of decoy and attack drones. It seems that on the morning of June 9, 1982 IAF pilots flew toward the missile defenses, possibly already alerted by decoy UAVs, then launched DELILAH and SAMSON decoys, causing the Syrian defenders to turn on their fire direction radars. Attacks by aircraft with standoff radar homing missiles, by a newly developed surface-to-surface missile called the Ze'ev, or Wolf, and by artillery soon followed. The result was destruction of 17 of 19 Syrian SA-6 missile batteries, plus several SA-2 and SA-3 launch sites. The two remaining SA-6 sites and some replacement missiles brought in overnight fell to the same Israeli tactics on the 10th.¹¹

At the same time, Israeli air controllers watched the pictures coming from cameras in the mini-RPVs orbiting above Syrian fighter bases. Crewmen aboard Israeli command and control aircraft then guided IAF fighters to intercept the Syrians, while electronic warfare units jammed Syrian air control frequencies. The result was a loss of 23 Syrian MiG-21s and -23s on June 9 and 10, with no reported aerial combat losses of Israeli jets (one IAF fighter apparently was shot down by SA-7 weapons; at least three other losses came from undisclosed causes). By the end of July 1982, Syria had lost 85 jet fighters in a continued series of air battles.¹²

Comparing 1967 and 1982

The precision with which the Israelis operated in June of 1982 was reminiscent of the June 1967 war between Israel and the Arab states. At that time, Israel scored an astonishing victory in a series of air strikes that wiped out virtually all of the Arab air forces. The 1967 strikes were preceded by months of intensive training in the Negev desert against targets made to look like specific Arab air bases. On the morning of that 1967 attack, the IAF's pilots flew toward the targets at extremely low altitude and in complete radio silence. Back home, each airfield broadcast tape recordings of normal flying transmissions that completely fooled the Arabs. There may have been much of the same type of practice and deception prior to the 1982 conflict, but its extent has not been made known by the Israeli MoD.¹³

Nonetheless, it seems fairly evident that the Israelis stalked the Syrian air defenses for at least a year and a half before the Lebanon fighting. This was not done with

a specific date in mind for the war's beginning. Rather, it came from the certainty that there would be trouble and that Israel would not be caught short when it came. The repeated Israeli electronic surveillance blended the IDF's traditional guile and deception with its desire for surprise. In their usual circumspect way, the Israelis told reporters only some of what they were up to in 1981 and early 1982. In doing so, they almost certainly tried to mislead the Syrians as to the extent, purpose, and vulnerability of their reconnaissance. They seem to have succeeded. The result was the lopsided combat tally not only of surface-to-air missiles destroyed on the 9th of June, but also of Syrian planes shot down in the ensuing fighting.

Jane's Defense Weekly on October 5, 1985 summarized Israel's electronic warfare operations during the 1982 conflict that destroyed 19 SA-6 batteries and downed some 80 Syrian MiG fighters. The story was based upon an unspecified University of Pennsylvania study which claimed that Israel used reconnaissance UAVs accompanied by RF-4E aircraft during the year before the Bekaa Valley fighting (approximately June 1981 to June 1982) to seek out and record data on Syrian defenses deployed in Lebanon. The same story also included a discussion of Israel's use of aerial decoys (DELILAHs and ECM-equipped SAMSONs) to entice the Syrians to turn on their fire direction radars, thus making them excellent targets for both airborne and ground launched antiradiation weapons.¹⁴

The news stories are interesting in light of the often made assertion that small, remotely piloted air vehicles are virtually undetectable, and difficult, if not impossible, to shoot down. If it is indeed true that small UAVs are so hard to hit, then one must assume that the Israelis made their small reconnaissance aircraft vulnerable by use of radar reflection enhancement techniques during the months that they patiently charted and recorded Syrian reactions. In fact, Lt. Gen. Rafael Eitan, Israel's Chief of Staff in 1982, implied in an interview about a year after the fighting that his forces had done just that at some point, either before or during the 1982 clash. In addition to the small UAVs, the Israelis probably used the FIREBEEs and CHUKARs to draw AA responses. These latter craft were, of course, easier for radar systems to find and track, as the IAF well understood from its 1973 experience.¹⁵

Despite public speculation to the effect that the IDF's tactics included laser target designation by SCOUT or MASTIFF aircraft, there is little indication that such occurred or how such tactics may have been used. Possibly, Israel found it unnecessary in light of her other abilities, or perhaps development of such equipment had not reached a stage that allowed its use.¹⁶

Although General Eitan noted the loss of several UAVs during the fighting, he attributed them to technical and operational causes. To complicate any attempt at assessing the UAVs' combat effectiveness, the Israelis have

not stated the number of sorties required to support operations, the loss rates of UAVs in combat, or the losses they may have sustained in their pre-strike practices. From the earlier press accounts, the Syrians seem to have been able to hit even the small UAVs while in flight. Clearly, the unmanned aircraft were not invulnerable to ground fire, so we should be cautious in accepting Eitan's flat disclaimer. We are probably safe in assuming that combat losses were not great. Lacking specific information, however, it would be no more than speculation to assume the extent or causes of such losses.¹⁷

Israel's use of remotely piloted aircraft for more than a decade extended electronic warfare techniques in the modern battlefield. In addition to radar and communications jamming, the IDF relied extensively on unmanned aircraft to map, record and help analyze Syrian defenses for a long period before the actual fighting. Once fighting began, the UAVs continued in their role as surveillance platforms capable of returning real-time intelligence on enemy activity. That information was quickly and effectively integrated into the IAF's command and control process. The Israeli experience should be assessed carefully, however; what was effected in fighting in the compact area where Israel, Syria and Lebanon meet would not necessarily work in similar form elsewhere. As Martin van Creveld has pointed out, technology is best applied in warfare when it masks one side's strengths as it exploits an enemy's weaknesses.¹⁸

General Eitan noted that in 1982, tactics and training were far more important than Israel's technological advantage.¹⁹ Eitan was doubtless correct; but in retrospect, the combination of technological superiority and finely honed tactics produced an overwhelming edge for Israel.

Israel's exploitation of her enemy's weaknesses in 1982 was characteristic of the style of warfare practiced by her leaders since the country's founding in 1948. Some critics have said that Israel set herself up for long term trouble in exposing her most modern electronic warfare and command control secrets in a battle that brought no strategic advantage (and may, in fact, have created far more conflict than it eliminated). Whether or not that was true is as yet unclear. What was been unmistakable, however, was the superiority of Israel's tactics and preparation.

John Kreis is a retired U.S. Air Force officer and defense analyst who wrote the book, Air Warfare and Air Base Air Defense. He is preparing forthcoming works on airfield ground defense and the use of intelligence by AAF in World War II.

Notes

1. John F. Kreis, *Air Warfare and Air Base Defense, 1914-1973* (Washington, DC, 1988), p. 323; *Jane's All the World's Aircraft, 1975-1976*, pp. 75-76, 553.
2. Kreis, *Air Warfare*, p. 330; *Jane's, 1975-76*, pp. 75-76, 550, 553; The International Institute for Strategic Studies, *The Military Balance, 1981-82*

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(London, 1982), p. 52; Air Chief Marshal Sir Michael Armitage, *Unmanned Aircraft* (London, 1988), p. 85.

3. Interview, Brereton Greenhous with Gen. (Ret.) Benjamin Peled, Jan. 13, 1984 (Office of Air Force History). *Jane's*, pp. 553-554. 4. *Jane's*, pp. 75-76, 557; Kenneth Munson, *World Unmanned Aircraft*. (London, 1988), pp. 154-155.

5. Munson, *World Unmanned Aircraft* pp. 55-58; "Israel's Spies in the Sky, Major Israeli Intelligence Technology Thrust," *Defense Update/80*, pp. 43-45; Armitage, *Unmanned Aircraft*, pp. 82-84.

6. Benjamin S. Lambeth, *Moscow's Lessons from the 1982 Lebanon Air War*, RAND Report R-3000-AF (Santa Monica, CA, 1984), pp. 4-12.

7. John Kifner, "Syrian Soldiers Are Jubilant as Missile Brings Down Israeli Drone," *New York Times*, May 15, 1981, p. A-3; *Jane's Weapon Systems*, 1986-87, (London, 1986), pp. 104-105.

8. David K. Shipler, "Missiles From Syria Down Israeli Drone: Begin Makes Offer," *New York Times*, May 26, 1981, p. A-1; "Syrians Fire at Israelis," *Flight International*, Jan. 30, 1982, p. 212.

9. Kreis, *Air Warfare*, pp. 299-342; Lambeth, *Moscow's Lessons*, pp. 4-12; Shlomo Argov, "On Peace and Security: Perceptions and Principles of Israeli Security," Lecture at the Royal United Services Institute, Jan. 27, 1982.

10. Clarence A. Robinson, Jr., "Surveillance Integration Pivotal in Israeli Successes," *Aviation Week and Space Technology*, July 5, 1982, PP 16-17.

11. Lambeth, *Moscow's Lessons*, pp. 4-8; "An Israeli Lesson in Electronic Warfare," *Jane's Defence Weekly*, Oct. 5, 1985, p. 741; Armitage, *Unmanned Aircraft*, p. 85.

12. Lambeth, *Moscow's Lessons*, pp. 5, 8-10.

13. Interview, Brereton Greenhous with Gen. (Ret.) Mordechai Hod, Jan. 16, 1984, pp. 2-3 (Office of Air Force History); Kreis, *Air Warfare*, pp. 313-314.

14. *Jane's Defence Weekly*, Oct. 5, 1985, p. 741.

15. Interview of Lt. Gen. Rafael Eitan, Chief of Staff, IDF, in *Military Electronics/Countermeasures*, Feb., 1983, p. 101.

16. Paul S. Cutler, "ELTA Plays a Decisive Role in the EOB Scenario," *Military Electronics/Countermeasures*, January 1983, p. 136; W. Seth Carus, "The Beka'a Valley Campaign," *The Washington Quarterly*, Autumn 1982, p. 39. Although Cutter and Carus mention Israeli use of laser directed bombs, neither gives an authoritative source for his information. Robinson, in his *Aviation Week* article notes the Israeli capability for laser target designation, but does not claim that such was used.

17. Eitan, Int., p. 101; "Syrians Fire at Israelis," p. 212.

18. Martin van Creveld, *War and Technology from 2000 BC to the Present* (London, New York, 1989), p. 320. See also van Creveld's discussion of technical progress as decisive in war, pp. 218-219; on the formulation of doctrine, on the totality of factors and their use to best advantage, and on the countering of weapons and the idea that technology on its own will seldom decide a war's outcome, pp. 227-233.

19. Eitan Interview, p. 96.



IAI/Tadiran Mastiff III UAV at Muzeyon Heyl ha-Avir, Hatzirim airbase, Israel. March 3, 2006 (Source: Wikimedia Commons Photo by Bukvoed)

PREDATOR: A PERSONAL HISTORY



An MQ-1 Predator, armed with AGM-114 Hellfire missiles, piloted by Lt. Col. Scott Miller on a combat mission over southern Afghanistan. (U.S. Air Force Photo / Lt. Col. Leslie Pratt)

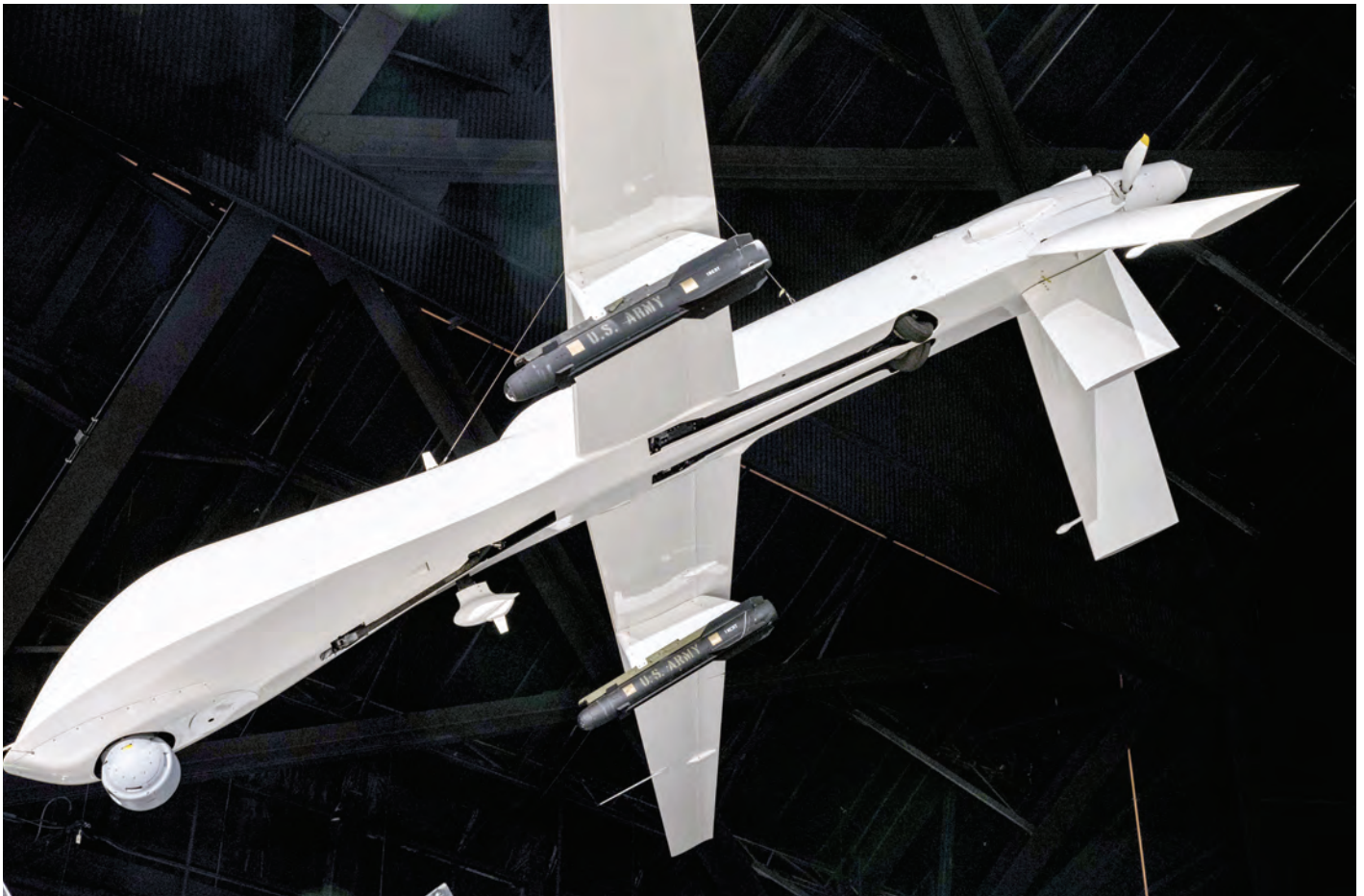
James Clark

The history of the Unmanned Aerial Vehicle (UAV) or drones can be traced back as early World War I, use of unmanned flying bombs such as the JU-88/FW-180 and B-24's in World War II, in Vietnam reconnaissance drones flew over Hanoi and Haiphong. But it wasn't until the late 1990's that UAVs came of age in the skies of Bosnia and Kosovo, and it was called Predator.

In an age of Supersonic Fighters, Stealth Bombers, and precision-guided weapons, the Predator was the most unusual hero. It was a 48-foot glider with an Austrian snow mobile engine and a TV camera racing through the skies at a blistering 70 knots. But what the Predator did was solve one of the most basic commanders problems; what threats lay on the other side of the hill. Predator solved that problem by electronically downloading a TV picture over enemy territory to the battlefield commander miles away, but what was even more remarkable was that the aircraft could be controlled from hundreds and now thousands of miles away through the use of some very creative communication satellite technology. Now a commander on the ground and the President in Washington could see the battle in real time. What is even more remarkable is how quickly this "transformation" technology was developed, fielded in combat, and quickly modified to meet the emerging enemy threat. In a time where weapons systems are developed over a series of year, the Predator's wartime capabilities were modified in days and weeks. A great example of "Yankee technology" in the 21st century. This Vignette is a personal account of some of this history.

The Predator was born in 1994 as an advanced concept technology demonstration (ACTD). Rather than test it in the safe skies over Nellis AFB, Nevada, the Predator was raced into action in Albania in 1996 and was deployed to Operation Joint Endeavor in Bosnia. It was there that our paths crossed, General Ronald Fogleman, Chief of Staff, United States Air Force wanted someone with no UAV experience to take an objective outsider's look into Predator operations. As an Air Force Colonel assigned to the Pentagon, I was "volunteered" to do the study. What I found was remarkable, this little drone could fly hundreds of miles away, provide colored TV and infrared video surveillance of enemy activity without risking the life of a pilot. In a control van, which was a converted NASCAR car transporter trailer, I watched pilots and sensor operations sitting in front of computer screens actually flying this thing: simply remarkable. After my report was done, I was convinced that the Predator and I would go our own separate ways...I was wrong!

On April 2, 1999, while sitting at my desk at the Pentagon, the phone rang, it was General Michael Ryan, Chief of Staff of the Air Force and he said, "Snake, I just got done talking to Lt General Mike Short, 16th Air Force Com-



General Atomics RQ-1 Predator on display in the Cold War Gallery at the National Museum of the U.S. Air Force. (U.S. Air Force photo by Ken LaRock)

mander and he needs the ability to get precision geographic locations of where the Predator TV is looking". I said, "It doesn't exist," he said, "I know...invent it!"

Forty-eight hour later, I was on a plane to NATO Combined Air Operations Center (CAOC) at Vicenza, Italy to invent "precision Predator". Operational Allied

Col. James "Snake" Clark, USAF (Ret.), born in Carney, New Jersey, is a 1973 graduate of the Catholic University of America Air Force Reserve Officer Training Corps (AFROTC) who served as a USAF officer and F-4 pilot, retiring at the rank of colonel in 2001. He has been described as one of the most colorful, innovative, and risk-taking U.S. Air Force (USAF) warfighters in the service's 70-year history. He served in the Senior Executive Service. In a career spanning five decades, he enabled numerous tactical and strategic capabilities which shaped our modern-day USAF. He was an early advocate of the Predator UAV/RPA platform. His efforts brought innovation that changed the calculus involved in combat operations for the USAF, sister services, allies, and perhaps our adversaries and competing powers. He is rightfully known as "The Godfather of the MQ-1 Predator." A more complete biography of Col. Clark is found in the front of the magazine in the Awards Program.

Force was to ensure the safety of the people of Kosovo. Predators were flying surveillance mission's 24 hours a day, identifying hostile/illegal activities. The rules of engagement were that moving targets had to be identified visually by a forward air controller before any air strike.



A control team performs function checks after launching an MQ-1 Predator unmanned aerial vehicle August 7, 2007, at Balad Air Base, Iraq. The pilot and sensor operator, will fly the Predator in a radius of approximately 25 miles around the base before handing it off to personnel stationed in the United States to continue its mission. (United States Air Force photo by Master Sergeant Steve Horton.)



A Predator receives maintenance attention during Operation Iraqi Freedom. (USAF Photo.)



Two weapons loaders mount a Hellfire missile on a Predator. (USAF Photo.)

In Kosovo, most villages and buildings looked the same so, “talking” the eyes of the strike pilot on to the target was a challenge. To solve this problem, we turned to a legendary Air Force group called “Big Safari”, who made the impossible routine. They recommended installing a laser designator on to the Predator to pinpoint accurate target locations from the Predator to the F-16’s. Within 18 hours, Big Safari had “borrowed” a laser designator from the US Navy and began testing. They deployed it in 38 days for its first combat mission. On the 39th day, the Serbs surrendered.

As part of the “lessons learned” from Operation Allied Force, it was determined that if the Predator had a weapon on it, we could cut the time between identifying a target and then destroying it. This is called the “Kill Chain”. General John P. Jumper, Commander, Air Combat Command and later, Chief of Staff of the United States Air Force, directed the weaponization of Predator with the Army Hellfire missiles. The original plan was a multi-year, multi-million dollar program. General Jumper thought that this was too long and too much, and told them to try again. In September 2000, real world events clearly demonstrated the immediate need for the weaponized Predator. General Ryan, who was the Air Force Chief of Staff, directed us to do this quick and dirty. Thanks to the magicians at Big Safari, 61 days later Predator #3034, chained to a test stand at the Navy Test Center, China Lake, fired the 1st Hellfire. The wings rocked and tail fluttered, but did not fall off (parts of that hellfire sits on my desk today).

Twenty-four days later on February 16, 2000, Predator #3034 took its first successful Hellfire shot from the air, and to all of our surprise, it worked! Through the spring and summer, we aggressively tested our new Predator capability.

The morning of September 11th, 2001 changed our lives and the future of the Predator. From my office in the Pentagon, we watched the attack on the World Trade Center until the explosion and shock of Flight #77 as it crashed into the Pentagon. Late on the evening of September 12th, a lone C-17 took off from an airfield

on the west coast with its cargo of Predators and Hellfire missiles. Days later, one of America’s 1st responses to the terrorist attacks on 9-11 was in place and ready for combat.

During Operation Enduring Freedom, combat operations in Afghanistan, the Hellfire Predator combination proved to be lethal against the Taliban. Today in Afghanistan and Iraq, armed Predators are patrolling the skies providing support and protection to U.S. and coalition forces being flow from 8,000 miles away at a base in the United States.

Predator #3034, the 1st UAV to test the Hellfire, and the 1st to shoot in combat on October 7, 2001, after serving many years in combat has returned safely to the United States and now awaits its place of honor at the Smithsonian National Air and Space Museum in Washington, DC. Our “unmanned hero”...Not bad for a glider with a snow mobile engine and a team of outstanding Americans who made it possible. ■

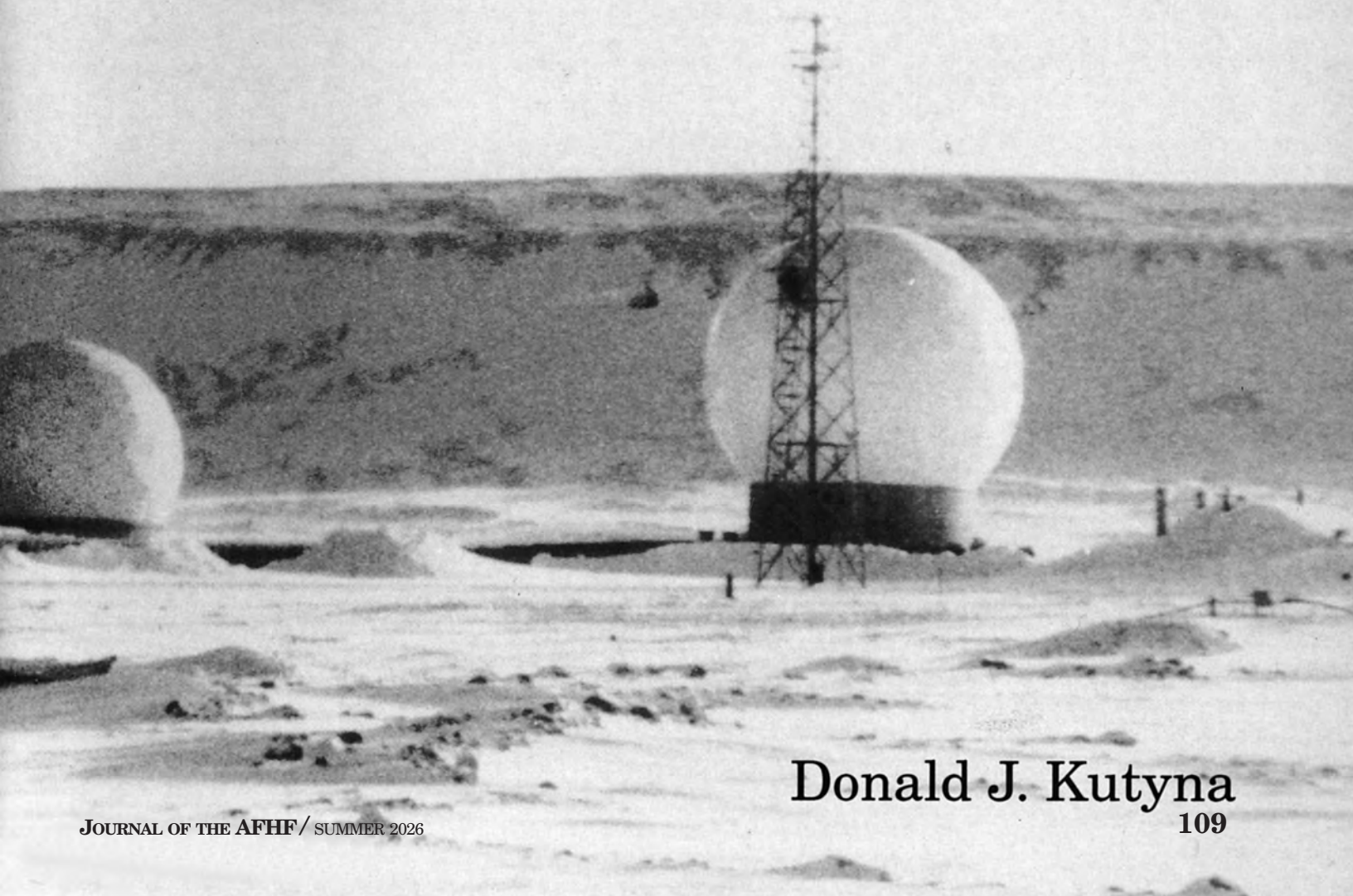


An MQ-1 Predator armed with an AGM-114 Hellfire missile flies a training mission. The MQ-1’s primary mission is interdiction and conducting armed reconnaissance against critical, perishable targets.

