

FALL 2023 - Volume 70, Number 3
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Journal of the Air Force Historical Foundation



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WINGS OF VALOR

HONORING VIETNAM AIR WAR VETERANS

ARMY / AIR FORCE / COAST GUARD / MARINES / NAVY

**2023 Air Force Historical Foundation annual Symposium/Air & Space Museum Conference:
"The U.S. exit from Vietnam—1973."**

<https://www.afhistory.org/events/afhf-symposium/>

The Denver Hyatt Tech Center hotel will be host to the symposium part of the conference on September 15-17.

The culminating event will take place at the **Blue Sky Gallery** at Exploration of Flight-Wings Over the Rockies (address below). The theme for the evening is "Wings of Valor: Honoring Vietnam Air War Veterans" from 6-9:30 PM, Sep 18, 2023.

JOINT WOTR/AFHF EVENT—BLUE SKY GALLERY

"Wings of Valor: Honoring Vietnam Air War Veterans"

Sep 18, 2023

Exploration of Flight, Wings Over the Rockies Centennial Airport
13005 Wings Way, Englewood CO 80112

Gen. Mike Holmes, USAF (Ret.), Air Force Historical Foundation Chair, to present the Awards

AFHF Best Article of 2022

Deploying the Air Commandos in Air Command, South-East Asia: An Alternative View
Edward M. Young (Summer 2022)

First Annual AFHF Book Prize, 2022

Fallen Tigers: America's Missing Airmen in China During WW II
Daniel Jackson (Kentucky, 2021)

I.B. Holley Award, 2022

Col. Phillip Meilinger, USAF (Ret.), PhD
Guest Speaker, Gen. Ronald Fogleman, USAF (Ret.)
AFHF Special Award

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Vietnam War Commemoration

Air Force Historical Foundation Participates in The USA Vietnam War Commemoration Event

The Air Force Historical Foundation (AFHF) was one of many organizations that participated in The United States of America Vietnam War Commemoration held on the National Mall in Washington DC May 11-13, 2023. This year marks the 50th Anniversary since the end of US involvement in the Vietnam War. The milestone event was not only a Welcome Home to those who served in the War but was also a chance to remember and honor those who did not return, while also honoring the families of those who fought. It was a privilege for the Air Force Historical Foundation to be a part of the event.

The Foundation enjoyed great synergy by sharing the same tent as the Air & Space Forces Association and the Civil Air Patrol as each organization drew people into the shared area. The AFHF Secretary, Frank Blazich, played the lead role for the Foundation's participation and we are grateful for his efforts. Other volunteers who supported the effort from AFHF were Joe Burke, Mick McKewon, and Steve Newbold (seen in photo at right).

AFHF was able to engage with some of the thousands of people who attended this remarkable event. We heard many stories directly from Vietnam War veterans as well as their families about their experiences. And AFHF volunteers shared information about the Foundation to include our mission. As a result, we were able to sign up a few new members.



The AFHF Symposium is back!

AFHF's original charter made clear that interaction with museums, Air University, and the USAF Academy, as well as many other organizations involved with the preservation of airpower and space history was expected by those early Airmen who created the Foundation in 1953.

This year we rekindle that tradition by hosting the 2023 Air Force Historical Foundation annual Symposium/Air & Space Museum Conference: "The US exit from Vietnam—1973." The Denver Hyatt Tech Center hotel will be host to the symposium part of the conference on September 15-17. The culminating event will take place at the BLUE SKY GALLERY at Exploration of Flight-Wings Over the Rockies Centennial Airport, 13005 Wings Way, Englewood CO 80112. The theme for the evening is "Wings of Valor: Honoring Vietnam Air War Veterans" from 6-9:30 PM, Sep. 18, 2023. Festivities will include an aerial demonstration, an Air Force birthday celebration, presentation of our annual history awards, and a special presentation by former Chief of Staff, Gen. Ronald Fogleman.

It would be wonderful to see you at the celebration. It is not too late to sign up. Here is the link to the registration site. <https://www.afhistory.org/events/afhf-symposium/>

In the past year, AFHF has expanded its programs and we wanted to list them all here so that our members are aware of them, and that all may participate in ways that mean the most to them personally. All of these may be accessed through the AFHF website: <https://www.afhistory.org/>

The Book Club, This Day in History, and the 9/12 Project continue to thrive. We have added "War Stories," an interface with the Air University Library Archives, and developed a Joint Imprint with Air University Press (the first digital volume will be an expanded edition of, *A Few Great Captains*, by Pete Copp). In June, the first *Journal of the Air Force Historical Foundation* was published in print as an expanded "Special Edition" highlighting the USAF's participation in Vietnam.

On June 1, the Foundation presented two of its most prestigious awards—the Doolittle Award and the Spaatz Award—to the 480th ISRW and Gen. Greg "Speedy" Martin (respectively). On September 18, the Foundation will present its Best Article of the Year award to Ted Young, the inaugural AFHF Book Prize to Daniel Jackson, and its highest award for preserving and teaching USAF History, The I.B. Holley Award. This year, Col Phillip Meilinger, USAF (Ret.) is the recipient of the trophy.

Even more exciting are a few upcoming projects that will kick off in 2024. AFHF will launch a quarterly Newsletter. The format will allow for contributions by aspiring airpower and space history writers, will provide information about upcoming events, and offer a discussion forum for various topics.

In early 2024, the Foundation will launch a new evening series—"Space Stories that are Out of this World." Much like War Stories, this format will highlight space history in a focused and unexpected way. It is our plan to launch a Podcast that highlights our unique content at some point during the year. If your company or organization would like to sponsor the AFHF Podcast Series, we would like to hear from you!

On a more somber note, the former Editor, and current Editor Emeritus, Jack Neufeld, passed away on August 5, 2023. He was the Editor from 1993 until 2016, and his imprint on the production of this magazine remains strong. He will be sorely missed as a voice of reason and humanity. We will have his full life history in the Winter issue.

Gen. James "Mike" Holmes
Foundation Chairman

Jonna Doolittle Hoppes
Foundation President

Awards Banquet

The Air Force Historical Foundation presented the 2023 Foundation Awards in ceremonies that took place in the greater Washington DC area on June 1. The weather at the AF Memorial was perfect.

Seen here are representatives from the award-winning unit.



**The 480th ISR Wing
Langley AFB, Virginia**



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 General Carl “Tooe” Spaatz Award recognizes an individual who has made significant contributions in their lifetime to the making of Air Force or Space Force history.

Gen. Mike Holmes, AFHF Chairman, General Gregory S. “Speedy” Martin, Spaatz Award recipient, and Jonna Doolittle Hoppes, AFHF President at the June 1 Awards Banquet.



Former AFHF Executive Director, James Vertenten, received the Inaugural AFHF President’s Medal for Lifelong Service to the Foundation. It was presented to him by the Foundation Office Manager and long-time teammate, Angela Bear.

From the Editor

This issue makes note of the passing of Jack Neufeld, Editor of this magazine from 1993 to 2016. He was an honorable and remarkable man. We will have an “*In Memoriam*” page in the next issue.

We have more than our usual number of articles in this issue, so let’s get started.

We start with an article by return contributor William Head, with his coverage of the Mayaguez Incident at the tail end of the Vietnam conflict, as a reminder of the impact of unexpected events.

Our second article is also by a returning contributor, Jayson Altieri, who writes about the development of the Iroquois jet engine with the help of a USAF loan of a TB-47 aircraft.

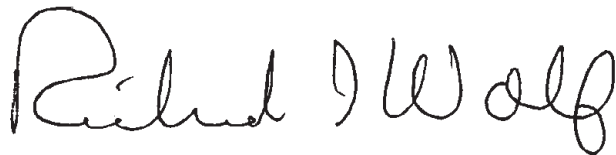
Our third article is by repeat contributor Fred Allison, who describes the activities of Christian Arzberger, who is helping to memorialize fallen airmen of World War II.

Our fourth article is by new contributor Andrew English, who covers the Keystone bomber and the 1929 “Raid on New York.” It’s a very interesting story.

Our fifth article is by another long-time contributor, David Stumpf, with a short piece on Operation Button Up, increasing security in USAF ICBM facilities.

Our final article is by noted aviation author, and return contributor, Thomas Wildenberg, with a history of the Marine Corps EA-6B Prowler. He is always a joy to read.

The Leadership’s Message can be found on page 4. It’s worth the read to keep you abreast of our changes. We also have coverage of the annual Awards Banquet from this past June. It includes the award for our recently-retired Executive Director, Jim Vertenten. His work was instrumental in helping carry the Foundation through heavy turbulence to calmer skies. Don’t miss Upcoming Events on page 68. And the issue closes with the Mystery. Enjoy!



War Stories for September

JOIN US FOR “War Stories”

September 28, 2023 7PM to 8:15PM ET

Honored Guest: Brigadier General Dale E. Stovall, USAF (Ret.)

Register : <https://www.afhistory.org/programs/war-stories/>

Dale Stovall graduated from the U.S. Air Force Academy in 1967. In 1972 then-Captain Stovall, flying an HH-53C Super Jolly Green helicopter, rescued 12 downed U.S. airmen from North Vietnam and Laos. General Stovall retired from the Air Force in 1993 and moved to Missoula Montana where he was a corporate pilot flying the Citation 500 and Westwind 1.



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We Came to Save a Nation & Saved a Ship Instead: Airpower's Role in the Mayaguez Incident

William P. Head

Aerial of the container ship *Mayaguez* with two Khmer Rouge gunboats alongside.

On April 17, 1975, the Khmer Rouge seized Cambodia and two weeks later, Communist forces overran South Vietnam. Concurrently, the Laotian Government fell to the Pathet Lao, and “United States Forces departed the immediate area except for those in Thailand.” However, events in mid-May, in the waters off Cambodia, forced them back to Southeast Asia.¹

On May 12, 1975, Khmer naval forces, operating former U.S. Navy “Swift Boats,” approached the container-ship SS *Mayaguez*, en route to Sattahip, Thailand, flying an American flag in the Gulf of Siam, eight miles from Poulo Wai Island and 60 miles south of Cambodia. For generations, these had been accepted as international sea lanes. The new Cambodian regime claimed this area as their territorial waters. Initially, the communists sprayed machine gun fire and Rocket Propelled Grenades (RPGs) across the ship’s bow. Concerned for the safety of his crew, *Mayaguez*’s Captain Charles T. Miller, directed the engine room to reduce speed.²

Miller, realizing the peril he was in, had his radio operator send a general “Mayday” and stopped the ship. After delaying as long as possible, Miller finally allowed seven Khmer Rouge, led by Battalion Commander Sa Mean, to board. Once aboard, they and the Captain began difficult communications during which Sa Mean accused the crew of spying and had some of them subjected to “intense interrogation” or “torture.” With the radio operator still secretly sending SOS signals, Sa Mean pointed to a map and demanded Miller sail his ship east to Poulo Wai Island—which he did.³

Soon, an Australian ship received the call for help and radioed their home offices which sent a message to U.S. officials. When the *Mayaguez* reached Poulo Wai it was boarded by twenty-three Khmer soldiers. They insisted Miller proceed to the port of Ream on the Cambodian coast. Miller, using hand gestures, explained the ship’s radar was inoperative and he feared the *Mayaguez* might run aground. Sa Mean radioed his superiors who instructed him to stay at Poulo Wai. Unknown to the participants, the ship’s distress signal had been received by other listeners most notably, John Neal, a member of the Delta Exploration Company, Jakarta, Indonesia who notified the U.S. Embassy. The Embassy sent a message to Commander-in-Chief, Pacific Command (CINCPAC) for transmission to Washington, D.C. It read, “Have been fired upon and boarded by Cambodian armed forces at 9 degrees/48 minutes north/102 degrees /53 minutes east. Ship is being towed to unknown Cambodian port.”⁴

That afternoon, several messages reached the National Military Command Center (NMCC) in Washington alerting American government and military officials to events unfolding half a world away. As this transpired, a U.S. Navy P-3 *Orion* surveillance aircraft began searching for the ship. While taking fire from Khmer forces, the P-3 identified the *Mayaguez* at anchor at Koh Tang Island, 50 miles off the southern coast of Cambodia.⁵



The Khmer Rouge on Koh Tang were heavily armed with RPGs, Mortars, and AK-47s.

Initial Responses

President Gerald R. Ford received the news during his morning briefing. Already devastated by the fall of Saigon two weeks earlier, the Ford Administration was now confronted by another potentially humiliating incident they feared might further damage the nation's reputation.⁶ On May 13, the President convened the National Security Council (NSC) to decide what to do. It was during this time, the NMCC directed CINCPAC, Admiral Noel Gayler, to launch the previously mentioned P-3 aircraft in an effort to locate the ship.⁷

The NSC members were concerned for the crew and, this latest attack on U.S. prestige. Everyone was determined to save the crew and right the attack on U.S. honor. Having been president for only ten months and having not been elected, Ford believed he had to use military force. He was mindful that cautious action might be compared with

Dr. William P. Head is Chief, 78th ABW History Office, Robins AFB, Georgia. He received his Ph.D. in U.S. diplomatic history from Florida State University in 1980. He has fourteen book-length publications to his credit. His most recent book is Storms over the Mekong: Major Battles of the Vietnam War (Texas A&M, 2020). For his work Shadow and Stinger: The History and Deployment of the AC-119G/K Gunships (Texas A&M, 2007), he received the AFMC Book Award and won the Frank Futrell Air Force-level prize. He also wrote Night Hunters: A History of the AC-130s and their Role in U.S. Air Power (Texas A&M Press). Dr. Head has authored forty articles and a like number of book reviews in such journals as Air Power History, Virginia Review of Asian Studies, Journal of Third World Studies, Journal of Military History, and the Journal of American History. He has made presentations on Modern Military, air power, Asian and American history to 106 scholarly meetings over the past thirty years.

the apparently "timid" action taken by President Lyndon B. Johnson during the USS *Pueblo* incident of 1968 when North Korea captured and held a U.S. Navy intelligence ship and its crew for eleven months. Throughout the Communist World, leaders used the event to embarrass the United States.⁸

The President knew any military action would be complicated since U.S. forces were scattered all over the Pacific as they left Southeast Asia. Ford believed he had few options since the U.S. had no diplomatic contact with the new Kampuchean regime. His close advisers believed negotiations were not feasible. In hindsight, one wonders if they had not been so anxious to act militarily if an avenue to backdoor negotiations, such as those undertaken during the Cuban Missile Crisis, might not have been possible. Whatever the case, following the NSC meeting, military action was agreed to. Even without diplomatic contact with the Khmer government, the President directed Secretary of State Henry Kissinger to ask the People's Republic of China to persuade them to release the *Mayaguez* and its crew. Kissinger instructed George H.W. Bush, Chief of the U.S. Liaison Office in Beijing, to deliver this message to the Chinese Foreign Ministry, even though diplomacy never really had time to succeed.⁹

Ford publicly declared the seizure an act of "piracy," and secretly ordered military leaders to draw up a plan to retake the ship and its forty-man crew. He redirected the aircraft carrier, USS *Coral Sea* (CV-43), and her task force, headed for Australia, to the Gulf of Thailand. Military planners readied ten Air Force CH-53 *Knife* or *Sea Stallion* (not capable of aerial refueling) helicopters of the 21st Special Operations Squadron and nine HH-53 *Super Jolly Green Giant* helicopters (capable of aerial refueling) of the 40th Air Rescue and Recovery Squadron both stationed in Thailand. The next day, U.S. officials sent 600 Marines from Okinawa, Japan, and Subic Bay, The Philippines to U Tapao Royal Thai Air Force Base (RTAFB), Thailand. They did so without the permission of the Thai government.

Ford directed the Seventh Air Force (7 AF) to "keep an eye" on the *Mayaguez* to prevent the communists from moving the crew to the mainland port of Kampong Som from which rescue would be nearly impossible. Initial planning even considered using B-52D bombers to attack positions along the Cambodian coast to limit Khmer Rouge response from the mainland in support of their forces at Koh Tang Island.¹⁰

The main American reaction force came from the Second Battalion, Ninth Marines (BLT 2/9) commanded by Lt. Col. Randall W. Austin. They were conducting a training exercise on Okinawa when orders to redeploy arrived. Normally, the response force would have been the BLT 1/9, but the vast majority were at the end of their tours in Asia which could not be extended. The BLT 3/9 forces were just returning from Operation *Frequent Wind* and were scattered across the Western Pacific. Ironically the 9th Marines had been the first U.S. ground forces committed to the Vietnam War in 1965.¹¹

On May 13, before the Marines were alerted, the Air Force moved 125 Security Police to U Tapao. One of the

CH-53s crashed and killed eighteen personnel of the 656th Security Police Squadron (656 SPS) and five airmen. The next day, F-111A fighter-bombers from the 347th Tactical Fighter Wing (TFW) and F-4Ds of the 388 TFW, Korat RTAFB located the *Mayaguez* which was being escorted toward mainland Cambodia by four gunboats. AC-130 fixed-wing gunships of the 16th Special Operations Squadron (16 SOS) were ordered to shadow the four gunboats and fire across their bows to prevent them from reaching the coast. The *Spectre's* 40mm cannons and 105mm howitzers forced three of the gunboats to turn back. F-111A, F-4D, and A-7Ds fired around the last gunboat. It refused to stop, so an A-7D sank it.¹²

The aircraft reported they had spotted “a fishing vessel approximately forty feet in length with approximately 30-40 people . . . seated on deck.” Soon, this wooden fishing boat departed Koh Tang Island. In the after-action report, air crews noted, “This boat . . . was not taken under direct attack because of the probability of Americans being on board.” During the four hours it took this boat to reach Kampong Som, A-7s and F-4Ds dropped ordnance in front of the ship to make it return to Koh Tang. As it turned out, the crew was on the small craft but, since this could not be confirmed, planners acted as if the crew were still on the Koh Tang Island.¹³

Rescue Operations

With time running out and organizers expecting the mission to be of low intensity, the rescue took on an ad hoc nature. Marine units and helicopter crews scheduled to attack Koh Tang were unaware the island was defended by Khmer Rouge infantry forces. Worse, with Ford pushing for quick action, planners worked with inadequate intelligence. They expected twenty to thirty lightly-armed militia. Instead, they found a well armed reinforced company of 120-150 men.¹⁴

Throughout, U.S. reconnaissance indicated there were only eighteen to twenty Cambodians on Koh Tang Island. However, on May 13, Intelligence Pacific reported to the Marine Ground Security Force (GSF) commander that the “Khmer Communists” had a company of about 90-100 men with “heavy weapons.” Somehow, this piece of information never reached the GSF commander. It did reach the transport helicopter pilots but was overridden by another report which read: “According to Major J.B. Hendricks, Operations Officer of the Second Battalion of the Ninth Regiment, from which the Koh Tang Island assault force was drawn; ‘there were 20-30 Khmer Rouge irregulars on the island, possibly reinforced by whatever naval support personnel that were there associated with the gunboats sighted in the area.’”¹⁵

The Joint Chiefs of Staff (JCS) “After-Action report,” confirmed that the Defense Intelligence Agency (DIA) specified there were at least 100 and probably more Khmer Rouge regulars present. This was one of several examples of the lack of communication between the various agencies and services involved.¹⁶

When BLT 2/9 arrived, Col. Austin undertook an aerial inspection of Koh Tang in a U.S. Army U-21 Beechcraft *King Air 100* aircraft. Fearing he might compromise the secrecy of the mission, “we were limited to a minimum altitude of 6,000 feet and could not see the necessary detail.”¹⁷ He decided the island had such dense undergrowth the only two practical landing zones were beaches on the eastern and western shores of the northern portion of Koh Tang. Plans called for 57 Marines of “Delta” Company, BLT 1/4 to be transferred, by three helicopters, to the destroyer escort USS *Harold F. Holt* for boarding the *Mayaguez*. A larger force of 600 Marines from BLT 2/9, composed of “Golf” and “Echo” Companies, was assigned to conduct an assault in eight helicopters to seize Koh Tang and rescue the crew. The assault force was comprised of 227 Marines with the remainder held in reserve.¹⁸

At this point, with Kissinger’s back channel diplomacy delayed, the military plan began to evolve into a hastily created mission based on a complex plan that not only included multiple groups of Marines but, eight to eleven helicopters. There were several moving parts, and they all had to function perfectly for the mission to succeed. From the outset, there was confusion over command and control as well as a long chain of command stretching back to the White House. This trickled down to the JCS, CINCPAC, Marine, Air Force, and Navy forces on the scene and numerous intelligence agencies such as the DIA, Naval Intelligence, the Central Intelligence Agency (CIA), and even layers of the State Department, the NSA, and the Ford Cabinet. It resembled the highly restricted decision-making that troubled Johnson’s handling of Operation *Rolling Thunder*. In retrospect, had the planners had more time things might have gone better, but with Ford determined to act “decisively,” they did not!¹⁹

At least this made more sense than the original plan to use 125 Air Force security police personnel to rescue the crew. In the final version, officials called for the four helicopters of the first wave to attack in four directions, two landing on the east beach and two on the west. Once a foothold was established four more helicopters would land the remainder of the first wave. Two other CH-53s were to act as search and rescue helicopters, supported by an HC-130 *King* command-and-control aircraft. Planners assigned the guided-missile destroyer USS *Henry B. Wilson* (DDG-7) to support the Koh Tang operation, and the frigate USS *Frank H. Schofield* (FFG-3) to block the water passages between U.S. forces and Khmer reaction forces on the mainland. Aircraft from the *Coral Sea* were to attack targets on the Cambodian mainland to prevent interference with the rescue. Initial plans considered using B-52Ds stationed at Andersen AB, Guam but, at the last minute, Ford decided this was overkill and opted for the use of tactical carrier based aircraft.

One puzzling aspect of the rescue proved to be the near omission of close air support (CAS) by AC-130 gunships. Located in nearby Thailand and having been so effective during the Vietnam War, this asset seemed, in retrospect, to be an obvious element of the operation. Indeed, in the August 2021 evacuation of Afghanistan the AC-130s were



AC-130s such as this one played a critical role in saving the Marines on Koh Tang Island.

so effective, in similar operations, that the crews of Shadow 77 and 78 won the 2021 Mackay Trophy. Ultimately, while gunships in 1973 did participate in this operation, with positive results, at this point they were mostly relegated to a backup role. Ultimately, the Air Force provided significant CAS including the extended services of 24 A-7Ds, 17 AC-130 gunships, and 40 OV-10 Forward Air Control (FAC) aircraft. The expectation there were only a few enemy troops on Koh Tang probably influenced the decision to not to use CAS as much as they eventually did.²⁰

In looking back, even with time constraints, why did the U.S. not use forces that were still close by? That is why the initial plan called for using 75 to 125 Air Force security police and, when twenty-three airmen died in the aforementioned crash, planners had to turn to Marines in the area. As for the number of Marines sent to Koh Tang, there were many more available but, to quote the official report, "Helicopter availability dictated the size and composition of forces; thus, the initial insertion was marginal in size, and rapid buildup ashore was not possible." Worse yet, the CH-53s did not have aerial refueling capabilities and had to land to refuel.²¹

At 0300 on May 15, D Company's fifty-seven Marines, an Army linguist, six volunteer Air Force bomb disposal experts, six sailors from the USS *Duluth*, and six volunteers from the Merchant Sealift Command boarded 3 helicopters in Thailand and took off for the *Holt*. The destroyer's crew had jury-rigged a boarding platform top side for the assault

on the *Mayaguez*. Since the CH-53 *Knifes* were too big to land on the ship's helicopter pad, they hovered over the *Holt* so the first Marines could deploy a rope and help those on board the choppers descend down the cargo ramp as the CH-53s rear wheels touched down.

At 0600, the operation began following the transfer of Marines to the *Holt*. At 0720, the destroyer escort came alongside as an A-7 aircraft dropped tear gas on the *Mayaguez*. Wearing gas masks, the Marines captured the ship after a relatively brief fight only to discover the crew was not there. Within minutes, they had raised a U.S. flag over the *Mayaguez* and had her in tow. As this transpired, five CH-53 *Knifes* and three HH-53 *Jolly Green* helicopters attacked Koh Tang Island landing on the east and west beaches. They encountered unexpectedly heavy automatic weapons and RPG fire. One CH-53 *Knife 23* was hit and crash-landed on the east beach. Its twenty Marines and crew of five survived. They quickly established a defensive perimeter but remained isolated until the end of the operation.²²

Soon after the first CH-53 went down, a second (*Knife 31*) was shot down by two RPGs. It crashed just offshore where the pilot, five Marines, and two Navy corpsmen were killed. Another Marine drowned swimming from the wreckage, and three Marines were killed by gunfire trying to reach the beach. A tenth Marine died of his wounds while clinging to the burning wreckage. The surviving ten Marines and three Air Force crew members had to tread water for four hours before being rescued by the *Wilson*.²³



Co. D, 1st Batt., 4th Marines board *Mayaguez* wearing gas masks since the ship was bombed with tear-gas canisters.

On the west beach, two other CH-53s (*Knife 21* and *Knife 22*) arrived around 0630. As the Marines began to off-load, they came under heavy fire and *Knife 21*, piloted by Lt. Col. John H. Denham, lost its engine. After some frantic repair efforts, the chopper took off covered by suppressing fire from the second CH-53 *Knife 22*. Bellowing smoke, the first CH-53 flew out to sea and was able to ditch a mile offshore where all but one crew member was rescued by another helicopter. Soon, the enemy damaged the second CH-53 so severely it turned back with its Marines, including the company commander, and crash-landed on the Thai coast, where all on board were saved. The helicopters of the two remaining sections of the first wave landed their Marines around 0930. They were supported by fire from an AC-130. The *Spectre* was literally able to cut a path through the enemy positions and escort the helicopters to their landing area. They landed eighty-one Marines on the west beach. About fifty more soon followed.²⁴

With AC-130 *Spectre 61* overhead, the tactical situation began to improve. The pilot identified himself to the pinned-down Marines and fired several spotting rounds—one of which hit an enemy bunker. “How was that?” an AC-130 spotter asked. “Right on, but it didn’t do much,” a Marine replied. Then the *Spectre* fired a 105mm round which demolished another bunker. “Jesus Christ,” the Marine exclaimed. “What was that? Man, have I got targets for you!” The firepower from *Spectre 61* and her sister ships enabled the Marines to join forces.²⁵

As the 130 Marines on the west and east beaches carried out their mission, they continued to meet heavy resistance. Only fire support from mortars, as well as CAS allowed them to make any progress. Of the eight helicopters assaulting Koh Tang, three had been destroyed, and four others were damaged so badly they could not continue. One of the three choppers originally employed on the *Holt* portion of the operation had also been severely damaged attempting to pick up the platoon isolated on the east beach. This left three helicopters of the original eleven available. To compensate, the helicopters scheduled for search and rescue were re-assigned to carry troops. They airlifted the 127 Marines of the second wave from U Tapao around 0900.²⁶



U.S. Marines run from a CH-53 helicopter during the *SS Mayaguez* operation.

A cruel irony was that the crew of the *Mayaguez* had been moved from the mainland two days earlier. From the beginning, the Khmer Rouge had publicly indicated, though not in direct communication with the U.S. government, that the crew would be released. Around 1045 hours, the *Holt* took the *Mayaguez*, now flying its American flag, in tow. Even as the battle for Koh Tang raged, a Thai fishing boat approached the *Wilson*. On board was a Thai crew, Captain Miller and his thirty-nine-man crew. They were exhausted but, for the most part, they were in good health. Earlier that morning they had been moved from Kompong Som in a small Cambodian gunboat and released on tiny Kach Island. From there, the Thais had taken them to the *Wilson*.

Clearly, the process of releasing the crew members and invading Koh Tang Island by the Marines were nearly simultaneous events which was not obvious, at the time. Some newspapers reported the Koh Tang assault took place after the crew was released. At first, this created a growing public belief that the Ford White House initiated the attack on Koh Tang to make up for the losses in Southeast Asia suffered during the previous month. Even though many experts are still not convinced the Koh Tang assault was necessary, the vast majority of scholars and military specialists agree that in the chaos of the frantic efforts by the U.S. to recover the crew and ship, the attack was underway before the release of the crew members. In the fall of 1976, both the previously cited CINCPAC report and a General Accounting Office report, circulated in October 1976, raised questions about Ford’s handling of the incident. Neither agency was concerned whether the Koh Tang attack preceded the crews’ release. They were more interested in why Ford had not tried diplomacy.²⁷

With word of the ship’s rescue and the crew’s release, the JCS decided to recall the Marines. At Koh Tang, Lt. Col. Austin requested additional troops to prevent his forces from being overrun as they departed. *Jolly Greens 11, 12* and *43*, and *Knife 51* successfully landed additional Marines. At midday the Marines on east beach began a linkup with “Golf” Company on the west beach. Supported

by CAS that cleared the jungle between the two forces, they finally reached the west beach perimeter. They evacuated nine wounded which left a total of 202 Marines and five airmen on the west shore including the twenty from east beach.²⁸

Supported by AC-130s and mortar fire, the evacuation of these Marines continued all night under heavy fire. Each time a helicopter picked up a group of Marines it required a gunship to escort the Marines back to the *Coral Sea*. As they withdrew, the Marines had to contract their perimeter. Plans called for three helicopter crews, flying *Jolly Greens 43 and 44* as well as *Knife 51*, to remove Marines from Koh Tang supported by fire from AC-130s and naval gunfire from the *Holt*. The Marines waited for evening and, at 1830 hours, the first forty-one Marines departed on *Knife 51*. Thirty minutes later they landed on the *Coral Sea*. They were soon followed by fifty-three on *Jolly Green 43* and thirty-four more by *Jolly Green 44*. Those still on the Island came under intense attack and were in danger of being overrun.

To facilitate the evacuation, *Jolly Green 44* pilot 1st Lt. Robert Blough decided to deliver his Marines to the *Holt*, the nearest ship. Despite flying in pitch black darkness, he hovered his damaged helicopter over the ship with only its front wheels touching down, in order to deliver his cargo. Using this extraordinary technique, he was able to return to Koh Tang in only five minutes and extricate forty more Marines.

Finally, *Knife 51* landed and thought they loaded the last thirty-nine Marines on board. Pilot, Captain James H. Davis, Gunnery Sergeant Lester A. McNemar and TSgt. Wayne Fisk made one last search of the beach for stragglers. Finding none, they left Koh Tang at 2010 hours and arrived at the *Coral Sea* at 2035 hours. It appeared to be a perfect evacuation, carefully supervised with the redeployment of remnant forces to ensure no one was missing. However, during a final head count, officers discovered three Marine machine gunners were absent. During the operation, officials decided to cover the withdrawal by using a specially rigged C-130 *Hercules*, that dropped a BLU-82 15,000-pound bomb in the jungle between the east and west beaches to destroy any enemy positions threatening the Marines. At the time, this was the largest conventional bomb in the American inventory.²⁹

The Cost of Honor

All together, fourteen Marines were killed or missing, two Navy corpsmen and two airmen were killed. In an apparent attempt to reduce the shock of the casualty list, officials waited until later to announce that twenty-three airmen had died in the pre-operational crash in Thailand on May 13. This raised the final U.S. death toll to forty-one. The Marines had thirty-five wounded and the Air Force six.