INDISPENSABLE:



SPACE SYSTEMS IN THE PERSIAN GULF WAR



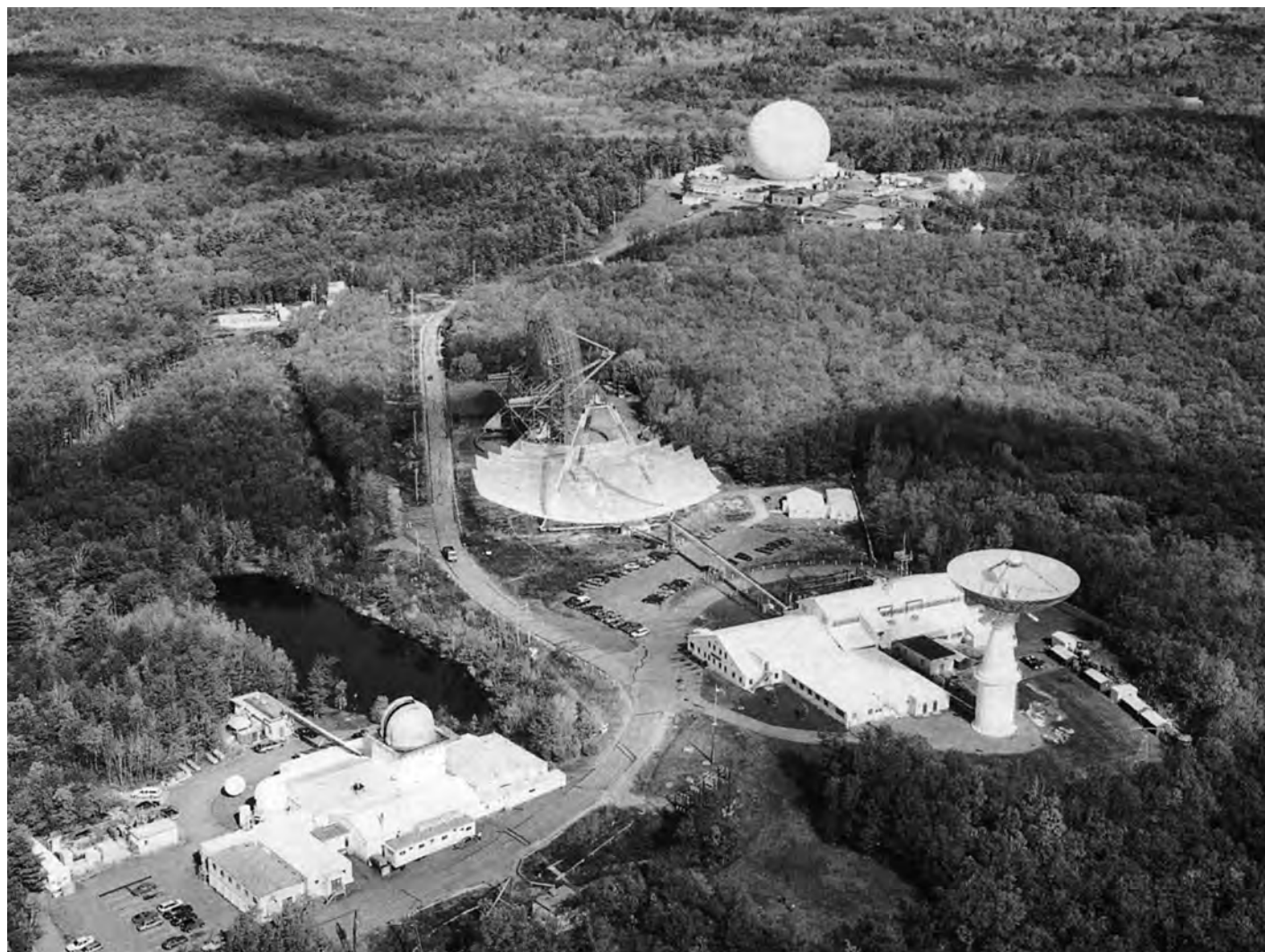
Donald J. Kutyna
109

(Overleaf) Ballistic Missile Early Warning System (BMEWS) site, Thule, Greenland.

(Below) Millstone, New Hampshire.

The Persian Gulf War was the first conflict where space played a major role in support of our land, sea, and air forces. And it marked the first time that combatants, at all levels, felt the presence and effect of our space systems on their missions. Indeed, our space forces were available before the war, during the war, and after the war, because they were already on orbit, and the space force structure is used just as much in peacetime as during times of crisis.

Worldwide navigation and weather information in peacetime, require the same satellites on orbit as during wartime. And, intelligence garnered from space, is probably more important before a crisis starts to avoid our being surprised. Essentially, the forces available in space before a war starts will be the same as those after it starts. That is fortunate because we could not have supplemented our space forces, even if we had wanted to during the war.

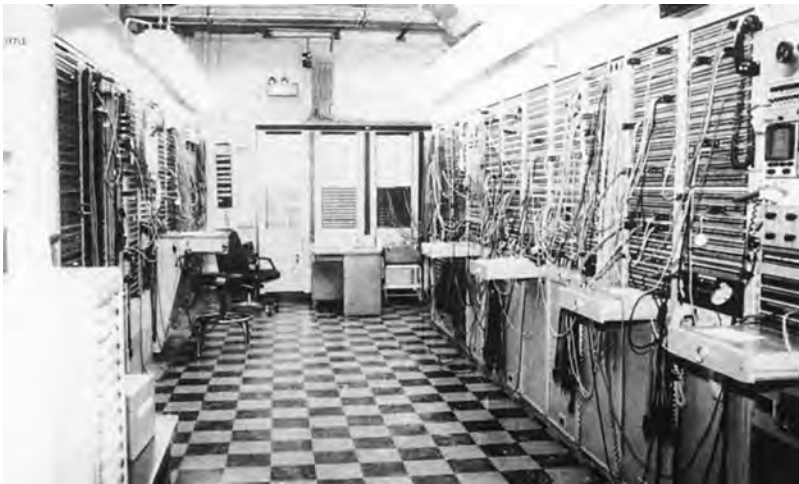


Gen. Donald J. Kutyna, USAF (Ret.) is Vice President, Advanced Space Systems, at Loral Corp. Before retiring in July 1992, he commanded NORAD, the U.S. Space Command, and Air Force Space Command. A graduate of West Point, he also earned an M.S. degree in aeronautics and astronautics from MIT. After his first USAF assignment as a B-47 combat crew commander he became a student and then staff director at the Aerospace Research Pilot School at Edwards AFB. During the Vietnam War, General Kutyna served with the 44th Tactical Fighter Squadron, completing 120 missions aboard the F-105. In 1982 he became deputy commander for space launch and control systems, where he managed the DOD Space Shuttle Program. In 1984 he was named director of Space Systems and Command, Control, and Communications at Headquarters USAF. In January 1986 he served as a member of the presidential commission that investigated the space shuttle Challenger accident. This article is based on General Kutyna's presentation at the Air Force Historical Foundation's symposium September 21-22, 1995 and published in the proceedings, The U.S. Air Force in Space: 1945 to the 21st Century, (Washington, D.C.: Air Force History and Museums Program, 1998).



(Above) The "Blue Cube,"
Onizuka AFB, California.
(Far right) Pave Paws radar
installation.

Space, to most people, suggests satellites on orbit. However, a large infrastructure of bases, command and control networks, and space sensors support those satellites. There were some sixty bases around the world, including Vandenberg,



(Above) Interior view of
remote tracking station.
(Right) Ballistic Missile
Early Warning System, site
1, Thule, Greenland.

Patrick, and Thule, as well as many installations manned by only four or five people on remote mountain tops who maintained space equipment.

Our major organizational entities in space are the United States Space Command and its Army,

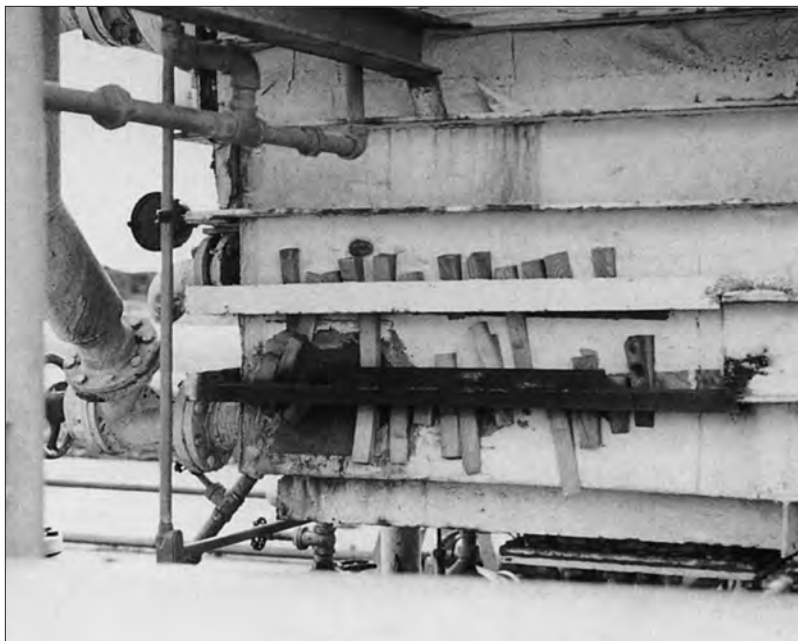
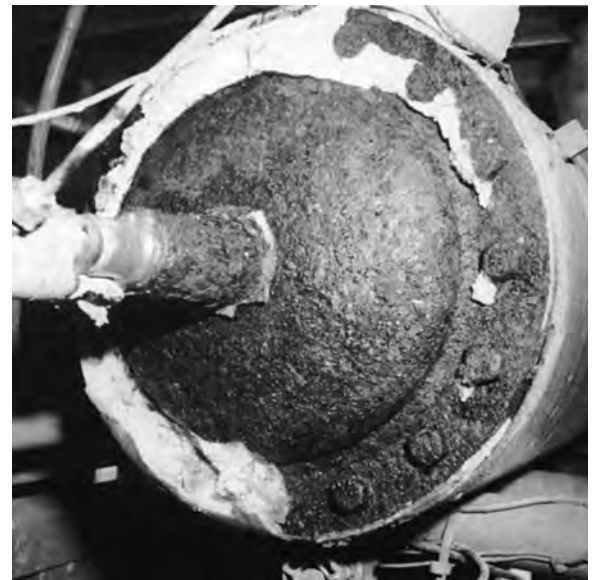




(Right) Rusting chiller at downrange tracking station.

(Below) Deteriorating chiller downrange.

Navy, and Air Force Space Command components. While, the Air Force held the lion's share of the funds and people invested in space, the contributions of the Army and Navy were also vitally important.

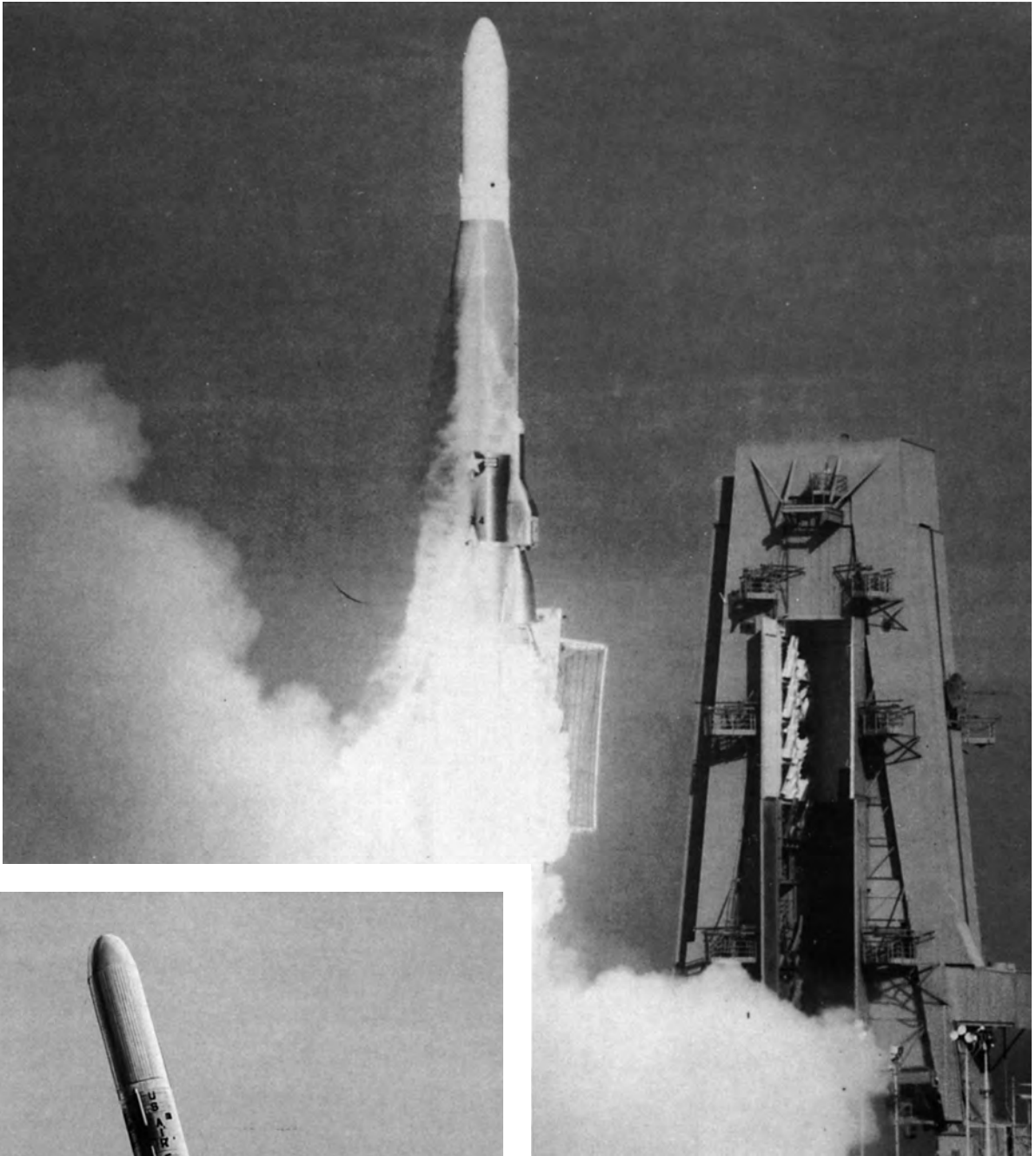


A cursory look at our range facilities today, suggests that they are in good shape. Upon closer inspection, however, a different picture emerges. The genesis of the problem stems from the early 1970s, when the United States decided to develop the Space Shuttle as a reusable launcher. Then, in February 1978, Congress halted production of any additional expendable launch vehicles. The expendable launchers went out of production in 1986. Coincidentally, that same year the Challenger accident occurred and the Shuttle was grounded. As a result, there were no launchers to substitute for the Shuttle. We tried, but could not gain approval, to fund more Titan launch vehicles and launch pad upgrades, resulting in an extended shutdown of military space launches after the accident.

(Left) Launch of space shuttle Challenger.

(Right) Launch of Atlas.

(Below) Artist's concept of Titan II in flight.



Today, the launch pads are held together by “wooden wedges and duct tape.” Major pieces of equipment are rusting and impede progress in the quest to modernize our operational space assets. The electronic equipment is not much better and “Radio Shack” boxes are launching billion-dollar satellites on our ranges. The same is true with range control centers. We are not using state-of-the art equipment, we are using 1960s technology.

As an example, to convert from a Titan to an Atlas launch set up requires going through a control room, pulling out cables, and reconfiguring them. We are acquiring new programs, such as the Evolved Expendable Launch Vehicle, which promise to fix many of these ills, and the space budget has risen significantly to modernize the ranges so that we can be more responsive in the future.

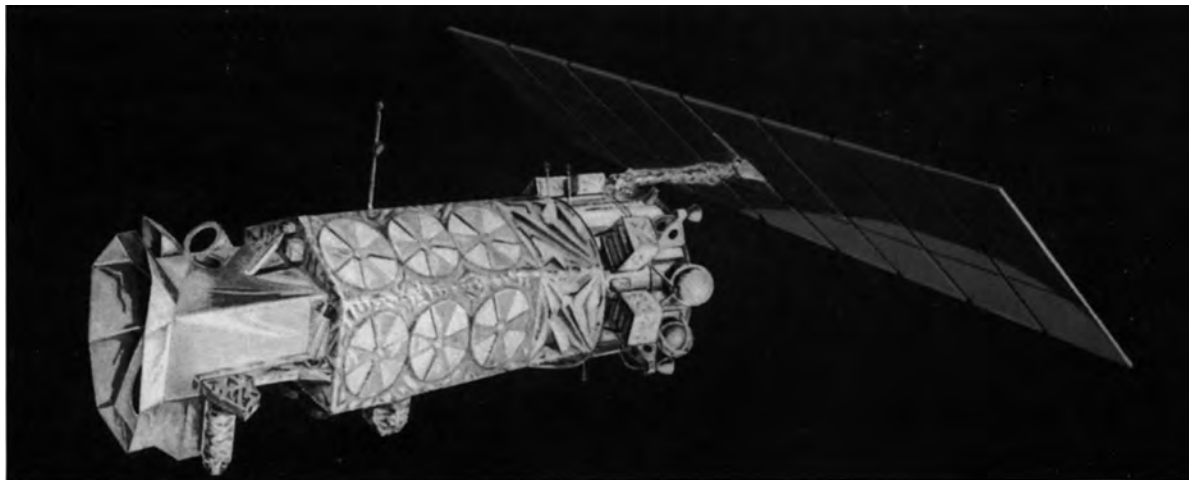
Launch of Atlas Agena at
Vandenberg AFB,
California.



Artist's concept of Delta II
in flight.

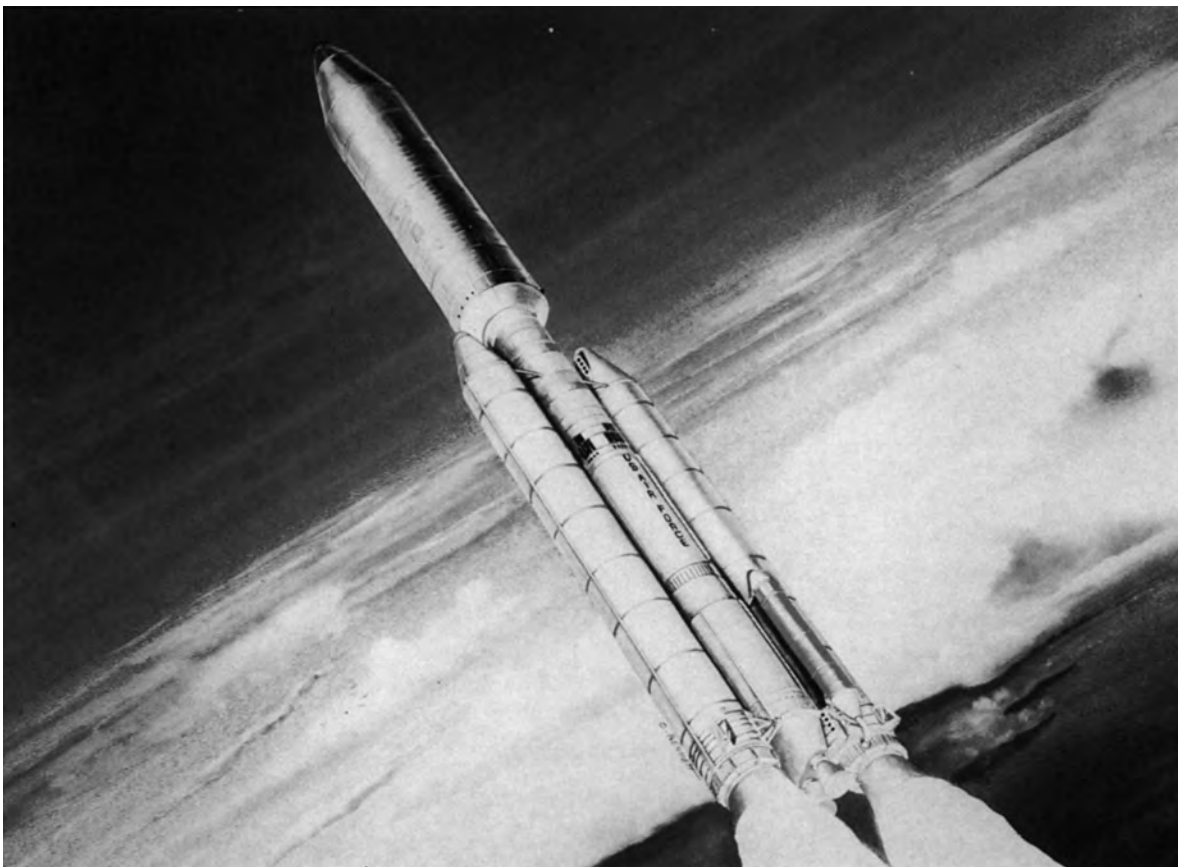


Artist's concept of a
Defense Meteorological
Satellite Program satellite.



There was a major impediment concerning our launch vehicles. The Space Shuttle no longer served DoD space operations, but we had many good expendable launch vehicles. Still, while the Titan IV carries heavy payloads to orbit, the process to get that booster off the ground takes anywhere from 200 to 270 days. The Gulf War was much shorter than that. It proved impractical to even consider getting off the ground in time to augment our satellite forces. The same was true of the Atlas, where processing time took from sixty to ninety days. The Thor/Deltas and Titan II vehicles had similar problems; it takes seventy to eighty days to process a Delta and almost 140 days for a Titan II.

Artist's concept of a Titan IV in flight.

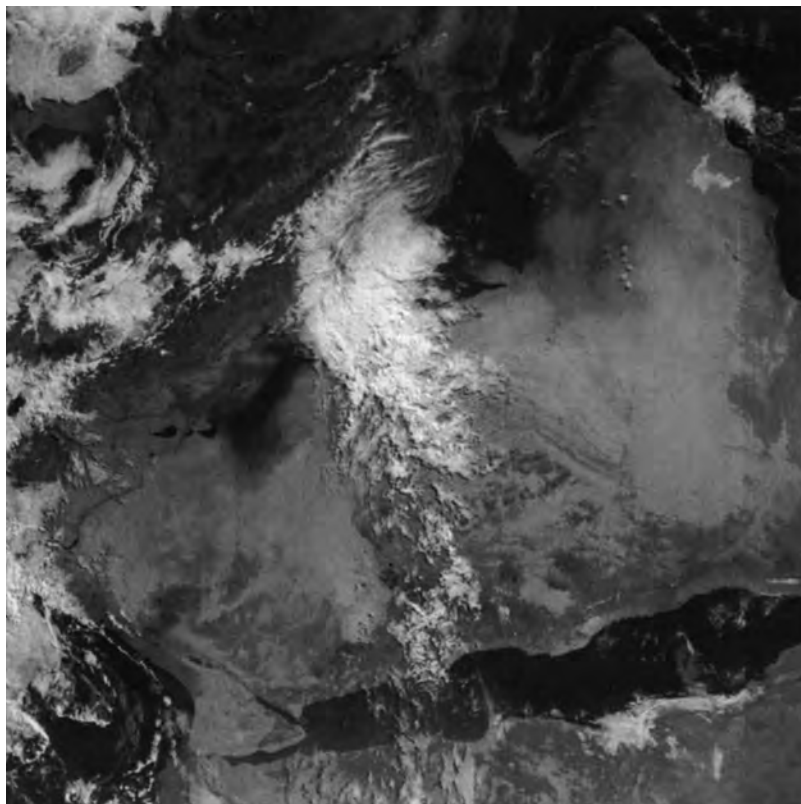


Even satellites on orbit experience time consuming problems. Once, we had a Defense Meteorological Support Program (DMSP) satellite go out, while the second one—of the two in the con-

stellation—malfunctioned. The first satellite “died” in September and (despite our best efforts) we could not launch a replacement until April of the following year.

Artist's concept of early warning satellite.





(Above) Defense Meteorological Satellite Program photo of Iraqi theater on first day of Desert Storm.

We were fortunate that our satellite force structure sufficed for the Gulf War. There were several “birds” on orbit, including warning, communications, weather, multi-spectral imagery, and navigation satellites. Also, the intelligence community had a full complement of operational satellites on station. Excluding the Global Positioning System

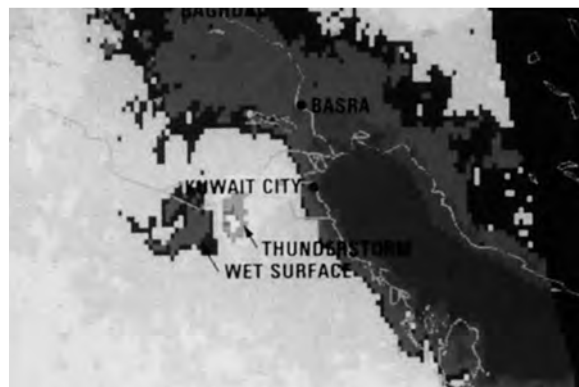
(GPS) constellation of twenty-four satellites, the NRO has more, and also different types of satellites on orbit than does the Air Force.

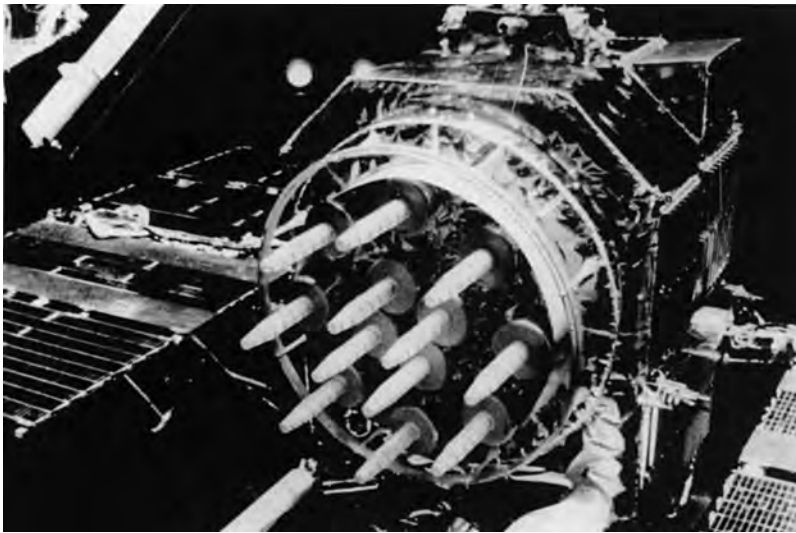
Of our unclassified satellites, the first category is force enhancement, one of our primary missions in space. Space applications enhance our military forces’ capabilities beyond ground-based systems. Among the most important are weather satellites, the DMSP, with a couple of them on orbit continuously. During the first day of the Gulf War, we learned that the so-called *featureless* desert was hardly featureless. There was a lot of cloud cover in Iraq and, in fact, during the war we experienced some of the worst weather ever over the region. However, DMSP pinpointed the wet areas in the environment and provided much needed data.

Among the missions weather satellites supported were strike planning, redirection, weapons loading, air refueling, and displaying flood plains. These were vital to Gen. H. Norman Schwarzkopf. His “Hail Mary” maneuver succeeded because the general knew the weather and was able to move his tanks effectively. The one drawback was the need to have a Mark 4 weather van in theater to get weather information. Only thirty-seven Mark 4 vans were distributed worldwide among the Army, Navy, Air Force, and Marines. We did not have one in Saudi Arabia when the crisis occurred because of the van’s low priority on the “Tip Fiddle” (TPFDL, an acronym for Time-Phased Force Deployment List) and did not get one in-country until the Marines brought in a van a month before the war began.

(Far right) Defense Meteorological Satellite Program photo depicting moisture data.

(Near right) Mark 4 weather van.





(Above) Global Positioning System satellite, block I.

In desperation, Army Space Command bought some commercial computers and displays and used the TIROS, a civilian satellite, to get their weather. Later in the war we acquired more vans. Gen. Robert Yates, commander of the Air Force Materiel Command, tried a "fix" by installing a portable set-up. In the future we will have better and smaller equipment, capable of accompanying the troops anywhere they go.

(Right) Transpak small lightweight Global Positioning System ground receiver.



(Right) Magellan commercial Global Positioning System receiver.



(Far right) Tank, guided by Global Positioning System, crosses minefield during Desert Storm.