The Khmer Rouge lost 50-60 killed and had about 20-30 wounded. The U.S. casualties included 2d Lt. Richard Vandegeer, the pilot of *Knife 31* and SSgt. Elwood E. Rumbaugh, the flight engineer on *Knife 21*. Rumbaugh drowned



Marine captain prepares to destroy a downed helicopter, during the rescue of the U.S. Merchant ship *SS Mayaguez* and its crew. Marines destroyed important equipment on the disabled HH-5.

when his CH-53 ditched. His remains were never recovered. Ten of the Marine dead were from the 2/9 Battalion and included: LCpl. Gregory S. Copenhaver, LCpl. Andres Garcia, PFC Richard W. Rivenburgh, PFC Walter Boyd, PFC Antonio R. Sandoval, PFC Daniel A. Benedett, PFC James J. Jacques, PFC James R. Maxwell, PFC Kelton R. Turner, and PFC Lynn Blessing. The Navy corpsmen included HM1 Bernard Gause, Jr. and HN Ronald J. Manning. They were all killed in the crash of *Knife 31*. Their bodies were recovered and returned home. Four Marines were not recovered. These included the three left behind: LCpl. Joseph N. Hargrove, PFC Gary L. Hall, and Private Danny G. Marshall. LCpl Ashton N. Loney also perished on Koh Tang, and his body was never recovered.

There were plenty of living heroes. Colonel Austin, Marine Corps 1st Lts. Michael S. Eustis and Terry L. Tonkin as well as Air Force Sergeant Thomas J. Bateson and A1C Brad E. Marx won the Silver Star. TSgt. Wayne Fisk, a Pararescueman on *Knife 51*, MSgt. John J. Eldridge, USAF and SSgt Joseph S. Stanaland, USAF received a Bronze Oak leaf cluster representing a second Silver Star. For his decision to airlift Marines to the *Holt* to facilitate the evacuation, Lt. Blough was awarded the Silver Star. Capt. Rowland Purser, pilot of *Jolly Green 43*, 1st Lt. Donald Backlund, pilot of *Jolly Green 11*, 1st Lt. Richard C Brims, pilot of *Knife 51*, and SSgt. Jon Harston, flight mechanic of *Knife 31* all received the Air Force Cross. Marine 2nd. Lt. James V. McDaniel won the Navy Cross.³⁰

Those Left Behind

On 21 July 1976, the three missing Marines were reclassified killed in action due to what senior USMC officials called “a lack of reliable information to corroborate their survival.” Later, unproven stories arose suggesting they had survived the battle only to be murdered by the Khmer Rouge. The body of LCpl. Loney, who was killed early in the battle, was also left on the beach. As the helicopters came

in during the rapidly encroaching darkness the Marines had to contract their perimeter on the west beach. For example, LCpl. John S. Standfast, squad leader of the 3d Squad, 3d Platoon, Company E and his Marines covered Company G's withdrawal during the contraction of the perimeter. Once complete, he pulled his squad back. They had repeated this procedure each time a choppers took off. Each time, his platoon withdrew into a new defensive position, they searched forward to be sure no one was left behind. In spite of these efforts, the three-man M60 machine gun team was overlooked.

Hours after the evacuation was completed, with the returning Marines located on three Navy ships, Company E commander, Captain Mykle K. Stahl, discovered his Marines were missing. The Marines double-checked every inch of each ship hoping they might have been wounded and unable to speak. They never found Hargrove, Hall, and Marshall, who had been originally ordered to protect the right flank of the ever-shrinking perimeter. According to the subsequent interviews with the Marines on Koh Tang, Sgt. Carl C. Andersen had been the last person to see the three men alive at about 2000 hours when he ordered them to move back to a new position located on the left flank commanded by Captain James H. Davis.

Their fellow Marines proposed a rescue operation, but their superiors declined since they considered it too dangerous, and they lacked evidence the men were still alive. The *Holt* continued to patrol the shore off Koh Tang for the next 48 hours in case any of the missing men emerged from the jungle and tried to swim out to sea. This never happened and, eventually, officials listed them Missing in Action (MIA) and presumed dead.³¹

In his report of the evacuation and the loss of the Marines, Major Peter Brown concluded:

That all Marine force personnel exercising authority over Hall, Hargrove and Marshall performed their duties in a satisfactory manner.

That Hall, Hargrove and Marshall did not obey the order issued by Sergeant Anderson to report to Captain Davis' position and moved elsewhere.

That Hall, Hargrove and Marshall were not in the helicopter landing site area after liftoff of the 5th and 6th extraction helicopters.

That Hall, Hargrove and Marshall were not in the helicopter landing site area after liftoff of the 6th and final extraction helicopter landed.

That if Hall, Hargrove and Marshall had been in the general vicinity of the helicopter landing site area they would have attempted to board either the 5th or 6th helicopter unless they were unconscious, incapacitated because of wounds, or were dead.

That if Hall, Hargrove and Marshall had been conscious, and/or wounded or separated from the Marines remaining in the helicopter landing site area, they would have called for help during the 30-40 minute period of quiet which prevailed after the 5th of 6 helicopters lifted off.

Supporting Data Attached.

That Hall and Hargrove would not have attempted to swim from Koh Tang Island because they were unqualified swimmers.

That Marshall could have attempted to swim to safety from Koh Tang Island.

That Hall, Hargrove and Marshall could have been fatally wounded subsequent to the time they were last seen by Sgt. Anderson about 2000 and the time when the final helicopter lifted off, since there was firing by both enemy forces and the Marines awaiting extraction from Koh Tang Island.³²

As a result of his investigation, Brown recommended "the status of Hall, Hargrove, and Marshall be changed from MIA to KIA body not recovered." His superiors agreed.³³

Over the next several years, this official explanation stood. Among family members and some authors, such as Lt. Col. Ralph Wetterhahn, U.S. Air Force, retired, the explanation was not satisfactory. Headed by the Joint Task Force-Full Accounting (JTF-FA) service, from 1991 to 1999, American and Cambodian authorities conducted seven joint searches for remains of the Marines. Three times, Cambodian officials, without urging, gave the U.S. the remains of American servicemen. In October and November 1995, specialists from both nations undertook an underwater recovery of the *Knife 31* crash site where they located numerous remains and personal effects. The Navy salvage vessel, USS *Brunswick* (ATS-3), helped with this effort. The Vietnamese also helped and turned over remains positively identified as those of 2nd Lt. Richard Vandeger, LCpl Gregory S Copenhaver, LCpl Andres Garcia, PFC Lynn Blessing, PFC Walter Boyd, PFC Antonio R Sandoval, and PFC Kelton R. Turner.

In 1995, the controversy was resurrected when a supposed eyewitness reported the three Marines survived for several days on the island without supplies, or ammunition before they were captured, tortured, and executed. This person said a Marine, possibly Hargrove, resisted capture and was killed by order of the Khmer Rouge commander on the island, Em Son. The report claimed the other two were, later, captured taken to Kompong Som and killed.³⁴

Recovery efforts continued to 2009, both by the JTF-FA and Duplin County Commission Chair Cary Turner (Kenansville, North Carolina) 2007-2009. He was Hargrove's cousin and the family's representative. Supported by Wetterhahn and important journalists and investigators, they found several bone fragments and remains. In all cases, the subsequent DNA tests proved inconclusive. As a result, the original report, by Brown, remained the official Marine Corps position which did not believe the Marines were alive when the last helicopter departed.³⁵

Success or Failure?

Subsequent diplomatic controversy arose since the Thai government never gave the U.S. approval to use U Tapao RTAFB for the rescue. Some Thai officials called it a violation of their national sovereignty. To calm things



USAF pararescueman Stu Stanaland, from the 40th Aerospace Rescue and Recovery Squadron, guides Marines to a rescue helicopter.

down, returning Marines were spirited off to The Philippines. Many Thai groups called for the withdrawal of all U.S. forces. During the ensuing months and years, U.S.-Thai relations became strained.

In some quarters then, and now, the American military has been criticized for its failure to determine where the *Mayaguez* crew was and identify the large enemy force on Koh Tang. Reproach over the timing of the Koh Tang attack also swirled around Washington until it became clear that combat operations had been underway before the crew was released. Later, the Marines who participated in the operation were critical of the haphazard nature of the operation and blamed pressure from the White House for the hastily constructed plan they believed was designed to save face for the loss of Vietnam.³⁶

The one clear success was the performance of the AC-130s. Even though they were not originally a primary component, the 16 SOS remained on constant alert at their bases in Thailand, acting swiftly to deal with each emerging crisis during the mission. When it became clear how much resistance the Marines were facing, they covered the injection of troops and once the Marines dug in, the gunships protected them against enemy fire. Lastly, the AC-130s escorted each rescue helicopter on their way to the ships at sea.³⁷

Throughout the operation, the AC-130s provided accurate suppressive fire and used their sensors to confirm the location of friendly units. They proved so effective that many in Special Operations wondered, in retrospect, why the gunships had not been used more. The *Mayaguez* recovery was an ideal scenario for the AC-130, but its full capabilities were not completely understood by officials who, at that time, were mostly Navy personnel who had never worked with a side-firing gunship. While the *Spectres* made a vital contribution to the mission, they could have done more if the full potential of their precise firepower,

and video tape documentation capabilities had been better understood and utilized.³⁸

Observations

In any important military mission adequate planning, professional skill, and brain power are indispensable. In a sense, what took place off the southern shore of Cambodia violated this notion. Inside the White House, some advisers realized they had been lucky to recover the ship and its crew. Not long after the *Mayaguez* incident, a chagrined Henry Kissinger admitted privately, “We entered Indochina to save a country and ended by rescuing a ship.”³⁹

President Ford makes an easy target for critics but, as he pointed out years later, given the timing of the event, he believed he had no practical choice but to take military action as quickly as possible. If he had not, he might well have wound up in the same public relations mess as Jimmy Carter did in Iran only a few years later. Considering the devastation U.S. pride had suffered with the fall of Vietnam, one sharp punch in the nose of some international “bad guy” seemed to satisfy American governmental leaders and public opinion. Most polls at the time were supportive of the President’s actions. The *Time Magazine* edition of 26 May 1975, described the President’s “resolve” in glowing terms.⁴⁰

The official report on the incident by CINCPAC quoted Admiral Gayler as saying that:

Cambodian adventurism tested the United States with the seizure of the merchant ship *MAYAGUEZ* on the high seas in May. The recovery operation has left no doubt as to our resolve and capabilities in that part of the world. Our Marines, sailors and airmen again met the challenge. Stories of their courage abound – from the Marine who directed air strikes while swimming off-shore after his

helicopter was shot down, to the sailors in the motor whale-boat who took on dug-in heavy weapons with small arms, to the Air Force pilots who forced their way into the landing zones while taking hits.⁴¹

The military options also had appeal to the White House given the lack of any sort of relationship with the anti-American Cambodian regime. As for casualties, once Ford committed to military action, the chance of some Americans dying was a foregone conclusion since no rational analyst can deny military action is without risk. Many have argued it was, regrettably, the only course open. The same *Time Magazine* article that noted the public relations success of the U.S. handling of the *Mayaguez* Incident also indicated the seizure of the ship was something the President was not at all sorry about since he had been hoping for weeks to find a way to demonstrate to the world that the Communist victories in Indochina had not turned the U.S. into a paper tiger. He had been searching for a means to show that the U.S. was conducting what Kissinger called an “abrasive” foreign policy. The article noted that prior to the seizure of the *Mayaguez*, “one policy planner had told *Time*, ‘There’s quite a bit of agreement around here that it wouldn’t be a bad thing if the other side goes a step or two too far in trying to kick us while we’re down. It would give us a chance to kick them back—hard!’”⁴²

Conversely, the Tokyo newspaper *Yomiuri Shimbun* asked, “Why did [the U.S.] have to use a cannon to shoot a chicken?” As it turned out, the cannon proved effective because it demonstrated to the international community that America was not going to pull in its horns and accept every humiliating provocation her enemies might want to dish out. As the *Time* article stated, “the U.S. success owed almost as much to luck as to skill in combat. If the Communist Cambodians had dug in and refused to release the *Mayaguez* crew, the military mission might well have aborted.” In an interview with *Time* correspondent Joseph J. Kane, Secretary of Defense James Schlesinger admitted: “The outcome was fortunate.”⁴³

While the President and his advisers were seeking only what was best for the nation, its reputation, and future in the world community, their rush to act tough was, at least, partly the cause for the loss of 41 American lives and what can at best be described as a flawed rescue operation. Then, as now, conservative analysts have blamed Democratic President Lyndon B. Johnson for constantly interfering with military planning and execution keeping the U.S. military from winning the war. Yet, it was Republican President Ford’s advisers who micromanaged this operation and hurried, on several occasions, to construct and execute aspects of their plan without all the facts. Worse, their plan had too many moving parts, few aspects of which worked well together. In retrospect, with the lack of good intelligence and poor cooperation among the military services, it is a matter of wonder; and a tribute to the commitment and bravery of America’s fighting forces, that things did not go much worse since what made the mission “successful” was the ability of its attack forces to “adapt and overcome.”

In May 1975, the U.S. military was not fully prepared to execute such a rescue. Military leaders hated the operation mostly because of their lack of confidence in the directives coming from the White House. To quote Vice Admiral George P. Steele, the 7th Fleet commander:

“The sad part is that we had sufficient force coming up with the Seventh Fleet, after it had been turned around from the evacuation of Vietnam, to seize Southern Cambodia. I begged for another day or two, rather than commit forces piecemeal as we did. The idea that we could use U.S. Air Force police and Air Force helicopters as an assault force appears to me as ridiculous today as it did then.”⁴⁴

Then again, leaders make mistakes, and the U.S. military tries to learn from them. It took several more rescue disasters before decisive steps were taken to create a formal structure to extricate captured Americans. Carter’s failure in Iran, Ronald Reagan’s misstep in Grenada and George Bush’s costly mission in Panama finally led to the creation of the Special Operations Command in the early 1990s designed to, among other things, coordinate military action for complex rescue missions. Even so, the lack of intelligence cooperation for America remained an issue as demonstrated by 9-11.

The best known critic of the *Mayaguez* rescue was Lt. Col. Ralph Wetterhahn who is a decorated Air Force pilot having flown 180 missions while in Vietnam. Not only has he written a scathing critique of the operation in his book *The Last Battle: the Mayaguez Incident and the End of the Vietnam War*, but he has led the search for the three Marines he believes were abandoned on Koh Tang Island. Throughout his work, which is well researched, he hammered the Ford policy-makers. He describes them in stark contrast to the performance of the heroes on the ground. To him this was an example of how desperate Ford and Kissinger were to make up for the fall of Southeast Asia. He is convinced the three Marines left behind were tortured and executed by the enemy and blames American officials for this catastrophe.⁴⁵

Many others have been reticent to go so far in their criticism recognizing the conundrum in which America found herself in May 1975. They have argued that the official reports of the incident made adequate suggestions to prevent a reoccurrence of similar events. At the same time, considering the fact that DNA tests could not prove beyond a doubt the three Marines were left alive on Koh Tang, it is hard to dismiss the official USMC version of the overall mission.⁴⁶

Ultimately, *Mayaguez* remains an addendum to the history of the Vietnam War. The desire of the nation to distance itself from the Vietnam debacle has had much to do with that. The final paradox is that the *Mayaguez* rescue was technically a success, since it recovered the ship and its crew. It defined the Ford Presidency’s foreign policy and, until his death in 2006, he pointed to the mission as one that saved America’s pride and reputation. In spite of all the missteps this much cannot be denied. However, if it can be called a “success,” it came at a high price making it the last tragedy in a decade long tragedy on the mainland of Southeast Asia. ■

NOTES

1. CINCPAC Command History, by Command History Branch, Office of the Joint Secretary, Appendix VI – “The SS ‘Mayaguez’ Incident, 1975” Camp H.M. Smith, Hawaii, 1976, 1, 3, [hereafter “Mayaguez Incident”].
2. John L. Frisbee, “Mayaguez Incident,” *Air Force Magazine*, 74, no. 9, (Sep 1991), [hereafter “Mayaguez Incident”]; John P. Guilmartin, *A Very Short War: The Mayaguez and the Battle of Koh Tang*, (College Station, TX: Texas A&M University Press, 1995), 27-30, [hereafter *A Very Short War*]; Ralph Wetterhahn, *The Last Battle: The Mayaguez Incident and the end of the Vietnam War* (NY: Carroll & Graf, Inc, 2001), 25-27, [hereafter *The Last Battle*]; Ralph Rowan, *Four Days of Mayaguez* (NY: W.W. Norton, 1980), 15-22, [hereafter *Four Days*]. U.S. Merchant Marines, “Capture and Release of SS *Mayaguez* by Khmer Rouge forces in May 1975,” 2000, <http://www.usmm.org/mayaguez.html>, [hereafter USMM Mayaguez]. It was launched April 1944 as the SS *White Falcon*, built by North Carolina Shipbuilding Co., Wilmington, NC and renamed three times. In 1960, she became a container ship with 382 containers below and 94 above decks. She was named the *Mayaguez* in 1965 and scrapped in 1979.
3. George M. Watson, Jr., “The Mayaguez Rescue,” *Air Force Magazine.com*, (July 2009); 92: No. 7, 1-2 [hereafter “Mayaguez Rescue”], [http://www.airforce-magazine.com/Magazine Archive/Pages/2009/July%202009/0709May](http://www.airforce-magazine.com/Magazine%20Archive/Pages/2009/July%202009/0709May); Frisbee, *Mayaguez Incident*; Wetterhahn, *The Last Battle*, 26-28; Guilmartin, *A Very Short War*, 29-31; Rowan, *Four Days*, 33-35.
4. CINCPAC History, “Mayaguez Incident,” 3; Watson, “Mayaguez Rescue;” Wetterhahn, *The Last Battle*, 25-32; Guilmartin, *A Very Short War*, 29-31, Rowan, *Four Days*, 35-38.
5. Wetterhahn, *The Last Battle*, 25-32; Frisbee, *Mayaguez Incident*; Guilmartin, *A Very Short War*, 29-31; Rowan, *Four Days*, 38-44; USMM Mayaguez.
6. Wetterhahn, *The Last Battle*, 30-34; Guilmartin, *A Very Short War*, 31-32; Rowan, *Four Days*, 44-48; CINCPAC History Office, “Mayaguez Incident,” 1, 3; Memo, Secretary of Defense to President, “Seizure of U.S. Merchant Ship *Mayaguez*,” 12 May 1975.
7. Wetterhahn, *The Last Battle*, 33-36; Guilmartin, *A Very Short War*, 32-39; Rowan, *Four Days*, 49-52; CINCPAC History Office, “Mayaguez Incident,” 13-14.
8. Wetterhahn, *The Last Battle*, 33-36; Frisbee, *Mayaguez Incident*; Guilmartin, *A Very Short War*, 32-39; Rowan, *Four Days*, 49-52; CINCPAC History Office, “Mayaguez Incident,” 1, 3.
9. Wetterhahn, *The Last Battle*, 35-38; Frisbee, “Mayaguez Incident;” Guilmartin, *A Very Short War*, 40-44; Rowan, *Four Days*, 50-55.
10. Guilmartin, *A Very Short War*, 32-52; Wetterhahn, *The Last Battle*, 33-41; Message, JCS to CINCPAC, *et. al.*, “Mayaguez/Koh Tang Planning Directive,” 140645Z May 1975.
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12. Guilmartin, *A Very Short War*, 55-60; Rowan *Four Days*, 89-93; USMM Mayaguez.
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14. Guilmartin, *A Very Short War*, 53-80; Rowan, *Four Days*, 79-93.
15. CINCPAC History Office, “Mayaguez Incident,” 19.
16. *Ibid.*
17. *Ibid.*, 16-25; Hunter, “Last Battle;” Wetterhahn, *End of the Vietnam War*,” 153-168; Guilmartin, *A Very Short War*, 53-81; Frisbee, “Mayaguez Incident.”
18. See note 17.
19. See note 17.
20. Watson, “Mayaguez Rescue.”
21. CINCPAC History Office, “Mayaguez Incident,” 21-22, 27-28.
22. *Ibid.*, 21-24; Guilmartin, *A Very Short War*, 82-104; Hunter, “Last Battle;” USMM Mayaguez.
23. CINCPAC History Office, “Mayaguez Incident,” 21-28.
24. Watson, “Mayaguez Rescue,” 3-4; Hunter, “Last Battle;” Wetterhahn, *End of the Vietnam War*,” 169-176; Guilmartin, *A Very Short War*, 82-104; Frisbee, “Mayaguez Incident.” George R. Dunham, *U.S. Marines in Vietnam: The Bitter End, 1973-1975*, Marine Corps Vietnam Operational Historical Series, 1990, Marine Corps Association, 239-263, [hereafter *Bitter End*].
25. Quote from Watson, “Mayaguez Rescue,” 4-5; Dunham, *Bitter End*, 238-263; Hunter, “Last Battle;” Wetterhahn, *End of the Vietnam War*,” 179-184; Guilmartin, *A Very Short War*, 53-81.
26. Guilmartin, *A Very Short War*, 77-102; Wetterhahn, *End of the Vietnam War*,” 223-250.
27. CINCPAC History Office, “Mayaguez Incident,” 1, 28; Guilmartin, *A Very Short War*, 129-144. For negative press examples see, “Report Casts Doubt On Ford’s Mayaguez Strategy,” *The Pittsburgh Press*, 6 Oct 1976; “U.S. Was Told Mayaguez Crew Was Off Island Before Assault,” *St. Petersburg Times*,” 6 Oct 1976; “GAO Report Says Rescue Based On Bad Information,” *The Spokesman—Review* , 6 Oct 1976; “Report Raps Mayaguez Rescue,” *The Milwaukee Sentinel*, 6 Oct 1976; “Debating our Destiny: Reaction to the Second Carter/Ford Debate of October 6th,” *MacNeil/Lehrer Report*, Public Broadcasting System, 7 Oct 1976.
28. Watson, “Mayaguez Rescue,” 5-6; Dunham, *Bitter End*, 238-263; Hunter, “Last Battle;” Wetterhahn, *End of the Vietnam War*,” 237-266; Guilmartin, *A Very Short War*, 129-144.
29. Guilmartin, *A Very Short War*, 129-144; Wetterhahn, *End of the Vietnam War*, 223- 250; Frisbee, “Mayaguez Incident;” Dunham, *Bitter End*, 255-263; USMM Mayaguez.
30. Guilmartin, *A Very Short War*, 145-161; Hunter, “Last Battle;” Wetterhahn, *End of the Vietnam War*, 281-290; Dunham, *Bitter End*, 255-263; Watson, “Mayaguez Rescue,” 5-6.
31. Message, Major Peter C. Brown to General Kenneth J. Houghton, 3d Marine Division, “Investigation to Inquire into the Circumstances Surrounding the Missing in Action Status in the case of Private First Class Gary C. Hall, 0331 USMC, Lance Corporal Joseph N. Hargrove, 0331 USMC, and Private Danny G. Marshall, 0311 USMC,” 7 Jun 75, [hereafter Brown Investigation]. This document was declassified and released to CBS News Los Angeles on 24 Jan 01. See, Wetterhahn, *End of the Vietnam War*, 223-290; Watson, “Mayaguez Rescue,” 6
32. Brown, Brown Investigation.
33. *Ibid.*
34. *Ibid*; Wetterhahn, *The End of the Vietnam War*; 69-74, 83-89, 125-130, 267-280, 291-314.
35. See note 34.
36. Guilmartin, *A Very Short War*, 128-160; Henry A. Kissinger, *Years of Renewal*, see chapter 18, “Anatomy of a Crisis: The ‘Mayaguez’”.
37. Maj. Gen. Clay T. McCutchan, “USAF Gunship Overview,” Jan 1994, [hereafter “Gunship Overview”]; Watson, “Mayaguez Rescue.”
38. McCutchan, “Gunship Overview;” Interview, Author with Maj. Gen. Clay McCutchan, Eglin AFB, Florida, 29 Jan 08, [hereafter McCutchan Interview].
39. McCutchan Interview; Kissinger, *Years of Renewal*.
40. “Armed Forces: A Strong but Risky Show of Force,” *Time Magazine*, 105, No. 22, 26 May 1975, <http://www.time.com/time/magazine/article/0,9171,917461,00.html>, [hereafter “Armed Forces”].
41. CINCPAC History Office, “Mayaguez Incident,” 3.
42. “Armed Forces.”
43. *Ibid.*
44. Dunham, *Bitter End*, 239.
45. Wetterhahn, *The Last Battle*, 291-314.
46. Guilmartin, *A Very Short War*, 145-161.

A Mount for the Iroquois: A USAF TB-47B Serving with the RCAF



Jayson A. Altieri

The CL-52 during a test flight with the Orenda engine.
(Photo courtesy of the Office of Royal Canadian Air Force
History and Heritage.)

Since the successful development of the airplane in the early twentieth century, aircraft have become not only part of our daily life, but also a key part of many nations' popular culture and image. Examples of such aircraft include France's Dassault F-1 Mirage fighter and joint Aerospatiale/British Aircraft Corporation Concorde supersonic airliner, Great Britain's Sopwith Camel and Supermarine Spitfire fighters, and the United States' (US) Ryan Aeronautical Company's NYP monoplane (Charles Lindbergh's *The Spirit of St. Louis*) and Boeing 747 airliner. One aircraft, while it never entered full production, but became part of Canada's aviation heritage and cultural image, was the short-lived and revolutionary, 1950's A. V. Roe (Avro) Canada Limited's CF-105 Arrow supersonic delta-winged interceptor.¹ While the Arrow, both in fact and legend, has assumed a historical significance in Canada's distinguished aviation history, what is less well known, is the important role a Florida based US Air Force (USAF) TB-47B Stratojet bomber played in the Arrow's development.

The Avro Canada CF-105 Arrow program, whose demise in 1959 was a classic case of the right airplane at the wrong time – was deemed obsolete as a weapons system due to the competing technologies of intercontinental ballistic and surface-to-air missiles.² Still the ability of Avro Canada, the Royal Canadian Air Force (RCAF), and the USAF to successfully combine a diverse range of resources and talents to test a key component of the Arrow Interceptor – the revolutionary Orenda Engines Limited (an aeronautical subsidiary of Avro Canada) Project Study 13 (P.S. 13) Iroquois turbojet engine, demonstrates the successes of international cooperation in advancing new aerospace technologies.³

The development of the Orenda Iroquois engine was an essential part the Arrow's ability to perform its planned role as a high-altitude, high-speed interceptor against the then Union of Soviet Socialist Republic's (USSR) long-range nuclear armed bombers designed to attack North America. Worried that Soviet bombers could attack via the North Pole, the US and Canada needed aircraft that, when combined with a defense-in depth early warning radar system, could intercept the Soviet bombers close to the Arctic Circle.⁴ The whole objective of the Arrow development was as a flying weapons system capable of intercepting and destroying a highspeed Soviet bomber invading North American airspace.⁵ To do this, the Arrow needed an engine capable of pushing the aircraft to altitudes and airspeeds not previously seen in the current cohort of 1950's era western interceptors. Such an engine would require a large aircraft capable of carrying one of the late 1950's most innovative jet engines. This need led to the Avro Arrow program engineers acquiring an USAF TB-47B bomber as the platform on which to evaluate the Arrow's powerful Iroquois engine – another milestone in the Arrow's radical design program.

Avro Canada's CF-105 Arrow

The development of the Avro Canada's CF-105 Arrow was the result of the west's immediate Cold War needs of protecting both North America and Europe from the threat of the USSR under dictator Joseph Stalin. While Canada, Britain, the US, and USSR had been allies against the twin threats of German National Socialism and Japanese Imperialism during the Second World War, at the end of the war the USSR was the dominant military power in eastern Europe and the main power rival of the United States – the Cold War had begun.⁶ The Cold War era also brought the proliferation of nuclear weapons by both sides – a significant existential military threat not seen until the end of the Second World War. As a result, in the early 1950's American and Canadian political and military leaders rightly feared nuclear weapons, delivered by Soviet bombers or missiles, might fall on their own cities. Based on western closed and open-source intelligence reporting (which later proved to be inaccurate and led to the "Bomber Gap" debate), Soviet aircraft like the jet powered M-4 Bison and the turboprop powered Tu-95 Bear long-bombers seemed the biggest nuclear threats to North American economic, military, and political centers of gravity.⁷

To counter the Soviet bomber threat, in the mid-1950's both the US and Canada relied on late first and early second-generation jet fighter aircraft like Convair's F-102 Delta Dagger, the Northrop F-89 Scorpion, North American F-86 Saber (known in Canada as the Canadair CL-13 Saber with an Orenda 10 engine), and Avro Canada's CF-100 Canuck to protect the continent. While all these aircraft were technologically more advanced than their late 1940's predecessors, many were single engine aircraft (ex-

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Orenda Iroquois Engine Mounted on the CL-52. (Photo courtesy of the Canadian Air and Space Museum.)

cept for the F-89 and CF-100) that lacked the range and maintenance reliability to operate in the extreme low-temperatures found over northern Canada.⁸ Due to the fact that none of the existing US and Canadian fighter aircraft could address these performance concerns, the RCAF issued Operational Requirement (OR) 1/1-63, "Supersonic, All-Weather Interceptor Aircraft," in November 1952.⁹

Avro Canada's Chairman Sir Roy Dobson and President/General Manager Crawford Gordon received from the RCAF in April 1953, Specification AIR-7-3 "Design Studies of Prototype Supersonic All-Weather Interceptor aircraft" based on the RCAF's 1952 OR.¹⁰ This RCAF specification led the development on what was to become the CF-105 Arrow, an aircraft that would help revolutionize fighter development into the Cold War and beyond into the Space Race.¹¹ In accordance with the AIR-7-3 requirements, the proposed CF-105 aircraft would be a twin-engine interceptor capable of maximum level speeds of Mach 2.0; a combat ceiling of 60,000 feet; a maximum mission range of 200 Nautical Miles on a supersonic mission (1,500 Nautical Miles Ferry range); and could be flown day, night and all-weather by a crew of two (Pilot and Radar Operator).¹² Additionally, the Arrow would include a number of innovative design features that became common for future generations of advanced combat aircraft including: an Automatic Flight Control System or "Fly-by Wire" system (a feature not seen in production aircraft until the late 1960's), a fully-integrated Hughes MX-1179 Fire Control System which was completely automated and controlled from a ground control station, and a removable internal weapons bay pack capable of firing either eight Hughes AIM-4 Falcon or



USAF TB-57B conversion to CL-52 Canadair November 25, 1956 at Cartierville, Quebec, Canada. (Photo courtesy of the Office of Royal Canadian Air Force History and Heritage.)

four Raytheon AIM-3 Sparrow Air-to-Air missiles.¹³ The total cost of this advance technology was estimated at nearly \$400 million (Canadian), a considerable sum for the time when the entire Canadian defense budget was \$2 billion with the RCAF having a larger budget than those of the Canadian Army and Royal Canadian Navy combined.¹⁴ The cost of the CF-105 development, due in part to unplanned cost overruns driven by changing RCAF requirements, would come to haunt Avro Canada's leadership by 1958.¹⁵

What was even more impressive for the time, in an era (even today) when high-profile military aircraft programs take decades to simply get a contract in place and many more years before actual delivery starts, Avro Aircraft Canada (now an aviation subsidiary of Avro Canada Limited and led by President Fred T. Smye), took the initial 1953 design to the Arrow's first flight by 1958.¹⁶ A total of six production model Arrows were built using the Cook-Craigie approach to aircraft development which meant none of the six aircraft were prototypes.¹⁷ In order to meet production timelines, all the initial Arrows flew with the US designed Pratt and Whitney J-75 engine while the Orenda Iroquois was in development. According Palmiro Campagna author of *The Avro Arrow: For the Record*,

Five Arrows flew by the end of 1958 and early 1959, achieving some 95 percent of the designed flight envelopes. On its third flight, [an] Arrow went supersonic at Mach 1.1, at 40,000 feet...on its seventh flight, using Pratt and Whitney J-75 engines, not the more powerful [and lighter weight Canadian designed] Iroquois engines specifically [built] for [the Arrow], it achieved Mach 1.52 at 50,000 feet, while still accelerating and climbing, with excess thrust available.¹⁸

Clearly the Arrow with an interim power plant like the J-75 engine could achieve all the designers promised, but the "Holy Grail" of merging the Arrow airframe with the Iroquois engine still lay ahead.¹⁹



RCAF CL-52 X059 during a test flight with the Iroquois engine mounted. (Photo courtesy of the Office of Royal Canadian Air Force History and Heritage.)

Orenda's Iroquois

The Arrow's powerplant, the P.S. 13 Iroquois engine, was developed in coordination with the Arrow airframe by Avro Canada's Orenda subsidiary also located at a multi-million-dollar facility in Malton, Ontario (today the home of Toronto's Pearson International Airport). The Arrow's engine requirements were for a high performance, axial flow, two-spool turbojet engine with an integral afterburner, and was specifically designed for operations under supersonic flight conditions.²⁰ In order to provide the new interceptor with the required maximum performance of 6-minutes from a runway standing start to reach Mach 1.5 at 50,000 feet, the engine would need to have a thrust-to-weight ratio of better than 5:1 and to produce a sea-level dry thrust of 20,000 pounds or 25,000 pounds with afterburner.²¹ The Iroquois weighed only 4,680 pounds, a remarkable achievement when compared to the 5,960 pound J-75 which was nearly 1,280 pounds heavier and produced about the same thrust weights.²² This cost savings in weight was due in part to Orenda's innovative use of titanium on many components (approximately 60% of the basic engine), rather than steel, saving as much as 20% on engine weight.²³ This thus allowing the Arrow to achieve the climb speeds needed for a high-altitude interceptor aircraft.²⁴

The Orenda team spent a considerable amount of time and resources evaluating the engine at the Malton plant, which put the engine development program over budget and behind schedule from the Arrow airframe development.²⁵ Ground tests for the Iroquois were a noisy and labor-intensive procedure that took place inside a special sound-proof chamber with the engines firmly bolted to struts embedded in the floor.²⁶ According to an engine production team member, when first tested the powerful engine nearly pulled the whole test stand out of its mounting sockets.²⁷ The testing proved successful and after four years of development, by 1957 nine of the originally planned nineteen Iroquois engines had been completed, with nearly 1,400 hours of development running on six of



The RCAF CL-52 X059 during ground tests of the Orenda Iroquois engine. (Photo courtesy of the Office of Royal Canadian Air Force History and Heritage.)

the engines accumulated.²⁸ A special unveiling of one of the new engines was held on July 22, 1957 at the Orenda Engine factory, with federal, provincial, and municipal civilian and military leaders (many from other NATO nations) in attendance including the RCAF Chief of Staff Air Marshal C. R. Slemon, Canada's Minister of Defense George R. Pearkes, and Orenda Engines Limited President and General Manager Walter R. McLachlan.²⁹

Still, for all the success Orenda engineers were having with the ground tests, high-altitude performance evaluations were necessary to prove the reliability of the new engine. In 1957 Orenda began conducting altitude performance investigations at the US National Advisory Committee for Aeronautics (NACA) supersonic wind tunnel facility in Cleveland, Ohio, with additional cold weather tests held at the Canadian National Research Council laboratories in Ottawa.³⁰ The success of the Iroquois' NACA engine tests led to the next phase of development, which required the engine be mounted on an airborne test platform and given the size of the engine, the Orenda engineers faced a challenge finding a suitable aircraft mount for testing. To meet the demands of an airborne platform capable handling both an extra engine of the Iroquois size and the power that the engine produced, Orenda engineers solved this problem by using an aircraft from outside the Canada and the Commonwealth and turned to the USAF for help.³¹

A Mount for the Iroquois

The mount chosen to flight test Orenda's Iroquois engine, the USAF's Boeing B-47 Stratojet bomber, seems like an unusual choice for a Canadian company with strong ties to the parent United Kingdom based Avro Limited, the same company that was building the Type 698 Vulcan bomber. But when viewed from a purely engineering perspective, the USAF's primary strategic jet bomber was the best choice to meet the company's needs. First, Orenda's then current airborne engine test platform was a war-surplus Avro Lancaster Mk 100 (Tail #FM209) which served as the testbed for the Orenda 11 engines used in the CF-100.³² With the increase in altitude, speed, and thrust of

the proposed P.S. 13 engine, a stronger platform, different from the venerable Lancaster was needed. Additionally, by 1956, the USAF had stopped buying the B-47 and was replacing them with the B-52 Stratofortress, meaning 2000 B-47's would soon be available for other duties.³³

Orenda engineer's specific choice of the B-47 as the Iroquois engines flying test platform was based on six design factors. It had to be immediately available, reliable, big enough to carry the necessary measuring equipment, with a speed approaching that of sound, capable of climbing to 45,000 feet with sufficient structural strength to take the high thrust of the Iroquois, and with sufficient air resistance to take the engine's high power output without entering dangerous speed ranges.³⁴ Orenda engineers studied eleven other US and British aircraft (like the Avro Vulcan and Boeing B-50) before tentatively deciding on the B-47.³⁵ With approval from the US and Canadian governments, on February 19, 1956, the Orenda team went first to the Boeing Airplane Company headquarters in Seattle, Washington, then to the Boeing B-47 production plant in Wichita, Kansas to discuss with the B-47 designers and engineers the Orenda team's assumptions of the aircraft test role.³⁶

The Boeing and Orenda engineers then met to consider methods of mounting the Iroquois for testing. The usual practice of mounting the test engine beneath a wing or above or below a fuselage, often so the test pilot could retract the engine when it was not operating, was impossible on the B-47 due to the tandem undercarriage installed in that area.³⁷ The B-47 wings were calculated to have sufficient strength to absorb the power of the Iroquois engine if installed anywhere on the aircraft, although the Iroquois developed more thrust than four of the B-47's own engines.³⁸ The Orenda and Boeing engineers finally settled on mounting the Iroquois engine on a 29.4 foot x 6 foot pylon fasted to the starboard rear side of the B-47's fuselage beneath the horizontal stabilizer, with a 5 degree off set from the aircraft's pitch axis (which would later contribute to a noticeable yaw during the actual test flights).³⁹ This installation would require changes internally to airframe to compensate for the weight changes on the B-47's bicycle undercarriage, gave adequate clearance off the ground, was easily accessible for service, and provided the test engine with an almost undisturbed airflow.⁴⁰ Canadair Limited of Montreal, was contracted by Orenda to begin the detailed engineering for the conversion of a production model B-47 into the proposed flying test platform configuration.⁴¹

While the Boeing B-52 Stratofortress is the aircraft most associated with the Cold War and despite its iconic station, its success is owed much to its lessor known predecessor, the Boeing B-47 Stratojet. First proposed during the Second World War as a highspeed propeller driven aircraft, the B-47 morphed into the world's first six-engine, swept winged, medium jet bomber that dominated the Strategic Air Command's (SACs) fleet for over a decade with over two thousand built between 1947 and 1956.⁴² While SAC relied heavy on the B-47 in the transition period from the hybrid Piston/Turbojet B-36 Peacemaker to



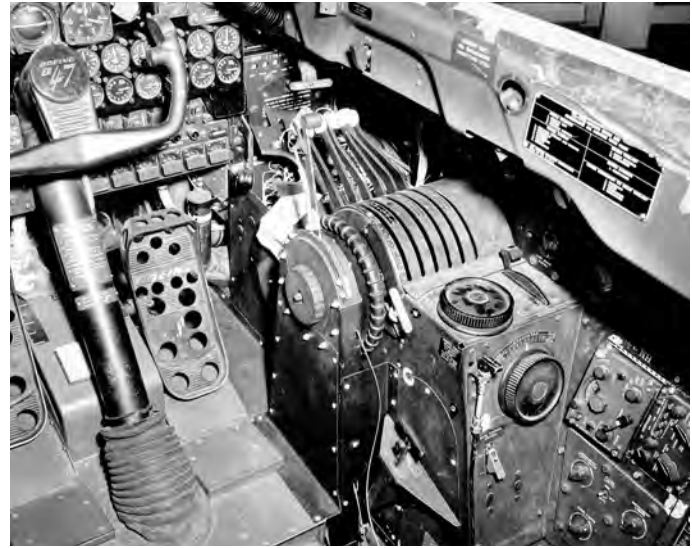
Avro Arrow 201 during a test flight with the US designed Pratt and Whitney J-75 engine while the Orenda Iroquois was in development. (Photo courtesy of the Edenvale Aviation Heritage Foundation Museum.)

the all turbojet B-52, the B-47 was never popular with SAC's Commander, General Curtis LeMay.⁴³ LeMay despised the B-47 due to its inadequate range, myriad of technical shortcomings, and inability to fulfill its mission. Over time, LeMay grudgingly accepted the B-47 as an interim solution pending delivery of the B-52 in the late 1950s.

TB-47B #51-2059 to CL-52 #X059

B-47A tail #51-2059, which became the only aircraft powered by the Orenda Iroquois engine, began its life as Production Model 450-11-10/Construction 4500112, with a rollout date at the Boeing Wichita, Kansas plant on November 20, 1951 and its first flight date on May 12, 1952.⁴⁴ The USAF Material Inspection Report date (the day the aircraft became US Government property) was June 18, 1952 and the aircraft left the plant for its future SAC assignment on June 30, 1952.⁴⁵ Tail #51-2059's first assignment with SAC was on December 10, 1953, after processing through the USAF's Air Material Command (AMC), Tinker Air Force Base (AFB), with the 3540th Flying Training Wing (later redesignated the 4240th Flying Training Wing) at Pinecastle AFB, Orlando, Florida, serving as a training aircraft for personnel flying the B-47A model in bomber units.⁴⁶ Later the aircraft was transferred to the 321st Bombardment Wing, 813th Air Division, also at Pinecastle AFB to serve in an operational nuclear deterrent role on 27 May 1954.⁴⁷

The 321st Bombardment Wing began as the 321st Bombardment Group (Medium) on June 19, 1942 and activated on June 26, 1942. Prepared for overseas duty with B-25 Mitchell bombers, the unit moved to the Mediterranean theater and served with the 12th Air Force from January 1943 to April 1945 in North Africa, Sicily, and Italy, and finally deactivated on September 12, 1945.⁴⁸ Established as the 321st Bombardment Wing, Medium, on March 23, 1953 and reactivated on December 15, 1953, at Pinecastle AFB, the newly formed 321st absorbed the resources of the 4042nd Flying Training Wing in late 1954, thus acquiring its B-47As and KC-97s. The Wing conducted bombing training and air refueling operations to



The CL-52 Cockpit-Throttle quadrant with Iroquois throttle lever on the far left of the quadrant. (Photo courtesy of the Office of Royal Canadian Air Force History and Heritage.)

meet SAC's global commitments from 1954 - 1961.⁴⁹ Once transferred to the 321st Bombardment Wing, tail #51-2059 was assigned to the 446th Bombardment Squadron where the aircraft served as a SAC alert bomber until it was sent back to Boeing on July 14, 1955, as part of the USAF's *Ebb Tide* modification program converting B-47As to TB-47B training models.⁵⁰

The *Ebb Tide* TB-47B models (tail #49-2642 thru #51-2091) lacked weapons and air-to-air refueling capability, but now included a fourth seat in the cockpit for an instructor used for pilot and navigator training, internal bomb bay tanks, and a solid nose with a bomb site perturbation; these modified aircraft were designed to turn out B-47 trained pilots and navigators as quickly as possible.⁵¹ It was during this time, due to US aircraft manufacturer and defense interest in the Arrow program, that the USAF agreed to loan tail #51-2059 to the RCAF as part of the Orenda Iroquois engine test while the aircraft was undergoing the *Ebb Tide* conversion at Boeing's Wichita plant.⁵² While tail #51-2059 was modified to a TB-47B, air and ground crews from Canada were designated to fly the bomber during the Orenda engine tests. Avro Canada Chief Test Pilot T.P.M. "Mike" Cooper-Slipper, Test Pilot Leonard "Len" Hobbs (from the United Kingdom), and Flight Engineer Johnny McLaughlin became the first non-US citizens to fly the B-47, spending ten-weeks training under B-47 Instructor Pilot USAF Captain Mike "Slim" Drew at McConnell AFB, Kansas, where USAF SAC aircrew qualified; while the ground crews trained at the Boeing Plant, Wichita.⁵³ At McConnell AFB, the Anglo-Canadian airmen earned the admiration of their SAC counterparts, especially when word got around the McConnell AFB Officers Club as to the reason why Cooper-Slipper, Hobbs and McLaughlin were attending the B-47 transition course. Said one USAF pilot from Texas, "Do you mean, that you little old Canadians have got the biggest jet engine in the world? And you are going to put it in the tail of the B-47? Man, you're crazier than we are."⁵⁴



Avro Arrow Test Pilot T. P. M. "Mike" Cooper-Slipper at the controls of the CL-52. (Photo courtesy of the Canadian Warplane Heritage Museum.)

During the Anglo-Canadian team's stay in Kansas, in what was a public relations coup for Avro Canada, the US and Canadian governments allowed *MacLean's* magazine reporter June Callwood to report on the Arrow Development and fly with Cooper-Slipper, Hobbs, and McLaughlin in a B-47 during their check-out at McConnell AFB.⁵⁵

After their B-47 check out in Wichita, Cooper-Slipper, Hobbs, and McLaughlin returned to Canada and USAF Colonel Robert E. Lee and Major Jay Brown delivered tail #51-2059 to the Canadair Plant at Cartierville Airport, Quebec, on February 16, 1956.⁵⁶ Over the following 14-months, Canadair engineers and mechanics would convert the TB-47B to a CL-52, tail #X059.⁵⁷ The modifications to the newly designated CL-52 included, besides the previously mentioned Orenda engine pylon, additional internal airframe structural stiffening, a dorsal fin extension for 100,000 feet of test wiring, an additional throttle for the Orenda engine, a removable test rack for monitoring instruments in the bomb bay, and two methyl bromide fire extinguishing systems (one for the engine and one for the test monitoring equipment).⁵⁸ To counterbalance the Iroquois engine and the pylon, 10,000 pounds of ballast was added to the front of the aircraft which comprised of two layers of canvas bags filled with lead shot and held in place with wooden planks.⁵⁹ Additionally, surface plating was added to the fuselage in case the Iroquois engine self-destructed.⁶⁰ With the modifications completed, and now sporting the distinctive RCAF Red Maple Leaf roundels on the fuselage and wings; RCAF tri-color fin flashes; and Orange painted bands and tail fin, the CL-52 (without an actual Iroquois engine in the pylon) with Cooper-Slipper,

Hobbs (in the pilot and co-pilot positions), and McLaughlin (occupying a position in nose of the aircraft) at the controls departed from the Canadair Plant to the Malton Plant on April 15, 1957.⁶¹

The Iroquois Takes Flight

Of the planned original nineteen Iroquois powerplants (series X101 thru X118 and X121), engine X106 was selected for testing on the CL-52.⁶² X113 and X114, designed



321st Bomb Group patch.



Avro Lancaster Mk 100 (Tail #FM209) which served as the testbed for the Orenda 11 engines used in the CF-100. (Photo courtesy of the Canadian Warplane Heritage Museum.)

to incorporate the latest development changes and be capable of passing a 50-hour preliminary flight rating test at full power, were also slated for testing on the CL-52, these two engines were never completed before the Arrow program's cancellation.⁶³ Developmental changes to future engines would be based on ground, altitude tunnel, and CL-52 flight tests.⁶⁴ With modifications to the CL-52 complete, based on previous test flights with a dummy engine and X106 installed on the pylon, the first flight and start of an Iroquois engine aloft with the engine running for a total of 6-minutes at 77% power took place on November 13, 1957.⁶⁵ When the Iroquois was operating at a high-power setting, it was necessary for three of the CL-52's General Electric J-47 engines on the starboard side of the aircraft to be reduced to idle thrust, the #1 J-47 on the port side operated at full throttle to countermand the yaw induced by the Iroquois, another port side J-47 was kept running at low power to keep the aircraft hydraulic systems operating, and the third port side engine was kept at idle.⁶⁶ While flight tests proceeded well, there were a few minor problems with the Iroquois and the CL-52.

On one occasion, there was an explosion in flight about 50-miles north of Malton, near Barrie, Ontario on March 26, 1958.⁶⁷ The problem began when the CL-52 started to climb with full Iroquois power on, this was the only recorded occasion that the Iroquois was put to full throttle while in flight test.⁶⁸ As the Iroquois was operated at full afterburner it threw turbine blades, caught fire, and caused extensive damage to the engine's nacelle and horizontal stabilizer.⁶⁹ The first indication to the aircrew of a problem was an enormous bang and the whole aircraft shook, followed by a deadly silence.⁷⁰ The pilot/co-pilot positions were a long way from the Iroquois but dust flew up in the cockpit.⁷¹ The Iroquois was immediately shut down and its fire extinguisher activated.⁷² The vibrations diminished as

the engine came to a stop.⁷³ A CF-100 chase plane, which was following the CL-52, flew up to the right side of the aircraft and the chase pilot noted lots of smoke, but no fire.⁷⁴ Upon landing at Malton, a second fire occurred in the engine, which was quickly put out by the airfield's fire department. After an inspection by the Orenda engineers, it was determined that an engine blade had failed and broken into pieces.⁷⁵ The damage to the aircraft and engine resulted in a redesign of the powerplant and a general beefing up of the CL-52 structure with "chain mail" sheeting paced inside the nacelle.⁷⁶ These changes allowed the Iroquois to obtain a total of 31 flight hours on the CL-52 before the Arrow program was cancelled.⁷⁷

The performance of the Iroquois during the CL-52 airborne tests completely justified the faith of those who put the project in motion, albeit with some "unserviceability arising from common or garden mechanical faults, many of which had been experienced long before on the test bed".⁷⁸ It should be noted that only today are jet engines routinely achieving the same thrust and performance as the Iroquois did in the late 1950s.⁷⁹ There were plans for future Iroquois engine tests until 1960 that would have increased the rated thrust by nearly 34%, possibly making the Iroquois suitable for a fighter, bomber, cruise missile, and possibly a civilian jet airliner.⁸⁰ Finally, Orenda's future tests in their high altitude facilities were scheduled to push the Iroquois performance at speeds of Mach 3 at 100,000 feet.⁸¹ But while the Arrow and Iroquois programs were proving the reality of a Canadian built high-speed/high-altitude interceptor, military and political changes were coming. First, the Soviet Union launched the world's first artificial satellite into earth's orbit in 1957, signaling that the USSR was leading the race in terms of intercontinental ballistic missiles. Second, because of this, there was a perceived diminished bomber threat. Third,



Iroquois Engine mock-up prior to mounting on the CL-52 at the Canadair Plant, Cartierville, Quebec, Canada. (Photo courtesy of the Office of Royal Canadian Air Force History and Heritage.)

Progressive-Conservative John Diefenbaker, who eventually cancelled the Arrow program, was elected Prime Minister in June of 1957 and again in 1958.

“Black Friday”

The Avro Arrow had “as a weapons system...become virtually obsolescent” in the minds of many Canadian officials just after the aircraft was displayed for the first time at the Malton Plant on October 4, 1957.⁸² This line of thinking was all due to the 184-pound Sputnik 1 passively orbiting 139 miles above the earth challenging the purpose of the 57,000-pound innovative interceptor. Launched on the same day as the Arrow inauguration, the Soviet’s Sputnik 1 suddenly forced western defense planners to reassess their assumptions, creating a perceived “Missile Gap” that now replaced the so-called “Bomber Gap”. If the Soviets could launch a rocket with a satellite, why could they not do the same with a nuclear weapon? Canadian leaders looked at missile interceptors like Boeing’s CIM-10 Bomarc nuclear armed surface-to-air missiles to deal with the perceived challenges of a reduced manned bomber threat, in lieu of continuing with the Arrow program. The latter it was now assumed was an “outmoded weapon.”⁸³ These missile interceptors, which were “state-of-the-art” for the late 1950’s, were cheaper to produce than manned aircraft interceptors like the Arrow.

Due to the Canadian Military and Civil government’s public reassessment of Canada’s manned interceptor aircraft needs following the launch of Sputnik, Avro Canada’s Arrow cost in the face of a diminished manned bomber threat and during an economic recession, Canada’s Army and Navy Chiefs needs to modernize their own Post-Second World War forces with potential funding available if Arrow was cancelled, and the possibility of a joint informal agreement between Canada and the US to “share in the productions of defense items of mutual interest”, the Prime Minister formally cancelled the CF-105 program on Fri-



CL-52 Model during wind tunnel test in 1956 at the Canadair Plant. (Photo courtesy of Bill Upton.)

day, February 20, 1959.⁸⁴ Known as “Black Friday” to many in the Canadian aerospace industry, the cancellation decision had the immediate impact of laying off 14,000 Avro Canada workers, with an additional 25,000 subcontractors also losing their jobs.⁸⁵ In addition to shutting down the Arrow production line, which had already produced six aircraft and three more still on the Malton assembly line, all completed, and nearly assembled aircraft were ordered by the Canadian government to be scrapped or destroyed along with all engines, drawings, jigs, and tools.⁸⁶

Captain Brian Jones, a 36-year retired veteran of Air Canada with experience flying bush planes to Airbus 340 airliners and a Canadian Warplane Heritage Museum docent, vividly remembers “Black Friday” and the impact it had on his father, the late Captain Gordon E. Jones. The elder Jones, an RCAF C-47 Pilot who flew missions during 1944’s *Operation Market Garden*, was then currently employed with Trans Canada Airlines (later renamed Air Canada). Brian recalls,

I was 11-years old and sitting in our kitchen eating breakfast before school listening to Montreal radio station, CJAD, on a small plastic radio. As announcer Bill Roberts read the 8:00 AM news, my father [Gordon] came downstairs and heard Roberts announce that Prime Minister Diefenbaker had just canceled the Arrow program and 14,000 Canadian workers would be laid off. My father, a levelheaded man, was so angry at the news, he smashed the radio on the kitchen floor, announcing “He [my father] would never vote for the Progressive Conservatives again!”⁸⁷

Broken Men and Mounts

Prime Minister Diefenbaker’s decision to cancel the Arrow program and buy the nuclear-armed Bomarc missile would eventually lead to his parliamentary government falling, with Canadians deciding the Progressive-Conservative party had mishandled the entire issue, electing the



The CL-52 X059 with Arrow 201 at the Malton Plant, Ontario, Canada. (Photo courtesy of the Office of Royal Canadian Air Force History and Heritage.)

Liberal Lester B. Pearson Prime Minister on April 8, 1963.⁸⁸ Additionally, while costing less than the Arrows, Bomarc missiles would eventually prove to be an operational failure and the limited threat of Soviet bombers to Canada and the US remained.⁸⁹ As a result of this reality, in 1961 the Canada government was forced to buy sixty-six of the McDonnell Aircraft Corporation's F-101B Voodoo (renamed the CF-101B) all-weather interceptor to fill the gap created by the cancellation of the Arrow program and the failure of Bomarc.⁹⁰

Another impact of the project cancellation was the eventual financial failure of Avro Canada, which depended heavily on Canadian government contracts since the Second World War. In July 1962, Avro Canada Limited was dissolved by Hawker Siddeley Aviation in Britain and what at one time had been the third-largest company in Canada ceased to exist.⁹¹ Avro Canada President and General Manager Crawford Gordon left Canada a broken man and never returned, dying nearly bankrupt in New York City in 1967.⁹² Sir Roy Dobson would continue as a leader in the aviation industry until his death in 1968.⁹³

Following Prime Minister Diefenbaker's cancellation of the Arrow program, Avro Aircraft's leadership directed Cooper-Slipper and his crew to return the CL-52 (now once again TB-47B tail #51-2059), with the test pylon and Iroquois engine removed, to the USAF's AMC at Tinker AFB on May 28, 1959.⁹⁴ The following day, in a fate similar to the Avro Arrows and as a result of both Canadair Limited extensive airframe modifications and the Orenda Iroquois engine's thrust on the right side of the TB-47B that de-

formed the airframe, the USAF decided to scrap the aircraft.⁹⁵ AMC elected to transfer the aircraft to the Arizona Aircraft Storage Branch, Davis-Monthan AFB, near Tucson, Arizona where the Iroquois' last mount was broken up and melted down for metal ingots on August 12, 1959.⁹⁶ The last USAF B-47 bomber was retired at the end of 1969 (with two US Navy EB-47E finally retiring in 1977), and the entire fleet was dismantled at Davis-Monthan AFB except for about 30 Stratojets which were saved for display at air museums around the United States.⁹⁷

Today, little remains of the original Avro Arrows except for the forward cockpit of aircraft RL-206, an ejection seat, two wing panels, landing gear, some blueprints, and photographs in places like the Canadian Air and Space Museum, Ottawa. Two Arrow replicas were eventually built by Arrow enthusiasts, one of the most detailed is aircraft RL-203 at the Edenvale Aviation Heritage Foundation Museum in Stayner, Ontario. Three Iroquois engines of the ones completed survive today.⁹⁸ Engine X106 used on the CL-52 and the only one that ever flew, is located at the Canadian Warplane Heritage Museum, Hamilton, Ontario.⁹⁹ The impact of the Arrow program, and the cooperation given by the USAF, demonstrates how combined international aerospace development can push the envelope of aircraft and engine development. Finally, the Arrow-Iroquois technology lived on in America's warplane and space program development. Following the cancellation decision, twenty-five ex-Avro engineers found work with NASA in the 1960s developing the successful Mercury, Gemini, and Apollo Space programs.¹⁰⁰ ■