Another force enhancement is the GPS spacecraft, a wonderful system of twenty-four satellites on orbit. The GPS is controlled by Air Force crews from the Consolidated Space Operations Center and serves Army, Navy, Air Force, and Marines, as well as a large civilian market. It has great accuracy. Although a full constellation of GPS satellites was not yet on orbit in time for the Gulf War, what we had available performed very well. Seven years earlier, we conducted tests using GPS and an F-4 to determine bombing accuracy from 10,000 feet, obtaining a Circular Error Probable (CEP) of between twenty and thirty meters. When the war started, the CEP was improved to about ten meters. However, only seventy-two Air Force fighters—F-16Cs and F-16Ds—carried GPS. And only thirty-seven B-52s, twenty-one Rivet Joints, a couple of helicopters, and two Joint Stars had GPS receivers. The Army had installed seven sets on their U-21s. The Navy had ten installed on mixed aircraft. The Marines had none. Although we were really slow in getting this system up, the GPS worked wonders.

The Army was especially resourceful. Before the war, Colonel Roland Ellis, who headed Army Space Command, demonstrated GPS receivers to fellow Army officers in the field; he showed them what GPS could do and how to employ them. Although the Army did not recognize the value immediately, Ellis showed them how GPS could sight artillery with incredible accuracy, and how to avoid getting lost in the desert and mountains. Thus, the Army was prepared to use GPS. The Army had 200 sets and the Air Force provided another 100. The Army used duct tape to put them on helicopters, tanks, and all manner of vehicles. They ordered 7,500 sets once the war started, and by the end of conflict had almost 3,500 sets in the field. Soldiers also used a commercial receiver called Magellan; many were sent from relatives back home, so that the GIs would not get lost in the desert. (Capt. Scott O'Grady, our airman who was later shot down in Bosnia, had a commercial GPS receiver; he did not have a military unit.) GPS was used for everything imaginable. On the first night Apache helicopters carried GPS receivers to position and launch their Hellfire missiles. Our tanks would not cross a mine field unless they had GPS receivers and coordinates for that field. GPS helped deliver Meals Ready to Eat to the troops out in the dunes.





(Above) Multispectral imagery photo of Kuwait City.

(Below) Multispectral imagery photo depicting surface moisture.

Another force enhancement capability, Multi-Spectral Imagery (MSI), involves taking pictures of the ground at different frequencies, providing images that the human eye cannot see. MSI is broad area surveillance, and we do not have systems other than short range, limited duration unmanned aerial vehicles that provide broad area

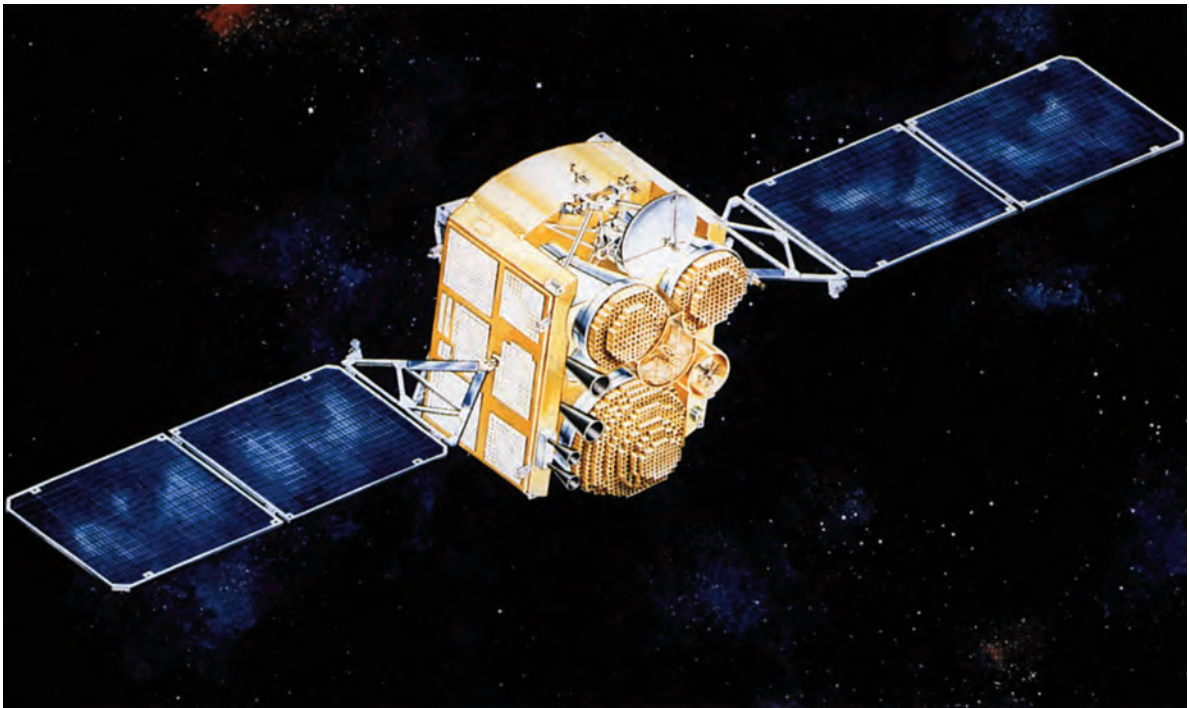
data. One particular MSI image pointed out that Kuwait airport was off by a mile-and-a-half from where it was shown on navigational charts. To counter such inaccuracies and produce better maps, the Army Space Command started using MSI photos of different areas where its troops were working. MSI brought out and showed in broad scale Saddam Hussein's tank traps, trenches, and other defenses enabling U.S. forces to maneuver around them. In another MSI image, in a different frequency, one could pick out swamps that might not otherwise be seen. On the "Highway of Death," where the Iraqis tried to escape near war's end, we determined from an MSI image that they could not go into the fields; they had to stay on the highway. We cut off the highway and destroyed the forces.

In yet another MSI image, the dark areas shown are sabkhats. To a tank commander, these appear as white sandy flats over which he assumes he can drive. However, underneath the sabkhats is deep water, in which a tank would sink up to its turret. Space systems helped us to see through the sand where these dangers lurked.

One limitation, with respect to MSI was that LANDSAT came around only once every fourteen days. In the future we will obtain information from commercial satellites coming around more often. It was recently predicted that there would be more than thirty suppliers of MSI before the year 2000—some with radar resolutions down to one meter.



Artist's concept of a Defense Satellite Communications System (DSCS) III.



The “black world,” represented by the National Reconnaissance Office (NRO), played a very important part in this war. Although the NRO was unjustly criticized for having faulty or inadequate intelligence, General Schwarzkopf enjoyed their highest priority. The difficulty was that we could not get it to him. We had a relocatable intelligence data receiver van, but we could not get it in-country for the same reasons the DMSP vans could not enter. A van did finally arrive in December; the war was to start January 17th. The van had a six

megabytes per second transmission rate capability, but controllers only used one and a half megabytes because the Defense Satellite Communication System (DSCS) was overloaded. There were so many pictures, that providing intelligence was like going through a narrow 1.6 megabyte funnel. Then, when the data arrived, we could not distribute it properly because we lacked in-country distribution networks. In the future, everyone will have MSI imagery, although we might not want all to have it.

Artist's concept of MIL-STAR satellite.

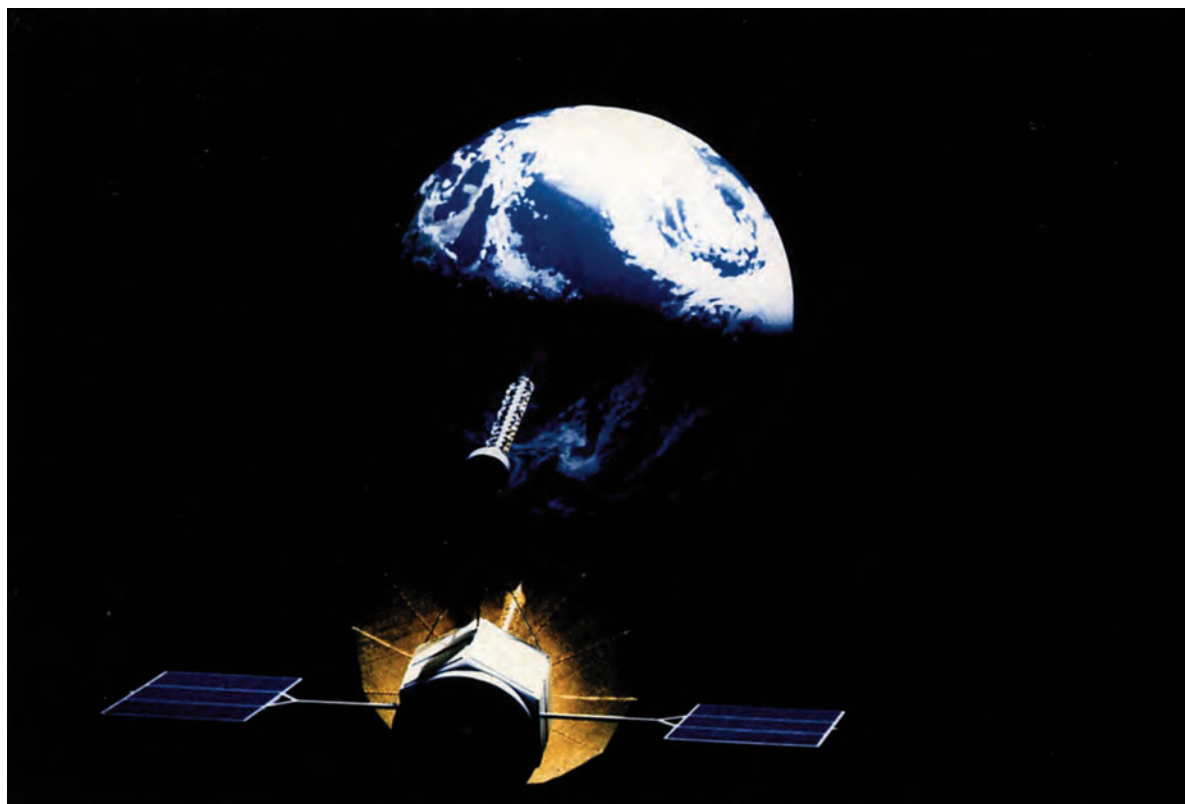


(Right) Artist's concept of Fleet Satellite Communication Satellite.

(Opposite page, top left) SCUD missile kill during Desert Storm.

(Opposite page, far right) Artist's concept of Defense Support Program satellite.

(Opposite page, lower left) Patriot missile launch.



During the Gulf War, 90 percent of communications into the theater was via satellites. Many believe that in the future communications will be carried by fiber optics. We knew where the Iraqi nodes were, targeted all of Saddam's fiber, and took out his communications links. Among our different communication systems were: DSCS with spot beams, which were very highly jam resistant;

(Below) Commercial communications satellite.



and the Navy FLEETSAT, which had a broad area of surveillance coverage, but was not jam resistant. While Saddam did not jam our satellites, our own transmissions did. Unfortunately, we did not have MILSTAR—a totally secure, jam free system; its terminal can be carried in a suitcase and set up in two and half minutes.

General Schwarzkopf needed total connectivity with his troops. Even though the Saudis had some in-country communications, most of Schwarzkopf's communications in-country was via satellites. The general's philosophy was to set up a mobile communications station, then move his forces forward with another mobile station. As soon as the latter was set up, the first was deactivated, and leapfrogged to the next position. Thus, Schwarzkopf had continuous communications connectivity throughout the conflict, and never lost it.

As for terminals, we had big twenty-footers for FLEETSAT, and small ones for unique applications. Our special forces went behind the lines looking for SCUDs using small, commercial INMARSAT terminals.

Since launch constraints were a problem, the answer was to use whatever was already on orbit. One can use commercial satellites to report routine data and military satellites for more critical functions. Cellular systems include Global Star, Iridium, and a couple of other commercial ones. These are free of DoD development funding and do not profit from the military, but from the civil market. Still, they are on orbit and we ought to factor them into our plans, because wherever our troops are in the world, day or night, twenty-four hours a day, they are going to see at least two of these satellites.



We made really good progress in the area of missile warning. The system was designed primarily for Soviet ICBMs and served as a wonderful trip wire. We had ballistic missile warning radars around our borders protecting the U.S. However, since we wanted to pick up missiles at launch, we had placed three or more DSPs on orbit. These gave us worldwide coverage. Although not designed for small tactical ballistic missiles, like SCUDs, our crews at NORAD and U.S. Space Command had tracked some 600 of these smaller missiles during the wars in Afghanistan, Iraq, and Iran, before the Gulf War. We knew their characteristics, what they looked like when launched, and their ranges.

During the Gulf War's air campaign, we declared that SCUDs were tactically insignificant, however, they were extremely significant politically. Every night we viewed scenes of SCUDs coming in, and after they hit, innocent men, women, and children being carried out. This got the American public's attention. It was very important we do something about SCUDs. We moved DSP, and took off dual coverage from other areas, and positioned DSP satellites to look down at Saddam. We had very good coverage. We were worried, however, about the vulnerability of our ground stations to terrorist attack. We had a half dozen pairs of mobile ground station vans in New Mexico and moved them to clandestine safe places. They could back up our fixed ground station, should a terrorist take one out.



Missile warning has always had wonderful communications; but unfortunately, the communications centered on the strategic mission. NORAD and Space Command communications were designed to inform the National Command Authority, of a Russian attack, and to execute our aircraft, missiles, and submarines retaliatory force. We used those communications when the Gulf War was about to start. Saddam did us a great favor when he test fired three SCUDs, on December 2nd. They were fired from east to west, toward Israel, but we knew they were going to fall short because of their range. Saddam wanted to see what he could do. We picked up all three, but when the first SCUD was fired, the console operator could not believe his eyes and did not report it. When we looked at the tapes afterwards, we saw

(Near right) SCUD missile readied for launch.

(Far right) Interior view of Space Defense Operations Center.



it. We picked up the next two SCUDs and gave warning, which took about eight-and-a-half minutes to broadcast. A SCUD flies for seven-and-a-half. In effect, we told those in the target area

that the blast they heard a minute ago was a SCUD. We worked on that.

Another problem was locating Iraq's mobile SCUD missiles. We found what we believed may be a mobile launch site and tried to calculate how far and where a mobile SCUD would move over time after launch. Our fighters could search in these areas. Although we did not strike a mobile or transportable launcher during the war, we refined the procedures and will do better next time.

We received access to Strategic Air Command's worldwide communications network, which kept track of all their forces. Now, we could get SCUD warning from DSP. That allowed us to get warning of SCUD launches to the troops in Saudi almost at the speed of light. It worked perfectly. The troops on the other end had time and opportu-



(Right) Artist's concept of space-based wide-area radar/infrared augmentation system.





(Top left) Artist's conception of Teal Ruby satellite.

(Top right) F-15 launches antisatellite missile during test.

(Above) Artist's concept of space-based surveillance system satellite.

(Below) Artist's concept of Brilliant Pebble satellite.

nity to put on chemical gear, and provided time for the Patriot missiles to arm up.

We executed well in SCUD warning because we had a “lock” on what was going on in space. We knew what the birds up there could do, their condition, their idiosyncrasies, and the best intelligence. Furthermore, we had seasoned professionals on the consoles, and that really counts. In the Tonkin Gulf incident, a misinterpretation of radar signals caused our ships to start shooting at each other, prompting the congressional resolution that led us into the Vietnam war. Before the Gulf War started there were 400,000 Iraqis on one side of

the border and about 300,000 American troops and allies on the other. We could not afford a Gulf of Tonkin type of false warning. I remember telling my people, “I can explain your missing the first missile. I cannot explain giving a false missile alert which causes retaliation, and then Bingo, 700,000 people are at war,” because of it. We need professionals on the consoles.

Gen. Bernard Schriever said, “We must have control of space as we have control of the seas.” As far back as 1985 we had an anti-satellite capability, when an F-15 fired a small canister toward a low altitude satellite in space—the canister hit the middle of the discarded satellite. Political considerations preclude their use today, but in the future, should our forces be targeted by enemy satellites we are sure to revisit this matter. Are we going to neutralize those satellites or not? The capability certainly is there, if we need it.

In the future, we need a credible missile defense. We have missiles that will destroy missiles. We need space-based sensors that can pick up SCUDs at launch. My favorite is Brilliant Pebbles. I would like to get to them from space because we would be over the enemy’s territory.

Space must be ingrained into our planning and practice. We should have space courses in every school at every level. We must practice to use space systems. Unless we practice it in every exercise, it will not be used in war. I believe that our CINCs are starting to appreciate that. ■





Fall Aerial Recovery

JC-130B preparing to catch descending space vehicle.
(Photo courtesy of author)

This article is dedicated to those who served with the 6593rd Test Squadron and the 6594th Test Group. Established on August 1, 1958, as the 6594th Recovery Control Group, its pilots first flew C-119s. On August 19, 1960, the 6594th made the world's first midair recovery of a space object when its members snagged the Discoverer 14 satellite capsule. Later, the 6594th transitioned to the C-130 as its prime recovery aircraft. In 1974, the 6594th assumed the additional role of rescue and recovery, flying a fleet of HH-53 helicopters.

All aspects of an operational recovery mission were based on the Estimated Time of Parachute Deployment (ETPD), the precise moment at

which the parachute in a recoverable reentry vehicle would deploy, permitting a slow descent toward the waiting force of recovery aircraft. Parachute deployment was programmed to occur at approximately 50,000 feet. The timing for an entire recovery operation—from crew briefing to engine start to takeoff to on-station arrival—was based on the ETPD.

The recovery force had at its disposal a rather formidable aircraft fleet. Five specially configured JC-130 aircraft composed the primary recovery element. Each was equipped with a highly trained, highly skilled crew, consisting of a pilot, navigator, flight engineer, telemetry and directional-finder operators, hydraulic winch

Presently with the American Defense Preparedness Association in Arlington, Virginia, TSgt Robert Flavell, USAF (Ret), served in the Air Force from 1961 to 1981. He was an instructor at the C-130 Aircraft Maintenance Technical School at Sheppard AFB, Texas. As an aircrew member and flight examiner with the 6594th Test Group at Hickam AFB, Hawaii, he participated in the aerial recovery of nine orbiting space capsules. TSgt Flavell earned two Air Force Commendation Medals.



Catch a ling Star

Recovery of Space Objects

Robert A. Flavell

operator, recovery-rig operators, and in-flight photographer.

Recovery gear consisted of several important pieces of equipment. First was a massive hydraulic winch, similar in operation to a conventional fishing reel. Second was a dolly assembly housing two 40-foot-long carbon steel poles on hydraulic actuators. These poles, trailing downward at a 45-degree angle behind the aircraft, held an assembly consisting of a loop of half-inch nylon rope to which were attached, at carefully selected intervals, large, bronze, four-tined grapple hooks which would engage the parachute upon contact. Third was electronic equipment used to detect, locate, and track the reentering space vehicle. Once the reentering craft was sighted, all maneuvering for recovery was accomplished strictly by visual references.

Other active participants in the recovery force were weather reconnaissance planes, two Air Force rescue and recovery aircraft with pararescue scuba divers on board, and a fleet of heli-

copters equipped to effect a wet recovery if necessary.

Crew proficiency was vital to the recovery mission, and crew integrity was the key to its overall success. Crew members had clearly identified, specialized jobs to perform, and they had to work in close harmony with their colleagues. Their precision and coordination accounted for the extremely high overall success rate of air-to-air recoveries.

Aircrew morale was another key factor. We were involved in unique aerial operations that no other organization—military or civilian—could perform. The recovery mission possessed an extremely high Department of Defense priority, which was but one indication of the mission's importance to overall national security during those years.

As with all organizations, the time eventually comes to close up shop. So it was with the 6594th Test Group. The last aircraft departed on July 22, 1986. The organization inactivated on September 30, 1986. The words "Ten seconds. . . Ready winch. . . Contact" most likely will never be spoken nor heard again, but they will always be remembered by those who participated in the work of the 6594th, and in a typical recovery mission.

Hours before dawn, the cloudless Hawaiian sky was still dark blue-purple. The stars sparkled brightly, and the tropical breeze blew gently. It was a quiet early morning. But it was already busy as a beehive at Operations. Crews were assembled, assigned to planes, and readied for briefings. Routes were plotted, code names and numbers were assigned, and takeoff times were posted.

At the recovery section, crews were being assembled, briefings given, and equipment issued, double-checked, and readied for delivery to the appropriate aircraft. On the flight line, aircraft were being fueled and "pre-flighted" for a long overwater trip. The equipment started to arrive and the recovery crew started to "pre-flight" their equipment.

Back at Operations, the front- and back-end crews were starting to assemble. They received routes, weather information, approximate recovery location, and takeoff times, they then reported to their aircraft. Pilots received their last briefing, and engines were ready to start. During engine start, the recovery crew gave their equipment one final check. Then it was time to taxi and take off. The long flight and mission began.

During the flight, the recovery crew readied their equipment. A new line was installed on the winch, and the loop was assembled to the winch line and recovery poles. The photo, telemetry, and EDF (electronic direction finder) crews also gave their equipment one last check. Now the wait began.

Far out in space, a satellite capsule was plummeting toward earth. It began to slow down and reentered the earth's atmosphere. As it descend-



AT THE REAR OF THE AIRCRAFT, THE RECOVERY CREW WAS VERY BUSY

ed, its heat shield ejected, its parachute opened, and it began to emit a radio signal. The recovery aircraft, picking up the signal, headed toward it. Soon crew members spotted the capsule's orange and white parachute, and the aircraft circled it like a hawk stalking its prey.

At the rear of the aircraft, the recovery crew was very busy. They opened the JC-130 rear cargo ramp and door, turned on the winch, and pushed the recovery poles to the aft end of the recovery dolly. Simultaneously, they deployed a portion of the recovery loop. They moved the recovery dolly aft to the cargo ramp, deployed the remainder of the recovery loop, and lowered the recovery poles. The aircraft was now prepared to recover the capsule descending beneath its parachute.

As the primary recovery aircraft circled the parachute, the pilot had to determine whether he could make a safe recovery. Safety was paramount in all aerial recovery operations. The pilot visually inspected the condition of the parachute, the shroud lines, and the capsule hanging from the lines. If he decided conditions were safe, he informed everyone that he was ready for recovery. He maneuvered the aircraft for a straight-in approach. After the pilot got one more "Ready" response from the recovery crew, he called out, "Ten seconds." The winch operator replied, "Ready winch." The aircraft approached the parachute.

As the JC-130 passed over the top of the parachute, it entangled the recovery loop, which snapped clear of the recovery poles. The aft rigger yelled, "Contact," and the winch line started to pay out from the winch, like a fish on a line. The winch drum brakes hummed as they slowed the winch to a stop. The aft rigger called out, "In trail."

The winch operator started to reel in the space capsule to the aircraft. As the capsule approached the rear of the aircraft, the cargo ramp operator kept the winch operator closely informed on the progress of the recovery. The recovery loop, with chute entangled, entered the opening of the recovery dolly first. The shroud lines followed. When the capsule system approached the recovery dolly more closely, the

winch operator lowered the forward part of the dolly so that it could be boarded safely. As the capsule approached, the winch was stopped. The extended dolly boom was raised upward so that the capsule would not hit the cargo floor, and the recovery dolly was moved to the forward position. With the capsule safely aboard, the poles were moved forward, and the cargo ramp and door were closed. The capsule was lowered into a container placed under it. A lid was put on the container, which was locked and sealed.

We headed home. We had "Caught Our Falling Star."

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China's Stealth Fighter: The J-20 'Mighty Dragon' & the Growing Challenge to Western Air Dominance. By Abraham Abrams. Barnsley UK: Pen & Sword Books, 2024. Photographs. Notes. Index. Pp. 290. \$39.95. ISBN: 978-1-03610-550-1

Abrams' theme is that the J-20 is paving the way for China to become the dominant 21st-century airpower, as its capabilities and production outpace anything produced in the West. He has the academic credentials necessary for this work, specializing in East Asia and China international relations and the history of the J-20 program.

China's drive to airpower dominance began in the Korean War. Early on, US B-26s and B-29s crushed Chinese and North Korean forces as they were chased northward. The Chinese push back down the peninsula was aided by a huge influx of Soviet MiG-15s. By war's end in 1953, the Chinese Air Force had reached a level of parity, and in some cases superiority, over the American F-86.

There was a huge transfer of military equipment and technology from the Soviet Union to China in the 1950s. After the Sino-Soviet split in the early 1960s, Chinese aircraft development stalled while the Soviet sector surged. The MiG-21/-23 fighters were better performers than the American F-100, F-104, and F-4. The Soviets then built the MiG-31 interceptor and the MiG-29 medium and Su-27 *Flanker* heavy fighters. The US introduced the F-15 Eagle in 1975 as the most capable Western fighter, but the *Flanker* soon exceeded it.

Fifth-generation aircraft development began in the late 1970s and soared in the 1990s. After the USSR's collapse, Russia sold a fleet of Su-27s to China. America's first Gulf War followed shortly thereafter. China then went to work on what would eventually become the J-20. By the early 2020s, the American F-22 and F-35, the Chinese J-20, and the Russian Su-57 were all operational. But F-22 production ceased, and the aircraft will be retired by 2035. The F-35 and J-20 are operational, but the F-35 is already facing production cuts, as the J-20 armada grows by the thousands.

Eight factors define a fifth-generation combat aircraft: 1) stealth and internal carriage of munitions, 2) active electronically scanned array radars, 3) sensor fusion, 4) network-centric warfare capabilities, 5) supercruise capability, 6) sophisticated electronic warfare suites and electro-optical defensive systems, 7) long range multi-band EO targeting systems, and 8) advanced glass cockpits. Abrams contends that the J-20 is the equal or better of all US fifth-generation aircraft in all categories.

The middle chapters of the book are heavy with technical language of aircraft design and weapons specifications. Abrams details the J-20's use as part of a network: fighter, bomber, intelligence gatherer, airborne early warning and control (AEW&C), synthesizer of artificial

intelligence, and flying command post to control drones and other aircraft. The AEW&C part should be particularly concerning, as the American E-3A Sentry is almost obsolete.

This book should interest all students of international affairs, because challenges abound. US combat-aircraft numbers are at pre-World War II levels. Chinese aircraft are more numerous, capable, cost efficient, and operationally effective. The F-22 and F-35 never met original production quotas. F-22 production is done, and F-35 production continues to drop. Some capabilities were never included, because they were thought to be unnecessary. In simulated war games, China regularly bests US and Western forces. The US is having to pull both aircraft out of operations and into training roles. Countries in East Asia have reacted with purchases of F-35s and Su-57s, but none can counter China.

The US must realistically and strategically assess threat environments decades into the future. Western intelligence has consistently underestimated Chinese capabilities; that must change. The F-22 and F-35 need operational upgrades to meet new threats. The West needs to produce hundreds more F-35s.

This book is definitely worth reading.

Lt Col Timothy J. Gochnaur, USAF (Ret)



Dakota Squadrons in Action from D-Day to V.E. Day: Airborne, Support and Supply Operations in the Liberation of Europe. By Clive Bennett. Barnsley UK: Air World, 2025. Photographs. Notes. Indices. Maps. Pp. 291. \$49.95. ISBN: 978-1-03612-119-8

Bennett's book sets out to document the operational employment of RAF Dakota squadrons in Northwest Europe, but it functions less as a narrative history than as a carefully assembled compilation of unit records. It is dense with sortie counts, aircrew rosters, aircraft movements, and operational summaries presented in a sterile, procedural format. Readers seeking a sustained narrative or interpretive account of RAF transport operations may find the work more archival than analytical in character.

This approach has consequences for the book's usefulness as a reference source. While Bennett includes an impressively detailed roster of aircrew, the volume lacks a correspondingly robust analytical index. As a result, researchers interested in tracing themes, doctrine, logistics, or institutional development will find the book harder to navigate than its apparent detail might suggest. It serves more effectively as a consolidated unit record than as a flexible research tool.

Structurally, the book begins very abruptly in early 1944, treating RAF Dakota operations as though they

emerged fully formed on the eve of the Normandy invasion. There is no substantive discussion of the RAF's extensive prior experience with the C-47 in other theaters, nor of the learning curve that preceded large-scale airborne and transport operations in Northwest Europe. The narrative, therefore, assumes institutional maturity without showing how it was earned, a jarring omission in a subject where adaptation and experience were decisive. Equally absent is any serious exploration of procurement choices: why the RAF devoted scarce Lend-Lease resources to the C-47 while continuing to produce indigenous medium transports in an already over-stretched aircraft industry, or why the Dakota was preferred over alternatives such as the C-53 or the more-capable C-46.

Bennett's stylistic restraint is consistent throughout. He works hard to remain an objective, non-partisan reporter, maintaining an even tone even when addressing emotionally charged subjects such as friendly-fire losses or the execution of civilians who aided downed airmen. While this detachment reinforces factual reliability, it also limits the book's engagement with the human and moral dimensions of transport warfare. Historians such as Michael Neufeld and William H. Tunner have demonstrated that it is possible to integrate logistics; lived experience; and limited, but meaningful, judgment without sacrificing scholarly discipline. Bennett, evidently, chose not to do so.

That choice is even more notable because, when Bennett turns briefly to RAF squadron life and personnel issues, he proves capable of moving beyond sortie totals and delivery figures. These passages are among the book's most engaging and suggest an author who can offer more than numerical accounting, but who elects not to sustain that approach.

In the tradition described by John Keegan, military history gains depth when it connects institutions, systems, and human experience without excess sentiment or advocacy. *Dakota Squadrons in Action* is firmly on the documentary side of that divide. It is reliable, diligent, and restrained; but readers may wish for more context, interpretation, and humanity than Bennett is prepared to provide.

Gary Connor, docent, National Packard Museum, Cortland OH



The Douglas Boston in RAAF Service: No. 22 Squadron 1942-1944. By Michael John Claringbould. Kent Town, Australia: Avonmore Books, 2024. Maps. Diagrams. Illustrations. Photographs. Contents. Glossary. Index. Pp. 148. \$42.95 paperback. ISBN: 978-0-97564234-4

Claringbould—the Energizer Bunny of aviation writers—focuses his prolific writing on aerial conflict in the South Pacific during World War Two. In this volume, he has produced another well-documented and well-illustrated history of the Douglas Boston (DB-7B and A-20 models) in RAAF (Royal Australian Air Force) service in New Guinea and the Dutch East Indies. Having published over 30 titles for Avonmore Books, he justifiably asks in his introduction: “Why another book about RAAF Bostons?”

It's simple, he admits. As an unapologetic “aficionado of the Douglas Boston/A-20, it was necessary to correct perpetrated errors about the type's markings, details of its RAAF service and its contribution to the SWPA [South West Pacific Area].” He is on a personal “myth busting” campaign and approaches this task by examining many resources, such as infrequently visited Japanese unit orders and operational logs.

This volume is not for the casual reader. But it may, in fact, be the definitive history of the Douglas Boston in RAAF service. Claringbould approached this task with his usual vigor and knowledge of the region's geography and history.

He contends that some history of the Boston has “opaque roots” and argues that the conventional theory that the RAAF effort in the SWPA was against relative “backwaters” is not supported by his research and analysis. He asserts that, while the RAAF was relegated to lesser geographic targets due to a combination of RAAF strategy, subservience to USAAF command, and Australian politics, Boston operations were strategically important deployments as the Japanese drove toward Australia.

Claringbould leaves few resources untouched in his research: Japanese Radio Tokyo transcripts, private diaries, translation of Japanese Navy messages, and captured military documents and manuals; and, from the Allies, the National Archives of Australia, accident reports, RAAF staff records, rare photos, and numerous Government documents on camouflage schemes and identification markings. In defense of his own vigorous research, Claringbould claims that one author, in describing the Battle of the Bismarck Sea, cobbled together so many diverse reports and “scattered dots” that resulted in a “third-class work from second-class sources, in a failed attempt to produce a first-class piece of history.” Claringbould speaks like an author who has confidently done his research.

He has also mastered aircraft graphics, as reflected masterfully in his previous books. This volume includes 32 profiles of Douglas DB-7B and A-20 variants, Dornier Do-24K flying boat, Aichi D3A1, Mitsubishi A6M3, Nakajima A6M2, and Nakajima Ki-43. All are perfect in detail.

Each chapter describes a particular No. 22 Squadron focus or strategic effort concluding when the unit

changed over to Beaufighters in January 1945—the end of an era.

There are several shortcomings. Depiction of the aircraft's interior to the level he reaches for armament and modifications would make the book an exhaustive triumph. Also, unfortunately, there are no footnotes. But Claringbould has achieved his usual high level in recording the history of often obscure and neglected segments of World War Two aviation.

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



Solomons Air War Volume 4: Operation Ke: The Evacuation of Guadalcanal January - February 1943. By Michael Claringbould and Peter Ingman. Kent Town, Australia: Avonmore Books, 2026. Glossary. Maps. Appendices. Bibliography. Index. Tables. Photographs. Illustrations. Pp. 184. \$38.95 paperback. ISBN: 978-1-764-19371-9

Claringbould is a recognized expert on Japanese aviation who has authored and illustrated many books on Pacific war aviation (a number of which have been reviewed in this journal). Ingman is a former business executive with a key interest in the early stages of the Pacific war. He is the chairperson of the South Australian Aviation Museum History Group and has written several books on World War II history.

Solomons Air War is a companion series to the authors' *South Pacific Air War* series, which chronicles the broader regional air campaign from the beginning of the Pacific War. The Allied invasion of Guadalcanal in August 1942 effectively split the air war into two operational theaters: the Southwest Pacific Area and the South Pacific Area, more practically understood as the New Guinea and Solomons campaigns. A major strength of both series is the authors' effort to align Japanese and Allied operational records, drawing heavily on Japanese primary sources that have become accessible only recently.

Operation *Ke* was a complex Japanese naval and air operation that successfully evacuated the Japanese 17th Army from Guadalcanal and ended the six-month campaign for the island. The book opens with a concise overview of Allied and Japanese air forces in the theater before moving into a chronological account of operations. These include the Munda bombardment, attacks on the "Tokyo Express," strikes against Vila, Japanese air raids, the Battle of Rennell Island, and the three evacuation runs of Operation *Ke*. The narrative concludes with the troubled introduction of the B-24 into combat operations and Operation *Clean Slate*.

The authors argue that the decisive outcome of the

air campaign was the effective conclusion of the Guadalcanal campaign itself, brought about by Japan's decision to withdraw its forces. They examine the performance of both American and Japanese air power during this period. By early 1943, the Cactus Air Force enjoyed a secure base at Henderson Field with two satellite fighter strips and a newly operational bomber base at Carney Field. Despite this growing Allied advantage, aircraft losses on both sides during the period remained broadly comparable.

As in previous volumes, this one includes short vignettes describing daily sorties by both sides. Pilots are named where possible, and combat outcomes (including aircraft losses, damage, and the fates of aircrews and naval personnel) are carefully documented. These narratives highlight the challenges of operating in the Solomons: rapidly changing weather, difficult terrain, limited communications, and strategies often shaped by incomplete information. The operational impacts of air attacks on ground and naval actions are also explored.

Supporting material is strong. The book provides data on personnel and units on both sides and includes numerous photographs, graphics, and theater maps. Particularly effective are the three-dimensional aircraft illustrations. These add visual clarity and enhance the overall presentation.

Overall, this volume maintains the standard established by earlier installments in the series. It is clearly written, well organized, and supported by a solid index and reference material. For researchers and enthusiasts of the Pacific air war, it offers a detailed and engaging account of the final phase of the Guadalcanal campaign and the air operations that shaped its outcome.

Frank Willingham, NASM docent



South Pacific Air War, Volume 6: Wau to Bismarck Sea, January to March 1943: By Michael Claringbould and Peter Ingman. Kent Town, Australia: Avonmore Books, 2025. Maps. Tables. Illustrations. Photographs. Notes. Bibliography. Index. \$48.95 paperback. ISBN: 978-0-9756423-6-8

Starting with *South Pacific Air War Volume 1* in 2017, Michael Claringbould has authored, either alone or with other writers, more than 20 books on aerial combat and aircraft in the southwest Pacific during World War II. This book continues his chronicle of the air war. His collaborator, Peter Ingman, also an aviation enthusiast, owns Avonmore Books.

As in their other books, the authors begin with two chapters devoted to a summary of each side's capabilities. After that, they proceed day-by-day. They highlight unusual events by providing background that empha-

sizes each event's relevance. Organizing the chapters thematically neatly packages the narrative.

Claringbould and Ingman begin by reviewing the circumstances surrounding the death of Brig Gen Kenneth Walker, Commanding General, V Bomber Command, during a bold attack on the Japanese base of Rabaul on the northeastern tip of New Britain. Walker, one of the Army Air Corps' airpower zealots of the 1930s, died in the daylight attack aboard a B-17. Unsuccessfully, he had attempted to disrupt a Japanese convoy that sailed the following day for Lae on New Guinea. Partly because of the weather, Fifth Air Force and Royal Australian Air Force assets mounted poorly coordinated attacks against the convoy that reached the Japanese base.

Airlift played a significant role in the New Guinea campaign. Few overland routes existed, and both sides' aircraft threatened maritime movements. When Allied intelligence learned the Japanese planned to send 2500 troops to wipe out a small Australian contingent at the inland base of Wau, planners responded by successfully transporting reinforcements.

What became known as the Battle of the Bismarck Sea dominates this volume. Taking full advantage of signals intelligence, Allied commanders knew when the Japanese planned to depart Rabaul with troop transports escorted by destroyers. After almost a year's worth of experience, American and Australian pilots possessed the means to decimate the convoy. Besides the escorts, the Japanese assigned Mitsubishi naval fighters in the morning and Nakajima army fighters in the afternoon to defend the ships as they approached Lae.

The Allies used Lockheed P-38s and Curtiss P-40s to counter the enemy, while four-engine bombers attacked in level flight. Meanwhile, North American B-25s and Bristol Beauforts struck at low level, strafing the ships with their intense firepower. This combination produced an overwhelming victory. The one-sided result played well in the English-speaking press. The authors argue the battle's outcome raised the profile of the New Guinea campaign, resulting in greater resources being devoted to that small theater.

As with the authors' other works in this series, this volume correlates the records of both sides on a day-to-day basis. It also calls into question the victory claims by all involved. This book is a must read for anyone with an interest in the southwest Pacific in the Second World War.

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



Lebanese Civil War, Volume 2: Quiet before the Storm. By Tom Cooper and Efim Sandler. Warwick UK:

Helion, 2021. Maps. Illustrations. Photographs. Notes. Bibliography. Pp. 70. \$25.00 paperback. ISBN: 978-1-914377-15-0

Cooper, an Austrian-born historian, has established himself as one of the foremost English-language authors of Middle Eastern military affairs. He has been extensively involved in Helion's Middle East @ War series, of which this effort is No. 41. In the other Cooper works I have reviewed, he paired himself with a native Arab speaker and regional expert. In this book, he turns to Efim Sandler, a former Israeli army officer, for assistance.

In the mid-1970s, violence between various Lebanese factions became widespread. Despite limited efforts by United Nation peacekeepers, the conflict persisted. In this volume, the authors proceed chronologically. Along the way, they highlight particularly intense fighting. They also interject numerous side bars, particularly concerning the use of air power. However, the book's emphasis is on land combat.

The authors begin by identifying both the combatants controlling various portions of Lebanon as well as peacekeeping forces. From there, they discuss the first of several significant battles—what later became known as the Hundred Days' War. This battle lasted from July to October 1978. It pitted primarily Christian forces against the Syrian Army fighting in and around Beirut, the capital city.

After that, Cooper and Sandler detail how Israeli Defense Forces (IDF) engaged in a war of attrition in 1978 and 1979. They discuss the modernization of the armor and artillery branches and also devote considerable space to the Israeli Navy. The Navy served as a coercive force, shelling Palestinian Liberation Organization (PLO) positions. Sea control also allowed the IDF to launch over-the-beach raids.

Following the Camp David Accords of March 1979 that resulted in peace between Israel and Egypt, Israeli leader Menachem Begin announced the Begin Doctrine. The IDF now would launch pre-emptive attacks as necessary. The increased use of attack aircraft prompted Syrian interceptors to attempt to down Israeli fighters. In a series of side bars, the authors discuss how Israeli F-15 Eagles consistently thwarted efforts by the Syrians to control the skies over Lebanon.

Relatively small-scale, but persistent, raids dominated Israeli action against the PLO in 1980. From March to June 1981, Christian forces withstood a Syrian siege of Zahle, Lebanon's third-largest city. However, Israel became increasingly involved. Its air force would pound targets in Lebanon over the next few months, before the parties involved agreed to a ceasefire in July.

I recommend this book for anyone with an interest in the tragic collapse of the Lebanese state and how Syria and Israel, along with the PLO and others, contributed.

Cooper has also provided excellent illustrations of value to modelers.

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



The U-2 Over the Soviet Union: America's Famous Cold War Spy Plane from the Soviet Perspective.

By Dmitry Degtev. Barnsley UK: Pen & Sword Air World, 2026, Maps, Illustrations, Photographs, Index, 259 pages, \$42.95, ISBN: 978-1-39906-739-3

In his latest work, acclaimed Russian analyst and researcher Dmitry Degtev offers an insightful exploration of one of the Cold War's most pivotal espionage programs. Drawing on his extensive expertise as the author of over 40 books, Degtev provides a nuanced account of the planning, execution, and ramifications of the U-2 reconnaissance flights over the Soviet Union from 1956 to 1962.

The narrative is anchored in a wealth of primary sources, including CIA records, declassified documents from the Russian Ministry of Defense, and firsthand testimonies from those directly involved in the operations. Through his meticulous research, Degtev illuminates the strategic military responses of the Eastern Bloc to these aerial incursions and delves into the technical challenges faced by the Soviets, including their unsuccessful efforts to develop a stratospheric interceptor.

A particularly compelling section of the book covers the infamous shootdown of U-2 pilot Francis Gary Powers on May 1, 1960, during a Soviet military parade that underscored missile superiority. Here, Degtev contextualizes the incident within the broader Cold War landscape, analyzing its implications on Soviet military doctrine and highlighting the regime's emphasis on its Strategic Rocket Forces as the dominant force in national defense. The unexpected inclusion of items confiscated from Powers upon his capture, such as women's jewelry, adds a humanizing touch to the complex geopolitical narrative.

Degtev also engages in a critical examination of the intelligence gathered during these missions, questioning the effectiveness of the U-2 flights in pinpointing key Soviet installations. These included the confidential sites associated with the Soviet atomic project that remain unidentified to this day.

By presenting these events through a Soviet lens, Degtev ensures that readers appreciate the nuanced dynamics of Cold War espionage, revealing how the U-2 incidents not only informed military strategies but also shaped the ideological confrontation between the superpowers.

In sum, *The U-2 Over the Soviet Union* is a significant scholarly work that sheds new light, from a Soviet

perspective, on a critical chapter of the Cold War. The book will undoubtedly be of interest to historians, military strategists, and anyone intrigued by the intricate web of international relations during a time of heightened tension and competition.

Colonel Charles P "Chuck" Wilson, USAF (Ret), Cold War U-2 Pilot, NASM docent



Luftwaffe Intruder Operations Over the United Kingdom: Fernnachjagd Units 1940 to 1944.

By Chris Goss. Barnsley UK: Air World, 2025. Photographs. Maps. Glossary. Bibliography. Appendices. Index. Pp. 212. \$39.95. ISBN: 978-1-03611-115-1

Chris Goss's *Luftwaffe Intruder Operations Over Great Britain* continues the author's long-established formula of combining meticulous research with his formidable photographic archive of Luftwaffe personnel and aircraft. As in his earlier works, Goss demonstrates an unparalleled command of his subject. The book is richly illustrated with rare and often haunting images that capture both the machines and the men behind Germany's nocturnal air war over Britain. These photographs alone make the book a valuable addition to any aviation historian's library.

The narrative builds steadily through detailed examination and cross-referencing of Luftwaffe and RAF operational reports, an approach that has become Goss's hallmark. He brings to light the often-overlooked "intruder" missions—operations in which modified or repurposed Luftwaffe medium bombers and heavy fighters such as the Ju 88, Do 17/217, and Me 110/210/410 patrolled the skies near RAF bases. Their purpose was not only to bomb airfields but, more often, to ambush returning or departing British bombers, adding a deadly layer to the air war's already perilous night dimension.

Goss also reminds readers that by 1941–42, Britain had developed a sophisticated and layered air defense system, complete with radar, ground control, and increasingly capable night-fighter forces. These advances steadily eroded the intruders' effectiveness and raised their losses to unsustainable levels. Eventually, the Luftwaffe withdrew the remaining intruder units to the Mediterranean and Eastern Front, where air defenses were thinner and prospects for success greater.

While Goss's research is exhaustive and his writing clear and careful, his dedication to precision and completeness can feel repetitive and dry. Still, it remains eminently readable and deeply informative. In some ways, his works resemble beautifully produced photo albums; yet to call them that would be to miss the depth of his scholarship and mastery of the Luftwaffe's operational history. If there is one area where Goss could elevate his

already distinguished output, it would be in offering more interpretive commentary, allowing readers the benefit of his analysis and opinions as well as his data.

That said, *Luftwaffe Intruder Operations Over Great Britain* is another outstanding contribution from a historian whose consistency, rigor, and integrity make his work essential reading. Strongly recommended.

Gary Connor, docent, National Packard Museum, Cortland OH



Out-Country War Volume 1: The Secret War Begins, Laos 1954-1960. By Albert Grandolini and E. R. Hooton. Warwick UK: Helion & Company, 2025. Maps. Illustrations. Photographs. Notes. Bibliography. Pp. 84. \$29.95 paperback. ISBN: 978-1-804518-83-2

Grandolini, a native of Vietnam, has produced more than a dozen books for Helion's various series. Hooton, a former defense journalist, most recently has focused his attention on diverse military history topics. He has co-authored more than ten books for Helion, most of them on Middle East conflicts. This work is No. 57 in Helion's Asia @ War series. The company also has established five other series covering Africa, Europe, the Middle East, Latin America, and Technology.

Wedge between Thailand, Cambodia, and Vietnam, the Laotians have faced threats from their neighbors for centuries. Thailand remained independent, while the French ruled over the three others in a colony known as French Indochina. This provided limited stability from the second half of the 19th century until after World War II.

By the late 1940s, the French granted the Laotians and several ethnic minorities greater autonomy. But Ho Chi Minh, the leader of the communist Viet Minh (primarily opposing the French in northern Vietnam), intervened. He began forming communist cadres in Laos known as the Pathet Lao.

The Laotian lowland population near the royal capital of Vientiane remained loyal to the government. However, in more distant regions, the Viet Minh influence grew. As the Pathet Lao numbers gradually increased, the Viet Minh integrated those fighters into its forces.

After the communists took control of China in 1949, American decision makers began paying more attention to Indochina. Once a truce halted fighting on the Korean peninsula in 1953, the United States expanded its support of the French. That support stopped after the French abandoned what became North Vietnam in 1954. The 1954 Geneva Conference divided Vietnam and established ground rules for external influence in Laos and Cambodia.

In the coming years, however, the communists and America would fight a war by proxy in Laos. Meanwhile,

the Geneva accords allowed the French to maintain a small path in Laos paralleling the Vietnamese-Laotian border. What became known in the west as the Ho Chi Minh Trail would profoundly influence the communists' ability to arm an insurgency known as the Viet Cong in South Vietnam.

This book is best suited for those interested in the origins of American military involvement in southeast Asia. It features many photographs from Grandolini's private collection. Modelers will appreciate Tom Cooper's excellent color illustrations.

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



Central Pacific 1943-45: Seventh Air Force's Island-Hopping War. By Brian Lane Herder. Place: United Kingdom. Oxford UK: Osprey, 2025. Photographs. Index. Bibliography. Maps. Drawings. Pp. 96. \$25.00 paperback. ISBN: 978-1-4728-6487-1

This is a concise and accessible contribution to Osprey's familiar campaign-style monographs, offering a broad overview of Seventh Air Force operations during the climactic island-hopping drive across the Central Pacific. As with many Osprey titles, its strengths lie in clarity, visual presentation, and its ability to orient the reader quickly within a complex theater of war.

Herder correctly frames the Pacific Theater in general—and the Central Pacific in particular—as a war defined by distance. Vast expanses of ocean shaped every operational decision, and the Seventh Air Force began the campaign with very few aircraft technically capable of prosecuting a long-range air war. This reality underpins one of the book's most important themes: the necessity of the island-hopping strategy. By seizing successive island groups, US forces could move short-range fighters, medium bombers, and support units progressively closer to Japanese targets, transforming otherwise limited systems into effective instruments of sustained pressure.

Throughout the narrative, Herder emphasizes the growing integration of land-based air power with carrier aviation in maintaining unrelenting pressure on Japan. This is one of the monograph's most promising analytical threads, but it is also where the limitations of the format become most evident. The narrative offers little detail on how these early iterations of joint operations worked in practice. Planning mechanisms, target allocation between the Army Air Forces and the Navy, command relationships, and coordination challenges are glossed over. Readers are told that integration occurred and that it was effective, but not how it was achieved.

A similar imbalance appears in the treatment of logistics and maintenance. The Seventh Air Force's expan-

sion across the Central Pacific required the rapid development of sophisticated support systems under austere conditions, yet this critical story receives scant attention. Notably absent is any discussion of the innovative *Ivory Soap* operation, which employed floating repair depots, helicopters, and DUKW amphibious vehicles to create a mobile maintenance and supply capability. This omission leaves a major gap in understanding how air power was sustained at operational scale across such enormous distances.

Visually, the book meets Osprey's usual exacting standards, with well-chosen photographs, maps, and artwork that enhance comprehension. What it lacks are the personal stories and anecdotes that often bring these campaigns to life. Ultimately, *Central Pacific 1943–1945* is most effective as a starting point. It raises important questions, and its broad-brush treatment invites deeper exploration—its greatest strength, even as its lack of depth occasionally frustrates the engaged reader.

Gary Connor, docent, National Packard Museum, Cortland OH



Kursk 1943: Airpower in the Eastern Front's Most Pivotal Battle. By William E. Hiestand. Oxford UK: Osprey Publishing, 2025. Photographs. Maps. Tables. Illustrations. Bibliography. Index. Pp. 96. \$25.00 paperback. ISBN: 978-1-47286517-5

The real story of a conflict is rarely a clean narrative of grand strategy and sweeping maneuvers. It's in the weeds—in the details. These often-overlooked characteristics are where the true character of a battle reveals itself. This book delivers generously on those details and provides a superb look at the aerial battle that raged over the Kursk salient.

Hiestand is a career military issues analyst with over 30 years' experience. His life-long interest in military history, especially armored and mechanized operations, led him to author several books for Osprey.

Operation *Citadel* (Battle of Kursk) was the main German offensive operation on the Eastern Front. Its goal was to weaken the Soviet potential for a Summer offensive in 1943 by cutting off a large force that the Germans anticipated would be in the Kursk salient. Discussion of the battle is often dominated by images of thousands of tanks grinding each other to dust on the plains near Prokhorovka; but this was also the Eastern Front's most intense, decisive air battle. In the end, the Battle of Kursk signaled the last gasp of Luftwaffe dominance on this critical front. Unlike the chaotic slaughters of Soviet Air Force (VVS) units in 1941 and 1942, the VVS fought their Luftwaffe counterparts to a standstill at Kursk.

Hiestand starts by discussing the chronology and campaign objectives for *Citadel*. He describes Luftwaffe and VVS equipment, personnel and their experience, and overall capabilities. Importantly, he also addresses the leadership of each force at various levels and how decisions were made and communicated. He then goes into a detailed examination of day-to-day actions from July 5th through the day German operations ended in the south, July 17th. The sheer scale of the air operation—struggles for air superiority, reconnaissance, strategic bombing of airfields and rail junctions, and ground attack missions (the domain of Ju 87 Stukas, Hs 129s, and Il-2 Shturmoviks)—is clearly and deeply explained.

Hiestand also addresses how air-ground coordination was especially important. The Luftwaffe employed their extant system of *flivo* liaison officers at all levels of the ground force command structure. This included *flivos* in advancing ground units who communicated directly with their air support. The VVS operated a top-heavy, fixed-objective system that prevented their effective use of air power for almost the entire battle. Hiestand's subsequent analysis section explains why the Luftwaffe, suffering detrimental attrition of aircraft and experienced pilots, as well as insufficient fuel resupply, ultimately did not make a difference to the overall battle. However, VVS performance improved as new, more-capable aircraft and new air-ground coordination procedures entered the arena.

If your knowledge of the Battle of Kursk is limited to tank silhouettes and tactical maps, this book provides a very readable account that successfully illustrates a clear understanding of the complexity and intensity of the air war. The narrative is well supported with easily understandable maps, comparative tables, and contemporary photographs of both sides. For historians, it offers a strong case for why the VVS's performance reached a significant turning point, while the Luftwaffe lost the ability to decisively influence the ground war in the East. It is highly recommended.

Tim Hosek, USG (retired)



Cuban Military Aviation Volume 1: Organization and Development of the Cuban Army Air Corps, 1913-1952. By Helio Higuchi and Antonio Luis Sapienza Fracchia. Oxford UK: Helion, 2025. Pp. 78. Photographs. Appendices. Illustrations. Maps. Diagrams. \$29.95 paperback. ISBN: 978-1-804517-17-8

Authors Higuchi and Fracchia are credited with numerous books and articles on Latin American military aviation. Their latest work details the history of the Cuban Army Air Corps (CAEC) from 1913 to 1952. Or-

ganized in 1913 and initially equipped with a Curtis FS flying boat, the CAEC trained Cuban aviators for World War I aerial combat in cooperation with the US. Several pilots served in France with the British and French. The Armistice ended plans to deploy a CAEC squadron trained at Kelly Field in Texas. Postwar, the CAEC flew surplus DH-4s and JN-4s. Later it acquired Curtiss Hawks, Vought O2U Corsairs, and Wacos.