1. According to the 1956 A. V. Roe Canada Limited Stock Prospectus, "[Avro Canada] was incorporated under the laws of Canada on September 1, 1945, as a wholly owned subsidiary of the Hawker Siddeley Group Limited, the largest aircraft organization in the British Commonwealth and a major producer of aero engines, diesel engines, motor cars and other industrial products. The [Avro Canada] company sought to establish in Canada a self-sufficient enterprise based on Canadian resources and personnel, capable of undertaking original aeronautical research and design." *500,000 Shares, A. V. Roe Canada Limited, Common Shares without Nominal or Par Value*. (Toronto: Wood, Gundy & Company, September 28, 1956), 1, Canadian Warplane Heritage Museum, Hamilton, CN.
2. The CF-105 Arrow was not the first organic fighter designed and built in Canada. In 1938, Canada Car & Foundry Limited produced the Gregor FDB-1 biplane fighter. Like the Arrow nineteen years later, the FDB-1 was overcome by strategic and technological changes and the Canadian government terminated the program. Graham Chandler, "Cancelled: The Gregor FDB-1," *Smithsonian Air and Space Magazine*, September 2014. <https://www.smithsonianmag.com/air-space-magazine/cancelled-gregor-fdb-1-180952402/> (accessed, October 11, 2022).
3. Randall Whitcomb, *Cold War Tech War: The Politics of America's Air Defense*. (Burlington, Ontario: Apogee Books, 2008), 61.
4. In the 1950s, US and Canadian defense planners depended on a three-layered air control and warning system consisting of the Distant Early Warning (DEW) line located north of the Arctic Circle from Baffin Island west to Alaska, the Mid-Canada line which ran from Newfoundland and Labrador west to British Columbia, and the Pine Tree Line which ran from the Gulf of Saint Lawrence west along the 50th parallel to the Pacific Ocean. Lloyd H. Cornett and Mildred W. Johnson, *A Handbook of Aerospace Defense Organization, 1946 – 1986*. (Peterson Air Force Base, Colorado: Office of History, Air Force Space Command, 2015), 7; Lawrence Miller, *The Avro Arrow: The Story of the Great Canadian Cold War Combat Jet – In Pictures and Documents*. (Toronto: James Lorimer & Company Limited, Publishers, 2014), 10.
5. Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*. (Erin, Ontario: Reprint, Boston Mills Press, [1980] 1998), 133.
6. Lawrence Miller, *The Avro Arrow: The Story of the Great Canadian Cold War Combat Jet – In Pictures and Documents*, 5.
7. Soviet Second World War era bombers, including the Tu-4 Bull (a copy of the Boeing B-29 Superfortress), did not have the range from Russia for a round trip to reach targets in the West. It was not until the development of aircraft like the Tu-95 Bear, with speeds approaching 600 mph and a range of 9320 miles, did western leaders believe the need for faster and higher-flying interceptors to deal with these new threats was necessary. *Ibid*, 9-10; Sherman Kent, *Memorandum for the Intelligence Advisory Committee, SUBJECT: Validity of Heavy Bomber Estimate in NIE 11-4-57*. (Washington, D.C.: Central Intelligence Agency, April 11, 1958), 1-3.
8. Lawrence Miller, *The Avro Arrow: The Story of the Great Canadian Cold War Combat Jet – In Pictures and Documents*, 36.
9. James Dow, *The Arrow*. (Toronto: James Lorimer & Company Limited, Publishers, 1997), 86.
10. *Design Study of Supersonic All Weather Interceptor Aircraft In Accordance with RCAF Spec. AIR-7-3, Report No. P/C-105/1, May 1953*. (Malton, Canada: A.V. Roe Canada Limited, May 1953), 1, <https://nrc-digital-repository.canada.ca/eng/view/ft/?id=9a63e8b4-6dd5-442a-b78f-16aedb947fd> (accessed, September 20, 2022).
11. Avro Canada's experience building aircraft began in November 1942 when the Canadian Government acquired the National Steel Car Company plant in Malton, Ontario to build Avro Lancaster bombers, Lysander Army Cooperation aircraft, and Anson twin-engine training aircraft for the RAF and RCAF, changing the name of the company to Victory Aircraft Limited. As part of the post-war changes in the Canadian aviation industry, the company's leadership placed a greater emphasis on both commercial and well as military aviation programs. As a result of these change, on December 1, 1945, Victory Aircraft Limited became A. V. Roe Canada Limited. Palmiro Campagna, *The Avro Arrow: For the Record*. (Toronto: Dundurn, 2019), 15.
12. *CF-105 Supersonic All-Weather Fighter: U.S.A.F. Presentation, August 1954*. (Malton, Ontario: A. V. Roe Canada Limited, August 1954), 3, Canadian Warplane Heritage Museum, Hamilton, Ontario.
13. Before the program was cancelled, the RCAF was considering the nuclear-tipped AIR-2A Genie rocket as potential armament for the CF-105 Mark 2 aircraft. This massive rocket, equipped with a 1.5 kiloton warhead, would have required a considerable redesign of the weapons bay and only two rockets could be carried. T.F.J. Leversedge, "Avro Canada CF-105 Arrow, RCAF Serial 25205 (Nose Sections and Components)," *Canada Aviation and Space Museum Aircraft*, n.d., <https://documents.techno-science.ca/documents/CASM-AircraftHistories-AvroCanadaCF-105Arrownose.pdf> (accessed November 2, 2022), 31; *Arrow 2: Twin Engine Supersonic All-Weather Fighter, Standard Aircraft Characteristics, Issue 2, March 1958*. (Malton, Ontario: Avro Aircraft Limited, March 1958) n.p.; Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*, 137.
14. James Dow, *The Arrow*, 88-89.
15. Fred Smye, *Canadian Aviation, and the Avro Arrow*. (Oakville, Ontario: Randy Smye, 1985), 74-75.
16. "Business Trends: A.V. Roe Management." *Canadian Aviation, January 1958*. (Toronto: McLean-Hunter Publishing Company Limited, January 1958), 3; Palmiro Campagna, *The Avro Arrow: For the Record*, 21.
17. The Cook-Craigie production model, developed in the US during the Second World War, reduced the time needed to bring a new aircraft design into service. Lawrence Miller, *The Avro Arrow: The Story of the Great Canadian Cold War Combat Jet – In Pictures and Documents*, 52.
18. The CF-105 Arrow's fastest recorded speeds in were Mach 1.90 in level flight and Mach 1.95 in a dive. *Ibid*, 21.
19. The Avro Arrow's closest western hemispheric rival on the drawing board was the North American XF-108 Rapier. The company's engineers designed the Rapier as an extremely high speed (Mach 3) interceptor and escort fighter for the B-70 Valkyrie bomber under development at the same time. The delta wing Rapier, in its pre-mockup phase, was to have a canard (forward-mounted pitch-control surface) and three vertical stabilizers: one on the fuselage centerline and a pair at the halfway point on the wing trailing edge for high-speed stabilization at speeds above Mach 2. Like the Arrow's fate, the XF-108 program was canceled by the US Government on Sept. 23, 1959, but never getting past the mockup phase. "North American F-108 Factsheet," *National Museum of the US Air Force*, n.d., <https://web.archive.org/web/20141228184033/http://www.nationalmuseum.af.mil/factsheets/factsheet.asp?id=2319> (accessed September 5, 2022).
20. *Iroquois 2 System Data, October 1958, B21-58*. (Malton, Ontario: Orenda Engines Limited, October 1958), 1, Ingenium, Canada Aviation and Space Museum Archives, Ottawa, CN.
21. "Comparison of Large Turbojet Engines," *CF-105 Development Programme, Iroquois Gas Turbine Development Programme*. (Malton, Ontario: Orenda Engines Limited, 1956), n.p., Ingenium, Canada Aviation and Space Museum Archives, Ottawa, CN.
22. For comparison, the heavier Pratt and Whitney J-75 engine could produce 16,800 pounds at sea-level dry thrust and 26,000 pounds with afterburner. "Comparison of Large Turbojet Engines," *CF-105 Development Programme, Iroquois Gas Turbine Development Programme*, n.p.
23. Victor Koby, "Orenda to fly its Power Giant," *Canadian Aviation, April 1956*. (Toronto: McLean-Hunter Publishing Company

Limited, April 1956), 33.

24. Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*, 123.

25. June Callwood, "The Day the Iroquois Flew," *MacLean's: Canada's National Magazine*, February 1, 1958. (Toronto: MacLean-Hunter Publishing Company Limited, February 1, 1958), 11.

26. The Iroquois engine design team did additional testing at another Orenda plant at Nobel, Ontario. Lawrence Miller, *The Avro Arrow: The Story of the Great Canadian Cold War Combat Jet – In Pictures and Documents*, 47.

27. *Ibid.*, 46.

28. *CF-105 Development Programme, Iroquois Gas Turbine Development Programme*. (Malton, Ontario: Orenda Engines Limited, 1956), 1, Ingenium, Canada Aviation and Space Museum Archives, Ottawa, CN.

29. Lawrence Miller, *The Avro Arrow: The Story of the Great Canadian Cold War Combat Jet – In Pictures and Documents*, 56.

30. *CF-105 Development Programme, Iroquois Gas Turbine Development Programme*, 1.

31. Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*, 125.

32. W.E. "Ted" Jones, "The Big Thrust," *New Horizons*, Winter 1956-7. (Toronto: Avro Canada Limited, 1957), 21, Ingenium, Canada Aviation and Space Museum Archives, Ottawa, CN.

33. June Callwood, "The Day the Iroquois Flew," *MacLean's: Canada's National Magazine*, February 1, 1958, 13.

34. W.E. "Ted" Jones, "The Big Thrust," *New Horizons*, Winter 1956-7, 21.

35. *Ibid.*, 21.

36. As a result of this agreement between the USAF and RCAF, Canada became the only country outside of the United States to operate the B-47 aircraft. There was discussion between the Australian and United States governments in 1963 to loan 24 B-47s to the Royal Australian Air Force (RAAF) as a stopgap measure until the RAAF's General Dynamic's F-111 Fighter Bombers were brought into service in 1968. This loan proposal was never accepted by the Australian government. *Ibid.*; C. Mike Habermehl and Robert S. Hopkins III, *Boeing B-47 Stratojet: Strategic Air Command's Transitional Bomber*. (Manchester, UK: Crecy Publishing Limited, 2018), 239.

37. Finding suitable and reliable airborne test platforms for prototype aircraft engines was not a new challenge. The German Luftwaffe, for example, used the twin-tailed Dornier 17 bomber as a test bed for early ram jet engines, with the test engine mounted on struts above the bomber fuselage, allowing the exhaust to pass between the bomber's twin tail configuration. "WWII Lorin Ramjet Experiments," *Engine History*, 2022. <http://enginehistory.org/Rockets/LorinRamjet/LorinRamjet.shtml> (accessed September 9, 2022); W.E. "Ted" Jones, "The Big Thrust," *New Horizons*, Winter 1956-7, 21.

38. *Ibid.*, 21.

39. *Ibid.*, 22; C. Mike Habermehl and Robert S. Hopkins III, *Boeing B-47 Stratojet: Strategic Air Command's Transitional Bomber*. (Manchester, UK: Crecy Publishing Limited, 2018), 84.

40. *Ibid.*

41. *Ibid.*

42. C. Mike Habermehl and Robert S. Hopkins III, *Boeing B-47 Stratojet: Strategic Air Command's Transitional Bomber*; 247, 273.

43. Paramount Studio's 1955 *Strategic Air Command*, starring Jimmy Stewart, June Allison, and Frank Lovejoy (the latter playing a very thinly disguised version of General LeMay) portrayed a "Hollywood" version of this transition period. "Strategic Air Command," *Turner Classic Movies*, 2022. <https://www.tcm.com/tcmdb/title/4246/strategic-air-command#overview> (accessed September 8, 2022).

44. The B-47 was built at the government-owned Boeing Plant II at Wichita, Kansas, since the Seattle plants were all committed to the manufacture of B-50 and C-97 aircraft, and the conversion

of obsolescent B-29s to tankers. C. Mike Habermehl and Robert S. Hopkins III, *Boeing B-47 Stratojet: Strategic Air Command's Transitional Bomber*, 248.

45. *Individual Aircraft Record Card, Type Model B-47B, A.A.F. Serial Number 51-2059, Contract Number AF 21-407*. (Washington, D.C.: US Government Printing Office, n.d.), 1, U.S. Air Force Historical Archives, Maxwell AFB, AL.

46. Pinecastle AFB (renamed McCoy AFB on May 7, 1958) closed in 1975 and became what is known today as Orlando International Airport. "Airport Profile 2015 by the Numbers, Orlando International Airport," *Florida Department of Transportation*. <https://www.florida-aviation-database.com/library/filedownload.aspx?guid=873b1bbd-7c98-4f57-8178-d72a7cda260c> (accessed September 8, 2022), 1; *Individual Aircraft Record Card, Type Model B-47B, A.A.F. Serial Number 51-2059, Contract Number AF 21-407*, 1.

47. *Individual Aircraft Record Card, Type Model B-47B, A.A.F. Serial Number 51-2059, Contract Number AF 21-407*, 2.

48. "321st Bombardment Group," *Army Air Corps Library and Museum*. https://www.armyaircorpsmuseum.org/321st_Bombardment_Group.cfm (accessed September 9, 2022).

49. "321st Bombardment Wing," *Strategic Air Command.Com*, 2003. <http://www.strategic-air-command.com/wings/0321bw.htm> (accessed September 9, 2022).

50. "Flying and Periodic Maintenance Schedule," *History of the 321st Bombardment Wing (M) (SAC), Pinecastle Air Force Base, Orlando, Florida, July 1955*. (Pinecastle AFB, Florida: 321st Bombardment Wing, July 1955), n.p., U.S. Air Force Historical Archives, Maxwell AFB, AL.

51. *T. O. 1B-47B-1, Flight Handbook: USAF Series TB-47B Aircraft*. (Saint Louis, MO: Universal Printing Company, August 31, 1956), iv, 10.

52. C. Mike Habermehl and Robert S. Hopkins III, *Boeing B-47 Stratojet: Strategic Air Command's Transitional Bomber*, 196.

53. Avro Canada's Test Pilots were both veterans of the Second World War. T.P.M. "Mike" Cooper-Slipper was a former RAF fighter pilot who received a Distinguished Flying Cross during the Battle of Britain for ramming a German Do 17 Bomber and for a short while was a POW with the Japanese following the Fall of Singapore. Len Hobbs, a former RAF bomber pilot, flew combat missions in B-24s in the western Pacific. June Callwood, "The Day the Iroquois Flew," *MacLean's: Canada's National Magazine*, February 1, 1958, 13.

54. *Ibid.*

55. "Writer Joins Crew," *The Wichita Beacon*, November 14, 1958. (Wichita, Kansas, The Wichita Beacon, November 14, 1958), 7.

56. "B-47 Arrival Heralds New Stage In Orenda Design, Development," *The Orenda*, Volume. 2, Number 4., February 24, 1956 (Malton, Canada: Orenda Engines Limited, February 24, 1956), 1, Ingenium, Canada Aviation and Space Museum Archives, Ottawa, CN.

57. While in possession of Avro Canada, the TB-47B was redesignated CL-52 by Canadair Limited and the aircraft operated with the Canadian aircraft registration X059. Had the Boeing bomber been fully integrated into the RCAF inventory, it would have received the Canadian military designation CB-47 (B for Bomber). C. Mike Habermehl and Robert S. Hopkins III, *Boeing B-47 Stratojet: Strategic Air Command's Transitional Bomber*, 196; Fred Paradie, RCAF Historian. Email to the author, Office of Royal Canadian Air Force History and Heritage, July 16, 2022.

58. *Ibid.*

59. *Ibid.*, 196-197.

60. *Ibid.*

61. The departure was a one-time deal as the Canadair plant's runway left little room to abort a takeoff. Fortunately, the lift-off was uneventful, unlike the landing at Malton, where the aircrew discovered the new pylon created additional lift, thereby dramatically changing the aircraft landing characteristics when in ground effect. Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*, 127.

62. Palmiro Campagna, *The Avro Arrow: For the Record*, 246; "Part 1, Scope of Work," *SE 10-58-4, Statement of Work Iroquois Program for The Arrow Weapons System, Issue 4*. (Malton, Canada: Orenda Engines Limited, January 27, 1959), n.p., Ingenium, Canada Aviation and Space Museum Archives, Ottawa, CN; P.Y. Davoud, Vice President Sales and Service, Avro Aircraft Limited, "Iroquois Compressor Designed Standard," Letter to Group Captain H.R. Foottit, Assistant for Arrow Weapons Systems, December 8, 1958, 1-2, National Archives Canada, Ottawa, CN.
63. "Part 1, Scope of Work," *SE 10-58-4, Statement of Work Iroquois Program for The Arrow Weapons System, Issue*, n.p.
64. *Ibid.*, n.p.
65. During this time engine X106 was designated model "A" and later "B" following post-flight modifications. W. E. Jones, *Flight Test Report – 65, Iroquois 106/6A and B Flight Testing and Ground Running while installed in B-47 Test Vehicle*, (Malton, Canada: Orenda Engines Limited, March 18, 1958), 5.
66. It was not possible for the CL-52 to fly with all seven engines at full power. Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*, 131.
67. *Ibid.*, 127; News article, n.p., March 28, 1958, Avro Arrow Museum, Calgary, CN.
68. *Ibid.*
69. C. Mike Habermehl and Robert S. Hopkins III, *Boeing B-47 Stratojet: Strategic Air Command's Transitional Bomber*, 197.
70. Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*, 127.
71. *Ibid.*, 127.
72. *Ibid.*
73. *Ibid.*
74. *Ibid.*
75. *Ibid.*
76. *Ibid.*
77. *Ibid.*, 127, 131.
78. W. E. Jones, *Flight Test Report – 65, Iroquois 106/6A and B Flight Testing and Ground Running while installed in B-47 Test Vehicle*, 3; *Ibid.*, 131.
79. *Ibid.*
80. *Ibid.*; "Part 1, Scope of Work," *SE 10-58-4, Statement of Work Iroquois Program for The Arrow Weapons System, Issue 4*, n.p.
81. Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*, 131.
82. Palmiro Campagna, *The Arrow: For the Record*, October 6, 2020, educational video, 1:08:27, <https://www.youtube.com/watch?v=fdxum20iBeQ>.
83. Canadian Defense Minister George Pearkes stated during an August 4, 1958, meeting with US Secretary of Defense Neil McElroy, "Notwithstanding the political difficulties, the Canadian Government might decide to scrap the CF-105 program and perhaps turn to missiles. It would be better to take the loss than to tie up a large part of the [Canadian] defense budget for the next five years making an outmoded weapon." Although the following day, August 5, 1958, Pearkes seemed to have second thoughts about "closing down the CF-105 production." Palmiro Campagna, *The Avro Arrow: For the Record – Update USA 2021*, July 29, 2021., educational video, 37:19, <https://www.youtube.com/watch?v=uLC Tf-Kj2Eo>.
84. In recommending cancellation of the Arrow, the Chiefs of Staff stated in a February 6, 1959 Top Secret memo to Cabinet that "[The Chiefs of Staff] are still of the opinion that the changing threat and rapid advances in technology, particularly in the missile field, along with the diminishing requirements for manned interceptors in Canada create grave doubts as to whether a limited number of aircraft of such extreme high cost would provide defense returns commensurate with the expenditures." Palmiro Campagna, *The Avro Arrow: For the Record – Update USA 2021*, July 29, 2021; Fred Smye, *Canadian Aviation, and the Avro Arrow*. (Oakville, Ontario: Randy Smye, 1985), 75-76.
85. *Ibid.*, 75; The number of subcontractors who lost their jobs is based on Diefenbaker's own cabinet documents, Palmiro Campagna, email to the author, October 30, 2022.
86. The Canadian government's decision to terminate and destroy all evidence of the Arrow program led to a variety of conspiracy theories ranging from the US Government's desire to eliminate Canadian aircraft competition (with some justification based on Palmiro Campagna's research) to a rumor that one Arrow, aircraft RL-202, was smuggled to the UK or hidden away at a secret location in Greenland. A likely explanation for the decision to destroy all Arrow aircraft and materials comes from a memorandum signed by the Canadian Chief of the Air Staff, Air Marshal Hugh Campbell, dated March 26, 1959, which states, "This course [of selling the aircraft as disposable property] could lead to subsequent embarrassment, that is... [the Arrow airframe] could be used as a public roadside stand [like a restaurant or car dealership]." Palmiro Campagna, *The Avro Arrow: For the Record*, 232; June Callwood, "Requiem for a Dream: A reporter remembers the glory days of the Arrow," *MacLeans: Canada's News Magazine*, January 13, 1997. (Toronto: MacLean-Hunter Publishing Company Limited, January 13, 1997), 56.
87. Brian Jones, Docent, Canadian Warplane Heritage Museum. Interview with the author, Canadian Warplane Heritage Museum, Mount Hope, Ontario, June 27, 2022.
88. "Bomarc Missile Crisis," *Parli: The Dictionary of Canadian Politics*, 2022. [https://parli.ca/bomarc-missile-crisis/#:~:text=In%201958%2C%20a%20decision%20by,planes%20headed%20to%20North%20America](https://parli.ca/bomarc-missile-crisis/#:~:text=In%201958%2C%20a%20decision%20by,planes%20headed%20to%20North%20America.). (accessed September 18, 2022); In a telegram from Prime Minister Diefenbaker to President Eisenhower, dated March 10, 1959, Diefenbaker stated, "[A] heavy tide of personal mail from all over Canada as showing far more bitterness towards the United States than he could previously recall, all in terms of the CF-105 decision." Palmiro Campagna, *The Avro Arrow: For the Record – Update USA 2021*, July 29, 2021.
89. Lawrence Miller, *The Avro Arrow: The Story of the Great Canadian Cold War Combat Jet – In Pictures and Documents*, 98.
90. Fred Smye, *Canadian Aviation, and the Avro Arrow*. (Oakville, Ontario: Randy Smye, 1985), 93.
91. Palmiro Campagna, *The Avro Arrow: For the Record*, 149.
92. "Crawford Gordon Dies at 52; Ex-Head of A.V. Roe Canada; Director of Arrow Interceptor Program Resigned When Production Was Halted," *New York Times*, January 28, 1967. <https://www.nytimes.com/1967/01/28/archives/crawford-gordon-dies-at-52-exhead-of-av-roe-canada-director-of.html> (accessed September 20, 2022), 23.
93. "Sir Roy Dobson," *Flight International*, 18 July 1968. <https://www.airfieldresearchgroup.org.uk/community/140282=15580-Sir%20Roy%20Dobson%20CBE.PDF>. (accessed September 20, 2022), 83.
94. Richard Organ, Ron Page, Don Watson, and Les Wilkinson, *Avro Arrow: The Story of the Avro Arrow from its Evolution to its Extinction*, 131.
95. Lawrence Miller, *The Avro Arrow: The Story of the Great Canadian Cold War Combat Jet – In Pictures and Documents*, 76.
96. *Individual Aircraft Record Card, Type Model B-47B, A.A.F. Serial Number 51-2059, Contract Number AF 21-407*. (Washington, D.C.: US Government Printing Office, n.d.), 6, U.S. Air Force Historical Archives, Maxwell AFB, AL.
97. "Scrapping of the B-47 Stratojet Fleet," *Airplane Boneyards*, 2022. <https://airplaneboneyards.com/davis-monthan-afb-amarg-airplane-boneyard.htm> (accessed September 18, 2022).
98. The remaining Iroquois engines are X116, owned by a private collector in Fort St. Johns, British Columbia and X117, which is owned by the Canadian Aviation and Space Museum, Ottawa, Ontario.
99. Gilbert J. Hunt, Letter to the Canadian Warplane Heritage Museum Board of Directors, Mount Hope, Ontario, dated January 15, 1997, n.p., Canadian Warplane Heritage Museum, Mount Hope, Ontario.
100. Palmiro Campagna, *The Avro Arrow: For the Record*, 185-188.

Christian Arzberger—Monument Man: Honoring the Fallen



Christian Arzberger (center) points to display board highlighting information about the bomber crashes near Strallegg, Austria during commemorative ceremony in 2015 at Strallegg. To his left is Royal Air Force Lieutenant Colonel Andrew James and behind him is Tech Sergeant Lance Tessler, USAF. (Photo provided by Christian Arzberger.)

Fred H. Allison

A flight of B-24H bombers of the 716th Squadron of the 449th Bombardment Group, 15th Air Force roared out of Grottaglie air base in southern Italy, bound for Regensburg, Germany. Their target was a Messerschmitt factory. Joining in a large formation with other bombers, the six bombers climbed to 25,000 feet to get above a solid layer of clouds.

Over Regensburg, the clouds remained solid below and obscured their target. The bombers diverted to a secondary target in Austria. In one of the bombers named, “Stinky the B.T.O. [Big Time Operator]”, the top turret gunner and flight engineer, Staff Sergeant Loyd D. Lewis, strained to see out the turret glass. The vapor clouds from contrails and the bright afternoon sun obscured his visibility. To his distant right he saw an ominous sight: German fighter aircraft diving down into the clouds. Through the intercom, he warned the other crewmen. That was the last thing he remembered. German fighters, Bf 109 Messerschmitts, and FW 190 Focke-Wulfs, attacked. One of their shells hit Lewis, wounding and knocking him unconscious. Two of the 716th bombers went down. One was “Pistol Packin’ Mama.” The entire 10-man crew bailed out and they all survived. Stinky the BTO was the other bomber that went down. Its crew was not so fortunate.

Lewis woke up in a German hospital. He was not sure how he got out of the plane. He suspected that another crewman, Second Lieutenant Harold P. Quisno, was responsible. While the plane was spiraling down, Quisno had pulled the bleeding and unconscious Lewis out of the top turret, got his parachute on him and then dumped him out the bomb bay. While this heroic action might have saved Lewis, it cost Quisno his own life. He evidently did not have time to bail out himself. Two others also perished, the bombardier: Second Lieutenant Nicholas D. Lannin, and the nose gunner, Staff Sergeant Elmer D. Howell. The other seven crewmen survived, were captured, and spent the rest of the war as prisoners. Stinky spiraled down and smashed into the Austrian countryside near the village of Wenigzell, Austria.*

In 2010, a plaque that listed Stinky’s crew, mounted on a memorial stone was dedicated in an impressive ceremony at the same Austrian village, Wenigzell, near where the bomber had crashed. Credit for this commemoration, and what would eventually be six other markers, goes to Austrian-native, Christian Arzberger. Arzberger is an automotive engineer by trade, but by passionate interest, he is a researcher of the air battles and crashes that occurred in eastern Austria, in his home province of Styria. Other Austrian citizens have erected four memorials for downed World War II Allied bombers. Arzberger, however, more than anyone else, has consistently been a driving force in the effort to commemorate, mark and remember, the Allied crewmen that died, and to mark the crash sites of their aircraft.

* Donna Trapp, Facebook post, October 25, 2021. The author thanks her for her very helpful post.



(Above & right) The plaque and monument at Ratten, Austria that lists the KIA and the survivors of a 301st Bomb Group B-17 shot down and crashed on July 26, 1944. (Photos provided by Christian Arzberger.)



This region saw hundreds of American and British aircraft fly over as they winged north from their Italian bases to hit targets in Germany or Austria. German fighter pilots ambushed bomber formations here both going to, and from, their targets. Indeed, it is estimated that 553 American aircraft and 31 Royal Air Force aircraft went down in Austria during the war.*

Whenever a bomber crashed, the first order of business was tracking down the crewmen who survived and turning them over to German authorities. Next, German troops searched the wreckage to obtain intelligence. Then, they scavenged the wreckage removing metal and electronics to find anything that might be used by their own war industry. The remains of the airmen who died were recovered and buried in the nearest town or village cemetery. When all was done, only small fragments of what was once a mighty bomber remained at the crash site.

When a boy of 10 years, Arzberger learned that seven American flyers were buried in the cemetery in his hometown, Sankt Jakob im Walde in the province of Styria. He was fascinated. He asked his schoolmates to interview their parents. He began to get tidbits of information. He interviewed one farmer who said a plane had crashed in the woods close by, but otherwise gave little information. Arzberger suspects that at that time, the mid-1970s, people were still traumatized by the death and destruction of the

war. Not so much from the bombing, as this was a rural area and there were few targets to bomb, rather from the heavy fighting between Germans and Russians in the last months of the war. Indeed, the fighting in and around Styria was some of the most brutal of the war. The follow-on Soviet occupation was additionally traumatic. The area saw extensive death, destruction, rape, and pillage.

Later, after completing college, Arzberger started his career as an automotive engineer in nearby, Graz, Austria. His interest in the aircraft crashes was reignited when the Allied nations (U.S., Britain and France) in 2005, sent representatives to Austria to celebrate 60 years of peace. They were held at local soldiers' cemetery.

He started researching the air battles over Austria again. He found a document that listed the names of American airmen killed and buried in the local cemetery. These were men from two B-17 Flying Fortresses of the 301st Bomb Group that were shot down on July 26, 1944 and crashed within a mile of each other and very close to his hometown. Further research revealed that an additional nine B-17s of that group went down the same day in the same area. Arzberger eventually was able to find records on all the downed Fortresses. He determined who was in each crew and located the crash sites. With a metal detector, he verified the crash sites by finding small metal fragments that remained.

With the existence of soldiers' cemeteries in the towns and villages throughout Styria that hold the remains of an international assortment of soldiers, Arzberger thought it would be appropriate to honor the Allied airmen that had been killed. He approached the mayor and the chairman of the local veteran's organization of his hometown about the idea. They agreed that such a memorial was appropriate.

In 2009, his first memorial was dedicated in his hometown of Sankt Jakob im Walde. It honored the two B-17 crews of the 301st Bomb Group, that went down closest to this village. A memorial was dedicated and a bronze plaque listing the names of the crewmen of each bomber were listed. It was tastefully done, a meaningful, and honoring

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* Christian Arzberger e-mail to author, Sept. 12, 2022.



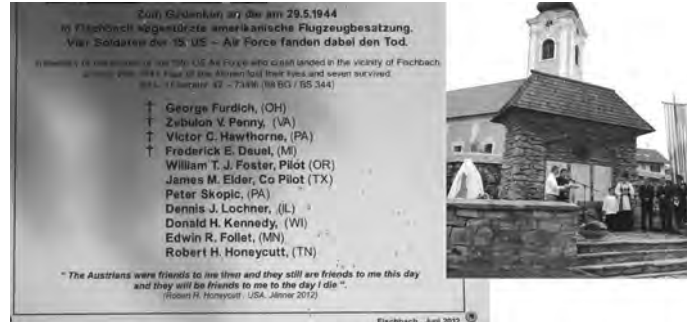
Christian Arzberger at the monument dedicated in 2022 to members of two B-17s shot down on July 26, 1944. This monument is at St. Jakob im Walde, Austria.

event. Bands played and about 1,000 locals and city officials attended. The U.S. Embassy sent representatives, which included military members of the embassy staff.

The memorial marker was unveiled by Bill Brainard, the radio operator on one of the Fortresses that had gone down. He was one of five survivors of that aircraft. Arzberger had contacted Brainard as he did his research. Brainard was most interested in what Arzberger had discovered. Brainard had written his memoirs but did not know where his bomber had crashed. Arzberger was able to provide that information. He also advised Brainard of the upcoming memorial dedication service and invited him to attend. Brainard, 87 at the time, deferred, saying he did not think he could make a trip from Florida to Austria. Four weeks later, he was there, having traveled with the niece and her husband of his B-17's co-pilot, Kenneth B. Kai-Kee who had been killed in the crash.

This memorial plaque was enlarged and beautified in 2022. Another ceremony was held with local citizens and officials, families of crewmen, and representatives of the U.S. Embassy in Vienna. A comment from Bill Brainard was added to the plaque: "Henceforth, let us be friends." A star was cut out from an artifact of the B-17 flown by Lieutenant Robert J. McManaman to symbolize the states from which the crewmen hailed. The star was presented to Colonel Erik Bauer, U.S. Army, an embassy official. Bauer placed the star on his office wall. The older plaque, from the 2009 ceremony was mounted on a stone and placed at the actual crash site of one of the B-17s.

The people in other towns were unaware of the bomber crashes nearby and were quite interested. Organizing the subsequent memorials followed the same pattern as the first. Local mayors and officials of the towns closest to the crash sites were briefed on the crashes. They all agreed that memorials would be appropriate. Invitations to veterans' organizations, officials, musical groups (to play Taps), the U.S. Embassy and religious leaders were sent. Memorials and plaques were created and dedicated. Additionally, Arzberger created appealing message boards that dis-



Monument and service at Fischbach, Austria in 2012. Commemorating the crew of a 98th Bomb Group B-24. Note the poignant quote of one of the American crew members that memorializes the kind treatment he received from Austrians.

played information and photos. He also organized displays of artifacts found at the crash sites. In the seven ceremonies, that he organized and led, nine bomber crews were commemorated.

Austrians enthusiastically welcomed the families of the honored airmen. Austrians have traditionally been interested in America and feel a connection to the U.S. This, by the way, was evident even during the war. This author has found little evidence that downed airmen, when captured in Austria, suffered little ill-treatment from Austrians in the Styrian region. Indeed, in some cases they were treated very well to include being given plenty of food and comfortable resting places until they were turned over to the German military.

Impressive examples of Austrian citizens' goodwill toward American flyers occurred in Graz, Austria, the capital



Memorial dedication at Wenigzell, Austria in 2010. U.S. Air Force representative, Senior Master Sergeant Judy Medeiros stands with Donna Trapp, the daughter of aircrewman Loyd D. Lewis who survived the crash of Stinky the BTO and whose name is shown on the plaque. (Photo provided by Christian Arzberger.)



A recent commemorative, this in Poellau, Austria for three downed bomber crews. The driving force behind this commemorative was a retired general officer, Rainer Karasek, of the Austrian military. Arzberger provided research assistance for the memorial. The photo depicts the elaborate and impressive ceremony attended by Austrian officials with representatives of the U.S. military present. (Photo provided by Christian Arzberger.)

of Styria, and Austria's second-largest city. It was bombed 57 times during the war and 2,000 civilians died as a result. Nazis in Graz lynched three members of a downed bomber in 1945. Instead of celebrating the lynching as "just deserves," citizens responded differently. Just months later, they erected a monument to honor the three dead airmen. The monument still stands in Graz and has recently been upgraded.

Police officers in Graz had also captured another crew member. Nazi officials had demanded that all captured airmen be executed. Two of the policemen, Mr. Ernst Strohrriegel and Mr. Franz Turber, however, took the airman to a river after dark, fired their guns to simulate an execution and pointed to a way of escape. He did escape, he survived the war and returned home to the U.S. The Nazis who had executed the three American airmen, later faced a war tribunal and were hung.

The families of U.S. crewmen (and in some cases the veterans themselves) often attended the commemorative ceremonies. They felt deeply honored, surprised by the Austrians' hospitality and friendliness, and were thankful to the Austrians for honoring their kin. The events were overwhelmingly positive, which proved inspirational and



This is the 1945 memorial that stands in Graz, Austria to three American airmen captured and lynched by a contingent of Nazis in Graz after their bomber was shot down. (Photo provided by Christian Arzberger.)

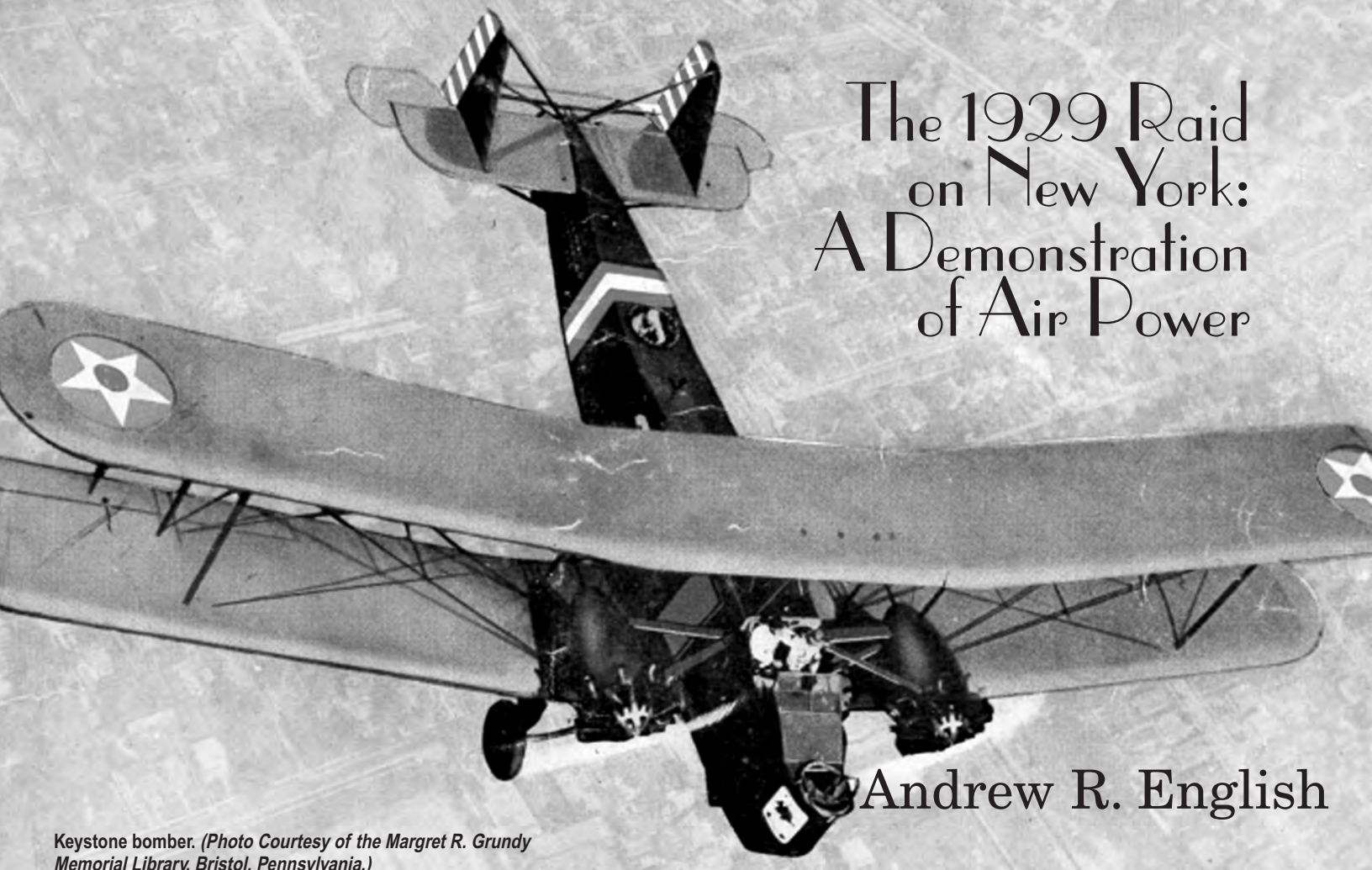
facilitated reconciliation between the two former enemy nations.

The third memorial, held in 2010, was for the crew of Stinky the BTO, the bomber mentioned at the beginning. The memorial was held in the Styrian village of Wenigzell near the crash site. Again, there was an impressive and well-attended ceremony. Donna Trapp, the daughter of Loyd Lewis, whose story of near-miraculous survival was told above, traveled to Austria for the ceremony. She did the unveiling of the monument at the site where her father's B-24 crashed. The four other memorials that Arzberger initiated, coordinated for, and supported with his research, occurred at the following locations in the years shown: Fischbach, Austria, 2012, Ratten, Austria, 2013, Strallegg, Austria, 2015, Bad Wimsbach-Neydharting, Austria, 2017. Arzberger continues to provide research support for other memorial projects in distant Austrian locales, such as one recently dedicated at Poellau, Austria.

Arzberger continues his investigations and research. He is at work on his eighth memorial project, to be done at Rettenegg. He is in contact with the pilot's daughter and her son who plan to attend the service. He has conducted deep research on an additional 20 crash sites and preliminary research on many more. There has been a total of 11 monuments to downed bombers' crews in Styria. Arzberger's and others' work is a truly commendable effort that honors valor, bravery, and service regardless of national affiliation. It speaks to an admirable spirit of peace, forgiveness and reconciliation.

Perhaps it was best said by American Robert H. Honeycutt, a crewman on a 98th Bomb Group B-24 that went down near Fischbach in 1944: "The Austrians were friends to me then and they still are friends to me to this day and will be friends to me to the day I die." This is embossed on the plaque that memorialized Honeycutt's crew in Fischbach in 2012. ■

This article is based on emails to the author from Christian Arzberger dated Aug. 17-18, 2022; Sept. 28, 2022, a video interview dated Sept. 9, 2022. In addition there have been numerous emails between this author and Christian over the past year in which he has assisted the author's research on the 15th Air Force, 449th Bomb Group. E-mails and interview notes remain in the possession of the author. The author sincerely thanks Christian Arzberger for his dedication to this work of goodwill, and his support of the author's research.



The 1929 Raid on New York: A Demonstration of Air Power

Andrew R. English

Keystone bomber. (Photo Courtesy of the Margret R. Grundy Memorial Library, Bristol, Pennsylvania.)

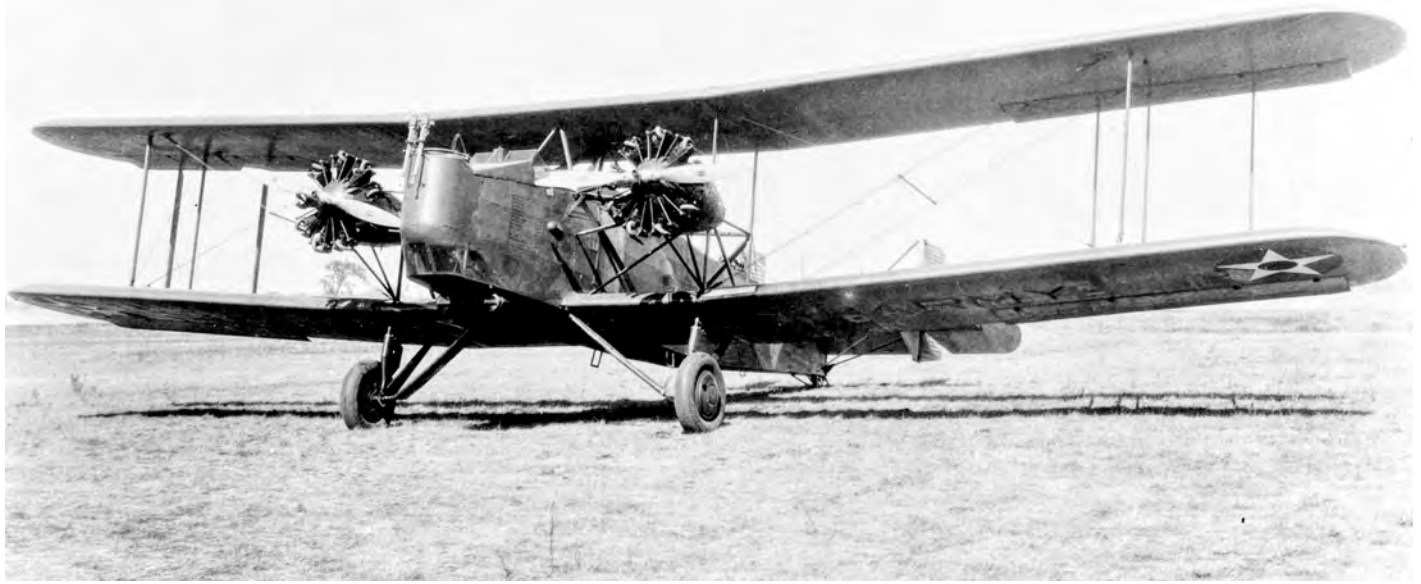
Range is to strategy more than force
T. E. Lawrence (1929)

Lawrence's remark refers to irregular warfare in the Arabian Desert in World War I, but it also applies to other aspects of warfare, especially with the right mixture of leaders, equipment, circumstances, and opportunities. He wrote those lines as a draft article to another veteran of the world war, Captain Basil Liddell Hart, who was then compiling a section on "Strategy" for the thirteenth edition of the *Encyclopedia Britannica*. That volume was appropriately published in 1929 as that year, American airmen dramatically proved the point made by T. E. Lawrence. However, that range was not demonstrated in the wastes of far-off Arabia, but over the towering man-made mountains and valleys of New York City.¹ H.G. Wells wrote of New York: "To Europe she was America, and to America she was the gateway to the world." His 1908 account *The War in the Air*, described an enemy attack on the greatest metropolis of the United States. He remarked "for many generations New York had taken no heed of war, save as a thing that happened far away," but in this sensational then-futuristic account, New York would be forced to pay heed.²

This brief but stark account of a great city under aerial bombardment depicted hostile airships raining bombs on the avenues, great buildings, "colossal bridges," and surging crowds below, but it also described American "aeroplanes" engaged in aerial combat over the city. Wells described an American craft as one with "double up-tilted wings and the screw (propeller) ahead, and the men were in a boat-like body netted over. From this very light long body, magazine guns projected on either side."³ Although fictitious, this account predicted aerial combat only a few short years in the future, a time when the confident striving of the Edwardian age, gave way to the relentlessness of total, industrial war. Wells described an aerial craft which compared to another real aircraft flown by American flyers two decades later, but in that machine, men would come to the skies over Manhattan not as defenders, but as aggressors, to demonstrate the realities of air power.

A Symbol of American Airpower

In mid-1929, American newspaper magnate William Randolph Hearst utilized his chain of dailies and journals to promote increased funding for more and improved American aircraft to defend U.S. cities against a potential attack by enemy bombers and dirigibles armed with, among their mixed ordnance loads, bombs filled with mustard gas. American defenses against an aerial assault were viewed as "totally inadequate, and great cities like New York, Washington, San



Keystone XLB-7 with twin guns forward. (Photo courtesy of the National Museum of the U.S. Air Force, Dayton, Ohio.)

Francisco, and Boston would be powerless before a modern invader.⁴ Twenty-four hours later, this point would be proven in the skies above New York. The instrument was a biplane; a twin tailed bomber designated the LB-7 (Light Bomber) manufactured by the Keystone Aircraft Corporation of Bristol, Pennsylvania. This was something of a misnomer as the “B” was to stand for a heavy bomber yet these were still in development (the B-2 Curtiss “Condor”), and the LB-7 was the heaviest bomber in front line use by the Army Air Corps at that time.⁵ The press was fascinated with the large Keystone bombers. The *Washington Evening Star* referred to these “olive-skinned” aircraft as a “gargantuan devil ship, an arsenal ship mighty enough to scatter an army.”⁶ The September 6, 1928 edition of the *Indianapolis Times* identified the bombers as “bulky machines” but that daily also employed a more colorful depiction of these big biplanes when it described them as “yellow-winged, brown-bodied dragon flies of war.”⁷ One pilot compared the “big crate” of the Keystone bombers to the earlier fighters he flew as “like changing from an auto racer to a tractor.”⁸ Referred to as the “Panther” by the manufacturer, the aircrews never used that name and mentioned them and their earlier, similar variants produced by that Pennsylvania company as “Keystone Comedies.”⁹ Yet these biplane bombers would be the test beds for those pilots as they

pushed the boundaries of range, endurance, and strike capabilities for the advance of American military aviation.

The Flight of the “Panther”

The Keystone factory was, in terms of machinists and transport of heavy equipment in a near ideal location, situated north of Philadelphia along the Delaware River. By 1928 Keystone expanded after acquiring the Loening Aeronautical Engineering Corporation, a firm that specialized in producing amphibian flying boats and pontoon aircraft.¹⁰ The LB-7 biplane bomber was an incremental step forward for Army long range bombardment aircraft. Equipped with two Pratt & Whitney Hornet air-cooled R-1690-3 radial engines each of 525 horsepower, the aircraft was also fitted with twin tails instead of the single vertical stabilizer as seen on the earlier army bombers also produced at the Keystone plant on the Delaware River.¹¹ The LB-7 was a move toward a more robust aircraft design as this bomber variant was fashioned out of a new all-metal tubular airframe.¹² Although the Panther was fabricated with new airframe construction methods, and more powerful engines, the wings and fuselage retained the intricate “fairly-like” lattice work, and fabric covering of cotton cloth (before 1914 the U.S. imported Irish linen for the surfaces) covered with the ubiquitous waterproof coating of aircraft “dope.”¹³ The dope was painted on, usually in five coatings of acetate of cellulose, followed by two coats of cellulose nitrate. All of these were typically blended with tetrachloroethane, a substance generally utilized to tighten the fabric into a smooth taut membrane over the aircraft surfaces.¹⁴ Resembling the profiles of older aircraft, the LB-6s and sister LB-7s were also the first Army bombers fitted with air-cooled engines.¹⁵

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LB-7 single forward gun mount, 9th Bomb Squadron. (Photo courtesy of the Margaret R. Gundy Memorial Library, Bristol, Pennsylvania.)

Fitted with a maximum of five Browning .30 caliber machine guns, the bomber was well-armed for the time. Although the guns were not side mounted in the canvass covered fuselage, the bomber was (without the netting and single airscrew) strangely similar to Welles imaginary machines of the early century.¹⁶ A close formation of LB-7s, was expected to provide intense covering fire, enough to make attacks by enemy pursuit aircraft “an exceedingly unhealthy business.”¹⁷ The forward aerial gunner’s position was a reason a third engine was not mounted as this would require fixed forward guns. The fixed guns firing through a synchronized propeller would require the less agile bomber to maneuver when an attacking enemy aircraft dove in. A gunner in the nose could quickly respond to an oncoming pursuit aircraft “with guns revolving around on a swivel...able to rake the sky in front of him left and right, up and down.”¹⁸

The tubular construction and new engines gave the Panther an altitude advantage over earlier American bombers. The LB-7 could climb to a ceiling of 14,000 feet with a full bomb load, double the ceiling of earlier Keystone variants, and could reach a top speed of 128 miles per hour, although the pilots usually throttled back to a cruising speed of between 95 and 100 mph.¹⁹ With an impressive wing span of 78 feet and a bomb load of 2000 pounds, the “big biplane” carried enough ordnance to “cut off a city from outside communication or sink a battleship.”²⁰ As Army bombers had already proven their ability to sink obsolete

and surplus battleships in aerial tests off the Virginia Capes earlier in the decade, a test against a major city was next in order.

The Bomber Boys

The pilots of the Army Air Corps were a young and determined lot. The Air Corps Tactical School was first established at Langley Field in Hampton, Virginia, a facility which retained its lineage with an earlier Army function as officers rode and housed the military horses at the base stables. The pilots of the prop and wing mounts were expected to learn to ride the flesh and blood stallions as part of their military training. Agility on the galloping steeds would undoubtedly encourage handling skills in the air, and would prevent a sharp and immediate separation from the old ground-tethered peacetime army.²¹ They flew, developed tactics, innovated, and improvised. Even at their mess tables, flying and aerial strategy was always buzzing around. Years later Air Force, Major General Harold George remembering those comrades and those times, remarked “we were highly enthusiastic.” Aviation was their bloodstream. Their motto was *Proficimus More Irretenti*, “We make progress unhindered by custom.”²² These horseback riding pilots continuously sought ways to test the margins of air power. Innovations were not limited to the aircraft. The pilots tested new equipment for high altitude flying, with the standard issue “5A” goggles remade into a double eye piece, electrically heated variant, heated gloves, and electrically warmed oxygen for the masks, these proved useful endurance enhancing adaptations for pilots flying in their open cockpit biplanes, sometimes in brutal temperatures 60-80 degrees below zero at higher altitudes.²³

The Army Air Corps began preparations after dawn on May 10, 1929 when 1st Lieutenant Odas Moon piloted one of three LB-7 bombers of the 11th Bombardment Group from Rockwell Field, at Coronado, California to Wright Field, at Dayton, Ohio in preparation for the biggest aerial exercise the U.S. Army had staged on the continent.²⁴ The aircraft were components of the “Gigantic war games in Ohio,” and Moon and his colleagues were part of the “largest peacetime concentration of Air Forces ever attempted by any nation.”²⁵ Led by the dynamic, larger-than-life Lt. Moon, the bomber crew would soon fly to set a new standard for air power. Moon had begun his army career flying along the U.S. southern border after WWI, would bomb the old battleships *New Jersey* and *Virginia* during air tests off the Virginia Capes in 1923, and would go on to other aerial achievements.²⁶ In 1924, during the run up to joint war games off the Caribbean coast of Panama, Moon claimed he happened upon the carrier *U.S.S. Langley* and “bombed” the Navy’s only flattop with a volley of three tomatoes he was carrying in the cockpit of his aircraft.²⁷ Moon was also responsible for training the most famous American airmen of the age in 1925.²⁸ The veteran pilot was among the cadre of skilled airmen who trained a young Charles A. Lindberg at Kelly Field in the skies above San Antonio, Texas prior to his famous Atlantic crossing two years later.²⁹



LB-7. (Photo courtesy of the National Museum of the U.S. Air Force, Dayton, Ohio.)

Fog and Mud

The LB-7 was the first Army Air Corps bomber to receive aerial refueling equipment. With additional fuel tanks fitted forward under the nose gunner's position and the receiving equipment mounted in the dorsal gunner's position, the Keystone would receive fuel from an aerial tanker flying overhead.³⁰ The tanker was a modified Douglas C-1 single engine biplane, the 'Old Number 1,' the first of the two aerial tankers remembered for mid-air refueling missions supporting the record setting endurance flight of the Air Corps tri-motor Fokker "Question Mark," in January of 1929.³¹ The C-1 would fly above the receiving aircraft and trail a hose below from a hole cut in the floor of the fuselage. The method referred to as "dangle-and-grab," called for a careful capture of the hose by the refueler in the receiving aircraft and the controlled playing out of the hose from the Douglas above.³² The "Question Mark," commanded by Major Carl Spatz, broke the previous record of air endurance set by the ill-fated French airship *Dixmude*, and Spatz reported to his senior commanders in the Air Corps, a change was now possible for the bombers, the "slowest" arm of the Air Corps. Spatz noted "In view of the lessons learned, it now is possible to take off with the same degree of safety with almost twice the bomb load and a very light gasoline load, and refuel in the air."³³

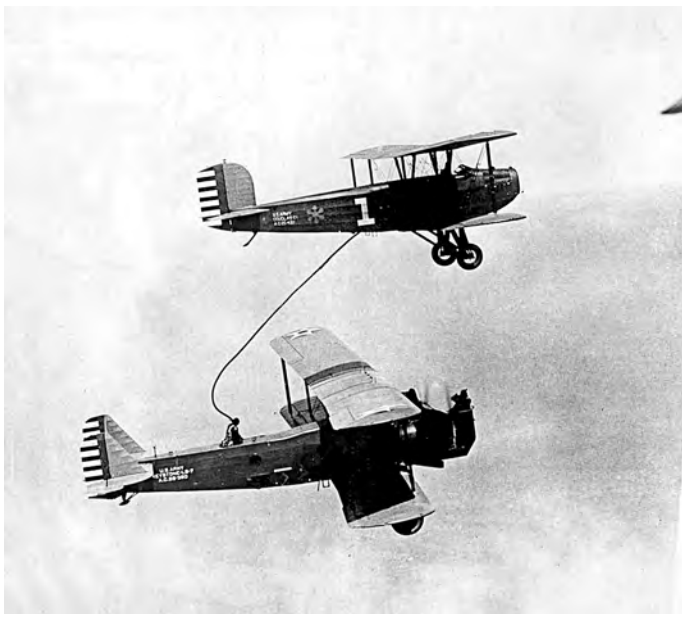
By May 1929, the Keystone had been modified to take on the fuel while in flight. The standard fuel tank on a LB-7 was 350 gallons but with two extra fuel tanks added, an additional 300-gallons was now available to take onboard. A forty-gallon auxiliary oil tank took up the forward gunner's cockpit to provide oil to either engine via a pump beneath the pilots' feet, and a separate gasoline wobble pump was fitted to move the fuel between the wing tanks. A three-inch-wide intake pipe was placed behind the rear gunner's position and a small round celluloid window was

fitted atop the fuselage nearby to help the flyer manning the improved refueling position, monitor the fuel gauges. The pilots were assisted with special sight gauges with night lighting and an additional light was attached adjacent to the rear gunner's position to aid night refueling. Drift lines were painted on the lower front celluloid panels to assist the pilots with the delicate refueling maneuvers.³⁴ The Keystone was ready for the test.

At 1 p.m. on May 21, 1929 the Panther was aloft to test another theory of air power, inflight refueling of a combat aircraft.³⁵ The aircraft encountered icy weather conditions over the Allegheny Mountains and the "Old No.1" with the escorting tri-motor transport, were forced to make an emergency landing at Uniontown, Pennsylvania where it became stuck in the mud on the new air strip.³⁶ Shortly thereafter, the LB-7 circled over Burgess Airfield at Uniontown for half an hour when the bomber crew received word that the refueling plane and radio-equipped tri-motor were grounded. The Panther forged on alone into the deteriorating weather and Lt Moon flew by magnetic compass until he picked up the Delaware River beneath the blanket of fog and turned toward his objective-New York City.³⁷

Air Raid-New York

At 9:30 p.m. on May 21, 1929 the single LB-7 "bombed" with three flares to represent 2000 pounds of ordnance over Fort Jay on Governors Island in New York in a simulated attack.³⁸ Anti-Aircraft gunners stood by their batteries ready for the order to fire on the assailant, but the bomber was invisible to the defenders. The officers at Fort Jay remarked the bombing of their guns by the lone aircraft as "astonishingly accurate," a feat made even more surprising as the officers at the fortification could not see the bomber, but could only hear its engines as it droned defiantly overhead.³⁹ Colonel Truman O. Murphy, the duty



LB-7 refuels over Dayton Ohio.

officer at Fort Jay, acknowledged any attempt to bring down the attacker was futile, adding that they heard the motors overhead at about 9:25 (p.m.) but the fog hid the bomber from the ground observers.⁴⁰ Army ground anti-aircraft weapons consisted of the 3-inch gun capable of firing a fifteen pound shell fused for contact or shrapnel burst to an altitude of 10,000 feet (rate of fire up to 28 rounds per minute) as well as .50 and .30 caliber machine guns mounted on tripods or in quad mounts to confront the lower altitude aerial attackers.⁴¹ Although the 3-inch mobile ordnance was considered the “backbone” of American Anti-Aircraft ground defenses, it was not able to threaten an aerial attacker that night.⁴² Colonel Murphy remarked that Fort Jay lacked searchlights for the anti-aircraft guns and as such the bomber was invisible; a heard but unseen attacker.⁴³

The following evening the bomber (after an overnight stop at Bolling Field, Washington, D.C.) flew over New York again, this time in the pre-dusk light as it refueled from an accompanying aircraft dubbed by the press as “the Army’s nursing bottle of the Air.” The aerial refueling on May 22 was an event in itself. Thousands watched as the refueling plane made five contacts with the bomber. Lt Moon was at the controls of the LB-7 and Captain Ross Hoyt guided the refueling plane (“Old No. 1”) ahead and above the Keystone as radio engineer O. B. Hansen of NBC radio give a live broadcast of the scene from an escorting Army Fokker trimotor observation aircraft. Hansen described the scene with a Navy blimp loitering in the distance over the harbor narrows and two civilian monoplanes closing in for photographs, as the bomber received fuel from the fifty foot long metal-lined hose as it dangled down from the “nursing bottle.” The pilots maneuvered the two aircraft “daintily” with the bomber looking like an “angered rhinoceros” compared to a little red civilian monoplane flying close to take photos.⁴⁴ The refueling was reported in one Connecticut newspaper as “an exhibition of expert airmanship” and described

how the aerial tanker refueled the bomber, or the “fighting ship,” with an orchestrated feat of skill as they were “rising and falling in perfect unison.”⁴⁵ Only one contact was an actual refueling with the last four tetherings for demonstration purposes only.⁴⁶ After the final refueling (each contact lasted about three minutes), the Douglas air tanker and Keystone bomber turned and flew above the Woolworth Building before flying to Mitchell Field on Long Island to mark the end of their portion of the exercise.⁴⁷ Despite the success with air tankers, the U.S. Army Air Corps halted work on aerial refueling for another twelve years until the realities of another global war and the needs for transcontinental and transoceanic ranges became apparent.⁴⁸

The flights were seen as a warning by some. One Washington D.C. newspaper remarked “figuratively speaking New York City is a jumbled mass of ruins...a heap of debris.”⁴⁹ From Chicago, *The Daily Worker* reported the event with a typical slant. Between the routine proclamations about the Soviet Union including praise for the film “Moscow Today” and the usual Marxist urgings about confrontation with the bourgeoisie (“the proletariat is really revolutionary”), this newspaper made mention that Lt Moon was “content to perform aerial antics for New Yorkers instead of showing them how easily he could wipe them off the map.”⁵⁰

The flight of the Panther over New York in late May 1929 demonstrated another factor of air power not fully appreciated at the time. The bomber had flown from a distant shore, bombed a fog shrouded metropolis on another coast, and recovered at an alternative location over two thousand five hundred miles from its home base. The proponents of American air power had demonstrated, the combat aircraft had continental reach. Lt Moon was clear about the intention of the exercise: “We have demonstrated that with proper equipment, trained personnel, and adequate navigation and radio facilities, raiding bombardment squadrons can go anywhere, at any time, under weather conditions.”⁵¹ The Army Air Corps dubbed the mission “a significant feat” and praised the bomber force as it “provided the Army Commander with long range artillery having great destructive power and reasonable degree of accuracy.”⁵²

Across the Atlantic, British newspapers carried the story. In London, *The Daily News* reported “A large part of New York is to-day-in theory-a heap of ruins following last night’s exploit by an Army aeroplane...”⁵³ The London newspaper noted the flight was, more than “an excellent personal achievement by the pilot,” that bomber portrayed a stark realism as it “demonstrated that fog and thick weather are no longer a defence against raiders.”⁵⁴

Defense Changes Wrought by Air Power

The raid on New York and Aerial War Games inspired changes in the American military. Anti-aircraft batteries under the Coastal Artillery were provided with sea coast searchlights, but these were designed to illuminate enemy surface ships not hostile aircraft. New, mobile searchlights of a billion-candle power was provided to the army coastal units and when paired with wheel-mounted four-horned



Lt Odas Moon (Left), pilot and Lt Eugene Eubank, co-pilot, immediately before the initial flight to New York. (Photo from Author's collection.)