Despite never having more than a few dozen aircraft at any one time, the Cuban military air establishment maintained a high standard of professionalism. Cuba established two squadrons, adopted unit insignia, and established flight and mechanics schools. Some pilot candidates were trained in the US. Coastal patrols, liaison, aerial mapping and goodwill flights evolved. American military aviators periodically advised the CAEC during these years, especially on new aircraft technologies. The CAEC's reputation for proficiency soon attracted trainees from other Latin American countries.

Cuba declared war on the Axis powers following Pearl Harbor, and Cuban military aviators flew combat with Allied forces in Europe. Examples include Lt. William Ralph Perez, who flew bomber escort in Eighth Air Force P-38s; and Flying Officer Miguel Seiglie, RCAF, who piloted Lancasters on bombing missions over Germany. Closer to home, the CAEC flew anti-submarine patrols in Lend-Lease T-6 Texans in conjunction with US forces that operated four-engine patrol bombers out of two air bases in Cuba.

CAEC occasionally obtained aircraft through unusual means. For example, in 1947 the Cuban government apprehended a rebel group, the *Cayos Confites* expedition, before it could act on plans to overthrow the government of the Dominican Republic. This resulted in a windfall for CAEC: a half-dozen P-38s, a few B-25s, and a four-engine PB4Y. However, operations and maintenance challenges meant a short service life for most of those planes.

The authors coherently cover the CAEC's role in Cuban politics and internal conflicts over the years, concluding with early air operations against pro-Castro forces. This book also profiles the early years of the Cuban Naval Air Corps.

Part of Helion's Latin America@War series, this book is the most comprehensive treatment yet of the pre-1952 Cuban air force. Previous coverage includes Andrade's *Latin American Military Aviation* (1982); Hagedorn's *Latin American Air Wars* (2006) and Hagedorn, Garcia and Overall's *Pulp Fiction Fighters* (2024). Sources include published memoirs, interviews, official documents, and correspondence. Many of the photos are sourced from private collections. An appendix lists all CAEC aircraft from 1913-1952. Clearly drawn maps depict areas of CAEC operations.

The narrative is fresh and lively, reading like a year-book in places, with flying school graduates of a century

ago diligently listed, and smartly uniformed pilots pictured posing proudly in front of their planes. It's a solid addition to historiography of Latin American military aviation.

Steven Agoratus, Hamilton NJ



The Vought F4U Corsair in the War Against Japan: A Photographic Record of the 15th Naval Fighter Wing at War 1944-45. By Tim Hillier-Graves. Haver-town PA: Air World, 2025. Photographs. Bibliography. Index. Pp. xiii, 135. \$37.95. ISBN: 978-1-03612-810-4.

Hillier-Graves is a retired Royal Navy officer who now writes books on military aviation and engineering subjects. He previously wrote *Widowmaker: Living and Dying with the Corsair* and *Heaven High, Ocean Deep: Naval Fighter Wing at War*. Both books dealt extensively with the F4U and Royal Navy fighter operations in the Pacific. This volume basically summarizes those two efforts with an emphasis on photographs. Included are more than 200 black-and-white and nearly 50 color images, most of which came from personal collections.

Much has been written about the Corsair's gull-wing design. The US Navy determined that early Corsair models were unsuitable for carrier operations due to a challenging landing envelope. Therefore, US Marines, operating from bases in the Solomon Islands in the southwest Pacific, introduced the Corsair to combat. However, the Royal Navy's Fleet Air Arm (FAA) pilots initiated carrier operations. Between World War I and II, the Royal Air Force emphasized bombers and interceptors and failed to develop capable carrier-based aircraft. As a result, the Admiralty turned to the United States for suitable planes. The Grumman F4F Wildcat preceded the Corsair in FAA service.

With the Corsair production line heating up and the US Navy sticking with the F4F until the Grumman F6F Hellcat arrived, the British seized the opportunity and began acquiring the F4U. FAA pilots traveled to the United States for training. While the initial version of the Corsair possessed significant deficiencies, engineers would eliminate these shortcomings in future models. Meanwhile, FAA pilots persisted with their training. Nevertheless, the Corsair challenged pilot skills. The FAA also acquired F6F Hellcats. Hillier-Graves estimates that the Corsair units experienced a 28-percent accident rate compared to 4 percent for the Hellcat outfits in British service over the final two years of the war.

Most of the book covers combat operations that began in 1944, when the Royal Navy dispatched its fleet carriers to, first, the Indian Ocean and, later, the western Pacific. There they operated as a task force within the US Navy's Third Fleet. As the Allies closed in on the

Japanese home islands, the 15th Air Wing experienced its most intense combat flying missions during the Okinawa campaign. These included suppressing potential attacks by hammering Japanese airfields on some of the smaller islands north of Okinawa.

This book is best suited for Corsair enthusiasts seeking unique photographs or, perhaps, descendants wishing to learn more about their relatives' experiences serving with the 15th Naval Fighter Wing.

Steven D. Ellis, Lt. Col., USAF (ret.); docent, Museum of Flight, Seattle



European Top Gun: The Tactical Leadership Programme: NATO's Advanced Aircrew Training School From the Cold War and Beyond. By Salvador Mafé Huertas and Rafael Treviño Martínez. Barnsley UK: Air World (Pen and Sword), 2025. Maps. Photographs. Index. Pp. 276. \$49.95. ISBN: 978-1-03612-179-2

Top Gun is a favorite topic of study for airpower scholars. This crucible of operational training furnishes a robust vehicle for advancing technological, operator, ground crew, and even logistician skills. The Air Force's current emphasis on Agile Combat Employment makes such training ever more urgent. This book is about the NATO equivalent, called Tactical Leadership Programme (TLP). The aircraft, the pilots, the maneuvers, even the ground equipment are pictured and described well by Huertas, who is an experienced defense author with numerous titles to his credit. His co-author, Martínez is a technical expert on defense aviation.

The book begins with a brief history of the origins of TLP. The strength of the narrative lies in the in-person research, interviewing people on the flightline and in the shops, and taking candid shots of participants, planes, weapons, and even ground-handling equipment from numerous annual TLP meets. The authors set this book apart by going beyond the usual flight and ground crews: even the air base liaison officer was interviewed for his thoughts on how to host such a large and complex training event. The narrative is written in a conversational style that makes it feel like you're walking down ramp with the authors, talking with people about the meet. The mundane is pictured as well as the exciting—a row of drop tanks on the ramp, a start cart, and even a tow bar.

This thick volume details every aspect of the planes, operators, combat generation, and even ground equipment of the TLP. The authors let the participants tell their own stories. For instance, the officer in charge of the Hungarian Air Force JAS 39 Grippen detachment narrates their challenges and successes, and how their Gripens performed versus other aircraft. Similarly, a

Hellenic Air Force Mirage 2000 pilot related his thoughts on how his unit's methods and capabilities measure up against those of other NATO nations.

This is the first book-length treatment of TLP. Elward's comprehensive *Top Gun: The Legacy* (2021) and Rininger's *Red Flag* (2006) nicely complement it from a US perspective. *European Top Gun* enhances the lessons in Guy Snodgrass, *Top Gun's Top 10: Leadership Lessons from the Cockpit* (2020). Pederson's *Top Gun* (2019) is the foundational work in this area.

The book reads almost as a planning manual on every aspect of a training exercise: how to integrate the activities of personnel of different partner nations, coordinate training flights, assure tanker support, allocate ramp space, even how to share ground equipment. There are well-researched profiles of partner nation squadrons and details of planes, weapons, and other items. For instance, the Hellenic Air Force and its Mirage 2000s are profiled.

The authors carefully outline the steps the 43-year-old TLP is taking to remain relevant to twenty-first century air war, with updated training facilities, emphasis on networking and electronic warfare, and operations in degraded environments, including agile combat employment techniques. The index is brief but useful. Terms are defined on first use, but a glossary would have been nice. Despite these, this book is highly recommended.

Steven Agoratus, Hamilton, NJ



Assembly Ships of the Mighty Eighth. By Jacek Jackiewicz and Robert Bock. Sandomierz, Poland: MMP Books, 2026. Photographs. Illustrations. Table. Diagrams. Pp. 184. \$55.00 paperback. ISBN: 978-83-67227-85-8

Combat box formations were developed as a means to provide the most defensive firepower possible for bomber formations on missions over contested areas. This book provides a detailed review of the reasons, methods, and very colorful aircraft used to aid the airborne assembly of the combat boxes.

Jackiewicz provided all the color profiles in this book and collaborated with Bock on the text. They previously produced several aviation history books including *Captured Butcherbirds*, *Japanese Aircraft in Foreign Service*, and *Hacks: Utility Planes of the Mighty Eighth*. This is an updated version of their *Assembly Ships of the Mighty Eighth* (published in 2007) that has over 60 additional pages.

Night bombing efforts by the RAF early in World War II produced inconsistent results and often proved very costly. The US Army Air Forces (USAAF) entered the fray in 1942. Its leadership insisted on daylight

bombing missions to achieve better results by concentrating more bombs on target. As long-range fighter escorts were not yet available, the best defense devised was the combat box—formations that concentrated the defensive firepower of the B-17s and B-24s. It was essential to assemble the formations as quickly as possible, and under radio silence, to not tip off the Germans; a process that typically took two to three hours. Assembly ships were war-weary B-17s and B-24s that were stripped of their armaments and given additional exterior lighting and flares (color coded for each bomber unit). Each carried two pilots, a navigator, a radio operator, and a flare operator. Painted in bright colors and outrageous schemes so they could be quickly located, they loitered in the unit formation areas to guide formation of the combat boxes. Once the lower echelons were assembled, the assembly ships would take their formations to locate and link up with other formations, increasing in size from element through group and wing combat box formations, before they returned to base.

The narrative begins with a review of RAF bomber tactics early in World War II. It then delves into USAAF arrival, the advent of daylight bombing, and the processes and problems organizing the large, massed formations. The general narrative concludes early in the book and is followed by reviews of individual assembly ships, from *Little Rock-ette* through *Green Hornet*. Each period photograph and supporting color profile showing the aircraft in four views includes detailed captions describing the scene and some history of that aircraft. Of special note are the photographs that show several of the assembly ships in their original paint schemes and unit markings before becoming assembly ships. The book also covers the little-known subject of formation monitor aircraft. Also known as shepherds, dogs, or cops, these war-weary P-47 Thunderbolts (including one with a Malcolm Hood canopy and some with D/F loop antennae) were assigned to get stray bombers into position in the combat boxes.

This is a great work on a unique part of military aviation history. The new photographs and profiles in this release are excellent additions. For the modeler, historian, or aviation enthusiast, it is worth reading every bit of text in this book and scouring the images; information is everywhere.

Tim Hosek, USG (retired)



Sepecat Jaguar: A Development and Operational History. By James Jackson. Manchester UK: Crecy Publishing, 2025. Photographs. Appendices. Maps. Illustrations. Diagrams. Pp. 336. \$55.95. ISBN: 978-1-80035-329-9

Jackson has numerous military aviation titles to his credit, among them *Teach for the Sky*, on RAF training (2021). In this book, he covers the twin-engine, Cold-War-era Jaguar fighter-bomber jointly developed by the UK and France. Powered by two Rolls-Royce/Turbomeca Adour low-bypass turbofans, it was optimized for rough-field, low-altitude operations, especially low-level delivery of tactical nuclear weapons in Cold War Europe. The RAF deployed Jaguars to forward-based RAF squadrons in Central Europe, replacing the FGR Phantom. They had a role in NATO war planning of low-level strike and interdiction with tactical nuclear and conventional munitions. After the Cold War, RAF Jaguars flew combat in the Gulf War, the Iraq no-fly zone, and the Balkans. Besides cooperative Cold War exercises with NATO, French Armée de l'Air Jaguars operated in Chad, Mauritania, Djibouti, the Balkans, West and Central Africa, and the Gulf War. The Indian Air Force purchased 40 Jaguars, license-built 120 more, and continues flying them today. Operations include conflicts with Pakistan as well as multinational exercises. Other operators included Oman, Ecuador, and Nigeria.

Jackson details the aircraft's design, development, manufacture, testing, operations and retirement. The concentration is on RAF and French service. The text's immersive, candid quality makes the reader feel as though they're standing under the aircraft with the crew chief and pilot before a sortie. This is especially true with discussions of airframe, engine, and weapons systems problems.

Aside from the expected in-flight and static shots, numerous photos (all taken by the author or supplied by civilian and military sources) detail aircraft features and weapons systems. There are unposed pictures of ground crews at work, engine changes, and aircraft opened up for heavy maintenance. Gritty Cold War reality is depicted by personnel in nuclear/biological/chemical-warfare suits servicing aircraft under the glaring illumination of hardened shelters in Germany.

Although the aircraft's development program—eight years from contract to ramp—roughly paralleled that of the contemporary F-111A, the thorough coverage here of the international development team confidently surmounting technical, funding, and political challenges one after another unintentionally inspires envy, at least for American readers accustomed to the grueling quarter-century of development routinely endured for modern tactical aircraft.

Appendices list and describe all models used by each operator. A glossary defines the terms for the Jaguar's often-obscure specialized weapons and electronics systems. Maps detail Cold War operating bases. Diagrams provide information about various aspects of the aircraft's production, performance, deployment, and weapons systems.

This is one of the more comprehensive efforts of recent years. Foster (2006 and 2017) focuses on operations

and squadrons. Napier (2025) relates pilot experiences on RAF combat missions. Griffin's 2016 effort focuses on the aircraft's service in Oman. Lake (1990) and Evan (2012) contains production and variant details. Although a bit dated, Taylor (1980) and Evans (1998) are informative. Braybrook (1986) details early operations.

Sources include official documentation on the aircraft itself, manufacturer files, and archives of military operations spanning a 40-year period. An aficionado's delight, this book is destined to become a standard reference.

Steven Agoratus, Hamilton NJ



Wings Over the Fleet: British Naval Aircraft Since 1945. By James Jackson. Manchester UK: Crecy, 2025. Photographs. Index. Bibliography. Appendices. Pp. 400. \$49.95. ISBN: 978-1-80035334-3

At first encounter, this book is an imposing physical object. Produced in a large, coffee-table format and printed on heavy, high-quality paper, the volume displays an extensive photographic record of Royal Navy aviation. The quality of reproduction is excellent, and the imagery is clearly central to the book's design and appeal. At the same time, its considerable weight and dimensions make it unwieldy for sustained reading and limit its portability. In practical terms, it is a work better consulted at a desk than carried for casual reading.

Despite its visual richness, the book is more than a photographic catalogue of aircraft types and pedigrees. Jackson provides a substantive narrative that traces the development of British naval aviation and the aircraft that served it. The prose is clear and well organized, allowing the narrative to move smoothly between technological description and institutional history. Nevertheless, Jackson frequently uses specialized flight test terminology and technical jargon—all with a “British-English” flavor. Readers unfamiliar with the often intricate and sometimes Byzantine structures governing British aircraft development and procurement may at times find the discussion challenging to follow.

As is often the case with works grounded in archival research, the depth of coverage varies across the aircraft and programs discussed. Some aircraft are presented with substantial contextual detail, including financial pressures, political influences, developmental challenges, and the eventual operational fate of the design. Other entries are necessarily more concise, reflecting the more-limited documentary record available to the author. While understandable, this unevenness may leave some readers with the impression that the treatment of individual aircraft programs is occasionally unbalanced.

One of the book's most valuable contributions lies in its discussion of technological innovation within the Royal Navy's carrier-aviation community. The Royal Navy has long been credited with pioneering several concepts that shaped the modern aircraft carrier, and Jackson appropriately highlights developments such as the angled flight deck and the mirror landing aid. Particularly noteworthy is his examination of more experimental initiatives, including the concept of inflatable flight decks designed to allow jet aircraft to operate without conventional landing gear. Although the idea proved impractical, British advocates succeeded in persuading the US Navy to modify both a carrier and aircraft to evaluate the concept—an illustration of the period's willingness to pursue unconventional solutions.

Jackson also emphasizes the growing importance of rotary-wing aircraft and the concurrent development of STOVL and VTOL platforms, both of which significantly altered the operational dynamics of the flight deck.

Overall, *Wings Over the Fleet* represents a substantial and carefully produced work that will be of particular interest to specialized audiences concerned with naval aviation history and aircraft development. While it is not a volume most readers will approach sequentially from cover to cover, it functions effectively as a reference and browsing resource. As such, it constitutes a useful—if specialized—addition to the literature on Royal Navy aviation.

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Q-Birds: American Manned Aircraft as Drones. By Frederick A. Johnsen. Manchester UK: Crecy Publishing, 2024. Diagrams. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. 208. \$49.95. ISBN: 978-180-035279-7

Johnsen, an Air Force historian and former director of the Air Force Flight Test Center Museum at Edwards AFB, has authored more than 20 books and numerous magazine articles over the past 40 years. In his latest book, he provides insight into what motivated the Air Force and Navy to develop and sustain a drone program relying on surplus manned aircraft. Along the way, he describes in detail how the military found various ways to employ drones in realistic scenarios, while minimizing the risk to associated personnel.

American use of manned aircraft as drones occurred toward the end of World War II. In one instance, military leaders intended to fly battle-weary Boeing B-17 bombers heavily laden with explosives into targets in Western Europe. These crude efforts relied on a two-man crew to control the takeoff and then bail out. This pro-

gram failed to achieve its operational goals but did provide a foundation for post-war drone development.

After the war, to determine the impact of atmospheric nuclear blasts and collect air samples from atmospheric nuclear detonations in the western Pacific, the Air Force used, primarily, B-17s; while the Navy used Grumman F6F Hellcats. The Navy continued to utilize the F6F in other roles: barebones flying bombs in the Korean War, and targets for testing the Sidewinder air-to-air missile.

Besides the Sidewinder, other missiles that relied on targeting drones to facilitate their reliability and accuracy included the Nike Ajax surface-to-air missile and the Falcon air-to-air missile. B-17s and, eventually, early jets such as the Lockheed T-33, proved to be reliable targets. Typically, two ground-station personnel managed takeoffs and landings, while an inflight controller maneuvered the target. The missiles usually lacked warheads. Drone personnel tried to reuse their aircraft as much as possible, but planes perished occasionally because of either structural damage from the missile or a communications breakdown that prevented the control ship from flying the drone. Chase planes, capable of shooting down the drone, accompanied each mission to prevent an out-of-control drone from approaching a populated area. For that reason, the New Mexico desert proved to be a popular operational site. In later years, of course, Tyndall AFB, on the coast of the Florida panhandle, became the home of the annual Air Force air-to-air competition which utilized drone aircraft as targets.

While many aircraft served as drones over the years, some suited the needs of the Air Force and Navy better than others. McDonnell Douglas F-4s and General Dynamics F-16s dominated the drone fleet for much of that time.

This book is highly recommended for anyone with an interest in American military aviation after World War II. Johnson has collected a wide assortment of photographs, many of them in color. He also has included color illustrations of interest to modelers. Relying mostly on primary sources, he has compiled a fascinating work.

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



F-35 In Service with Air Forces Around the World.

By Gerard Keijsper. Barnsley UK: Air World (Pen and Sword), 2024. Photographs. Appendices. Illustrations. Diagrams. Glossary. Appendices. Pp. 481. \$79.95. ISBN: 978-1-39908-353-9

The F-35 is arguably the plane of the moment. This book is packed with everything you could want to know about it—design, capabilities (kinetic and otherwise), op-

eration, servicing, armament, training, and manufacturing, among many other areas. There are lots of full-color photos of the plane, its weapons, and components. Gerard Keijsper is an authority on the F-35. This is his second volume on the plane. The previous volume (2008) focused on Joint Strike Fighter (JSF) development and design.

The text details every aspect of the plane and its operation. The international consortium that produces the plane is covered in detail—the contracts, customizations and special characteristics of F-35s produced abroad. The methods of flying the plane are described, and operations as of the publication date are detailed. An appendix lists the purchase packages offered, including various air-to-air and air-to-ground weapons, and spare engines. The pilot's helmet, integrated to make the pilot function almost as a part of the plane, is explored in detail. The Pratt and Whitney F135 engine is described in depth and its capabilities dissected. Ground equipment and infrastructure—servicing and diagnostic tools, training equipment, and software and hardware requirements—are all detailed in depth.

The implications of the F-35 as a weapons system are explored. There are thorough explanations of one of the most fascinating parts of this plane, the integration and networking that enables intelligence sharing. This goes well beyond passing targets on to fourth-generation fighters; it extends to ships, and even land-based artillery and rocket systems. F-35s can work with U-2s, satellites, ground stations, and other aircraft to gather, process, and relay targeting information and intelligence. Keijsper also describes purchase programs of international customers—their armament packages, electronics selections, intended mission sets, and planned deployment.

The book presumes familiarity with the principles of tactical aircraft, weapons, and the basic physics of supersonic flight. The text is written in a conversational tone that sounds as if the reader is on the ramp with Keijsper, discussing a plane in front of them.

Among the more recent books on the F-35 are Burbage, Clark and Pitman (2023), focusing on operational integration; and Thorn and Donald (2016), on variants, mission types, and deployments. Robert Jackson's 2018 effort discusses the plane's development, initial operational capability, and gradual adoption by overseas customers. Jon Lake (2019) emphasizes squadron service, basing, and the evolution of doctrine. Reyes (2025) focuses on the aircraft's design, weapons integrations, and integrated warfare capabilities.

The rather thorough glossary lists the acronyms that accompany weapons systems – from AAA (Anti-Aircraft Artillery) to 3BSN (Three Bearing Swivel Nozzle). There is no index or list of sources. For a book like this they are essential.

This thick, handbook-sized hardcover is a solid addition to F-35 scholarship. It is printed on heavy, perma-

ment stock and is intended to serve as a standard reference. You won't be able to put it down.

Steven Agoratus, Hamilton NJ



Russian Aircraft of WWI. By Viktor Kulikov. Reno NV: Aeronaut Books, 2026. Photographs. Illustrations. Diagrams. Tables. Bibliography. Pp. 422. \$79.99. ISBN: 978-1-964637-46-4

This book is the most comprehensive single-volume survey yet published in English on the airplanes designed and built within the Russian Empire during the First World War. Ambitious in scope and encyclopedic in execution, it documents the “most successful designs of original aircraft” produced in Russia between 1914 and 1917 as well as the broader industrial and technical ecosystem that produced them. In doing so, it fills a long-standing gap in aviation historiography, where Russian aeronautical development has too often been treated only in fragments or through secondary foreign-language syntheses.

Kulikov frames the study within the realities of Russia's limited industrial capacity, noting that between 1914 and 1917 some 311 original aircraft designs were created, of which 240 passed flight tests, and 38 entered serial production. This statistical grounding, supported by Russian archival and technical sources, provides a measured context for evaluating the country's wartime aviation industry. Foreign and license-built machines are treated only insofar as they illuminate the evolution of domestic design practice.

Organization by manufacturer and designer, rather than strict chronology, allows design lineages to be followed with clarity. Major chapters address the principal production centers—Anatra, Lebedev, Russo-Baltic (RBVZ), Dux, and the flying-boat designs of Dmitry Grigorovich—demonstrating the differing engineering cultures, resources, and strategic priorities that shaped each enterprise.

The treatment of the Anatra factory serves as an excellent example of this method. Development of the Anatra “Anade” and “Anasal” series is reconstructed through factory correspondence, acceptance reports, and pilot evaluations, presenting both the promise and the shortcomings of these airplanes with balanced precision. Testimony from front-line commanders and inspectors, quoted directly from period documents, gives texture to the narrative and conveys how technical deficiencies were perceived by those charged with flying the machines. These limitations are neither exaggerated nor excused. Instead, they are situated within the urgent improvisations of a nation struggling to build an air arm almost from nothing.

More than a third of the volume examines experimental and lesser-known projects, bringing together material rarely available in English. The inclusion of prototypes and unsuccessful designs conveys the breadth of aeronautical experimentation underway in wartime Russia and underscores the creative energy present, despite material constraints.

The visual and documentary apparatus is a major strength. Hundreds of photographs, supplemented by color profiles, drawings, and technical tables, provide substantial research value. Production figures, serial data, and a bibliography grounded in Russian archival sources confirm the seriousness of the scholarship.

Taken as a whole, *Russian Aircraft of WWI* succeeds in compressing an exceptionally wide and technically complex subject into a coherent and accessible survey. While detailed operational histories must be sought elsewhere, this volume provides the essential technical and industrial foundation upon which such studies depend and stands as an authoritative reference on Russian aircraft design and production during the First World War.

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



The Hump 1942-1945: America's First Massive Military Airlift. By Mark Lardas. Oxford UK: Osprey, 2025. Photographs. Bibliography. Drawings. Indices. Maps. Illustrations. Pp. 96. \$25.00 paperback. ISBN: 978-1-4728-6594-6

This book is best understood as a concise but highly effective introduction to one of the Second World War's most consequential—and most misunderstood—campaigns. Rather than treating the Hump as a series of dramatic aviation exploits, Lardas correctly frames it as a sustained logistics campaign whose success depended less on tactical brilliance than on organizational learning, leadership, and persistence in the face of extreme environmental constraints.

One of the book's greatest strengths is its stage-setting narrative. Lardas clearly explains how, by severing the Burma Road, the Japanese forced the Allies into an unprecedented solution: sustaining China entirely by air across the eastern Himalayas. He emphasizes that this was not a temporary expedient, but a four-year strategic commitment undertaken in some of the world's most dangerous flying conditions. The reader comes away with a powerful sense of why the Hump mattered not simply to local operations, but to Allied grand strategy in Asia.

The book's maps and diagrams are particularly effective. For a campaign defined by geography, weather, and distance, Lardas provides clear visual aids that help the reader understand routes, altitudes, airfield loca-

tions, and the sheer scale of the logistical challenge. These visuals do more than illustrate. They reinforce the argument that terrain and climate were the primary adversaries, often deadlier than Japanese opposition.

Lardas is also at his best when discussing the people and organizations that made the airlift work. He highlights the pivotal role of senior leaders—many with civilian airline and air transport experience—who transformed a hazardous, inefficient operation into a functioning logistics system. The narrative captures how the introduction of airline-style discipline, standardized procedures, maintenance planning, and systems thinking allowed throughput to increase dramatically even as losses declined. This “learning by doing” is presented as the decisive factor in the campaign’s success. And many of these key leaders would emerge years later to build the air logistic masterpiece that became the Berlin Airlift.

Equally valuable is Lardas’s treatment of the Japanese response. Rather than overstating Japanese incompetence, he shows how the Hump was not fully recognized by Japanese leadership as a strategic threat until late in the war. By then, their air forces in Burma and western China were still equipped with second- and third-tier aircraft, often poorly armed with rifle-caliber weapons and flown by pilots receiving ever-shorter training. Japan lacked the radar, command-and-control infrastructure, endurance, and doctrinal flexibility required to contest a sustained air logistics campaign. As Allied aircraft grew larger, with better trained crews and more-capable organizations, Japanese interdiction efforts stagnated or declined.