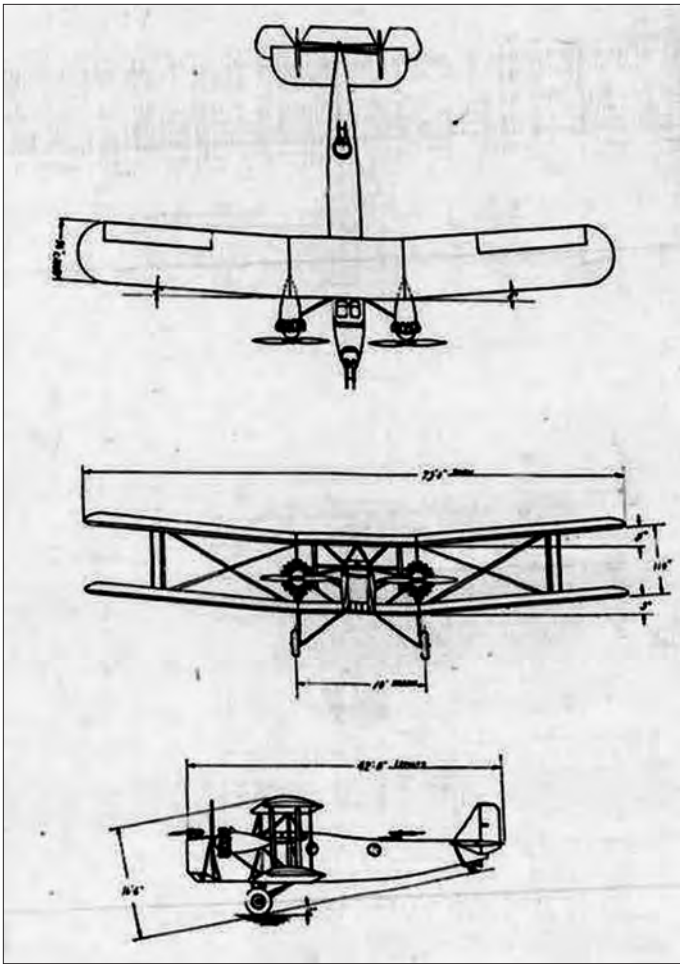
“sound locators,” the batteries were no longer trapped in darkness. Two observers fitted with stethoscope-like rubber ear pieces turned the square-mouthed horns until they detected the sounds of aircraft motors. The large horns allowed the operators to hear the approaching aircraft as the “propeller swish can be heard for miles even, when the airplane motor is idling.” When located within range of the battery, the searchlights would suddenly switch on and with angle and azimuth updates provided by the sound men, the beam would lock on the aircraft ready for the guns to open fire.⁵⁵

The gunners were aided by an automatic director, “an ingenious electrical device” keeping the guns trained on the incoming aircraft with the assistance of synchronized motors. An automatic 37-mm cannon provided anti-aircraft batteries with an almost constant stream of shells at around 90 rounds a minute. Fitted with sensitive fuses, these high explosive shells detonated upon contact with “so light a material as airplane wing fabric.” For protection against low-flying enemy aircraft, quad-mounted .50 caliber machine guns could hurl up to 500 rounds a minute of “hard-hitting, armor-piercing projectiles skyward.”⁵⁶

The bomber was the new and menacing figure of military power of the era. One Midwestern newspaper remarked “The bombing plane is regarded as potentially the most destructive agent of war, especially as to munitions and morale.” Each Panther bomber was estimated to cost \$35,000 without military (“battle equipment”) devices but this cost would soon climb to almost double the cost after the New York raid.⁵⁷ A new “device” reportedly capable of dropping a bomb down the funnel of an enemy battleship from an altitude of 1500 feet was purchased by the War Department for the Army Air Corps in September 1929. The new bomb sights were a major technical achievement as each was designed to take the speed of the aircraft, warship, ground speed, drift, and air pockets into consideration. The costs of this accuracy were staggering as the precisely calibrated bomb sight was created for an amazing \$28,000 each.⁵⁸



The Bomber and Refueler crews, 1929 Standing (L to R) (Bomber) Mr. Bradley Jones, Navigator; Lt Chas. T. Skow, Radio Operator; Lt. Odas Moon, Pilot; Lt. Eugene Eubank, Assistant Pilot; Lt. J. B. Richter, Refueler. Seated, (L to R) Refuelling plane, Sgt. Bremer; Capt. Ross G. Hoyt; Sgt. Simons. (Photo from Author's collection.)



Keystone LB-7 Bomber. (Image from the Author's collection.)

The following year, a Keystone bomber flying from Rockwell Field served as an aerial command post for chief of the Air Corps Major General James E. Fechet. Through radio “coaxed out of the heavens,” the general directed a squadron of eighteen Boeing fighters from a range of ten miles away as they flew to altitude in a simulated attack on mock enemy warplanes.⁵⁹ Other inventions of this era added other dimensions to accuracy, command and control, range, and firepower. In December 1929, an Army tri-motor transport flew from Dayton, Ohio to northern Virginia, a distance of over 350 miles without human intervention. An auto pilot adapted from navy gyroscopes, was developed by Elmer Sperry and his son to fly the aircraft to a landing at Washington D.C. Although one of the cooling fans malfunctioned on the auto pilot over Leesburg, Virginia, the human pilot, Lt. Albert F. Hegenberger, took over from the machine dubbed “Mechanical Mike” to recover at Bolling Field.⁶⁰ Other than the events of this “epochal trip,” that newspaper article also noted with uncanny accuracy how other similar machine pilots could be utilized in an air offensive of the future. “Using this device it may be possible for the Army bomber of the future to be a small two-man plane controlling by radio a large fleet of torpedo planes.” Although the torpedo plane was actually an unmanned flying bomb, the implications of more “Mechanical Mikes” at the



Hollywood actresses Winnie Lightner and Irene Delroy pose for the photographer while Lt William C. Kingsbury (later Major General) of the 11th Bomb Squadron looks down from the forward gunner's position on an LB-7. (Photo from the William R. Stein Collection, @ thejivebombers.com.)

controls of each unit of flying ordnance were clear. With an estimated range in excess of one hundred miles, each guided unmanned aircraft was expected to climb “to a predetermined height, then automatically leveled off for the flight were automatically guided with a high degree of precision, and when any number of predetermined miles had been transversed, suddenly turned and flew downwards. Each carried an enormous charge of TNT with sensitive contact fuses, enough in fact, to blow up a fortress or ammunition house.”⁶¹

The fabric covered biplane bombers piloted by the daring men of the “Bomber Mafia” remained in front line service for only a few years after the raid on New York. By the early 1930s all-metal, single wing, multi-engine bombers (with retractable landing gear) became a mainstay of airpower. Later that decade, the Boeing B-17 took the name once utilized by the press to describe the earlier Keystone Bombers, the “Flying Fortress.”⁶² The press remarked even before the raid on New York “with increased speed, extended cruising range, greater load capacity and improved bombing sights, the modern bomber is a factor to reckon with.”⁶³

Today the spirit of innovation and adaption so prevalent in those days of the Tactical Air School, are being harnessed again to meet the competing strategic requirements of range and force identified by T.E. Lawrence almost a century ago. ■

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MARINE AIR AND THE ORIGINS OF THE EA-6B PROWLER



A U.S. Marine Corps Grumman EA-6A Intruder (BuNo 147865) and a EA-6B-60-GR Prowler (BuNo 160432) of Marine Tactical Electronic Warfare Squadron 2 (VMAQ-2) "Play-boys" in flight. (Source: U.S. Navy - U.S. Navy National Museum of Naval Aviation photo No. 1996.253.7057.004)

Thomas Wildenberg

The EF-111A, the electronic attack version of the F-111A, first entered service in 1981 and remained in service until 1998 when the last of these aircraft was retired. The decision to retire the EF-111A, the only aircraft in the Air Force's inventory capable of providing Joint Suppression of Enemy Air Defenses (JESEAD) stemmed from decisions made by congressionally mandated Commission on Roles and Missions of the Armed Forces in November 1994. The Commission, which was established to eliminate redundancy and waste in the DOD, recommended that further funding for the EF-111A be cut. Christopher C. Kirkham, USN, noted in his excellent study of interservice rivalry, "The shifting of funds combined with the decision by top Air Force officials to retire the EF-111A left little doubt that the [EA-6B] Prowler was intended to be the sole source of Joint Suppression of Enemy Air Defenses (JESEAD) support into the 21st century." A number of factors contributed to the decision to retire the EF-111A in favor of the EA-6B. First and foremost was the issue of operating expenses. Although the F-111s made up nine percent of the aircraft in the Tactical Air Command, it used up twenty-five percent of the Command's maintenance budget. Furthermore, the cost to operate the EF-111A was \$5,500 per flight hour while that for the EA-6B was only \$3,255. Second, was the issue of upgrades. While both aircraft needed new ECM equipment to counter the next generation of SAM systems, the EA-6B's ICAP-II weapons system had a better tactical jamming capability. The EA-6B's four-man crew provided additional operational advantages over the EF-111A's two-man crew. The EA-6B was also equipped to fire the AGM-88 Harm, which the EF-111A was not. Lastly, and not of insignificance, "the Air Force was promoting a concept that stealth aircraft required no outside electronic support to perform their mission, thus no reason existed to maintain the EF-111A."¹

After the last EF-111 was retired in 1998, the EA-6B Prowler became the only aircraft in the U.S. military suited for the JESEAD mission until the EA-18G was introduced in 2009. The development of the EA-6B, which entered service with the U.S. Navy in 1971, evolved directly from the EA-6A, developed by the Marine Corps. The following story lays out the path that led the Marines to develop this highly specialized aircraft.

Marine airmen were some of the first American aviators to take a serious interest in Electronic Warfare. They flew the first electronic warfare mission of the Korean War and provided tactical EW support for the U.S. aircraft throughout the conflict. The experience gained by the members of Marine Composite Squadron 1 during operations in Korea led to a concentrated effort after the fighting stopped to improve the capabilities of Marine aircraft to provide Electronic Countermeasures (ECM) that would disrupt, jam or deceive an enemy's radar or radio signals. This activity resulted in the conversion of the A6-A into a dedicated EW aircraft, the EA-6A, that entered the Marine inventory just as Operation Rollin Thunder was getting under way during the war in Vietnam. The success of the EA-6A "Electric Intruder," enabled the Marines to

persuade the Department of Defense to fund the development and procurement of the EA-6B Prowler, the first U.S. aircraft designed specifically for electronic warfare.

In 1950, the only ECM aircraft in the Marine inventory were two TBM-3Q Avengers assigned to Marine Air Headquarters Squadron 2 (HEDRON-2). The TBM-3Q was a World War II vintage torpedo bomber that had been converted into an ECM platform via the addition of an APR-4 Receiver* and an APA-11 Pulse Analyzer that was used to intercept and classify radar signals. It also had a manually rotated dipole antenna extended from the fuselage belly that was rotated by an operator equipped with a set of earphones. He would listen to signals as he rotated the antenna seeking the audible null that would identify the bearing of the radar signal picked up by the APR-4. This data would be recorded in the flight log in order to plot the radar's approximate location based on the aircraft position at the time the data was recorded. The TBM-3Q was also outfitted with a chute to drop chaff. Although the TBM-3Q could optionally carry the APQ-2 jamming transmitter, air crews needed special permission to operate the jammer to prevent it from interfering with friendly radars. Given its primitive direction finding and jamming capabilities, the Avengers were used mainly for interception and classification of radar signals in order to identify what types of radars were in a general location.²

On July 7, 1950, ten days after the United States entered the war in Korea, the 1st Provisional Marine Brigade was activated in response for a call for American reinforcements from the Far East Command. The Brigade was an air-ground team built around the 5th Marine Regiment and Marine Air Group 33 (MAG-33) assigned to the 1st Marine Aircraft Wing (MAW-1). The air group's first ECM section was formed at K-3 airfield in Pohang, Korea when MSgts. Joe Bouher and Doc Grimes arrived from the United States. The two Marines transferred from the 2nd Marine Air Wing (MAW-2) where they had been serving in the Marine Corps first EW unit, the Airborne Early Warning (AEW) and ECM section of Headquarters Squadron 2 (HEDRON-2), MAW-2, stationed at MCAS Cherry Point, North Carolina. The two men were among the first enlisted ECM operators in the Marine Corps and had been flying in the two TBM-3Q Avengers assigned to the HEDRON-2's ECM section in 1950.³

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TBM-3Q Avenger of attack squadron VA-6A.

Before shipping out, Bouher and Grimes built and tested a rudimentary jammer in response to reports that the North Koreans were beginning to employ radar controlled anti-aircraft guns. Although they had brought this equipment with them, it was never installed in an aircraft or used in action. Shortly after their arrival, an ECM section was established in MAG-33's headquarter squadron using two AD-2Q** Skyraiders acquired from the Navy. The ECM gear on the AD-2Qs consisted of an APR-4 receiver and an APA-11 analyzer; there was no direction-finding equipment. Bouher and Grimes were able to locate two APA-17 Direction Finders, which they installed in the aircraft. Bouher and Grimes, the first USMC ECMOs to fly in combat as aircrew in the AD-2Qs that were used to support initial USMC EW operations in Korea.⁴

In February, 1952 the ECM Section was transferred to Marine Air Control Group's Headquarters Squadron at the K-3 Pohang airfield and reassigned to VMC-1. The change in squadrons coincided with the influx of enlisted aircrews. Unlike the initial cadre of ECMOs, few of the new aircrew were trained as electronic technicians. And while training syllabus was prepared for use by both pilots and ECMOs, the ECMO training was hampered by lack of multi-place aircraft that could be used to provide supervised instruction to the new operators. As there was no room in the AD-2Q for a second ECM operator/trainer, Bouher had to show the new men how to turn on the equipment and to adjust the various dials on the ground hoping they would become familiar with it during a few familiarization flights to become proficient in its use. Since there was no room in the AD-2Q, Bouer was unable to accompany his students and had no way to monitor the trainee's progress. As T. J.

* Equipment nomenclature and Joint Electronics Type Designation System: In non-official references to electronic equipment, the "AN" prefix is often omitted, which will be the practice followed in this paper.

** The AD-2Q was a modified version of the propeller driven AD-2 Skyraider (later redesignated the A-1), which was the Navy's primary attack aircraft in the immediate post WWII era.



F3D-2Q Skyknight of VMCJ-1 in flight, 1962.

O'Brien, a former ECM operator himself noted, "One had to assume that he knew what he was doing and in a hostile environment that was a giant assumption." VMC-1's ECM section desperately needed a training aircraft.⁵

In July the squadron was assigned its first AD-4NL, the winterized version of the AD-4N night attack Skyraider. By then, Bouher and Grimes had gone back to the United States and it was up to TSgt. Dan Georgia, the most experienced electronics technician and ECMO in the squadron, to supervise the transformation of the 3-place AD-4N into a dual position ECM aircraft – an idea he had pitched to the squadron's CO who readily accepted it. Georgia modified the aircraft with the help of the technicians from Marine Aircraft Squadron 17. To make room for the ECM gear in the crew compartment, the ACR-1 and its associated wiring was relocated to the forward compartment. They removed the wing mounted APS-31 radar, the APR-9 homing antenna system, and a crude pulse analyzer that had come with the plane. When they were done, they had created two operation positions within the crew compartment with one operator having an APR-9 receiver and the other operator having an older APR-4. The two positions shared an APR-11 signal analyzer and an APR-17 direction finder that had also been added to the aircraft's ECM suite.

The first combat mission of the reconfigured aircraft, with Capt. Gordon Keller as pilot and Dan Georgia the ECMO, was flown near Wonsan Harbor on November 17, 1952. After the mission, the aircraft was designated RM-1 and became the prototype for all modifications that were to follow. For his efforts in modifying the AD-4NL to allow inflight training in support of 1st MAW combat operations, Sergeant Georgia was awarded the Bronze Star.⁶

By November, VMC-1 was flying one ECM combat mission, on average, and two training missions per day, while conducting an ECM school for new ECMOs: The combat missions were, for the most part, Electronic Intelligence (ELINT) operations to detect, classify and locate enemy radars. A few chaff dropping training missions were also conducted against friendly radars.⁷

The passive ECM missions were flown on prescribed tracks up the East and West coasts of North Korea and

along the DMZ at an altitude of 10,000 feet between two visually located points. Occasionally, an overland flight in and around Pyongyang was also conducted. The ADs carried a 150-gallon centerline drop tank which gave them well over 4 1/2 hours endurance. Navigation and communications were handled by the pilot, while the enlisted ECM operators recorded reference points for line of bearing plots. The ECM operator also recorded signal characteristics (frequency, pulse repetition rate pulse width and sweep rates) of the intercepted radars. After landing the pilot and ECM technician worked together to plot the radar location data and file a post mission report.⁸

Because the majority of ground targets were flown by tactical aircraft during the Korean War, the need to provide ECM jamming did not arise since the main danger to these planes was from visually aimed automatic ground fire. Hence the role of the Marine Air ECM was limited to "ferreting" out the enemy's radars in order to determine their electronic order of battle. As Alfred Price noted in his *U.S. History of Electronic Warfare*, "the Korean war was like a catalyst in a chemical reaction — it sparked off some major advances [in EW]. Nevertheless, it provided the Marines with their first experience in equipping and operating ECM aircraft in combat and demonstrated that Marine Air personnel had the initiative, knowledge, and leadership support to make urgently needed changes to equipment and procedures dictated by wartime needs."⁹

Although no ECM jammers were employed by Marine Corps ECM units during the Korean War, there were those in the Corps' ECM community who were far sighted enough to foresee the need to provide active EMC support for attacking aircraft in light of the proliferation of radar-controlled weapons systems. A number of officers, including Maj. Thomas McDonald (he commanded the first Marine EW section in Korea), and a few senior enlisted men had served with the first EW units in Korea. These experienced airmen were familiar with the modifications they had made to the AD-4Ns during the war. In the late spring of 1955, someone serving in VMC-3 (it may have been Major McDonald) went to the Marine headquarters and suggested that the F3D-2s be converted into an ECM aircraft as a potential replacement for the piston engine AD-5Ns currently in use by all three VMC squadrons.¹⁰

According to the recollections of John Cleveland, an aviation electronics technician and ECM operator who served in VMC-3 and VMCJ-3 from 1954 to 1956, Captain Nobel, the squadrons' aviation office was in charge of the modification effort, that was largely carried out by WO Joe Bouher and MSgt. Doc Grimes. The latter seems to have coordinated the work done at the Overhaul and Repair activity at NAS North Island, which apparently was responsible for the modifications made to the two F3Ds.* The work in transforming the two aircraft moved swiftly during the summer of 1955 as ECM equipment identical to that

* Some sources say the work was allegedly accomplished in a small wooden shed at the far end of the flight line at El Toro. It's possible that each of the two, or possibly three, aircraft were modified simultaneously in two different locals.



A Grumman EA-6A Intruder ECM-aircraft (BuNo 156986) of U.S. Marine Corps composite reconnaissance squadron VMCJ-1 at Da Nang, South Vietnam in June 1970.

used on the AD-4s was installed and tested on the F3D-2s. Col. H Wayne Whitten USMC (Ret.), in his book *Silent Heroes*, described the objective of the Marines involved in modifying the Skyknight:

*One of the goals of the conversion was to significantly improve the active ECM or jamming capability of the AD-5Ns. This meant the Marines had to find suitable systems and components from a variety of sources and develop an integration plan. The selected ECM package included two ALT-2 noise, or continuous wave, jammers that were installed internally with antennas located in the nose compartment. Wiring provisions were added to control additional jammers mounted in removable pods on the two wing stations to accommodate carriage of chaff pods. This ECM suite was installed and tested over several months after integration of the receiving system.*¹¹

Final technical and operational flight tests of the modified F3D-2s was performed at the White Sands Missile Range in New Mexico and at the Navy's China Lake California test ranges. The electronic warfare systems performed so well during these tests that Major McDonal persuaded the Marine Corps Headquarter to obtain the necessary aircraft and funding to retrofit thirty-five Skyknights for electronic warfare. By then VMC-3 and VMJ-3 had merged into a single squadron consolidating the Third Marine Aircraft Wing's electronic warfare and photo reconnaissance capabilities. The newly organized squadron, designated VMCJ-3, was commissioned at MCAS El Toro, California, on December 12, 1955.¹²

In May 1956, the two modified F3D-2s in VMCJ-3's inventory were designated F3D-2Q variants and their modifications used as the basis to convert thirty-five F3D-2s that McDonal had obtained funding for. The first of the F3D-2Qs entered service with VMCJ-3, one of three Marine squadrons that would operate the modified aircraft. It completed its transition to the F3D-2Q in the Spring of 1958. The second squadron to receive the F3D-2Q was VMCJ-1,

commissioned at El Toro on July 1, 1958. The third squadron was VMCJ-2. It began to transition to the F3D-2Qs at MCAS Cherry Point early in 1958. The primary mission of the three Marine EW squadrons was tactical ELINT in support of amphibious operations and jamming enemy search and fire-control radars that might threaten such operations. One unquoted historical source told Price that "The provision of jamming escorts for Navy strike formations was not a Marine mission, and was not considered for the F3D-2Q."¹³

In August 1958, VMCJ-3 under the command of Lt. Col. Robert R. Reid, deployed to MCAS Iwakuni, Japan, with nine F3D-2Qs. Reid, was able to convince the Commander-in-Chief Pacific to allow the squadrons F3D-2Qs to join the Peacetime Aerial Reconnaissance Program (PARPRO). PARPRO missions were conducted under a special program authorized by the Joint Chiefs of Staff for conducting aerial reconnaissance along the periphery of the Soviet Union, its satellite countries, and Communist China to obtain data on the radar emissions emanating from these countries. PARPRO missions could only be undertaken on the authority of the theater commander and had to operate outside the twelve-mile territorial limit. PARPRO missions could be dangerous. Although they were perfectly legal, a few PARPRO aircraft were shot down when the inadvertently entered Communist territory. Several more were attacked and downed while they were over international water waters.¹⁴

The PARPRO missions flown by VMCJ-3 were code named "Sharkfin" and were routinely flown by two F3D-2Qs staging out of bases at Misawa in Northern Japan, Osan, Korea, and Tainan, Taiwan. The sensitive nature of these missions required a high level of security and were tightly controlled.¹⁵

The Sharkfin missions were typically conducted at a cruising altitude of 30,000 feet, which allowed the receiving sets to intercept early warning radars at ranges beyond 200 miles. The F3D-2Qs radar receivers included an array of tuners covering all of the adversary radar frequencies with an accurate direction-finding capability. However, the long over-water missions that required dead reckoning navigation based on line-of-sight observations, which affected the accuracy of the plotted emitter bearings. In addition to the receivers, the F3D-2Q's electronic warfare suite included a camera on the signal analyzer display and an analog tape recorder to record signal data and communications. The recorded data and the aircraft logs maintained during the duration of the flight were used for post-mission analysis and the report that was forwarded to the Pacific Command ELINT center at Fuchu, Japan, along with the tape recordings of the intercepted radar signals.¹⁶

The PARPRO missions flown by VMCJ-1, which came about through the initiative of Lt. Colonel Reid and the foresight of those Marines in the EW community committed to upgrading the capabilities of their EW aircraft, provided invaluable experience in conducting ELINT operations. It also enhanced the reputation and esteem of the EW community within the Marine Corps, as well as that of Marine Air.

In addition to flying thirty-three Sharkfin missions, VMCJ-1 flew ECM training missions against the Air Force radar on Okinawa with the A-4s from VMFA-322. During the first of these exercises VMCJ-1's F3D-2Qs would begin jamming at some given distance from Okinawa. The ALT-2 jammer didn't have enough power at this distance to be effective. Instead, it left a strobe on the GCI operator's scope in Okinawa that pointed directly at the approaching flight alerting the Air Force to the coming attack from the A-4s that had taken off with VMCJ-1's F3D-2Qs. The outcome was not good for the attackers that were intercepted by the Air Force planes.¹⁷

New tactics were suggested by CWO-3 Marty Lachow who thought they ought to have a more imaginative approach such as varying the arrival times and changing the altitudes and course of the attacking force. One tactic described in O'Brien's book, "was to send an F3D out on a totally unrelated azimuth and then begin jamming at some range . . . The Air Force interceptors responded to the single decoy bird, while the rest of the flight came in from a different direction and were successful in their mock attack."¹⁸

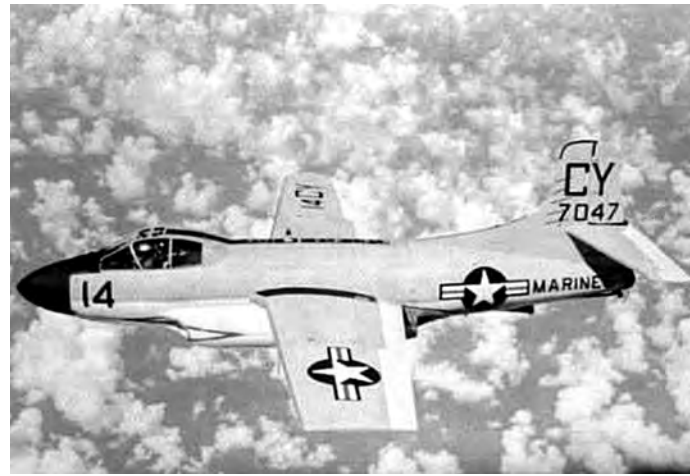
These ideas lead to the beginning of an ECM doctrine of sorts that allowed the ECM folks to coordinate the jamming in a concerted attack. This, O'Brien states, was the beginning of a theory "to develop that jamming is not an end in itself, but a part of an overall plan in which deception and ruse play as important a role as effective jamming. It was a lesson learned and unlearned from time to time." The Marines also learned that the F3D-2Q had to get close to be effective.¹⁹

When VMCJ-1 relieved by VMCJ-3 in late 1959, they continued to fly F3D-2Qs from MCAS Iwakuni on Sharkfin missions. All three VMCJs, according to Whitten:

Worked diligently after their transition to the reliable jet aircraft to establish and refine radar jamming tactics that would later pay off in the Vietnam War. Recognizing the relative low power of their jammers and employment limitation due to the lack of steerable antennas, the veteran ECMOs developed spot jamming techniques in conjunction with well-planned use of chaff to maximize effectiveness. They honed their skills conducting ECM training for Marine air control squadrons, and also provided ECM training for fighter pilots by jamming their aircraft target acquisition and tracking control radars after they were locked on to the Skyknight aircraft in mock combat. These missions were often referred to as "break lock" training.²⁰

While VMCJ-1 was conducting its Sharkfin missions, the Navy was in the process of soliciting designs for an aircraft to replace the Douglas AD Skyraider. The request was accompanied by Type Specification 149, which asked for a two-seat aircraft capable of performing in all-weather conditions. The design competition that followed was won by the Grumman Aircraft company, which received an initial design contract on February 21, 1958.²¹

While the design reviews of the new aircraft were under way, Captain "Poss" Morangville, a senior ECMO at-



Douglas EF-10B Skyknight of VMCJ-2 in flight, circa 1960s.

tached to VMCJ-1 involved in determining the F3D-2Q requirements for the Marines, discussed the requirements for a follow-on EW aircraft with senior staff officers at Headquarters, U.S. Marine Corps (HQMC) as well as Navy and Grumman engineers. As a result of Morganville's efforts, deputy commander for marine aviation asked the Navy program managing the A2F-1 contract to have Grumman conduct a feasibility study for an electronic warfare variant to replace the aging F3D-2Qs. The EMC community continued to follow this work with interest and at some point in 1961 convinced the authorities in HQMC to provide funding to modify two of the A2F-1 development aircraft into an EW variant. Money for this project was included in the FY-62 budget and Grumman was awarded a development contract for the modification work in March 1962. One of the original A2F-1 development aircraft, soon to be redesignated the A-6A, was selected as the aerodynamic prototype. It was fitted with outer wing panels and rudder, equipped with two wing pods for the passive receivers and tuners. Aerodynamic flight tests commenced on February 21, 1963.²²

The Marines now needed to obtain approval from Secretary of Defense Robert J. McNamara to proceed with a procurement request for production. McNamara would only consider procuring a new EW aircraft only after the Marines proved that the spot jamming technique could be effective against the known Soviet radars. The spot jammer, as opposed to barrage jammer that is designed to operate over a broad range of frequencies, concentrates all of its energy on one frequency, albeit it needs specific data on the enemy radar to be effective.²³

To prove that the Marines could accomplish this mission, the DOD set up an exercise in North Carolina using SCR-584 radars at abandoned World War II bases. The SCR-584 was similar to the Soviet "Fire Can" fire control radar. The Marines had to use their F3D-2Qs to find the hidden fire control radars and to jam them effectively. The Marines were not told the type of equipment or the frequency, only that they were to search for fire control radars. The F3D-2Qs found and jammed the surrogate radars as required satisfying the DOD observers who considered the



EA-18G Growler VX-9 from below, 2008.