The result, as Lardas makes clear, was a campaign that was dangerous for the allies but never truly contested. The Japanese endured the Hump rather than fought it as a system. That failure to adapt proved decisive.

As an introductory work, *The Hump 1942–1945* succeeds admirably. It demonstrates the Osprey formula at its best. The work does not attempt exhaustive technical or archival depth; but it provides a clear, well-structured foundation for understanding why this airlift mattered and how it worked. For readers seeking a lucid entry point into the logistics of modern air warfare—and a reminder that professionals talk logistics—Lardas’s booklet is an excellent starting place.

Gary Connor, docent, National Packard Museum, Cortland OH



The Sundowners, Pegasus, and Little Butch: Carrier Air Group 11 and the War in the Pacific, 1943–1945. By Brian D. Laslie. Annapolis MD: Naval Institute Press, 2025. Maps. Photographs. Appendices. Notes. Bibliography. Index. Pp. 248. \$23.89. ISBN: 978-1-682-47878-3

liography. Index. Pp. 248. \$23.89. ISBN: 978-1-682-47878-3

Dr. Laslie is the Command Historian at the United States Air Force Academy. He is the author of numerous books and chapters on US Air Force and air power history. Here he offers a gripping unit history that brings fresh focus to a single, highly effective element of the US Navy’s air war in the Pacific Theater. He follows the combat record of Carrier Air Group 11 (CVG-11) from its first deployment in 1943 through the closing campaigns of 1945, illuminating both operational detail and the lived experience of its aviators and crew.

Laslie sets the tone for the book with an initial description of the formation and identity of the group, explaining CVG-11’s organization of three squadrons: fighter, VF-11 *Sundowners*; bomber, VB-11 *Pegasus*; and torpedo, VT-11 *Little Butch*.

He then moves into CVG-11’s initial operations at Guadalcanal, where the air group first proved its mettle against entrenched Japanese forces. His interweaving of diaries, interviews with veterans, after-action reports, and official records provides the early chapters with a measured sense of immediacy by situating readers aboard ships and within operational cockpits as pilots grapple with carrier operations, rough seas, and relentless enemy defenses.

Laslie charts the group’s transition to service aboard USS *Hornet* (CV-12), where its operations expanded across the Central and Southwest Pacific, including Luzon, Mindanao, Mindoro, French Indochina, and Okinawa. Through these campaigns, the book emphasizes not only strategic outcomes, but also the tactical evolution of carrier aviation, illustrating how fighters protected bombers and torpedo planes with remarkable efficiency and how all three squadrons worked in concert to achieve air superiority and strike objectives.

A highlight of Laslie’s account is his treatment of the individual pilots and aces who emerged from these hard-fought campaigns. Detailing how CVG-11 produced four aces, including top scorer Charlie Stimpson (16 kills), the book humanizes the numbers and statistics that often dominate military histories. These personal stories of fear, skill, loss, and comradeship give emotional weight to the operational history and serve to broaden the book’s appeal to readers beyond strict tactical enthusiasts.

The final portion of the book synthesizes the air group’s record across multiple theaters and engagements, providing context for its cumulative impact on the Pacific War. The air group’s achievements during World War II were laudable, amassing 103 air-to-air victories, destroying 272 planes on the ground, and sinking more than 100,000 tons of Japanese shipping. Laslie concludes with informed reflection on how a single, relatively understudied unit’s perseverance contributed materially to the broader Allied victory.

This book is a well-researched and well-written unit history that balances tactical narrative with human dimension. Fans of World War II aviation, naval history, or unit-level combat studies will find it both informative and engaging, while its use of firsthand sources makes it valuable for researchers and serious history enthusiasts alike. This is a worthy addition to the historiography of the Pacific War and a fitting tribute to those who served with CVG-11.

Frank Willingham, NASM Docent



U.S. Mercenaries and the Condor Legion: Airpower in the Spanish Civil War. By Christopher G. Marquis. Annapolis MD: Naval Institute Press, 2025. Maps. Tables. Photographs. Notes. Bibliography. Index. Pp. xiv, 320. \$39.95. ISBN: 978-1-68247-973-5

Marquis, a retired US Air Force officer, earned his master's degree in history at Auburn University. While attending Auburn, he wrote a paper about airpower in the Spanish Civil War (1936-1939). That effort provided the foundation for this book.

Many books have been written about the Spanish Civil War in general. A number have examined the impact of air power in that war and the influence of the Condor Legion, Nazi Germany's expeditionary force. However, this work is unique, because Marquis introduces two significant personalities, Steven Fuqua and Thomas Griffis. Both Army officers collected information on the air war either through personal observation or by cultivating trusted sources. Thus, the title is rather misleading, as neither one engaged in combat. On the other hand, Marquis does include the experiences of American pilots who fought for the Republicans against the Nationalists.

Historians share their insights either chronologically or thematically. However, Marquis combines the two approaches, as he points out in the preface. He begins by looking at how airpower evolved from the Wright brothers into the middle 1930s. In the second chapter, he introduces Fuqua and Griffis while providing context for the causes of the civil war and the early actions by the Nationalists as they prepared to overthrow the government.

Most historians consider Germany's decision to provide Junkers Ju 52 trimotor transports to the Nationalists as the most decisive use of airpower in the conflict. Using the transports enabled the Nationalists to fly more than 15,000 troops from Spanish Morocco to southern Spain and gain a foothold on the Iberian Peninsula. The Spanish naval forces, which remained loyal to the government, deterred a serious attempt at maritime movement.

As the conflict unfolded, Marquis follows the fighting in chronological order. Along the way, he examines the various applications of airpower: counterair, interdiction, close air support, and aerial bombing. He also devotes a chapter to technology. The penultimate chapter emphasizes the significance of air superiority's influence on the land battle. He winds up with a look at Army Air Corps thinking from 1939 to the beginning of America's entry into World War II.

Along the way, Marquis interjects reports filed by Fuqua and Griffis. The latter, in particular, figures prominently in the narrative with his work discussed in considerable detail.

This book reflects an exceptional research effort. Marquis extensively mined the archives to bring to life the work of two exceptional individuals. This is an absolute must-read for anyone with an interest in the Spanish Civil War, the work of attaches, or the development of airpower doctrine between World War I and World War II.

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



The Spanish Civil War in the Air, Volume 1: 1936-1937. By Eduardo Manuel Gil Martínez and Juan Arráez Cerdá. Warwick UK: Helion, 2025. Maps. Photographs. Illustrations. Diagrams. Pp. 78. \$29.95 paperback. ISBN: 978-1-804517-19-2

The Spanish Civil War air war is almost as popular as World War II as a topic of airpower scholarship. The rapid evolution of air technology and tactics in just three years foreshadowed the World War II air war. Pilots, especially those of the Luftwaffe, gained combat experience. Aircraft such as the Bf 109, He 111, Do 17, and SM-79 were tested in combat. The authors have multiple Spanish military aviation works to their credit.

This very readable volume, covering 1936-1937, is the first of an intended multi-volume treatment in Helion's Europe at War series. The story is familiar and has appeared in such stalwarts as Larrazábal (1969), Ries and Ring (1992) and Proctor (1983), among many others. Howson (1990) is an authoritative source on the aircraft of both sides. Corum (1997) and Lopez and Franco (2017) focus on the Legion Condor and Luftwaffe technology.

At the start of fighting, the contending Nationalists and Republicans each employed the mostly antiquated planes immediately available to them. As those were exhausted, they sought newer designs abroad. Modern aircraft of various types soon found their way (by means legal and otherwise) to both sides. Soviet and German intervention eventually brought the most influential flow of higher-performance aircraft into the war. The air war

over Spain became a lab of modern airpower designs and tactics, observed with interest by many future World War II combatants.

Readers will find colorful narration of the contest for control of the air over the battlefields of Spain, as early-model Bf 109s wrested air superiority from Soviet I-15s. Fast Do-17s flew long-range photo and short-range tactical reconnaissance as well as serving as low-level bombers. Advances were not confined to technology. Denied use of the sea by the Republicans, the Nationalist side mass-airlifted troops from Spanish Morocco to Spain in German-provided Ju 52s. The evolution of fighter and bomber tactics is interwoven throughout the book. The role of such mercenary pilots as Frank Tinker is mentioned, although Marquis (2025) and Tremlett (2020) as well as Smith and Hall (2011) are more authoritative on such airmen of fortune.

Many of the photos are new, drawn from private collections. Planes are pictured on the ramp and in action. Photos of key pilots and leaders, airfields, in-flight shots of formations and targets, and even aircraft being serviced populate the pages. Diagrams and tables lay out key statistics of aerial campaigns, aircraft, and armament evolution. Maps trace the front lines and course of the aerial campaigns. Diagrams detail aircraft design, armament features, and bomb design. Modelers will welcome the color profiles.

The narrative painstakingly details aircraft types, quantities, equipment details, and units. Campaigns, troop movements, and geographical locations are clearly described. There are some quibbles: the text was imperfectly proofread; and no index or notes, both requirements for a history of this type, were found. The bibliography is brief but lists rarely seen sources. This book is a solid addition to the growing body of Spanish Civil War air war historiography.

Steven Agoratus, Hamilton, NJ



War in Ukraine, Volume 8: The Battle of Kyiv, February-April 2022. By Joseph Mathers. **and Volume 11: The Battle of Chernihiv, February-March 2022.** By Mykhailo Zhirokhov. Warwick UK: Helion, 2025. Bibliography. Notes. Photographs. Illustrations. Maps. Tables. Pp. 85 and 63 respectively. \$29.95 paperback each. ISBN: 978-1-804517-20-8 and 978-1-804519-67-7 respectively.

Helion's War in Ukraine has provided insights into many aspects of the conflict. These two volumes each detail a critical battle at the opening phase of Russia's assault on Ukraine. Volume 8 focusses on the Battle of Kyiv, saving the city from capture while delivering a much-needed defeat of Russian forces. Volume 11 exam-

ines the parallel battle of Chernihiv, a city through which a second Russian force had to pass on its way to Kyiv.

The war has now lasted four years without end in sight. Russian President Putin, the architect of the war, believed that it would last only days—not years. Senior leadership in Europe and the US agreed. So where did the invasion begin to unravel? These two volumes provide the answer.

The Russian strategy envisioned both a rapid advance on Ukraine's capital and installation of a puppet government loyal to Russia. Russian forces were forward positioned in neighboring Belarus during exercises without knowing that they would soon invade Ukraine. In fact, few outside Putin's closest circle were informed of the impending invasion. The exceptions were special forces and airborne troops who had rehearsed specific tasks within Kyiv to decapitate the government and military leadership. Thus, Russian doctrine calling for establishment of a Combat Management Group to plan operations long before fighting began did not actually occur until just prior to the invasion. That may have been the first major error.

Mathers points out Russia's early success with cyber-attacks and aerial bombardment was, however, followed by repeated failures to follow through on the ground. How the invasion itself played out, and the Ukrainian resistance to it, is detailed in both volumes, down to the tactical level. While Ukraine was ill-prepared initially, one is impressed with both its soldiers' tenacity and its civilian commitment to defending their country. Those qualities seem to have been lacking in the invading Russian soldiers. At the same time, the reader is disappointed to learn that there were traitors within Ukraine who assisted the Russians. Consequently, the early phases of the war were not a forgone conclusion for either side, and that becomes obvious as one reads both monographs. Volume 8 concludes with the withdrawal of decimated Russian units, desperate to reach Russia and safety.

The Battle of Chernihiv took place at the same time as Volume 8's action and was critical to the successful defense of Kyiv. Zhirokov first provides a succinct, yet important, discussion of events leading up to the invasion. As in the battle for Kyiv, Russian forces pressing forward toward Chernihiv (enroute to Kyiv) often outran critically needed supply replenishments. Outnumbered, but tenacious, Ukrainian forces destroyed stockpiles the Russians did create, often aided by civilians providing timely intelligence. In contrast, Russian soldiers seemed focused on looting and maltreating civilians rather than on their mission. In the end, the mounting number of tactical successes by Ukrainian forces led to operational success and the withdrawal of overextended Russian units to regroup outside Ukraine. It also becomes clear that Putin's hands-on meddling down to the tactical level was no small factor in the outcome.

These two volumes provide an understanding of how

Ukraine was able to survive the Russian onslaught during a critical phase of the invasion. The respective authors explain how victory in those two battles was achieved by Ukrainian forces, ultimately buying time for Ukraine to enhance its defenses against renewed attacks. Equally important, the authors highlight fatal errors committed by Russian forces leading to their withdrawal from the battlefield. Both volumes are well illustrated with maps, photographs, and depictions of aircraft, armor, and soldiers, and include orders of battle. Readers will gain an understanding of how the war unfolded in the Spring of 2022.

John Cirafici, Milford DE



TSR2: Britain's Lost Cold War Strike Aircraft, Third ed. By Tim McLelland. Manchester UK: Crecy Publishing, 2025. Photographs. Illustrations. Appendices. Bibliography. Index. Pp. 228. \$34.95. ISBN: 978-1-80035331-2

The first time I saw photographs of the TSR2 I thought it was a special effects model for a James Bond movie. If you've been to the Test Flight hangar at RAF Museum Midlands, you were lucky enough to see an example of the TSR2 looking as impressive today as it was on its first flight in 1964. The TSR2 could be called the most advanced aircraft in the world at the time. It could possibly have become a world-leading strike platform for the Royal Air Force (RAF).

This book is a comprehensive, detailed account of an amazing aircraft that never made it past one flying prototype. This third edition includes new appendices covering the design problems faced by the TSR2 (by historian Tony Buttler) and the background of the requirement that led to the TSR2 (by Clive Richards). The previous sections on the TSR2 flight and engineering manuals were updated with additional material.

The first-edition's author was the late writer Tim McLelland. An established aviation writer, he produced features for numerous magazines and journals such as *Aircraft Illustrated*, *Flypast*, and *Aviation News*. He also wrote over 40 books covering the Blackburn Buccaneer, Avro Vulcan, Hawker Hunter, Lockheed Hercules, English Electric Lightning, and others.

The TSR2 design resulted from requirement GOR.339 which called for a replacement for the Canberra tactical bomber/reconnaissance aircraft. It was designed for high-speed, low-altitude penetration of well-defended battlefields (often from rough or unprepared locations) and delivery of conventional and nuclear weapons to support Army operations. The prototype first flew on 27 September 1964. The development program produced a high-performing, aerodynamically sound

aircraft which featured many new and cutting-edge features regarding engines, landing gear, and navigation equipment/flight controls, especially terrain following. Plagued with engine and undercarriage problems and other delays, the TSR2 was excluded from the 1964 Farnborough Airshow, the first hint of its demise. In 1965 the program was cancelled. It was simply too expensive. The few completed aircraft and other associated airframes/components were scrapped or handed over for display in British museums. The TSR2 did leave a legacy: the Olympus engines planned for the TSR2 powered the Concorde airliner; and the Tornado, Jaguar, Nimrod, and Harrier all incorporated systems first developed for the TSR2.

The twelve chapters and five appendices of the book offer an honest look at the engineering, economic, and political basis for the TSR2's development and cancellation, dismantling the myths surrounding the project and, especially, its demise. The book is replete with all the data the authors could glean from every source they could locate on the TSR2 presented in an accessible style. It is worth reading every caption and sidebar in the book in addition to the main text—there's information in every sentence. The excellent photographs, diagrams, cutaways, and technical drawings, often from TSR2 operational manuals, are excellent. The References section includes a listing of additional books on the TSR2 with short reviews.

TSR2 is an outstanding work on the history of this amazing aircraft. The additions in this third edition are excellent. I recommend it for anyone's aviation library.

Tim Hosek, USG (retired)



AMX: Brazilian-Italian Fighter-Bomber. By João Paulo Zeitoun Moralez. Vienna, Austria: Harpia, 2022. Map. Tables. Diagrams. Illustrations. Photographs. Appendix. Glossary. Bibliography. Index. Pp. 141. \$41.95 paperback. ISBN: 9778-1-9503940-8-1

The what? Many readers are probably unfamiliar with this aircraft, although it was very important to both of the countries that developed and operated it—Italy and Brazil. Moralez is a Brazilian journalist who has written several books on aviation subjects. In this volume, he tells the story of the conception, development, fielding, and operations of this outstanding multinational aircraft very well.

Let there be no mistake: this book is well suited to the modelling community. There are superb photographs and illustrations that any modeler will appreciate. But it is, primarily, an excellent history of this important weapon system. Many of the best histories in the past several decades have come from this genre.

In the mid-1970s, The Italian Air Force (AMI) had the F-104 and Tornado as its front-line aircraft but needed more of something less expensive to take care of close air support, battlefield air interdiction, and reconnaissance work. With Italian industry, the AMI began exploring a new aircraft. Meanwhile, Brazil was retiring its B-26s and had new F-5s and Mirage IIIs that were good for air defense. But it needed a good air-to-ground aircraft. The Brazilian Air Force (FAB) looked at A-4s, A-7s, and other imports, but they could not fulfill FAB requirements. Brazil also wanted something else: technology and know-how to expand its fledgling aerospace industry. Italy was working on a new design, and it had a modern industrial capability. Thus, an international partnership ensued.

While the two air forces had similar requirements, there were major differences. The situation was not much different from the USAF/USN/USMC needs in the F-35 program, where three versions resulted with great commonality, but able to meet quite different requirements. Tornado, Eurofighter, Jaguar, and others have similar stories. The saga of how Brazil and Italy overcame differences and arrived at a joint program is very well told.

In the end, the program (70% Italian, 30% Brazilian) delivered 141 aircraft to the AMI and 58 to the FAB in both one- and two-seat versions. Brazil's vast territory dictated that the aircraft have very good range. External tanks and air refueling were required. Italy's requirements dictated an aircraft that could fight in the mountainous terrain to the country's north. Avionics differed for the two nations but, in the end, both the AMI and FAB got aircraft, in several models and modifications, that satisfied their needs.

FAB aircraft did not participate in any major military actions, but the AMI birds saw a great deal of combat. Italian AMXs participated in RED FLAG and went on to fly in *Deny Flight* in Bosnia, Kosovo, Afghanistan, and the 2011 Libyan intervention. While out of service now, both air forces got three decades of service from these highly maneuverable jets.

This is another quality production from Harpia that I recommend for readers interested in what makes joint or international programs tick. The narrative is full of first-person interviews from many of those who participated. It is THE book to read about this aircraft.

Col Scott A. Willey, USAF (Ret), Book Review Editor, and former National Air and Space Museum docent



RAF Jaguar Units in Combat. By Michael Napier. Oxford UK: Osprey, 2025. Photographs. Appendices. Illustrations. Pp. 96. \$25.00 paperback. ISBN: 978-1-47286525-0

Napier flew RAF Tornados for ten years and has several Osprey titles to his credit. His latest book recounts the RAF combat experiences of the classic British/French-developed, Cold War, ground attack jet, the SEPECAT Jaguar.

Originally designed as an advanced trainer, the RAF deployed Jaguars on Cold War frontlines for the first 15 or so years of its service. But it was after the Berlin Wall fell that the aircraft fought in wartime conditions, first in the Mideast and later over the Balkans. Those major RAF Jaguar combat operations are the subject of this book. They include Operation *Granby* (the RAF's name for *Desert Shield/Desert Storm*) in 1991, Operation *Warden/Resonate* (post-*Provide Comfort/Northern Watch*) from 1991-2003, Operation *Hamden/Deny Flight* (*Deny Flight* over Bosnia) from 1993-1995, and Operation *Vulcan/Deliberate Guard* (*Deliberate Guard* over Bosnia) from 1996-1998.

An entry in the Osprey Combat Aircraft series, *RAF Jaguar Units* focuses on pilots, operations, and campaigns. Numerous eyewitness accounts of combat over the Middle East and the Balkans populate these chapters, relating the experiences of low-level, precision bombing over highly contested territories, and endless patrols, featuring repeated tanking, over Central Europe. Details of aircraft and weapons performance abound. The core of this volume is air-to-ground combat, in all its vivid detail, as related by those who did the fighting. The reader gains the RAF perspective on those campaigns. For instance, observing USAF F-15Es being loaded for a mission over Iraq, one Jaguar pilot archly observed that the bomb load of a single Strike Eagle equaled that of three Jaguars. The candid combat accounts convey the urgency of daily operations in extreme weather conditions, with little to non-existing servicing facilities, and the fast-breaking, often random danger that accompanied the Jaguar's minimum-altitude bombing runs. For example, targeting radar of high-flying coalition interceptors regularly painted Jaguars scooting along at low altitude; frequent deconfliction by AWACS or RED CROWN accompanied such operations. In-action photographs of low-altitude runs bring home the close-in nature of the danger; some runs are close enough to show enemy personnel reacting. My only quibble is the sudden ending; Osprey's format leaves no room for concluding text.

Photos, many in color, are from official sources and participants. They depict pilots, planes (both in-flight and being serviced on the ground), austere ramps full of deployed aircraft, and unit heraldry. Sources include pilot interviews and official histories. There are the usual color profiles for modelers, including nose art. The index is brief but helpful.

This book's personal accounts and combat details nicely complement the comprehensive coverage of Jackson (2025), Bowman and Windle (2011) and Evans

(1998). Drendel (2022) and Hawkins (2017) pack a lot of information into well-illustrated volumes; Reed (1982) provides initial impressions based on just a few years' service.

A Cold War stalwart readily adapted for many missions, the Jaguar continues to serve with the Indian Air Force well into the twenty-first century. This book is a solid addition to the body of scholarship on the Sepecat Jaguar.

Steven Agoratus, Hamilton NJ



Air-to-Air Missiles Development and Combat Across 80 Years Volume 2: First Generation and Early Experience, 1944-1959. By Bill Norton. Warwick UK: Helion, 2025. Bibliography. Notes. Photographs. Tables. Illustrations. Maps. Pp. 90 paperback. \$29.95. ISBN: 978-1-804518-74-8

Norton is a retired flight test engineer whose career spanned 40 years, including 20 as a USAF officer where he also served as aircrew on test aircraft. He held numerous positions in dozens of aerospace programs spanning all aircraft types. He has penned scores of technical papers, books, and articles.

This is the second of a planned six-part series. It advances his comprehensive history of air-to-air missiles (AAM) by examining the first generation of operational systems and their early combat experience. Where Volume 1 established the rationale for AAM development and explained core technologies and employment concepts, Volume 2 moves into detailed historical analysis. Norton explores missile types within the first generation in terms of technical evolution, maturation, deployment, and operational performance.

The opening chapter addresses the "zeroth generation," placing missile development in the context of World War II. The global conflict accelerated advances in propulsion, guidance, control systems, and fuzing, all technologies essential to guided weapons. Major combatants pursued missile concepts, yet few progressed beyond experimentation. None achieved operational status before war's end. Norton surveys British Artemis experiments, German efforts by Henschel and Ruhrstahl, and early American programs including the Hughes Tiamat project and the Navy's Gorgon missile. Though unsuccessful operationally, these efforts laid the technological groundwork for postwar systems.

The second chapter is the core of the book, tracing postwar development during a period initially hampered by limited funding and shifting priorities. The onset of the Cold War revived urgency, particularly as jet aircraft and nuclear-armed bombers transformed the air defense problem. Norton carefully examines US technological

leadership, discussing systems developed by Hughes, Ryan, Kellogg, Bendix, and General Electric. He explains beam-riding, semi-active radar homing, and early active-radar guidance, linking technical design choices to operational implications. His treatment balances engineering discussion with strategic context.

Norton surveys missile development beyond the US, including the USSR, France, the UK, China, Canada, Israel, and South Africa, illustrating how first-generation AAMs emerged globally. His comparative approach underscores the influence of captured technology, intelligence exploitation, and parallel innovation.

The final chapter analyzes early combat employment in confrontations between the two Chinas, the 1965 Indo-Pakistan War, and the Ogaden War. These case studies reveal the gap between theoretical capability and battlefield performance. Reliability issues, seeker limitations, training deficiencies, and rules of engagement often constrained effectiveness. Missile success depended on not only technical sophistication, but also doctrine, tactics, and operator proficiency.

As with the first volume, given the technical aspects and range of programs covered, a more detailed descriptive index would enhance its value as a reference book. Nonetheless, this volume succeeds as both a knowledgeable resource and a good introduction to early AAM development. Norton's professional experience and clear descriptions clarify the technological challenges and incremental progress that characterized the period. By tracing the imperfect, but foundational, systems of 1944–1959, he provides essential context for understanding the evolution of modern air-to-air warfare.

Frank Willingham, NASM docent



The Shy Assassin: The Inspiring Story of Cyril 'Frank' Babbage, Battle of Britain Spitfire Ace Turned D-Day Mosquito Pilot. By Air Marshal G.A. Robertson. London: Grub Street, 2025. Photographs. Appendices. Glossary. Bibliography. Notes. Index. Pp. 192. \$39.95, ISBN: 978-1-911714-26-2

This is a biography of a Battle of Britain ace who flew Spitfires in Nos. 602 and 41 Squadrons of the RAF during that battle and then went on to fly night interdiction missions in Mosquitos of No. 464 Squadron, Royal Australian Air Force, in 1944 and 1945. It brings to light the story of one of Churchill's "Few."

Author Robertson began his career at the RAF College in 1963. Over the course of his 33-year career, he flew nearly every RAF front-line fighter and qualified as a helicopter pilot. His previous books include *Fighters in the Blood* (2020), *A Spitfire Named Connie* (2022), *From Spitfires to Vampires and Beyond* (2023), and *Flying*

Through the Ranks (2024). All are known for incorporating diverse sources such as family papers and memorabilia, official documents, combat and operations reports, as well as first-hand accounts.

Babbage began his RAF career in 1938 when he left his family's butcher business to join the RAF Volunteer Reserves to train as a pilot. By September 1939, he was mobilized into the RAF and began training in the Spitfire. Babbage flew his first operational sortie in the Spitfire on 13 February 1940. In missions during the Battle of Britain from August through October 1940, he was credited with six enemy aircraft shot down (for which he received the Distinguished Flying Medal) and a seventh shared with another pilot. In June 1941, Babbage started flying sorties against German-occupied France. During a bomber escort mission that September, he achieved his shared seventh kill, an aircraft he described as similar in appearance to a Curtiss Hawk 75. It was, in fact, an Fw 190. Babbage was the first RAF pilot to shoot down an Fw 190 and, in the process, killed German ace Walter Adolph.

From late 1941 through early 1944, he served as an instructor pilot. During this time, he also underwent training to fly missions in the de Havilland Mosquito. Starting in April 1944, he flew night intruder missions as well as sorties in support of the D-Day invasion.

Post war, Babbage returned to flight instruction. He led training units for the RAF's first jet fighters, the Gloster Meteor and de Havilland Vampire. Starting as a non-commissioned officer pilot in 1939, Babbage retired as a wing commander in 1964.

The narrative and appendices provide a detailed account of the realities; pressures; risks; and, in many cases, luck that defined the life of Babbage and his fellow aviators. Unfortunately, there are no personal accounts by Cyril Babbage that would foster a connection with him.