“enemy radars” to have been rendered non-operational. The success of the DOD test enabled the Marines to obtain funds to convert four more A-6As to EA-6As. Gruman converted another A-6A into an experimental prototype designated as a NEA-6A, which was later used to develop the concept for the EA-6B program. A new lot of six aircraft were subsequently converted by Grumman to round out the first twelve EA-6As procured under the initial Navy contract for the A-6A.²⁴

In its original configuration the EA-6A was to carry a Loral ALQ-53 surveillance system housed in the characteristic ‘football’ fairing atop the tail plus the standard Navy protection suite (a mixture of ALQs and ALTs) placed in eight ALQ-31A* under-wing pylon-mounted pods. The first operational EA-6A, delivered to VMFJ-2 at Cherry Point in late November 1965 only had seven storage stations consisting of one centerline station, four inter wing stations, and two outer wing stations beyond the wing fold. These outer wing stations initially were used to carry the low band receiver pods of the ALQ-53 EW receiving system. Later, these mounting points were used to support ALE-32 or ALE-41 chaff dispensing pods and the AGM-45 Shrike missile. The ALR-15 multi-band threat warning

system and ALQ-41 deception repeater Jammer were also installed on the wing stations as needed. To make room for all of the additional ECM equipment an eight-inch plug was inserted into the forward fuselage.²⁵

When problems with the ALQ-53 threatened to delay delivery of the EA-6A, the Marine team managing the EA-6A program issued turned to outside vendors for help. One of the unsolved design issues with the ALQ-53 involved its “look-through mode. Look through allowed the operator to observe the effect of his jamming on the subject signal. In its look-through mode, the ALQ-53 receiver periodically sampled the signal environment, updating the data that was presented to the operator so that he could adjust the jamming signal to the proper frequency. The effort to resolve the problems with the ALQ-53’s look-through mode was solved by issuing a contract to Bunker Ramo Corporation to produce modification kits that would convert the ALQ-53s already delivered into the ALQ-86. The new ALQ-76 was also behind schedule, forcing Grumman to outfit aircraft being readied to deploy in the fall of 1966 with vintage ALQ-31B pods with their lower powered ALT-6B noise jammers.²⁶

By the late fall of 1966, the air defenses deployed by North Vietnam Air Defense Command (NVADC) were over taxing the electronic countermeasure of the U.S. forces engaged in attempting to bring North Vietnam to its knees. The number of SA-2 sites continued to grow and intelli-

* Although the ALQ-31 bore an AN number designation for a jammer, it was just a streamlined container intended to carry jamming equipment.

gence estimates indicated that the NVADC had hundreds of radar-controlled anti-aircraft guns and over 200 radars providing warning and guidance to guns, SAMs, and MIGs.²⁷

In late October 1966, the first EA-6As arrived in theatre when six of these aircraft and an aircrew/maintenance cadre from VMCJ-2 joined VMCJ-1 at Da Nang. Because of their increased jamming capability, which was three times that of the F3D-2Q Skynights, the EA-6As were tasked with supporting 7th Air Force and the carriers in the Gulf of Tonkin during the operations conducted in high threat areas. During a typical ECM mission, the EA-6As carried three ALT-31 pods containing a pair of steerable ALT-6B jammers, two drop tanks, and two ALE-32 chaff pods in addition to the onboard ALQ-53.²⁸

The first significant operation conducted by the EA-6As assigned to VMCJ-1, occurred on the night of October 25, 1967, when they accompanied two Marine all-weather squadrons conducting a low-level strike on Phu Yen Air Field northwest of Hanoi. "The combination of teamwork, super flying, and VMCJ-1s jamming (and perhaps a bit of luck) enabled the Marines to strike the target without loss." Two days later, an EA-6A teamed with an A6-A from VMA(AW)-242 in a "Little Partner" mission to identify a Fan Song radar in western North Vietnam that was attacked with AGM-45 Shrike launched from the A6-A.²⁹

In January 1968, the first EA-6As equipped with the ALQ-86 system (the improved ALQ-53) and ALQ-76 ECM pods were ferried to Da Nang by transpacific flights to be swapped with those already in country. These EA-6As carried an internally mounted ALQ-55 VHF communications jammer that played havoc with the radio communications between the North Vietnamese fighter pilots and their ground controllers. For security reasons, the crews needed to obtain permission before they could use this device.³⁰

After the bombing of North Vietnam ended in November 1968, VMCJ-1 provided ECM support for the photo reconnaissance aircraft and drones that continued to fly over the North. The drone operation, code named "Bumpy Action" involved BQM-34F Firebee drones launched from DC-130s in the Gulf of Tonkin. In May 1970, the squadron's aircraft were credited with saving a drone from a MIG attack by jamming the North Vietnam ground controller's communication with the ALQ-55. VMCJ-1 also flew numerous sorties from late 1969 into the first half of 1970 in support of Operation Commando Hunt, the interdiction campaign in Laos. VMCJ-1 left Da Nang in July 1970 after logging more than 25,000 combat sorties. Their legacy was

the EA-6B Prowler derived from the Marine conceived EA-6A "Electric Intruder".³¹

Towards the end of 1965, as the Marines were first beginning to deploy the EA-6A, the Navy seeking a replacement for its aging EKA-3Bs issued a requirement for a carrier aircraft having a state-of-the-art countermeasures suite to "support tactical strike aircraft by denying the enemy effective use of his defensive radar and radio communications." Grumman was already at work on an improved version for the EA-6A based on the ALQ-99 Tactical Jamming System (TJS) being developed by the Airborne Instruments Laboratory. Unlike the EA-6A, which was modified from a medium all-weather bomber, the Prowler was designed from the beginning as an electronic warfare platform—the first for a U.S. aircraft. To accomplish this, Grumman redesigned the front fuselage that was 4 ft. 6 in. longer and carried a crew of four, with the two additional crewmen sitting, side-by-side in the new rear cockpit. Grumman also strengthened the airframe, added more powerful engines*, and beefed up the landing gear. The first EA-6Bs entered service in December 1971.³²

In fielding the EA-6A, Marine airmen created an aircraft that was on the leading edge of airborne EW. This achievement came about through the efforts of a talented group of enlisted personnel within the Marine EW community and the foresight and initiative of their leadership. This enabled Marine Air to be in the forefront of the Navy Department's airborne EW effort, which differed from that of the Air Force. Although both services conducted ELINT missions under PARPRO, their strike missions were different. The Air Force, which had a mix of heavy bombers and strike fighters, tended to focus on its heavy bombers and the need to protect them deep into enemy air space. This required the development of longer-range EW aircraft with a stand-off jamming capability that could accompany the bombers. The Navy and the Marine Corps of which it is a part, on the other hand, because of carrier borne aircraft limitations, concentrated on the ground attack mode. To protect its strike aircraft, the Marines needed a more agile EW platform. This led to the development of the carrier capable EA-6A and its offshoot, the EA-6B. The latter would serve for four decades as the Navy and Marine Corps primary electronic warfare attack aircraft from its introduction in 1971 until 2009, when the EA-18Gs entered operational service.³³ ■

* Starting with the 22nd aircraft.

NOTES

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2. H. Wayne Whitten. "MCARA Notables > USMC Electronic Warfare Pioneers." *MCARA*, https://www.mcara.us/notables_ew_pioneers.html; "2nd MAW Headquarters Squadron (HEDRON-2) AEW/ECM Section History," *Marine Corps Aviation Reconnaissance Association*.
3. H. Wayne Whitten. "1st Marine Aircraft Wing Headquarters Squadron (HEDRON-1) and MACG-2 AEW/ECM Section History." *MCARA*, <https://www.mcara.us/HEDRON-1.html>; Whitten. "MCARA Notables > USMC Electronic Warfare Pioneers.," J.T. O'Brien, *Top Secret: An Informal History of Electronic & Photographic Reconnaissance in Marine Corps Aviation 1940-2000* (Equidata Publishing, 2004), 79. [Note: Both Whitten and O'Brien claim that Bouher and Grimes arrived at the K-3 airbase at Phohang in July, but according Condon (*Corsairs to Panthers* p. 8) MAG-33 did not begin shore operations until August]; "2nd MAW Headquarters Squadron (HEDRON-2) AEW/ECM Section History," *Marine Corps Aviation Reconnaissance Association*, <https://www.mcara.us/HEDRON-2.html>.
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7. Whitten. "1st Marine Aircraft Wing Headquarters Squadron."
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9. Alfred Price, *The History of U.S. Electronic Warfare Vol II, The Renaissance Years, 1946 to 1964* (Association of Old Crows) [hereafter Price, Vol. II], 1989, 103, 110;
10. H. Wayne Whitten. *Silent Heroes: U.S. Marines and Airborne Electronic Warfare 1950-2012* (Colonel H. Wayne Whitten and Associates, 2011), 22-23; "MCARA Aircraft > F3D-2Q/EF-10B Skyknightb- History" *MCARA* https://www.mcara.us/EF-10B_history.php; O'Brien, *Top Secret*, 122-23.
11. O'Brien, *Top Secret*, 123; H. Wayne Whitten, "Maine Composite Reconnaissance Squadron -3 (VMCJ-3) History." *MCARA* <https://www.mcara.us/VMCJ-3.html>; "MCARA Aircraft > F3D-2Q/EF-10B Skyknight - History;" Whitten. *Silent Heroes*, 23-24.
12. Price, Vol. II, 198; Whitten. *Silent Heroes*, 25; Whitten, "Maine Composite Reconnaissance Squadron -3 (VMCJ-3) History." the modification effort was under direction of the avionics officer, Capt. Noble, but led by WO Joe Bouher, an electronics technician and ECMO (A pioneer in Marine Corps ECM dating back to 1950 in the TBM-3Q Avengers at MCAS Cherry Point) who had also performed early modification of AD-2Qs in Korea.
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16. Whitten. *Silent Heroes*, 28-29.
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18. O'Brien, *Top Secret*, 168.
19. O'Brien, *Top Secret*, 168.
20. Whitten. *Silent Heroes*, 30-31.
21. Joseph F. Baugher, "Grumman A2F-1A/A-6A Intruder." [joe-baugher.com, http://www.joebaugher.com/usattack/newaf6_1.html](http://www.joebaugher.com/usattack/newaf6_1.html).
22. Whitten, *Silent Heroes*, 44-46; H. Wayne Whitten, "MCARA Aircraft > Grumman EA-6A Intruder – Notables," *Marine Corps Reconnaissance Association*, https://www.mcara.us/EA-6A_notables.html; Swanborough and Bowers, *United States Naval Aircraft Since 1911*, 272; Rear Adm. Kieber S. Masterson, Chief of Bureau Weapons, testimony before congress, "Department of Defense Appropriations for 1964. Hearings Before a Subcommittee of the Committee on Appropriations, 88 Cong. 1st Sess., Part 5 Procurement," 449.
23. O'Brien, *Top Secret*, 148; see also statement of Congressman George H. Mahon, U.S. Cong., House, Subcommittee of the Committee on Appropriations, "Department of Defense Appropriations for 1964. Hearings Before a Subcommittee of the Committee on Appropriations," 449.
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25. Price, Vol. II, 267; Whitten "MCARA Aircraft > Grumman EA-6A Intruder – History."
26. Whitten, "MCARA Aircraft > Grumman EA-6A Intruder – History." Whitten, *Silent Heroes*, 50; See also statement of Gen. William H. Green, commandant of the Marine Corps, "Department of Defense Appropriations for 1964. Hearings Before a Subcommittee of the Department of Defense of the Committee on Appropriations and the Committee on Armed Services U.S. Senate, 88th Cong., 2nd Sess. on H.R. 10939, Part 1," 579.
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28. Whitten, "MCARA Aircraft > Grumman EA-6A Intruder – History; Whitten, *Silent Heroes*, 91.
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Operation Button Up: Security at Minuteman Launch Facilities



Workers prepare the sealing surface for the Personnel Access System hatch. This is the original hatch design, as can be determined by the interior hydraulic mechanism for raising and lowering the hatch. The hatch had to be large enough for equipment to be transferred to and from the Launcher Equipment Room. (Library of Congress)

David K. Stumpf

Operation Button Up was the program to correct deficiencies in the design of the Minuteman launch facility Personnel Access System (PAS). The liquid propellant Atlas, Titan I and II systems required complicated propellant transfer equipment at the launch facilities, requiring adjacent launch control centers manned by launch crews. The solid propellant Minuteman obviated this requirement, greatly simplifying the launch facility design and allowing it to be unmanned.

Minuteman launch facilities are situated on 1.8 to 2 acres of land surrounded by a 7'6" security fence. The original launch facility security system was divided into outer and inner zones. The outer zone included a radio frequency system that detected surface activity within the boundary of the fence. The inner zone included switches at the launcher closure, PAS hatch (primary door) and security pit which allowed access to opening and closing the primary door.

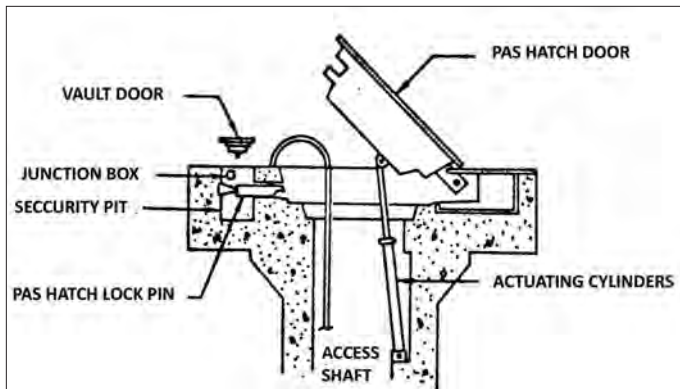
Operation Button Up began in June 1962.¹ The implementation was complicated by the need to modify a large number of partially or nearly completed launch facilities at the same time as the Army Corps of Engineers was completing their construction work or the Site Activation Task Force was installing the launch facility equipment. This article describes the genesis of Operation Button Up and major modifications made to the PAS.

Background

On April 1, 1960, Pres. Eisenhower approved deployment of 150 Minuteman IA missiles at the 341st Strategic Missile Wing (Wing I), Malmstrom Air Force Base, Montana.² Launch facilities were grouped 10 per flight with one launch control center per flight with the launch facilities approximately nine nautical miles from the parent launch control facility. Construction at Malmstrom began on 16 March 1961.

Col. Edward Hall's original concept for Minuteman was to have the ability to launch a squadron of 50 missiles at a time. An inadvertent or rogue launch of 50 missiles worried many inside and outside of the Pentagon. Two months earlier on February 12, 1960, Pres. Eisenhower's science advisor, Dr. George B. Kistiakowsky summarized his concerns about the Minuteman program command-and-control but no mention was made about security against unauthorized entry into the launcher.

On April 3, 1960, Lt. Gen. Bernard A. Schriever, Cmdr., Air Research and Development Command, requested an independent review of the technical and operational aspects of the entire ICBM program. The committee's report, sent to Schriever on May 31, 1960, listed the developmental problems with Minuteman but did not make recommendations on



Original PAS components. A portable ladder section was brought to connect to the retractable section attached to the wall and retracted or extended by the motion of the B-plug. (*Minuteman Illustrated Technical Requirements*)

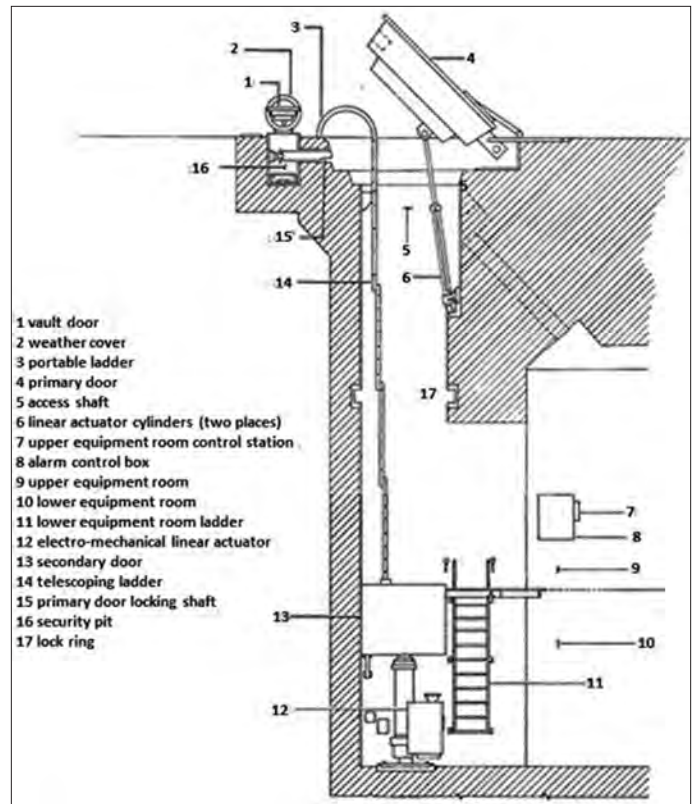
command-and-control nor reference to the physical security of the launch facilities.

A year earlier, in September 1959, the Joint Chiefs of Staff requested a study, by the Weapon System Evaluation Group (WSEG), of the strategic bombers, air-to-surface missiles, ICBM's, FBM's and IRBM's, with a recommendation for the number of each weapon system to be deployed. The preliminary findings of the WSEG Report 50: Evaluation of Strategic Offensive Weapons Systems, were released on September 15, 1960. Severe deficiencies in the command-and-control of the Minuteman force were discussed.

The Lauritsen Committee was reconvened in April 1961 to conduct a follow-on review of the Minuteman program in light of the WSEG Report 50 findings. The committee's report, released on June 15, 1961, concurred with the WSEG findings but again no mention was made of deficiencies of physical security of the launch facilities.

On July 6, 1961, the Air Force forwarded a report written by Brig. Gen. Phillips, director of the Minuteman program and Col. R. T. Hemsley, chief, Minuteman development branch, to Dr. Herbert York, director of the Directorate of Research and Engineering in the Defense Department. The report addressed the Lauritsen committee findings including budget estimates for their implementation. This triggered another round of review by outside experts as the Defense Department was in complete disagreement with the Air Force findings.

David K. Stumpf, Ph.D., is a retired plant biochemist living with his wife, Susan, in Tucson Arizona. He has written three nuclear weapon histories, Regulus the Forgotten Weapon, a history of the Navy's Regulus I and II cruise missiles; Titan II: A History of a Cold War Missile System and Minuteman: a Technical History of the Missile that defined American Nuclear Warfare, published February 2021. Dr. Stumpf volunteered at the Titan Missile Museum, Sahuarita, Arizona, as an historian and as a tour guide for 15 years. He was instrumental in the effort to gain National Historic Landmark status for the museum.



Installed PAS components circa 1962-1963. The most time consuming and difficult modification was the installation of the lock ring assembly due to the confined space of the access shaft. (*Minuteman Familiarization*)

On July 30, 1961, the Fletcher Committee, chaired by James Fletcher and formally known as the Minuteman Flexibility and Safety Group was formed by Secretary of the Air Force Eugene Zuckert at the request of Secretary of Defense Robert McNamara. The committee focused solely on the question of Minuteman weapon system safety against accidental launch and the feasibility of increased target flexibility.

The first mention of the vulnerability of the Minuteman launch facility to unauthorized penetration occurred in the Fletcher Committee report released on September 15, 1961. While the major focus of the report was on command-and-control issues, the report recommended modification of the PAS.³ This was in response to the results of tests run by the Nuclear Weapon Safety Group in August 1961 which had succeeded in defeating the operational PAS security system currently being installed at Malmstrom and Ellsworth.⁴

The response to the Fletcher Committee's recommendations was immediate. Boeing, the Minuteman assembly and checkout contractor, issued Contract Change Notice (CCN) 299 on October 24, 1961. CCN 299, also known as Block Change 1, implemented the command-and-control changes which involved substantial modifications to the majority of the existing command-and-control equipment. In April 1961, CCN 299 was amended to include modifications to the PAS. All of the modifications had to be accomplished without impacting the deployment date of October 1962 for Wing I.⁵



Left: Senior Airman Charles W. P. Michaels ascends PAS ladder, December 11, 1962. 1) original 22-inch autocollimator sight tube has been reduced in diameter to prevent unauthorized access. 2) the hydraulic system for opening and closing the door were originally inside the access shaft. Right: the sight tube was abandoned in place and the hydraulic system replaced with an exterior manual system during the Force Modernization program. 3, 4, 5) are the portable, fixed and extension ladder sections respectively. (*Library of Congress*)

Operation Button Up

Original Personnel Access System

The original PAS security system consisted of the security pit weather cover, and the 166-pound security vault door. The security pit housed a combination lock, controls to raise or lower the 10,000-pound PAS shaft hatch and the hand-driven linear actuator which locked or unlocked the PAS shaft hatch. The original hatch door hydraulic actuators were in the upper part of the interior of the access shaft, protected by the hatch door.⁶

Records for the launch facility penetration tests conducted in August 1961 remain classified. Presumably they showed that well-prepared intruders could pick the combination lock on the security pit vault door and raise the PAS hatch door before a security team arrived.

Installation

Wing I

The R. M. Parsons Company won the contract for the Operation Button Up engineering design and hardware procurement for Wing I Flights A and B cook. Boeing received the contract for hardware installation and checkout. A preliminary installation was made at Launch Facility 06 at Vandenberg Air Force Base and the design was determined to be operationally feasible. On June 20, 1962, at the 45th meeting of the Designated Systems Management Group, Operation Button Up was approved and operational base implementation was begun at a cost of \$70 million.⁷

Now the problem was how to get the system incorporated at this late period in construction at Wing I while

working with an evolving design for the Button Up hardware. The Army Corps of Engineers phase of launch control center and launch facility construction at Wing I was completed on September 21, 1962. Scheduling the retrofit work around the Site Activation Task Force installation of operating equipment made a difficult situation even worse. Installation at Wing II began in March 1963. The remaining wings had the installation as part of the original construction.

Installation took place in two phases. Phase I was the retrofit construction phase carried out by the Army Corps of Engineers. It involved modifying Launcher Equipment Room Level 1 floor framing and connections to the access shaft, adding the cutout for the locking ring in the access shaft, cutting out the steel floor at the bottom of the access shaft to accommodate the secondary door (see below) and its operating mechanism, rerouting hydraulic and electric lines, modifying the auto-collimator sight tube diameter, modifying the ladder in the access shaft, adding a ceiling mounted monorail for equipment handling as well as providing a new seal for the primary door (see below). Phase II, carried out by Boeing, was assembly, installation and checkout of the new equipment.⁸

The Facilities Engineering staff at Malmstrom worked closely with Parsons and Boeing as the design and installation was fine tuned to accommodate inevitable variation between launch facilities. Over 90 new drawings were prepared during this process, many of which were incorporated in the final design package. The Operation Button Up Phase I work at Flight A was completed by 13 July 1962, and Flight B followed a month later. Phase II was completed at both flights by early October.⁹



Secondary door fully retracted, Launcher Equipment Room Level 2: 1) 4-inch diameter locking bolts; 2) linear actuator; 3) manual override drive for linear actuator. (Library of Congress)

Operation Button Up PAS Modifications

Vault Door

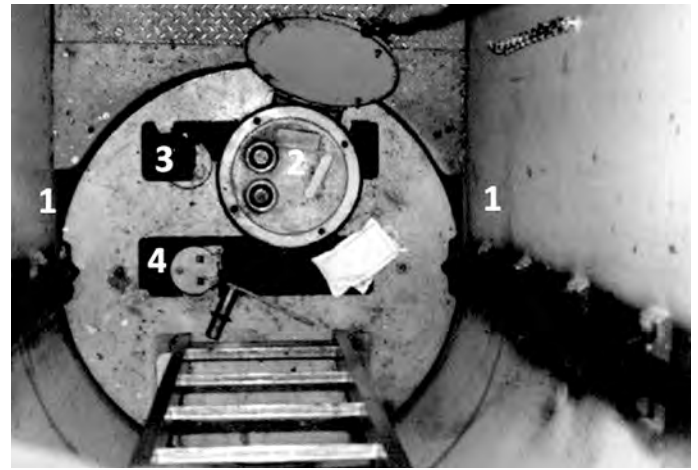
There were no modifications to the vault door (also referred to as the A-plug).

Security Pit

The security pit was modified with additional controls for lowering and raising the new secondary door (also referred to as the B-plug).

Secondary Door

The Parsons solution was elegantly simple as well as massive. The 42-inch inside diameter, 21-foot-deep access



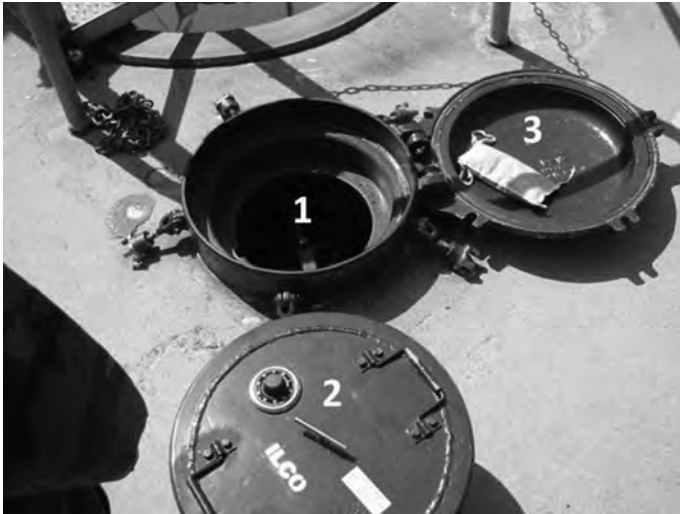
Top view of secondary door in the lowered position. 1) secondary door guide rails; 2) secondary door locks and cover, 3) emergency override port; 4) lock pin actuator gear shaft access. (Author's Collection)

shaft was now blocked with a movable 14,000 pound, 41-inch diameter, 45-5/16 thick, the secondary door. The secondary door was built with four layers: copper to absorb heat from a torch, hardened steel to resist drilling, Mylar composites to resist impact, and dust creating devices to impair the vision of intruders.¹⁰ The original be-plug was raised or lowered hydraulically a rate of 9.5 inches per minute. A time delay device provided added security to the system by delaying the time between withdrawal of the Be-plug locking bolts and the time the linear actuator began operation. The duration of the delay depended on the security team response time from the parent Launch Control Facility.¹¹

The top of the secondary door had a large covered recess containing two combination lock dials and a lock release handle. Unlocking either of the combination locks permitted withdrawal of the locking bolts from the locking ring by means of a hand crank installed on the locking bolts actuator shaft. One smaller covered recess housed the locking bolt actuator shaft and the other a mechanical override access adapter which was part of the manual B-plug lowering system.¹²

Table 1. Corps of Engineers Ballistic Missile Construction Office Start and Completion Dates

Wing	Start	Completion	Days
341 SMW Malmstrom AFB	16 Mar 61	21 Sep 62	585
44 SMW Ellsworth AFB	21 Aug 61	22 Apr 63	609
455 SMW Minot AFB	18 Jan 62	11 Jul 63	539
351 SMW Whiteman AFB	2 Apr 62	7 Nov 63	584
90 SMW F.E. Warren AFB	25 Oct 62	19 Jun 64	603
321 SMW Grand Forks AFB	12 Mar 64	10 Dec 65	638
Squadron 20 Malmstrom AFB	8 Mar 65	26 Oct 66	597



Primary Door Security Pit: 1) primary door security pit vault which houses the linear actuator unlocking mechanism for the primary access door as well as the hydraulic controls for raising and lowering the door; 2) 166 lb. vault door; 3) vault weather cover, the white packet is desiccant. (Author Collection)

Linear Actuator

The linear actuator consists of a hydraulically operated ball screw jack 51.3 inches long when retracted and 198.9 inches long when extended.¹³ If the hydraulic system fails, a three-piece, 20-foot shaft can be lowered through the secondary door to a receiver in the linear actuator permitting manual operation from the top of the secondary door.¹⁴

Access Ladder

The base of a telescoping ladder was attached to the top of the secondary door. A short removable section of ladder and short fixed section of ladder mounted on the wall

were installed between ground surface and the top of the telescoping ladder.

Lock Ring

A lock ring was embedded in the wall of the access shaft to receive eight 4-inch diameter secondary door lock bolts when the door is in the raised position. The lock ring supports the secondary door during ground shock or penetration attempts and maintains electrical continuity with the facility.¹⁵

Autocollimator Sight Tube

With the V-plug in the normal raised position, the original 22-inch inside diameter autocollimator alignment sight tube was now a potential entry point for an intruder. A 9-inch diameter tube was welded inside the larger tube and the remaining space filled with grout.¹⁶

Launcher Equipment Room Level 1 Platform

The top of the retracted Be-plug is flush to the floor of Launcher Equipment Room Level 1. The linear actuator is located on the floor of Launcher Equipment Room Level 2.

Summary

At first glance the original Minuteman launch facility and anti-penetration security design seems woefully insufficient and was readily proven so well after construction had begun on the first two Minuteman wings. Installation of the new system was part of the original construction for Wings III-VI and Squadron 20 at Malmstrom. \$70 million Operation Button Up retrofit program solved the problem and has had a number of updates made over the 60 years of Minuteman deployment. ■

NOTES

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14. Launch Facility Personnel Access Systems, 1-11.
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16. History of Minuteman Construction Wing II Ellsworth, 154. This document refers to a 9-inch diameter insert, the as-built drawings reference an 8-inch diameter tube insert.

Urgent Fury: Grenada 1983. By Sanjay Badri-Maharaj. Warwick UK: Helion, 2022. Contents. Illustrations. Photographs. Maps. Notes. Pp. 82. paperback. \$22.50. ISBN: 978-1-915070-73-9

This is another great monograph by Helion. One of the *Latin America@War* series, it examines Operation *Urgent Fury's* October 23, 1983 intervention in Granada. Badri-Maharaj, however, goes much beyond military operations by first covering unfolding events—especially a bloody coup on the island and the presence of hundreds of Cubans. They were ostensibly there to construct Point Salines Airport but caught the attention of the White House. Thus, the first one third of the monograph is focused not on the intervention but on both the rapidly changing situation as key personalities competed for control of the island's government and on the violence that followed.

Badri-Maharaj highlights a number of players. Eric Gaily was a labor leader and the first elected prime minister. His opponent, the charismatic Maurice Bishop, later seized control of the government. Finally, there are Bernard Coard and Hudson Austin who, in turn, took control of Granada and were responsible for Bishop's murder and the deaths of scores of civilians. Badri-Maharaj also discusses the Cubans on the island and what that signified. Another factor in the impending intervention was concern by the United States for the safety of Americans attending medical school there. Ultimately, because of the violence, the students, and the presence of Cubans, the American president felt it prudent to react with overwhelming force in a nation only one third the size of New York City with a population of little more than 100,000. The second third of the monograph is about Operation *Urgent Fury* itself, and how the situation at times became challenging for US forces. Finally, the last section is about the aftermath.

The initial phase of *Urgent Fury* lasted just four days, during which Granada's People's Revolutionary Armed Forces (with their limited equipment) unexpectedly put up a stout resistance. Likewise, the Cubans at Point Salines Airport resisted at first and then capitulated. In the case of the Cubans, Fidel Castro was furious that they did not fight to the bitter end. When their on-scene commander, Colonel Tortolo, returned to Cuba, he was demoted to private and sent to fight in Angola—where he died.

In the conclusion Badri-Maharaj lists the disproportionate losses of American forces, considering the very limited capability to resist on the part of the Grenadians. Nine helicopters were destroyed and others damaged. Nineteen Americans were killed and perhaps 219 wounded. In the numbers for wounded, two Air Force personnel are mentioned without further comment. Who were they? Badri-Maharaj mentions in error that there were Army Pathfinders in the initial special operations parachute assault on Point Salines Airport. Actually, they were Air Force special operations combat controllers who fully took part in the airfield seizure and the establishment of an assault

zone for follow-on air landings. Their vital role goes without mention.

This well illustrated monograph pretty much captures the essentials for understanding the events of October 1983 in Granada. It provides the backdrop to Operation *Urgent Fury* and then follows with a discussion of the operation by US forces assisted by other Caribbean troops and police. It provides the justifications for intervention and, finally, the outcome. For a snapshot of what happened, a reader is well served by this monograph.

John Cirafici, Milford Del.



Original Sin: Power, Technology and War in Outer Space. By Bleddyn E. Bowen. New York: Oxford University Press, 2022. Figures. Tables. Notes. Bibliography. Index. Pp. xviii, 445. \$29.95. ISBN: 978-1-0197677315

The tantalizing main title of Bowen's new book, *Original Sin*, promises to attract an audience of space professionals and lay readers alike. An Associate Professor of International Relations at the University of Leicester, he also serves as a space policy consultant to the UK Parliament, the European Space Agency, and the Pentagon, offers a fresh perspective on a familiar story: the use of powerful rockets, originally developed to deliver thermonuclear weapons over intercontinental distances, to launch militarily strategic support platforms—reconnaissance, early warning, command-and-control (C2)—into Earth orbit. From this “original sin” evolved a host of satellites that evolved for technological fulfillment of broader military applications.

Bowen observes how the “twists and turns” of maturing space technologies, as users sought to satisfy military needs, was “not a clear-cut path of technological ‘progress’ nor merely a story of rational policy making.” When it came to signals and imagery satellites, however, technological maturation resulted in “applied witchcraft.” No amount of “technical wizardry” in orbit, however, could completely eliminate the “fog of war.” As using space capabilities for the “full spectrum” of military combat—not just for nuclear operations—has become the norm, space systems have become targets in any crisis or wartime situation.

According to Bowen, as more nations began developing their own rockets and satellites, they became spellbound by pursuit of the same militarized space technologies that had ensnared the Soviet Union and the United States during the late 1950s. The Space Age was never just about two superpowers, he asserts, but was “global” from the very beginning. Envisioning possible human expansion into deep space, he foresees no escape from the sin of pursuing militarized space technology “so long as humanity's international system is still made up of sovereign states that possess nuclear weapons.” Since “international anarchy is

the product of people, their ideas, and their machines,” Bowen believes “the threat of nuclear ‘omnicide’ will remain even in a multi-planetary civilization.”