This is a good biography of an aviator who took part in two defining moments of the war. It sheds light on a pilot who is representative of the heroism and humility of the period and is a worthwhile read for anyone interested in the Battle of Britain, night interdiction, and RAF fighter operations in World War II.

Tim Hosek, USG (retired), NASM docent



The Tokyo Sixteen: The Heroes of Doolittle's Raid on Japan in April 1942. By Geert Rottiers. Barnsley UK: Air World, 2025. Photographs. Sources. Pp. IX, 210. \$34.95. ISBN: 978 1 03613 438 9

It would never have occurred to me, 83 years after the daring B-25 Doolittle Raid on Japan in April 1942,

that a new publication would again emerge and retrace the extraordinary mission and human drama of the mission's volunteer crews—and do so by profiling the individual lives of the 16 courageous pilots. But Rottiers, “an amateur historian,” accepted the challenge and has written this well-researched, engaging, and approachable volume while avoiding, in most part, the inevitable and predictable pitfalls of biographical repetition.

There are clear, simple, and inescapable personal generalizations. Many pilots were raised in small towns, in mid-America, in often rural and isolated, tight-knit communities. They exhibited an early interest in aviation and engineering. Most were athletic, and many came from working-class families. They generally had strong, independent mothers and devoted spouses. The pilots were invariably influenced by the Depression which, importantly, developed their self-reliant characters. They were industrious and disciplined and possessed a strong sense of duty. Many were the first in their family to attend college. They were just the type of pilot you'd want to fly an important and dangerous secret mission over an ocean most had never seen before. And, of course, they all volunteered for the mission that was revealed to them aboard the USS *Hornet* only after departing from San Francisco on 2 April 1942. Remarkably, not one pilot—nor any of the 64 other crew members—resigned the assignment when they learned that their perilous one-way target was Japan. Not surprisingly, four of the pilots later became generals.

Although the Doolittle raid resulted in little actual military and industrial damage to the Japanese targets, the bombing had a profound psychological impact on the Japanese who had been promised that Japan would never be attacked. And the positive morale impact on the American population—something they needed—was palatable.

As the fleet approached Japan, the mission was launched prematurely for fear the carrier fleet may have been detected by Japanese picket boats. At that moment they were 10 hours and 170 nautical miles farther from Japan than planned, and the prospect of fuel starvation was inescapable. After dropping their bombs and passing over Japan, all but one of the aircraft headed for their intended Chinese landings. But after 13 hours of flight, with their fuel exhausted, the crews either bailed out or crash landed in the East China Sea or mountainous Japanese-occupied China. Three crew members died during that process. Remarkably, one aircraft landed in the Soviet Union, where the crew was imprisoned for a year. Unfortunately, eight men were eventually captured in China and endured frightful torture and malnutrition. One man died because of that incarceration, and three were tried and executed.

Rottiers has created an accessible and well-examined volume elucidating the lives of the 16 intrepid pilots who represented the finest of that Great Generation. Anyone who enjoys biographies and wants to learn more about

the Doolittle Raid will appreciate this volume.

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



Bombing To Provoke: Rockets, Missiles, and Drones as Instruments of Fear and Coercion. By Jaganath Sankaran. New York NY: Oxford University Press, 2024. Bibliography. Notes. Index. Pp. 212. \$29.95 paperback. ISBN: 978-0-19779263-6

Dr. Sankaran (PhD in Policy Studies, U of Maryland) is an associate professor in the Lyndon B. Johnson School of Public Affairs at The University of Texas at Austin. He is also a non-resident fellow in the Brookings Institution's Foreign Policy program. His primary interest areas are problems at the intersection of international security and science and technology. In this book (his first), he aspires to contribute to the literature on coercive statecraft but ultimately offers little that is original or analytically fresh. What emerges instead is an unbalanced, citation-heavy exercise that leans more toward pseudo-academic polemic than disciplined scholarship. Sankaran relies so heavily on external sources that his own analytical voice often disappears. The text reads like a patchwork of other people's arguments held together by commentary that rarely advances beyond summary.

Sankaran also misuses his footnotes as a kind of license to say anything. If someone else once made a claim, it must, therefore, be correct. This approach results in uncritical repetition rather than genuine synthesis. Compounding this weakness, he devotes an inordinate amount of space to restating his methodology and organizational structure, as though repetition might substitute for rigor.

While the narrative is, to his credit, an easy read, Sankaran's overuse of hyperbolic intensifying adjectives—"stupendous," "tremendous," "immense," and their kin—gives the prose a breathless, journalistic tone inconsistent with the analytical detachment expected in serious scholarship.

His grasp of military technology and history is equally uneven. He confuses the German V-1 and V-2 weapons and even invents nonexistent systems such as the "Mirage F-15E." These errors undermine his authority when discussing the technological foundations of coercive capability. The internal contradictions are striking. He chastises the Gulf War Coalition for being intimidated by Saddam Hussein's SCUD missiles yet elsewhere insists that Iraq possessed a "well-equipped arsenal of missiles and weapons of mass destruction." Historians have long traced coercive diplomacy to the Bronze Age (around 2300 BCE), demonstrating that its logic is timeless: demonstrate capability, suggest willing-

ness, compel behavior without total war. Sankaran's work neither challenges nor extends that understanding. Despite Dr. Sankaran's credentials, *Bombing to Provoke* adds nothing new to the discussion of coercive statecraft.

Gary Connor, docent, National Packard Museum, Cortland OH



Operativo Independencia, Volume 1: Armed Insurgency in Argentina 1955-1974 and Volume 2: Guerilla War, the 1976 Coup d'Etat, and the Dirty War in Argentina. By Antonio Luis Sapienza Fracchia. Warwick UK: Helion. 2024. Photographs. Drawings. Index. Bibliography. Appendices. Pp. 74 and 102 respectively. \$29.95 paperback each. ISBN: 978-1-8045-1467-2 and 978-1-8045-1576-1 respectively

Argentina has a reputation for volatile domestic politics that frequently finds expression through extremist rhetoric, violence, and associated economic instability—not to mention corruption and criminal behavior at all levels of government and society. It is nominally a federal, presidential, representative democracy with a multi-party system. But its frequent forays into fascism, totalitarianism, and military dictatorships have made it an historically unreliable ally and a troublesome neighbor in what can be seen as a difficult neighborhood. Fracchia's two-volume set covers one of the most horrific examples of the Argentine character in recent history. Volume 1 covers the political/social foundation of Argentina's armed insurgency in the mid-twentieth century. Volume 2 begins with a 1976 coup and covers the aptly named "Dirty War." While there is a military component to both volumes, I found these works to be more political in nature and not military histories as such.

Volume 1 offers a clear look at how Argentina's armed forces turned political and economic unrest into a stepping stone for dictatorship. Centered on the 1975 campaign in Tucumán, the book shows how the military claimed to be fighting guerrillas but, in fact, assessed the same tools of repression that would later define the "Dirty War." The story is less about defeating insurgents than about seizing political ground. With inflation raging, strikes spreading, and the Peronist government weakened, the army presented itself as the only reliable institution. By exaggerating threats and declaring civilian leaders incapable, the generals positioned themselves as guardians of order. Operation *Independencia* gave the military cover to use disappearances, torture, and censorship long before it officially took power in 1976.

These activities were not simply a response to violence, but a deliberate strategy. The junta wrapped its actions in populist language, claiming to defend "ordinary Argentines" while dismantling the very democracy

they said they were saving. That blueprint—using fear, unrest, and patriotic slogans to justify repression—has echoes far beyond Argentina. From Latin America to other regions, military and political elites have often created, and then exploited, domestic turmoil to sideline democracy in the name of security. This volume shows how quickly “emergency measures” and rubber-stamped executive fiats can become permanent tools of control. It is a timely reminder that the pattern Argentina lived through in the 1970s still resonates in the choices many governments offer their citizens today.

Volume 2 deepens the story of how Argentina’s military transformed a regional counterinsurgency into the foundation for nationwide repression. Picking up after the initial campaign in Tucumán, the book shows how the army steadily widened its methods—detentions, disappearances, and covert killings—while refining the political narrative that would support the 1976 coup.

Where Volume 1 highlighted the military’s entry into domestic politics, Volume 2 makes clear how repression through extra-legal means became institutionalized. The Tucumán campaign was no longer an “exception.” It was the model for how the junta would rule the entire country. The governing elites classified dissent as subversive and ordinary political opposition as a security threat, while the armed forces dismantled the line between war and governance. That blurring created the machinery of the “Dirty War,” in which tens of thousands of Argentines were targeted—not because they bore arms, but because they represented alternative ideas.

Fracchia underscores how the generals wrapped their brutality in language of patriotism and renewal. They spoke of saving Argentina from chaos, of protecting family and nation—messages that resonated with many who feared the country’s economic collapse and political unrest. It is precisely this blend of fear and populism that gave authoritarianism its foothold.

Volume 2 succeeds in showing how Operation *Independencia* was not just a military operation, but a political strategy to normalize dictatorship. In doing so, it warns how quickly democratic institutions can erode when a crisis narrative allows those in power to equate order with repression.

Fracchia’s books are not the usual type I review. They are high on political theory and Argentine domestic politics and, aside from drawings and photographs, short on military content. But they offer a valuable lesson on how elites can use fear to destabilize democratic institutions and make what were unimaginable actions acceptable to an apathetic population. These books are not for everyone, but I recommend them.

Gary Connor, docent, National Packard Museum, Cortland OH



Battle of Britain: The Final Curtain: 1 October 1940-31 October 1940. By Dilip Sarkar, MBE. Barnsley UK: Pen & Sword Books, 2025. Photographs. Bibliography. Appendices. Pp. vi-297. \$44.95. ISBN: 978-1-39905-806-3

This book is Sarkar’s seventh and penultimate volume in his history of the Battle of Britain. It covers the final phase of the “official” period of the Battle of Britain from July 10 to October 31, 1940. Sarkar has spent four decades researching and writing about the Battle. He has conducted extensive interviews with participants: pilots, ground crew, and civilians. This series of books, the most detailed study of the Battle to date, was written in cooperation with the Battle of Britain Memorial Trust.

Sarkar begins with a prologue that covers events up to October 1, when the nature of the Battle changed dramatically. By the end of September 1940, the German daylight bomber offensive had been defeated. The Luftwaffe shifted its bomber force to night attacks and resorted to high-altitude sweeps with its day fighters, some equipped with bombs, to keep pressure on the Royal Air Force (RAF). Sarkar then proceeds to describe combat between the RAF and the Luftwaffe day-by-day during October, drawing on combat reports and interviews with pilots and participants. With the benefit of research done over the past few decades, he is often able to match up combatants in some of these combat actions. An interesting point that comes out is the many cases of RAF pilots separately, but unknowingly, submitting claims for the same German aircraft. At the end of the descriptions of fighter combat, he includes a mention of actions by Bomber Command and Coastal Command, who are often absent from histories of the Battle. What is particularly interesting in the book are the notes that Air Vice-Marshal Keith Park (then commanding the key 11 Group covering the approaches to London) circulated to his squadrons concerning tactics. Sarkar argues that the Luftwaffe strategy of sending in high altitude sweeps with light bombing was a sensible one. Although the bombing did little damage, the sweeps forced the RAF to respond, thus continuing to pressure Fighter Command.

Sarkar goes into the “Big Wing” controversy in which—at the recommendation of Squadron Leader Douglas Bader—Air Vice-Marshal Trafford Leigh-Mallory argued for employing wings of three to five squadrons to attack the Luftwaffe raids. His firm conclusion is that the Big Wing approach was not, and would not have been, successful in the conditions of the Battle. He is scathing in his denunciation of the Air Ministry’s treatment of Air Marshal Hugh Dowding and Air Vice-Marshal Keith Park, who were dismissed shortly after the Battle ended through the machinations of Leigh-Mallory and Air Marshal Sholto Douglas. A moving final chapter includes reflections of pilots who flew in the Battle, looking back on their experiences years later.

This is not a book for someone looking for an introduction to the Battle of Britain. Stephen Bungay's *The Most Dangerous Enemy: A History of the Battle of Britain* would be a better book to start with. But those with a keen interest in, and knowledge of, the Battle will find Sarkar's books riveting for their detail and the quality of the combat descriptions. Highly recommended.

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



Battle of Britain Remembered. By Dilip Sarkar, MBE. Barnsley UK: Pen & Sword Books, 2025. Photographs. Bibliography. Pp.vi-305. \$44.95. ISBN: 978-1-39905-811-7

This final volume in Sarkar's history of the Battle of Britain covers how the Battle has been remembered and memorialized in British culture since the end of the Second World War. The book considers memorials, memoirs, and how the Battle has been depicted in British cinema.

Sarkar argues that the Battle of Britain remains relevant today for its legacy. It still looms large in British memory as one of Britain's finest hours. There are many memorials dedicated to the Battle and the men who lost their lives flying in defense of Britain. They range from the National Battle of Britain Memorial at Capelle-Ferne on the Channel Coast near Folkestone, to the Battle of Britain London Monument on the Embankment near Westminster, to memorials to individual pilots and statues of Lord Dowding and Air Marshal Sir Keith Park—for many, the Battle's two heroes. The memoirs chapter covers some of the great books that came out during the war and after, notably Flight Lieutenant David Crook's memoir *Spitfire Pilot, Arise to Conquer* by Wing Commander Ian Gleed, and *The Last Enemy* by Richard Hillary.

The Battle of Britain was portrayed in several films. Sarkar mentions wartime films such as *A Yank in the RAF*, *Mrs. Miniver*, and *The First of the Few*. *Angels One Five* and *Reach for the Sky*, about the life of Group Captain Douglas Bader, came out during the 1950s, followed by the epic *Battle of Britain* in 1969. More recently the BBC produced a dramatization of Geoffrey Wellum's book, *First Light*, his memoir of being an eighteen-year-old fighter pilot during the Battle.

Sarkar includes a chapter on aviation archeology relating to the Battle of Britain, an effort that began after the war to identify the locations of British and Luftwaffe aircraft downed during the Battle and to excavate the crash sites. In the process, the groups involved recovered the remains of some pilots who had remained missing during the war.

Perhaps the most helpful chapter for an American

with an interest in the Battle of Britain is a selective guide to memorials commemorating the Battle and "The Few" and to museums that feature extensive displays relating to the Battle. As many of these memorials and museums are located in the area surrounding London, most are accessible as part of a day's excursion. Among the museums worthy of a visit are the Kent Battle of Britain Museum on the site of the war-time Hawkinge airfield; the Biggin Hill and Tangmere Military Aviation Museums, both on the sites of Battle of Britain airfields; the Bently Priory Museum, which was Dowding's headquarters during the Battle; and the Battle of Britain Bunker and Visitor Centre at Uxbridge, which was the Operations Room for Park's 11 Group. He also mentions other related sites as well as museums that have examples of aircraft from the period. From this chapter, a visitor to London can create a full Battle of Britain itinerary. Highly recommended for those with a consuming interest in the Battle of Britain.

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



Nagasaki: The Last Witnesses. By M. G. Sheftall. New York: Dutton, 2025. Maps. Appendices. References. Notes, Index. Pp. 476. \$35 hardbound, \$14.99 ebook. ISBN: 9780593472286 (hardcover), 9780593472293 (ebook).

This is the second volume of Sheftall's *Ember Series*; I really like it. An American graduate of one Japanese university and a career professor at another, he explains why there are far more books about the Hiroshima bombing than that of Nagasaki. He answers many questions in a magnificently researched examination of the second atomic bombing. "The last witnesses" are several of Nagasaki's younger *hibakusha* (survivors) who shared their intimate and very compelling stories of survival with Sheftall, who had a knack at gaining their trust. Two ladies he interviewed had already survived the firebombing of Tokyo before moving to Nagasaki, so he's included a chapter on that as well. The survival stories and many other spinoffs are compelling:

How Nagasaki, once a pirate port, became an early outpost of Portuguese Catholics and maintained its minority Catholic population even after years of persecution (which explains why a ruined cathedral is a standard image associated with the bombing);

How *Bockscar's* mission went so wrong after *Enola Gay's* nearly flawless mission just three days before;

How the Japanese cabinet got so hopelessly deadlocked over whether to accept the provisions of the allies' Potsdam Declaration;

Why Hiroshima's virtual lock on "atomic-bomb tourism" (my term) is so strong.

Sheftall tells these and other stories skillfully and meaningfully without getting sucked into excessive detail. Thankfully, he didn't drag readers into the "did Truman make the right decision" argument that's been rehashed so many times.

This book is organized more chronologically than *Hiroshima: The Last Witnesses* (reviewed in the Spring 2025 issue), making it easier to follow. For some reason, both books have no table of contents or chapter numbers, so chronological organization really helps the reader. The extensive 22-page reference section contains many internet URLs (some, unfortunately, in Japanese) for readers wishing to research practically any topic brought up in the book. This is followed by 39 pages of notes; Sheftall well documents his research! However, if you're looking for illustrations, this is not the book for you. It has three maps, and one of them is of Tokyo.

What makes Sheftall's two *Ember* books relevant to me is that they don't just stop at the end of hostilities; they also lightly cover the American occupation and recovery of both cities right up to the present. The epilogues of both books are well worth reading, because they help understand the meanings of both atomic bombings in today's sense. As a docent at the National Air and Space Museum's Udvar-Hazy Center, I show *Enola Gay* to visitors from everywhere. The epilogue's description of the 1995 "culture-war" debate over the proposed NASM *Enola Gay* exhibit was both thoughtful and well-balanced.

I recommend this book, especially for those who want to understand the bombing, or the city of Nagasaki, or *Bockscar*, or the ending gambits of the Pacific war. It is evenhanded—neither hawkish nor dovish—and factual. While not full of judgmental assessments about what we did by dropping the bomb, it leaves no doubt about how it happened and the effect it had on the city, on the Japanese government, and the people impacted on both sides.

Maj Gen John B. Handy, USAF (Ret), NASM docent



New Guinea 1942-1943: Halting the Last Japanese Advance. By Mark Stille and John Rogers. New York: Osprey, 2025. Map. Diagrams. Illustrations. Photographs. Bibliography. Notes. Index. Pp. 96. \$25.00 paperback. ISBN: 978-1-4728-6655-4

Lead author Stille, a former intelligence analyst and naval officer, has written numerous books about World War II in the Pacific. His co-author, Rogers, has a similar background in intelligence and as a naval officer.

This volume, part of Osprey's series on air campaigns, follows the publisher's tried-and-true format. The

two-page introduction provides the strategic context for both the Japanese advance into the southwest Pacific and the Allies' subsequent efforts to counterattack.

The authors discuss Japanese capabilities at the beginning of what became the New Guinea campaign. As elsewhere in the early years of America's involvement in World War II, Japanese aviation in the southwest Pacific initially enjoyed a quantitative and qualitative advantage. The Allies endured costly lessons, including a significant overestimation of the capabilities of their aircraft, while underestimating those of Japanese aircraft.

The Allies benefited from a competent command structure. Douglas MacArthur, the overall Allied commander, found in George Kenney an ideal commander for tactical aircraft operations. However, the single Japanese headquarters in Rabaul on New Britain had to cope with competing objectives once American forces landed on Guadalcanal in the Solomon Islands. Allied leaders chose to split the region between MacArthur in New Guinea and, ultimately, William Halsey in the Solomons. The two worked well together.

Aided by superior intelligence, MacArthur and Kenney realized they could strangle the Japanese sea lanes. Horizontal bombing had underperformed against shipping. Kenney emphasized low-level attacks by various techniques such as skip and parafrag bombing and strafing. The Zero, or *Zeke*, Japanese naval fighter initially appeared in superior numbers and gave the Bell P-39s all they could handle. The increasing numbers of Curtiss P-40s and the introduction of the Lockheed P-38 eventually gave the Allies an edge, though air superiority remained difficult to achieve.

Perhaps the key battle for New Guinea occurred when Allied air power decimated Japanese shipping in the Battle of the Bismarck Sea. From then on, the Japanese would find supplying their forces in New Guinea very difficult.

Elsewhere, Boeing B-17s and Consolidated B-24s regularly attacked Rabaul northwest of the northern Solomons. These raids forced the Japanese to retain resources that might have been employed against Guadalcanal as well as New Guinea.

New Guinea lacked a surface transportation network, and enemy aircraft constantly threatened coastal shipping. Allied airlift played a critical role in helping the infantry gain a foothold on the north side of the imposing Owen Stanley Mountains.

This volume accurately summarizes the impact of air power in the first half of the battle for New Guinea. It is highly recommended for anyone interested in learning about a frequently overlooked part of World War II.

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



Pearl Harbor: Japan's Greatest Disaster. By: Mark E Stille. Oxford UK: Osprey, 2025. Maps. Photographs. Index. Bibliography. Illustrations. Notes. Appendices. Pp. 448. \$35.00. ISBN: 978-1-47286531-1

The attack on Pearl Harbor remains a unique event in American military history. No other single engagement has exerted such a profound and immediate influence across America's social, cultural, economic, and military institutions. For decades, Prange's *Pearl Harbor* trilogy stood as the gold standard for understanding the attack and its origins. In recent years, however, his work has come under increasing scrutiny. With this book, Stille may represent the passing of the torch to a new generation of historians specializing in the Pacific Theater.

The attack was primarily the intellectual and operational product of Admiral Isoroku Yamamoto who, as commander of the Combined Fleet, was revered in Japan for his embrace of naval aviation and reputed insight into the character of America. Stille carefully leads the reader into Yamamoto's strategic mindset, revealing not merely his intellect, but also his fundamental misreading of the American character of the 1940s. In many respects, this psychological exploration proves more illuminating than the detailed reconstruction of the attack itself. Stille demonstrates that the consequences of Yamamoto's flawed judgment were magnified by parallel failures among American senior leaders—Admiral Kimmel and General Short—whose lack of imagination, institutional rigidity, and racialized assumptions prevented them from conceiving of Japan's innovative and audacious plan.

Stille encourages readers to reexamine Pearl Harbor through a distinct 1940s psychological and cultural lens. In the immediate aftermath of the attack, American narratives portrayed Pearl Harbor as the product of a flawlessly executed Japanese masterstroke. Stille demonstrates that the Japanese plan was strategically short-sighted, operationally brittle, and unevenly executed, succeeding less because of brilliance than because it collided with American senior commanders who lacked imagination, misinterpreted intelligence, discounted clear tactical warnings, and failed to adapt defensively.

American commanders could not have stopped the attack outright, but the scale of destruction and loss was not inevitable. Elevating Japanese skill served an important psychological function within America but obscured the degree to which Pearl Harbor was enabled by American leadership deficiencies as much as by Japanese action.

From this psychological and strategic perspective, Stille presents Pearl Harbor as a case in which a short-term, identity-affirming success for the attacker catalyzed long-term defeat. Japan's actions struck those institutional and social mechanisms—American political unity, civil-military integration, and industrial mobiliza-

tion—that made US power uniquely lethal over time. The attack resolved America's prewar ambivalence toward global war, collapsed isolationist resistance overnight, and transformed shock and humiliation into moral clarity and national purpose. It produced a level of sustained national effort that Japan neither anticipated nor could match. In material terms, the damage inflicted was modest relative to American industrial capacity. Japan mistook an emotionally satisfying upset for a decisive blow. Within eight months, the US had translated outrage into production, organizational learning, and adaptive strategy, placing Japan on the strategic defensive and ensuring its eventual defeat.

Stille's insight into Yamamoto's mindset is the book's most compelling contribution. Yamamoto's belief that the destruction of five or six American battleships would demoralize the United States into accepting Japanese terms reflects what psychologists would describe as strategic mirror imaging rooted in projection bias. As Stille demonstrates, Yamamoto projected Japan's own greatest fear—catastrophic fleet loss as a political and psychological death blow—onto an adversary whose sources of resilience and total capability were fundamentally different. In Japan's strategic culture, naval annihilation implied national humiliation, regime crisis, and the collapse of imperial legitimacy. Yamamoto assumed the United States would interpret such a blow in the same way, an assumption reinforced by his historical memory of Tsushima and the Russo-Japanese War.

When Yamamoto first proposed the idea of a surprise attack on Pearl Harbor in 1939-40, Japan did not have the doctrine, tactics, or technology to accomplish that mission. Through his personality, reputation, and force of will, he pushed the Imperial Navy to develop the doctrine, tactics, and weaponry required and selected his acolytes, Fuchida and Genda, as operational planners who gave life to his plan. Unfortunately, they also brought their own flaws and biases which compounded those already inherent in Yamamoto's plan. Pearl Harbor emerges not merely as a tactical gamble, but as a psychological error at the grand-strategic level—one born of projecting Japan's own vulnerabilities onto an opponent whose response to humiliation was not surrender, but transformation.

At the start, I expected a retelling of a familiar story. Instead, I encountered a deeply analytical exploration of the mind of the architect of a bold, innovative, and profoundly misguided venture that cost enormous lives and treasure on both sides. Osprey has rendered a significant service to military historians. It has my unqualified recommendation.

Gary Connor, docent, National Packard Museum, Cortland OH



The Last 30 Seconds: A Brief History of the Evolution of Hit-to-Kill Technology. By David K. Stumpf. Fayetteville AR: The University of Arkansas Press, 2024. Tables. Illustrations. Photographs. Notes. Bibliography. Index. Pp. xvi, 160. \$40.99. ISBN: 978-1-68226-255-9

In 1960, the Defense Department's Advanced Research Projects Agency published the Project Defender Review, which discussed the enormous challenges associated with defending the country against a ballistic missile attack. In its simplest form, air or missile defense has always involved four basic tasks: detect the target, identify or characterize it, intercept it, and destroy it. Project Defender explored numerous ways to approach these tasks, one of which was the idea of "hit-to-kill," which would use direct impact rather than blast effects to destroy incoming ballistic missiles. Although this concept—in effect hitting a bullet with a bullet—seemed unrealistic to many observers at the time, hit-to-kill (HTK) has now become the foundation for all the United States' missile defense efforts, encompassing both theater and strategic levels of operation.

In this book, Stumpf presents a clear, comprehensive description of the work that has been done to achieve HTK capability. The narrative is a robust discussion of the staff organizations that were established to address the challenges, the research they conducted, and the hardware they developed and tested.

The book is exceptional for several reasons. First, Stumpf's coverage of HTK history is incredibly thorough in both its breadth and depth. The work is clearly the result of a tremendous amount of research, and it covers the complete range of research and testing programs across all military services. Second, he "connects the dots" in a way that makes DoD's development of HTK capability seem much more organized than it was to individuals who tried to monitor the events in real time. His analysis shows the logical connections across multiple programs that are sometimes difficult to see when we focus on a specific service or agency. And third, Stumpf is a superb writer who has the ability to present complex issues in a way that satisfies all readers, whether they are well-versed in the technology or have limited technical background.

Today, HTK technology has been deployed in multiple weapon systems. These include the Army's Patriot Advanced Capability-3 and Terminal High Altitude Air Defense system, the Navy's Aegis, and the Missile Defense Agency's Ground-Based Interceptor. Stumpf lays out the path for how each of these was developed by building upon previous successes, and establishes a current foundation from which to assess future developments. For anyone interested in the subject of the hit-to-kill approach to ballistic missile defense, this book is the perfect addition to the library.

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



Suicide Jockeys-The Making of the World War 2 Combat Glider Pilot. By Monique Taylor. Virginia Beach VA: Köehlerbooks, 2023. Bibliography. Appendices. Photographs. Pp.160. \$24.95. ISBN: 979-8-88824-146-2

Monique Taylor is a researcher specializing in lesser-known areas of history. She holds a BA in English literature, an MA in history, and a JD, and previously taught history at the college level. The daughter of a World War II glider pilot, she brings both scholarly rigor and personal insight into her work. Taylor is a researcher with the National WWII Glider Pilots Association, a frequent national and international speaker on combat glider pilots, and the author of numerous articles on the subject.

The need for combat gliders in World War II emerged from the Allies' search for a stealthy method to insert forces where conventional powered flight or parachute drops were insufficient. After the Germans demonstrated the tactical utility of gliders in early campaigns, Allied planners embraced glider operations to land troops, vehicles, and heavy equipment behind enemy lines with precision and surprise. In the European Theater, gliders proved essential in operations such as Normandy, *Market Garden*, and the crossing of the Rhine. In the China-Burma-India (CBI) Theater, they helped supply and reinforce isolated fronts where conventional airfields were scarce or nonexistent.

The narrative progresses logically from concept to combat, tracing the emergence, development, and battlefield employment of American combat glider pilots. Taylor establishes the strategic and doctrinal environment in which glider aviation emerged, explaining how gliders became essential tools of airborne warfare and why their pilots occupied an uneasy place within military hierarchies—neither conventional aviators nor infantrymen.

She examines the technical and psychological realities of glider operations, in which pilots flew without engines or parachutes on one-way descents into combat, tasked with delivering heavy loads onto unimproved landing zones with no margin for error. This combination of silence, vulnerability, and inevitability explains their grim nickname.

Taylor then traces how glider pilots were recruited, trained, and shaped into a distinct cadre, highlighting the steep learning curve and institutional friction caused by their ambiguous status within the USAAF. These tensions complicated training, support, and battlefield integration.

The narrative broadens to place gliders within the larger airborne framework, emphasizing their indispen-

sable role in delivering artillery, vehicles, and other heavy equipment that parachute operations alone could not provide. The book concludes with combat operations in the European and China–Burma–India theaters, underscoring the extraordinary courage required of pilots who routinely crash-landed under fire with minimal equipment and immediate exposure to enemy forces.

An appendix details the flow of students through the glider training program and illustrates the training pipeline, attrition rates, and the scale at which the USAAF built a new class of combat aviator.

Suicide Jockeys is a well-researched and movingly told account that fills a substantial gap in World War II aviation history. While the subject may be unfamiliar to many readers, Taylor's narrative makes it accessible without sacrificing depth. This quick and interesting read is recommended for combat aviation enthusiasts seeking a richer understanding of airborne operations and the mavericks who flew silent wings into harm's way.

Frank Willingham, NASM docent



The Allied Bombing of Central Italy: The Restoration of the Nile Mosaic and Sanctuary of Fortuna at Palestrina. By Teresa Fava Thomas. New York: Routledge, 2024. Photographs. Notes. Bibliography. Index. Pp. xviii, 182. \$49.59. ISBN: 978-1-032049418-0

Thomas, a history professor at Fitchburg State University in Massachusetts, has taken a special interest in modern Italian history. In this work, she discusses the history of the Nile Mosaic and the discovery of the Sanctuary of Fortuna. About a quarter of the text covers air power. Otherwise, she emphasizes the value of ancient relics and the destruction of the small town of Palestrina and its recovery after World War II.

The Romans created the Nile Mosaic about 100 BC. This floor mosaic, about 12 feet by 17 feet, remained in Palestrina, a small mountain town about 20 miles east of Rome, for most of its existence. Religious authorities moved it to Rome briefly in the 17th century. Italian specialists recognized its vulnerability as World War II closed in on central Italy. They again moved it to Rome in December 1943. Today visitors can see the mosaic in a national museum in Palestrina.

Thomas opens the book by describing the mosaic and the history of the Sanctuary of Fortuna. She devotes two chapters to a struggle for control of the mosaic. The Barberini family, one of the wealthiest in central Italy and serious art collectors, had acquired the mosaic in the 17th century. Faced with deteriorating finances in 1920s and 1930s, the family began selling its collection. At the same time, Italy's fascist government attempted to acquire the mosaic. The family, however, retained control.

The fascist government collapsed in 1943 after the Allies invaded Italy. Nazi Germany then attempted to hold off the Allied armies. Palestrina, situated on the side of a small mountain, became a target for Allied bombers.

Before examining the impact of bombing on Palestrina, Thomas devotes a chapter to Giulio Douhet's post-World War I theory of how strategic bombers alone would determine the outcome of future wars.

The one chapter on the bombing of central Italy focuses on the 321st Bomb Group, a B-25 unit, and the challenges its inexperienced crews faced in locating and accurately hitting their targets. Two major raids, one in January and the other in June 1944, destroyed much of Palestrina. The bombing left most of the residents homeless, and many families perished. However, in the rubble, the survivors discovered the Sanctuary of Fortuna. The Romans constructed this religious complex around 100 BC. Through the centuries, residents built over the ruins.

After the Allied armies pushed north, art experts passed through Palestrina. They noted its significance as a heritage site. After the war, the town's residents confronted the challenge of rebuilding their community.

This book should be of little interest to air enthusiasts. However, individuals seeking insight into the after-effects of aerial bombing on a civilian population may benefit.

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



Hybrid Threats: Concept and Recognition Guide. By Michael Fredholm von Essen. Warwick UK: Halion & Company, 2025. Bibliography. Notes. Photographs. Illustrations. Map. Tables. Pp. 72. \$25.00. ISBN: 978-1-804518-80-9

What are hybrid threats? Von Essen makes it clear that there is no universal agreement on a definition, even within our own agencies. Rather, it can be seen as an umbrella term. The following definition is generally acceptable and will guide the reader of this monograph: *hybrid threats are coordinated and synchronized actions by state or non-state actors that combine military and non-military means to exploit the systemic vulnerabilities of both nations and non-nations*. Their aim is to destabilize the target while remaining below the threshold of formally declared warfare. They challenge territorially defined concepts such as sovereignty and national defense; and they exploit vulnerabilities such as power grids, critical infrastructure, and electronic movements of money. Thus, an adversary simultaneously and adaptively employs some

fused combination of political, military, economic, social, and information means, and conventional, irregular, terrorist, and disruptive/criminal methods. Most hybrid operations are covert, with deception playing a major role. In other words, nothing is what it seems. Further, hybrid warfare (previously encapsulated in the phrase asymmetric warfare) will blend the lethality of state conflict with fanatical irregular warfare. Al-Qaida's 9/11 attacks are examples of the latter.

The nature of war is rapidly evolving; and tactics have been significantly updated through technology, thus creating a shift in what constitutes actual conflict. This vagueness is the arena where plausible deniability is a tool used by rogue players, while changes have taken place so quickly that current threats may not be easily recognized. Von Essen addresses those changes and takes readers well into the 21st-century concept of warfare where hybrid threats are now a major concern.

The monograph also guides readers from working definitions to a grasp of who the actors might be, with an understanding that non-state actors may, in fact, be proxies for state actors. He then goes on to use various non-state actors as illustrations. The final section deals with countering these threats.

Perhaps the most interesting section of this monograph discusses what has been called the Gerasimov Doctrine, articulated by General of the Army Valeriy Gerasimov, Chief of the General Staff of the Armed Forces of Russia since 2012. He added the concept of non-military actions to Russian strategic thought. He took his lessons from the West's new way of conducting war (where nonmilitary operations were used over military operations by a ratio of 4:1) and concluded that non-military methods were the key means to achieving political and strategic goals.

The concept of conflict has been changing right before our eyes, and this monograph captures one critical area of change that must be understood in this country. Already, our physical infrastructure, banking, and communications are under attack every day by proxies of state actors, giving them plausible deniability. Thus, it is imperative that government and non-government entities understand the threats and act to neutralize them. Since all Americans are potential targets of hybrid threats, this monograph should be read by a far-wider audience than military history buffs as an introduction to a very serious problem.

John Cirafici, Milford DE



Operation Gardening: Bomber Command Minelaying in Danish Waters 1940-1945. By Frank Weber. Warwick UK: Helicon, 2025. Maps. Tables. Illustrations.

Photographs. Appendices. Bibliography. Pp. 284. \$47.95. ISBN: 978-1-80451895-3

This book is about more than the title would suggest. Based on Weber's graduate thesis, it is a comprehensive history of 20th-century mining operations, treaties and laws of war, and the technology of mines and countermining measures. As expected in a thesis, the book is heavily footnoted from original Danish, British, Swedish, Norwegian, German, and Dutch sources.

During the inter-war years, both Britain and Germany went from floating and tethered mines to magnetically triggered mines which could lie on the seabed. Triggering mechanisms were also improved to make sweeping more difficult. A German magnetic mine that landed on a tidal flat provided the British with an intelligence bonanza.

After the "peaceful invasion" of Denmark, Germany allowed the Danish navy to operate smaller vessels but expected the Danes to assist in minefield maintenance and minesweeping. Because of Danish reluctance, most minesweeping and all minefield maintenance became German tasks. The Germans also demanded that Sweden allow them to navigate through Swedish territorial waters and to send troops and supplies via Swedish railways to minimize transit through mined waters.

Initially, mine-laying operations ("Gardening" was the RAF code word), were carried out by Hampden bombers, which could carry only one mine each. With the advent of larger, more capable bombers, the British campaign intensified. Wellingtons, Stirlings, and Lancasters, including Gee-equipped aircraft to permit operations in extreme weather conditions, were used. The campaign helped the Battle of the Atlantic by slowing the flow of U-boats from Baltic shipyards and training areas to the North Sea and beyond. The technology race continued: more complex (and sweep-proof) magnetic and acoustic triggers; German airborne minesweeping, and improved countermeasures.

The RAF stepped-up its mining campaign in 1943, as the Germans attempted to move capital ships into the Atlantic to attack Allied shipping. Mines failed to damage any German warships, but the increased aerial activity led a cautious Admiral Raeder to call them back.

As German sweeping operations became more successful, the RAF added fighter patrols to take out minesweeping ships and aircraft. German anti-aircraft defenses over Denmark were boosted, so RAF drops increased from 300-600 ft altitudes up to 15,000 ft. Germany responded with increased night fighter forces in Denmark.

As D-Day grew closer, mining efforts not directly aiding the invasion were cut back. But troop and supply transport through Danish waters was important enough that "gardening" continued there. This became so effective that Swedish insurers refused to cover their ships

sailing in the area, effectively ending Swedish Baltic and North Sea mercantile activities.

The last chapter summarizes and analyzes mining operations throughout the war. Overall, mining operations were more successful in terms of ships sunk/damaged and had lower loss rates than bombing or strike operations; it was only at the end of the war, with Coastal Command's strike wings coming into their own, that direct attacks on shipping became more successful than mining operations.

This book is a thorough examination of aerial mining and countermining around Denmark and neighboring waters during World War II and well worth reading.

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



The CAC Boomerang: Australia's Own WWII Fighter. By Don Williams. Kent Town, Australia: Avonmore Books, 2024. Maps. Tables. Diagrams. Illustrations. Photographs. Appendices. Bibliography. Index. Pp. 104. \$24.95 paperback. ISBN: 978-0-97564232-0

As World War Two approached, Australia feared that it could not acquire any first-line fighter planes from Britain or the US. It decided to design and produce its own aircraft, a formidable challenge in a country that had never before done so. Using archival histories, Williams chronicles the trials and tribulations of arriving at the decision to advance the contract of the proposed fighter before it ever took a test flight.

What soon became known as the Boomerang was an anticipated line of interceptor-fighters whose "great disadvantage...because of its low speed" was that it "could not get away in the event that the fight should turn against it"—obviously not a desirable fighter-aircraft feature. The Boomerang's ancestry included the two-seat Wirraway, a general-purpose, radial-engine-powered aircraft from Melbourne's Commonwealth Aircraft Corporation (CAC). It was a licensed derivative of an upgraded American NA-16/33 and was related to the P-64. This aircraft was the initial step in developing a nascent military-aircraft industry to reduce Australia's dependence on foreign manufacturers. A prudent provision in the licensing agreement allowed CAC to use the Wirraway's airframe as a modifiable template for a future fighter.

In aerial trials against the American built P-40 and P-39, the Boomerang was measurably slower and inferior at altitude, but it was deemed more maneuverable with a superior rate of climb. However, Williams concludes that, based on a few actual encounters with the Japanese, future battles could have been disastrous for the Boomerang. Incredulously, due to the unfortunate realities of partisan politics, some of this comparative in-

formation was not brought to the attention of all the reviewing parties. One is led to believe that the war-time politics of employing a local workforce to produce 250 Boomerangs may have influenced the decision makers who controlled production and oversight.

While waiting for American-produced fighters, the underpowered Boomerang became the country's best hope for an aerial defender against the Japanese. History may have loosely called it a fighter; but, whatever its classification, the Boomerang eventually found limited success in an army cooperation role flying artillery and photo-reconnaissance missions, strafing, and flying lead-in strikes where it identified obscure targets. This was an important ground-support activity in New Guinea and the Solomon Islands during the Pacific War.

The airplane's comprehensive story is told in eleven chapters: Strategic Leadership of Australia's Air War in WWII; Why Australia Needed an Emergency Fighter in WWII; A Battle Won: Approval to Produce an Australian Interceptor Fighter; Tests and Further Orders; The Production Battle: Early Victories and Later Losses; The CAC Boomerang Described; The Boomerang Goes to War: RAAF Service; No. 4 Squadron; No. 5 Squadron and Other Units; Prominent Boomerang Pilots; and Assessing the Boomerang.

Williams includes profiles of pilots and circumstances involved in fatal accidents, and the profiles of several important Boomerang pilots. Over 45 photographs are included along with the usual appealing digital color illustrations by fellow Aussie Michael Claringbould. Other than the sometimes confusing and complex political machinations, this book is an informative history of Australia's only home-designed and -produced fighter—one that never claimed an enemy aerial victory.

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



The Consolidated B-24 Liberator: Reuben Fleet, the Factories, and the Product. By William Wolf. Havertown PA: Fontheill, 2025. Bibliography. Index. Photographs. Diagrams. Illustrations. Tables. Pp. 623. \$59.95. ISBN: 978-1-78155-840-9

Wolf is a prolific aviation historian and author whose work concentrates on American air power in World War II. He has written more than two dozen books examining US bombers, fighters, and aerial weaponry, with particular emphasis on technical detail and operational history. After a 22-year career in dentistry, he turned his full attention to research and writing, drawing on an extensive personal archive of thousands of original documents, photographs, and microfilm records. Widely

regarded as an authority on American aircraft, especially bombers and their armament, his work is known for its depth, precision, and documentary foundation.

This is the first of a planned three-volume set best described as an industrial biography of one of World War II's most consequential bombers, told through intertwined stories of leadership, manufacturing innovation, and technical evolution. Organized in six parts, the book moves from corporate origins to production expansion and, ultimately, to the aircraft itself.

Part I examines Reuben Fleet and the corporate foundations of Consolidated Aircraft, establishing the human and institutional roots of the B-24 program. Fleet was not only a capable executive, but also a disciplined industrial strategist whose management philosophy directly shaped the Liberator's development. The B-24 was not merely a byproduct of wartime urgency. It was the result of deliberate corporate vision and calculated risk. Fleet's leadership—decisive, technically informed, and efficiency-driven—proved critical when Consolidated was asked to expand beyond anything previously attempted in American military aviation. This part is the framework for understanding the extraordinary production effort that followed.

Part II looks at the production pool and the contracts.

Part III centers on the Consolidated factories in San Diego and Fort Worth. Wolf details the industrial expansion that transformed the B-24 into America's most-produced military aircraft. He traces factory development, workforce growth, assembly line organization, and the transition from B-24 production to follow-on aircraft. This section underscores the scale and complexity of the undertaking, particularly as wartime demand accelerated.

Part IV is the book's most compelling industrial study. Wolf focuses on Ford's Willow Run plant. It was not merely as a symbol of mass production, but a case study in industrial adaptation under pressure. He explores tooling challenges, workforce recruitment and training, supply chain coordination, quality control issues, and the constant struggle for standardization across multiple contractors. The narrative covers the plant's conception, construction, engineering processes, raw materials management, government-furnished equipment, and the social and operational crises that accompanied rapid workforce expansion and integration. For readers interested in wartime mobilization, Part IV alone makes the volume worthwhile.

Parts V and VI address the North American (Dallas) and Douglas (Tulsa) facilities in somewhat less depth than Willow Run.

Wolf succeeds in weaving leadership, industry, and engineering into a coherent and persuasive narrative—a study that treats the B-24 not simply as an aircraft, but as a product of American industrial capacity and

managerial will. For readers seeking a production-centered history rather than a combat chronicle, this first volume stands as a substantial and authoritative contribution.

Frank Willingham, NASM Docent



Hitler's and Hirohito's Kamikaze Flying Bombs: The Axis' Manned Suicide Attack Aircraft of WW2.

By William Wolf. Barnsley UK: Air World, 2025. Photographs. Drawings. Bibliography. Index. Pp. 222. \$39.95. ISBN: 978-1-03611-927-0

This book addresses an emotionally charged subject: the late-Second World War Axis turn toward weapon systems and tactics that blurred the boundary between high-risk military service and intentional self-destruction. Wolf compares German and Japanese approaches to so-called "kamikaze" weapons. While full of technical and operational detail, it struggles to provide the cultural, ideological, and analytical balance required to support its central thesis.

Both Japan and Germany framed kamikaze or suicide tactics as ideologically redemptive acts that subordinated individual life to transcendent collective purpose. In Japan, these were cast as ultimate expressions of loyalty to the Emperor and purification through self-sacrifice. German late-war suicide operations were rationalized as heroic offerings to racial purity and survival of the Reich. In both cases, death was not merely accepted but instrumentalized, ritualized, and propagandized as morally ennobling, reinforcing regimes that equated personal annihilation with national, ideological, or metaphysical continuity. The absence of such cultural framing and explanation in Wolf's book is a significant omission, as it leaves the reader without a clear understanding of why superficially similar weapons emerged from profoundly different moral and institutional environments.

The book's central weakness is treating German and Japanese attitudes toward suicidal warfare as broadly equivalent. The evidence, much of which Wolf himself presents, indicates that senior Nazi political and Luftwaffe leadership never fully embraced an extremist kamikaze philosophy comparable to that institutionalized by Imperial Japan. While figures such as Hanna Reitsch and Otto Skorzeny advocated sacrificial concepts, these ideas failed to gain sustained traction at the highest levels. Organizational commitment, doctrinal development, and industrial prioritization necessary to produce true kamikaze systems on a Japanese scale never materialized in Germany. The book insufficiently grapples with this disparity, resulting in an implied equivalence that the historical record does not support.

But Wolf demonstrates a genuine command of the factual landscape surrounding these weapon systems. The book contains a wealth of technical details derived from his personal library and his familiarity with secondary literature. However, this strength also exposes a limitation: there is little that is genuinely new. Rather than advancing original interpretations or uncovering new archival material, the narrative restates the findings of earlier researchers, often without clearly distinguishing synthesis from contribution. For readers already familiar with the subject, this may feel repetitive rather than revelatory.

The strongest section of the book is its treatment of the US Navy's response to the emerging kamikaze threat. Here Wolf's narrative becomes notably more disciplined and effective. The discussion of radar pickets, combat air patrols, damage control doctrine, and tactical adaptation is clear, technically competent, and accessible without oversimplification.

Yet even here, the broader strategic assessment remains incomplete. While kamikaze attacks imposed tactical costs and exacted a terrible human toll, their overall effect on the outcome of the war was negligible. This does not diminish the suffering of those killed or wounded, nor the trauma inflicted on families and crews, but it does matter analytically. The book tends to blur this distinction, allowing the emotional weight of the attacks to stand in for strategic consequence.

Wolf's narrative style is clear but frequently undermined by amateurish stylistic choices and structural inconsistencies. Of particular concern is his treatment of Hanna Reitsch, who is consistently praised for her

achievements while her ideological extremism and ethical compromises receive little scrutiny. When Wolf credits her with crucial work on the Ju 87 program, the claim is sufficiently questionable to raise the possibility of his confusion with other female German aviators, such as Melitta Schenk Gräfin von Stauffenberg. Such moments distract from the analysis and erode confidence in Wolf's critical rigor.

While not a bad book, it is inconsistent and unbalanced. Readers seeking a clear-eyed, culturally grounded comparison of German and Japanese approaches to suicidal warfare will find valuable information here, but they will also encounter missed opportunities where context, balance, and analytical restraint were most needed.

Gary Connor, docent, National Packard Museum, Cortland OH



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Coming Up



Compiled by
George W. Cully

May 14-15, 2026

The **Society for History in the Federal Government** will present its annual meeting in the Library of Congress' James Madison Memorial Building in Washington, DC. For registration see the Society's website at [Society for History in the Federal Government - 2026 Annual Meeting](#).

June 5-6, 2026

The **Vietnam Center & Sam Johnson Vietnam Archive and Institute for Peace & Conflict** at Texas Tech University and the Vietnam National University are pleased to jointly announce a conference focused on "History, Archives, and U.S.-Vietnam Relations." To be held in Hanoi, Viet Nam, the conference will examine a wide range of historical topics related to the diplomatic, economic, political, social, cultural, international, regional, domestic, and military aspects of the U.S.-Vietnam relationship. For more information, see the Center's website at [The Vietnam Center and Sam Johnson Vietnam Archive: Events](#).

July 8-12, 2026

The International Women's Pilot Association, better known as **The Ninety-Nines**, will hold its annual international conference at the Westin San Diego Hotel in San Diego, California. Registration deadline for the meeting is May 31. For details, see their website at [99s International Conference & Career Panel 2026 - San Diego, California](#).

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](#).

July 31-August 1, 2026

The **National WWII Museum** will host a symposium to honor the 25th anniversary of the HBO mini-series "Band of Brothers"

at the Museum's conference Center in New Orleans, Louisiana. Guests will enjoy behind-the-scenes insights from the series' actors, exclusive stories about the making of the series, and hear firsthand accounts from the real Easy Company veterans through preserved oral histories. For registration, see the Museum's website at ["Band of Brothers" 25th Anniversary Symposium | The National WWII Museum | New Orleans](#).

August 20-22, 2026

The **Tailhook Association** will host its annual premier naval aviation reunion and symposium at the Grand Sierra Resort Hotel in Reno, Nevada. For reservations and more information, reach out to the Association at [The Tailhook Association | 9696 Business Park Avenue, San Diego, CA, USA](#).

September 12-13, 2026

The **Air & Space Forces Association** will offer its annual meeting at the Gaylord National Resort and Convention Center in National Harbor, Maryland. For registration, see the Association's website at [2026 National Convention - Air & Space Forces Association](#).

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](#).

September 23-26, 2026

The **Society of Experimental Test Pilots** will hold its 70th annual symposium and banquet at the Grand Californian Hotel in Anaheim, California. For presentation proposals and other details, see the Society's website at [70th Annual Symposium & Banquet - Call for Abstracts | Annual Symposium & Banquet | Symposium/Meetings](#).

October 8-11, 2026

The **International Committee for the History of Technology (ICOHTEC)** will hold its 53rd annual meeting in Alexandroupolis, Greece. This year's gathering will be hosted by the Democritus University of Thrace, in collaboration with the Laboratory of Technologies, Research & Applications in Education and the Ethnological Museum of Thrace, and its theme will be "Engaging the History of Technology: Bridging Disciplines and Perspectives for Global Challenges." For registration and other details, see the Committee's website at [Annual Meeting](#).

October 14-17, 2026

The **Oral History Association** will host its annual meeting in Portland, Oregon. The Association recently issued a call for paper proposals for this event; see their website for details at [Annual Meeting - Oral History Association](#).

November 19-21, 2026

The **National WWII Museum** will host its 19th Annual International Conference on WWII at the museum's compound in New Orleans, Louisiana. For registration and other details, visit the Museum's website at [19th International Conference on World War II | The National WWII Museum | New Orleans](#).

January 7-10, 2027

The **American Historical Association** will hold its annual meeting in New Orleans, Louisiana. For details as they become available see the Association's website at [Future Meetings - AHA](#).

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:

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Answer: The North American B-45 Tornado first flew in 1947 and entered service in 1949. The Tornado was the first jet bomber to enter Air Force service and was the Air Force's first four engine bomber. The B-45 had a crew of four: 2 pilots, a navigator/bombardier, and a tail gunner. Considered a light bomber by today's standards, the B-45 was capable of carrying both nuclear and conventional weapons. Based on its limited performance, budget cuts, and the potential seen in other jet bombers being developed, the B-45 production topped out at 143. The last 33 were the RB-45 reconnaissance variant. The Tornado holds the distinction of the first jet bomber to conduct air-to-air refueling. The B-45 saw combat service during the Korean War, thus making it the first Air Force jet bomber to enter combat. Sadly, the RB-45 has the distinction of being the first jet bomber to be shot down by another jet in combat, having been shot down over China in 1950. In 1952, the crew of a 91st Strategic Reconnaissance Wing RB-45 Tornado won the MacKay Trophy for being the first fly non-stop across the Pacific Ocean. Ushered into retirement by the fielding

of the much more capable B-47 Stratojet, B-58 Hustler (entered service 1960), and B-52 Stratofortress, the B-45 was operationally retired in 1959. It would continue to serve as a test platform until the early 1970s.

To Learn more:

B-45:

<https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/196105/north-american-b-45c-tornado/>

Encyclopedia of U.S Air Force Aircraft and Weapons Systems, Volume II: Post-War Bombers 1945-1973:

<https://media.defense.gov/2010/May/26/2001330264/-1/-1/0/AFD-100526-026.pdf>

Steadfast and Courageous: FEAF Bomber Command and the Air War in Korea:

<https://media.defense.gov/2009/Aug/14/2001330299/-1/-1/0/AFD-090814-035.pdf>



This Issue's Quiz:

Question: The 1950s was a decade of aviation advancements. Similar to last edition's question about the 1920s, the 1950s also saw advancements including rapid aeronautical innovation (aerial refueling) and record-setting feats (transatlantic crossings, endurance flights, and long-distance military demonstrations). Air Force advancements also included the fielding of jet aircraft. While the early versions of the B-52 and KC-135 entered service in the 1950s and remain stalwart warriors in today's Air Force, some aircraft did not stand the test of time and were retired before the end of the decade. The answer to this edition's question is such an aircraft. Having first flown in the late 1940s and delivered to the Air Force in 1949, this jet bomber achieved many firsts in its roughly decade of service. Somewhat of an interim aircraft bridging the gap between propellor bombers and intercontinental jet bombers, this jet bomber became an import multi-role aircraft. Can you name the aircraft? As a supplemental hint, it is one of two aircraft named after a weather event (the other is the WC-130 "Weatherbird") Can you name any of its "firsts"?



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