Pulling back from an expansive vision of humanity’s future in outer space, Bowen introduces what might generate the most discussion among military space professionals, academicians, or other informed readers. Berating the “imperial thought” of outer space as the “ultimate high ground” for military purposes, he perceives Earth orbit as “something of a cosmic coastline, a littoral environment, or orbital flank defined by proximity and intimacy with Earth itself.” To him, the cosmic coastline analogy seems “more useful for in-depth thought about space warfare and military space strategy.” This is especially true when it comes to discussing spacepower’s possibilities and constraints in “astroeconomic warfare, where the more dependent economic infrastructure . . . increases the potential payoffs of attacking those space systems that support it.”

Bowen’s eye-catching, thought-provoking use of an essentially Judeo-Christian concept to question humanity’s space future makes this a tome worthy of careful reading. As plans for space warfare proceed and commercial activities beyond Earth continue to proliferate among an increasing number of nations, informed consideration from whence present circumstances have evolved and whether current pathways only replicate, possibly even compound, past transgressions. *Original Sin* merits more than a single cover-to-cover reading before you shelve it.

Dr. Rick W. Sturdevant, Director of History, HQ Space Training and Readiness Command



Black Sunday: When Weather Claimed the US Fifth Air Force (2d edition). By Michael John Claringbould. Kent Town, Australia: Avonmore Books, 2022. Photographs. Illustrations. Maps. Pp. 136. \$44.95 paperback. ISBN: 978-064524698-8

Black Sunday tells an interesting, but sad, story of a strike mission that went wrong. As is usually the case when military missions go wrong, a price was paid in blood and iron. In late 1944, the war in New Guinea had turned in the Allies favor; and the writing was on the wall for the Japanese Empire. Short on supplies, men and equipment, Japanese forces were holding on by their fingertips to a few bases which were under unrelenting attack by the US Fifth Air Force.

When faced with a strike force of over 300 aircraft, the Japanese could not launch a single defender. But they had an ally on that day, the weather. And the weather would exact a heavy price for the hubris of the Allies.

Claringbould’s superb research paints a detailed picture of the force that would be brought to bear against Hollandia on April 16, 1944. These forces included strategic

and tactical bombers, medium bombers and gunships, strategic and tactical reconnaissance platforms, search and rescue assets, fighter cover for ingress and egress, and a variety of liaison and utility aircraft. There was no mention of defense suppression assets; because, I assume, there were no meaningful defenses to be suppressed. But, in a cruel twist of fate, all the elements of this aerial armada were to find themselves subject to the same horrific weather. Many shared the same fate.

Claringbould is an effortless writer; his narrative style is smooth and casual and makes for an extremely easy read. I finished *Black Sunday* in a few hours. He weaves first-person accounts throughout the work, and they add immeasurably to the story. The photographs are high-quality and add to the story—and probably to the cost of the book.

But Claringbould left many questions unanswered. Throughout the book, it is obvious that weather was going to be a major factor. Most units felt the mission would be cancelled. Numerous aircraft launched before the main strike package and reported deteriorating weather conditions. The strike targets had been hit many times in the days immediately prior to Black Sunday; Claringbould made no mention of any high-priority, time-sensitive target that required a “press-on” posture in the face of deteriorating conditions. So why did the mission launch? Gen Kenney clearly regretted the mission, so who exactly made the “go-no go” decision? Were there repercussions? Were weather forecast and reconnaissance procedures changed? Did A-20 units begin issuing maps to all aircraft and not just squadron commanders? Were the Kempeitai officers who oversaw the execution of American POWs held to account in war-crimes trials? Perhaps Claringbould is saving those issues for a third edition.

Gary Connor, Cortland, Ohio



The United States Space Force: Space, Grand Strategy, and U.S. National Security. By Dr. Lamont C. Colucci. Santa Barbara, California: Praeger, 2023. Figures. Bibliography. Index. Pp. xiii, 153. \$77.00. ISBN: 978-1-44087483-3

National security and foreign policy expert Colucci, inaugural director of doctrine development for the United States Space Force (USSF), delivers a meaty tome that will take any serious reader a while to chew and even more time to digest. He places the United States historically at “an existential crossroad” not unlike the one that resulted in the National Security Act of 1947. He argues the USSF should be completely separate and independent from the Air Force to prevent the latter “from raiding the space budget for their own purposes.” Not shrinking from other bold statements, Colucci asserts “the only path for serious

national security for the United States is to be the dominant space power,” which means abolishing the 1967 Outer Space Treaty. An unabashed proponent of extensive space weaponization, he advocates employing orbital armament not only to defend satellites but to deliver lethal force from outer space against terrestrial targets.

Colucci correctly identifies the importance of applying a knowledge of geopolitical history—especially American history—to the formulation of a grand strategy that links a strong US national security presence in space with expanding US commercial activity in that domain. Some readers, however, might question how he interprets certain aspects of that history. Perhaps the validity of Frederick Jackson Turner’s frontier thesis, for example, should be re-examined carefully. They also might ponder, furthermore, whether Colucci’s adherence to the nineteenth-century concept of Manifest Destiny in the twenty-first century really sends an appropriate strategic message to other space-faring nations, be they US partners or adversaries.

This book contains substantial food for thought and serious discussion about the importance of how “a robust national security doctrine” can, and should, provide “a foundation for grand strategy.” In the third chapter, the “cycle of support” between space commerce and space force military strength merits quiet contemplation, as does thoughtful consideration of Colucci’s charge that “one of the significant defects among great power analysts and space power advocates is their inability to see the synthesis of the two.” I envision graduate-level seminar debates over whether “American interests are only vital as long as America stands as the bulwark of Western civilization.”

Anyone interested in the USSF, its doctrine, and the development of a grand strategy for that nation’s future in space should mark *The United States Space Force* as a “must read” volume. Some might be disturbed, however, by Colucci’s self-righteous condemnation of citizens who might disagree with his perception of the way forward. He castigates “a rising progressive movement that doesn’t want American primacy in the future.” Several pages later, he perceives evolution of the *Star Wars* franchise as “an attempt by the political left to force moral relativism down the throats of every American.” Such rhetoric does not promote opportunities for fruitful debate.

Colucci certainly is right to say that “voters need to be educated about the current value of space technology, such as GPS, weather forecasting, communication, and military surveillance, to name a few, and protections for generations to come.” As he observes, without the electorate’s advocacy, prospects for strengthening the US military capabilities in outer space likely will fall short of future needs. His presentation of how “space power and fiction have merged into their own synthesis,” might help improve public advocacy for the Space Force. If we need heroes in the public mind, as William Shatner suggested and Colucci apparently thinks, perhaps “this would best be done by linking Space Force with science fiction like *Star Trek*.”

Dr. Rick W. Sturdevant, Director of History, HQ Space Training and Readiness Command



Ready for Takeoff: Stories from an Air Force Pilot. By David Dale, Lt Col, USAF (Ret.) Spicewood Tex.: David Dale, 2022. Photographs. Appendices. Pp xx, 333. \$14.99. paperback. ISBN: 979-8-9868336-1-3

Dale, who became a Southwest Airlines pilot after retiring from the Air Force, reflects on his military career. He shares his flying experience as well as his approach to leadership. In the preface, he emphasizes that this work is a collection of short stories rather than a traditional autobiography detailing his life. Many of the 57 chapters are only a few pages in length.

Dale first flew an airplane at age 16. While enrolled at the University of Texas at Austin and participating in the ROTC program, he discovered his vision was inadequate for pilot training. As an alternative, he chose to be a navigator. For about three years, he crewed Boeing B-52G bombers. In early 1988, he received a waiver for his vision and entered pilot training. Upon completion, he flew McDonnell Douglas KC-10 tankers. Missions with the KC-10 took him all over the world. During Operations *Desert Shield* and *Desert Storm*, he supported numerous ground-attack and air-superiority sorties. Next came support for Operation *Restore Hope* in Somalia.

His career took an interesting turn in 1993 when he was accepted as an exchange pilot with the Royal Netherlands Air Force (RNLAF). Before moving to Holland, he and his wife studied Dutch in Monterrey, California.

Besides the US, the Netherlands is the only other country to have included KC-10 airframes in their inventory. Dale notes that Dutch fighters were unable to participate in *Desert Storm* because they lacked experience with air-to-air refueling. After that conflict, the RNLAF contracted with McDonnell Douglas to modify two DC-10s formerly flown by the airline Martinair. Dale went to the Netherlands to help train crews in what the Dutch called the KDC-10. He details how the KDC-10 used a radically different approach for the crewmember managing the refueling. Unlike the Boeing KC-135 and the KC-10 with the “boomer” located in the rear of the aircraft, that crewmember rode up front while monitoring the receiver’s aircraft on a high-resolution television screen. While Boeing recently has faced technical problems installing a similar system in its KC-46, its legacy partner McDonnell Douglas succeeded 20 years earlier.

Back in the US, Dale briefly manned a desk before returning to the cockpit with a special-missions squadron at Andrews AFB. He flew Gulfstream C-20s and C-37s before moving on to his final assignment with the 310th Airlift Squadron at MacDill AFB, Florida. The 310th

performed a similar mission as Andrews. Dale retired as the 310th commander.

This book is very well written, especially for a self-published effort. The stories are insightful and entertaining. More importantly, they emphasize the value of aerial refueling and world-wide airlift. I recommend this book for fans of flying stories and those wishing to learn more about aerial refueling.

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



F-4 Phantom II Wild Weasel Units in Combat. By Peter E. Davies. Oxford UK: Osprey, 2023. Illustrations. Photographs. Appendices. Index. Pp. 96. \$25.00. paperback. ISBN: 978-1-47284-5456-8

Peter Davies has become one of Osprey's regulars with more than 30 titles under his belt. He focuses on post-World War II aviation, with an emphasis on Vietnam. He has contributed to several different Osprey series such as "Duel" and "Dogfight." This volume marks No. 147 in the publisher's series about combat aircraft.

Davies briefly reviews the concept of SEAD—suppression of enemy air defenses—and its beginnings. The US Air Force's efforts to reduce the effectiveness of Russian-built surface-to-air missiles (SAM) emerged during the Vietnam War. North American F-100 Super Sabres were the first Air Force aircraft employed to specifically attack SAM sites. However, the Republic F-105 Thunderchief, using antiradiation missiles that homed in on enemy radar emissions, dominated weasel operations in Vietnam.

As the McDonnell Douglas F-4 Phantom II achieved prominence in the Air Force inventory in the late 1960s, that aircraft became the understandable successor to the F-105. Initially the widely available F-4C took on the weasel mission. However, installing the necessary electronic suite posed a challenge, an issue that would remain for some years as systems evolved.

The final American variant of the F-4, the G version, focused on the SEAD mission. As might be expected, F-4G squadrons went where the threat was greatest in the post-Vietnam years, primarily western Europe. Back in the United States, George AFB, California, became the center of active-duty weasel operations. The Idaho Air National Guard also handled that mission; some of its aircraft eventually flew combat missions.

Davies' index lists ten different combat operations involving weasel units mentioned in the book. Aside from Operation *Linebacker* at the end of the Vietnam War, the most prominent, of course, is Operation *Desert Storm* in 1991. The heart of the book is devoted to the weasels' success in eliminating Iraqi radar sites before the ground attack. Davies includes numerous excerpts from interviews with

crew members associated with the most active squadrons—the 23rd, 81st and 561st.

Besides detailing flight operations, Davies also discusses the evolution of the necessary electronic components. He also reviews the progress in antiradiation missiles from the Shrike and Standard ARM (Anti-Radiation Missile) to the HARM (High-Speed ARM)

This book is suitable for anyone wishing to learn more about SEAD operations in the post-Vietnam era. Model builders should find the 24 color illustrations helpful, but the book is much more than that. It's a solid introduction to understanding and appreciating the challenges of defeating sophisticated anti-aircraft defenses.

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



Canberra: The Greatest Multi-Role Aircraft of the Cold War, Volumes 1 and 2. By Ken Delve and John Sheehan. Stroud, UK: Fonthill Media, 2022. Diagrams. Photographs. Glossary. Pp. 1119 (512 and 607). \$125.00 (\$60.00 and \$65.00). ISBN: 978-1-78155-874-4 and 978-1-78155-875-1 respectively

This monumental two-volume work is an expanded version of Delve's *English Electric Canberra* (Midland Counties Publications, 1992), co-authored with Peter Green and John Clemons. Delve was a Canberra navigator and formerly edited *Fly Past* and later was editor-in-chief for Key Publications. He has written more than 50 books and numerous articles. Sheehan has been a Canberra enthusiast since childhood.

Delve and Sheehan tackle the Canberra story from a topical perspective. The first volume focuses on the Canberra in Royal Air Force (RAF) service. The emphasis is clearly on RAF Cold War operations and activities in various British colonies before they achieved independence.

Designers conceived the Canberra as a high-altitude bomber in the late 1940s to replace the RAF's piston-powered fleet prior to the arrival of the V bombers. Volume 1 begins by looking at the Canberra as a key element in Bomber Command's early post-World War II history. Chapter 2 examines variants of the Canberra in the strike and interdiction role serving in Germany, the Middle East, and Far East.

In Chapter 3, the authors detail the Canberra's use as an exceptional reconnaissance platform. Whereas Chapter 5 lists the aircraft's tenure in every squadron in which it served, Chapter 4 looks at how the RAF used the Canberra in miscellaneous roles.

Volume 2 opens with the aircraft's design and development by English Electric. Because of the wealth of information concerning Canberra operations with the RAF, Delve and Sheehan probably decided it was better to in-

clude all other topics in this volume. Chapter 2 looks at No. 231 Operational Conversion Unit. This organization trained aircrew members, especially those transitioning from prop-powered planes.

More than 130 pages are devoted to the 13 international operators of the aircraft, with India possessing the most. The Royal Australian Air Force's support for American combat operations in Vietnam receives considerable attention.

In the next chapter, readers learn how Martin built several variants of the Canberra under license. The result was the B-57 whose most obvious physical difference was the tandem cockpit and long, narrow canopy compared with the original British bubble canopy. Martin also exported the B-57 to Pakistan.

The final chapters cover trials and testing; Canberra flight teams and flyovers at air shows and other events; surviving aircraft or cockpits; technical details on a variant basis; color schemes and markings specifically intended for modelers; first flights, records, and anniversaries (the RAF retired its last Canberra in 2006); and a production list including conversions.

This work is highly recommended for Canberra aficionados. There are dozens of interviews with RAF personnel as well as those of other air forces. Even though an index has been omitted, these two volumes are a worthy addition to any aviation generalist's reference collection.

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



Nakajima Ki-49 'Helen' Units. By George Eleftheriou.: Oxford UK: Osprey Publishing. 2023. Photographs. Illustrations. Appendices. Bibliography. Pp. 96. \$25.95. paperback. ISBN: 978-1-47285449-0

With Osprey products, the book buyer knows exactly what they are getting for their money: a well-researched, richly illustrated document in a relatively inexpensive package. Eleftheriou's product falls squarely into those categories. The Ki-49 performed a specific role for the Imperial Japanese Army Air Force, but it is not a well-known platform like the Japanese Navy *Betty* or Army *Oscar*. From the perspective of educating the reader, the book is a clear winner.

Eleftheriou and his editors do a very good job matching the books' copious photographs to the written narrative. When he talks about the Helen's rear turret resembling a "bucket and cage" it helps to have a picture nearby. When he talks about the poor performance reliability of its radial engines, it helps to have several photos showing various stages of engine repair and replacement. But rigidly following this format is when problems start to appear.

The text explains that the Japanese recognized the weaknesses inherent in their medium bomber force and

asked manufactures for a more robust design. Headquarters wanted an aircraft that was fast and heavily armed to be more survivable even when operating without escort fighters. But it didn't take long for the war to show that the Ki-49 was not that airplane. First-person accounts from crew members paint a clear picture of an aircraft that, while relatively heavily armed and armored, was incapable of protecting itself. When coupled with underpowered engines, the aircraft frequently had to fly with reduced payloads or reduced crew to have sufficient range to reach targets.

I think that Eleftheriou missed a unique opportunity to discuss survivability. Interviews with Allied pilots or extracts from Allied post-mission reports could have documented whether Allied pilots thought the Ki-49 was more survivable than its predecessors. The book's cover art shows a P-51D having its way with an unfortunate *Helen*. I don't think the Mustang pilot was too impressed with the bomber's armor or armament.

The book comes with several pages of color plates showing camouflage and unit markings. It also has several color photographs of damaged or destroyed airframes on fields across the Pacific.

For the dedicated historian specializing in Japanese aviation, this book is a welcome addition. Scattered throughout the expected information are Easter eggs of knowledge. Both Chambers' *Wings of the Rising Sun* and Melzer's *Wings for the Rising Sun* call attention to Japanese designers' willingness to find shortcuts by copying American designs and technology. Eleftheriou adds to their case by pointing out the features of the Ki-49 that were "borrowed" from the license-built DC-2s rolling off the Nakajima production line.

Gary Connor, Cortland OH



Air Battle for Burma: Allied Pilots' Fight for Supremacy. By Bryn Evans. Barnsley UK: Pen and Sword, 2022 (2016 reprint). Photographs. Maps. Tables. Glossary. Notes. Bibliography. Index. Pp. 251. \$29.95. paperback. ISBN: 978-1-39907486-5

While the China-Burma-India (CBI) theater remains the least-written-about theater of World War II, more and more memoirs of the combatants are finding their way into print, bringing the war in that far-off region to readers and armchair historians. While the title implies that the book covers the spectrum of aviation (i.e., fighter, bomber, transport, reconnaissance, etc.), it does, in fact, focus largely on fighter vs. fighter encounters of the RAF and the IJN and IJAAF in the theater. Other Allied air forces are given brief mention, but this is very much an RAF-centric work. In fact, it is very much a Hurricane vs. Oscar tome.

Evans writes smoothly; and, while the short chapters

with end notes for each chapter make for a choppy read, the chapters themselves flow nicely. He uses pilots' own words to add life to his detailed research. The text pays a lot of attention to how Japanese forces were able to run rampant through the CBI from 1941-1942. Simply put, they had air power in place in the theater; and the Allies did not. Post-1942, heavy Japanese losses coincided with the movement of RAF forces into the theater from Northern Europe and the Mediterranean resulting in a shift in balance. Not only did Allied numbers increase, but also older aircraft models were replaced by newer upgrades (Hurricane Mk Is were replaced by Mk IIs with more powerful engines, and these were eventually replaced by Spitfire Mk Vb fighters).

While the focus on fighters is exciting, Evans really missed an opportunity to make this book something more. He gives minimal attention to the bomber side of the house, where the Allies' use of Blenheims and later Beaufighters and Mitchells raised havoc with Japanese logistics. This slowly degraded the Japanese ability to generate sufficient sorties to counter Allied attacks. Thankfully, Colman's *Beaufighters: Over Sea, Sand and Steaming Jungles* is an excellent read on that topic.

Evans unintentionally built the case that the use of in theater aerial transport not only redefined logistics but also allowed the Allies to rapidly redeploy forces to block Japanese last-gasp offensive initiatives. Perhaps inadvertently, he builds a strong case for the C-47 Dakotas as the most valuable aircraft in theater. Several times I found myself wondering if the lessons learned flying strategic transport missions over the "Hump" laid the groundwork for the later Berlin Airlift. How many of the key personnel supporting Operation *Vittles* learned their trade in the CBI?

Air Battle for Burma is a solid read. Evans' meticulous research and smooth writing style make for a comfortable reading experience. I was left with the feeling that he just wasn't sure how to end the book. He gives an Epilogue, followed by a Postscript, followed by Statistics. But what he doesn't give us is a balanced presentation of the whole of the air battle for Burma. The air battle he described was more than Hurricanes, Buffalos, Oscars, and Hamps. This isn't a bad book; it is just a book that could have been so much more.

Gary Connor, Cortland OH



Me 262-Northwest Europe 1944-45. By Robert Forsyth. Oxford UK: Osprey Publishing, 2023. Maps. Diagrams. Illustrations. Photographs. Appendices. Bibliography. Index. Pp. 80. \$23.00. paperback. ISBN: 978-1-472-85051-5

For those unfamiliar with Germany's iconic and innovative Messerschmitt 262 jet and its presence in the skies over war-torn Western Europe in the last throes of the Sec-

ond World War, this informative and richly illustrated volume will be a welcome resource. As part of Osprey's Dogfight series, this book continues Forsyth's scholarly histories of German military activities of the Second World War. With over 30 books to his credit—many chronicling the Luftwaffe in that war—Forsyth now focuses on this unique chapter in the European air war.

His approach to telling the story of the twin-engine Me 262 interceptor relies upon his personal relationships with many German and Allied pilots and crewmen who participated in the action from the summer of 1944 - May 1945. He interviewed or corresponded with at least eight Me 262 pilots during the late 1980s and early 1990s. They recounted their aerial encounters and the strengths and limitations of the airplane. The fighter was not easy to fly, especially for single-propeller fighter pilots. Some former multi-engine-bomber pilots were recruited who had to quickly learn the intricacies of tactical and strategic aerial confrontations. On the Allied side, Forsyth recounts recollections of eight former USAAF pilots who fought the Me 262. Strap yourself in for many of these unique 500-mph encounters.

Originally conceived by Hitler to be a high-speed bomber (which it partially became later in the war as Allied ground forces moved toward the Rhine), the 262 was truly a unique aircraft which could outrun all Allied aircraft in straight-and-level flight. But, because of the shortage of serviceable aircraft, supply disruptions, and the questionable availability of fuel, the 262 never quite achieved its potential. It wasn't long before the Allies realized that their propeller fighters could out turn the jet and that the 262's preferred attack position on bomber groups was straight and level at the "12" or "6." As a result, Allied fighters dove down from altitude to gain comparable speed while focusing on the predictable attack patterns. They successfully pursued this strategy, but it soon became apparent that the jet was most vulnerable when landing. Targeting the jets when they had to land was called "rat-catching."

In a brief Aftermath, Forsyth reflects upon the influence of the aircraft technology. He opines that the 262 "went on to influence both late-war German projects as well as American and Soviet jet fighter aircraft well into the 1950s and beyond."

This book is visually appealing with over 50 photographs, specially commissioned ribbon diagrams, and full-color artwork. Of particular appeal are the superb diagrams of the Me 262's armament of four MK 108 30mm cannons in its nose and the 12 x 55mm R4M rocket armament under each wing. This was a deadly combination—when the systems worked.

Forsyth has done a yeoman's job in describing the Me 262's history and its manufacturing, propulsion, armaments, flight characteristics, and pilot strategies. It makes for an informative and historic publication.

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



Dornier Do 17; In the Battle of Britain; The 'Flying Pencil' in the Spitfire Summer. By Chris Goss: Yorkshire UK: Air World Books, 2022. Photographs. Appendices. Bibliography. Glossary. Pp. 220. \$42.95. paperback. ISBN: 978-1-52678120-8

This is not so much a book as it is a curated and annotated photo album focused on the Dornier Do 17 during a very narrow three-month window from July to October 1940. Without question, the book is very high quality. The excellent paper shows the photographs in detail. Most of the photographs have captions of 60-100 words that contain excellent detail. Unfortunately, none of the captions contains citations or attribution. The cover notes indicate the photographs are from the author's collection, but there is no provenance provided beyond that. This, I believe, limits their utility as research tools.

Aside from the captions, the written word is at the minimum. A three-page introduction to the book followed by short introductions to each of the chapters does not give Goss the chance to demonstrate his writing style. Fully half the book consists of various charts, lists, and appendices that are little more than reformatted database products that provide little need for style or command of the language.

Perhaps most surprisingly, Goss makes no mention of the salvage and restoration of the only surviving Do-17. Discovered by divers in the early 2000s, the veteran airframe from the Battle of Britain is listed in the myriad of charts but does not make it into the book's body. I count that as a major missed opportunity.

In total, with the addition of some color profiles, this book would seem more suited to the modeler market at a significantly reduced price. When I completed my first reading, my thoughts turned to an old Peggy Lee cover of the Leiber/Stoller song, "Is That All There Is?"

Gary Connor, Cortland, Ohio



Lawrence of Arabia's Secret Air Force: Based on the Diary of Sergeant George Hynes. By James Patrick Hynes. Barnsley UK: Pen & Sword Aviation, 2023. Photographs. Notes. Bibliography. Index. Pp. x, 146. \$29.95. paperback. ISBN: 978-1-39902-061-9

George Hynes' nephew, James Patrick Hynes, in 2008 realized that his deceased uncle had left more than 200 pages of memoirs with his cousin, George's daughter. In 2010, James Hynes published his discoveries. This volume is a reprint of that edition.

George, a talented mechanic, served for several years in X Flight, a unit subordinate to the Royal Flying Corps' No. 14 Squadron. The squadron's history of support to British forces for nearly three years in the Middle East is

well documented. Hynes points out, however, that as far as X Flight was concerned, it seldom was acknowledged in administrative channels. George Hynes claimed he was never paid while serving with the unit. Officials in Cairo quickly disbanded the unit after hostilities ceased.

This independent outfit's primary responsibilities were reconnaissance and attacks on enemy positions. It also attacked airfields and infrequently skirmished with Turkish aircraft. Occasionally, T.E. Lawrence relied on X Flight to journey to meetings with Arab leaders. X Flight went to war equipped with the Royal Aircraft Factory's infamous B.E.2c and the Martinsyde G series Elephant. Over time, X Flight received improved B.E. aircraft and the very capable Bristol F.2.

Proceeding in chronological order, James Hynes intertwines X Flight's weekly operational reports with his uncle's diary accounts. He also includes pertinent passages from Major Lawrence's own writings. As a mechanic, George based his comments regarding flight operations on conversations with pilots. Otherwise, he provided a very detailed account of life in the desert.

Several aspects are revealed in considerable detail. X Flight depended on wheeled vehicles. The unit had access to a few Crossley tenders (trucks). They proved essential, helping support forward bases and retrieving downed aircraft. George and his mates became very adept at extricating Crossleys from soft sand.

All X Flight personnel dealt with the harsh desert environment. Living conditions were extremely austere, and food rations were quite limited. Many became reasonably fluent in Arabic. The unit, on occasion, hired Egyptians or Arabs or both. When operating from remote locations, X Flight sometimes encountered Arab tribes transiting their airfields. These posed a security risk, since the Turks attempted to lure some Arabs to their side. Despite some tense moments, X Flight usually maintained cordial relations with the local populace.

George met Lawrence on several occasions. They corresponded after the war. Harvard University holds their letters in its archives.

This book offers an intriguing insight into World War I aerial operations that are rarely discussed. The absence of maps will most likely require the serious reader to consult an atlas to adequately appreciate the location of airfields as well as the Turkish strongholds.

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



From F-4 Phantom to A-10 Warthog: Memoirs of a Cold War Fighter Pilot. By Steve Ladd, Col, USAF (Ret). Barnsley UK: Air World Books, 2020. Maps. Tables. Diagrams. Illustrations. Notes. Appendices. Glossary. Index. Pp. vi, 279. \$34.95. ISBN: 978-1-52676-124-8

I approached this review with a jaundiced eye. I, too, went through USAF Undergraduate Pilot Training and conversion to F-4 fighter pilot within one year of Colonel Ladd. In fact, many of our anecdotes and experiences are similar. I have also read and listened to fighter pilots sharing their experiences on many occasions. Often “there I was . . .” could be replaced more accurately with “once upon a time . . .”

In his introduction, Ladd promises a look at the fighter pilot worldview and not an autobiographical look at his achievements. He couldn't have done it an iota better. His recollections are thoughtful, extremely accurate (in my assessment), and self-deprecating. His writing is artful and compelling. He separates the wheat from the chaff. If a leader is weak or ineffective, he identifies what constitutes this judgment. If some fighter pilot antics are juvenile and thoughtless, he says so without making excuses. What Ladd does most effectively is describe the fears, joys, and values unique to the professional fighter pilot. All of this is accomplished in a most readable and interesting journey through his career and experiences. The reader is taken through the rigors of flight school, starting in a small prop aircraft and culminating in piloting the sleek “White Rocket” Talon jet. He explains the rationale for aircraft mission selection and brings Survival Escape Resistance and Evasion training into the reader's mental image.

True to his promise, war exploits are treated in a matter-of-fact manner, but the squadron pilot's exploits of “baby” bullfighting in Spain and the grand destruction of an Officer Club's grand piano are sure to entertain any reader.

Ladd provides quite an excellent description of the challenges of being a flight instructor and then transitioning to a new aircraft, the A-10 Warthog. He is skilled and tenacious in his defense of this pointedly single-mission ground attack aircraft that is slower, uglier, and more basic than all of its predecessors.

Ladd's biggest challenge might be his ground staff tour at a European NATO headquarters. His description of the personalities and idiosyncrasies of our allies is perceptive and entertaining. Needless to say, he was effective in this assignment and was rewarded with another opportunity for airborne leadership of his fighter-pilot brethren.

This book is informative, funny, entertaining, and a truly excellent read. On a personal level, I enjoyed most the evaluation of leadership opportunities both seized and squandered. Colonel Ladd not only provides their descriptions, but also thoughtfully analyzes their results.

My critical read of this book yields very high marks indeed for accuracy, readability, and humor. Upon completion of your reading of this book, I'm confident you will be able to answer Ladd's question: Was he lucky?

Joseph T. Anderson, Maj. Gen., USMC (Ret)



The Black Scorpions: Serving with the 64th Fighter Squadron in World War II. by Gen. James A. Lynch and Gregory Lynch Jr. Havertown PA: Casemate Publishers, 2023. Appendices. Index. Photographs, Maps. Pp. 384. \$39.95. ISBN: 978-1-63624-307-8

General Lynch began his Army career as a private and ended it as a brigadier general. He spent 33 months with the 64th Fighter Squadron—the Black Scorpions—first as an adjutant and later as ground executive officer (think Harvey Stovall in *Twelve O'Clock High*). As a censor for the 64th, he collected letters, reports, and pictures from squadron members that were not supposed to be kept, for fear of them falling into enemy hands. After the war, with the help of his grandson, Greg, he used the information he had collected and turned it into this book.

The North African campaign took place from June 1940 to May 1943. It included the Western Desert campaign in the Libyan and Egyptian deserts, Operation *Torch* in Morocco and Algeria, and the Tunisia campaign. After the Allied victory in North Africa, the Italian campaign began with the invasion of Sicily in July 1943. Allied forces then landed in Italy in September 1943. Allied forces continued to liberate Italy from German occupation until the end of the war in May 1945.

Originally a P-40 Warhawk pursuit squadron, the 64th was assigned to the US Army Middle East Force in Egypt in July 1942. It took part in the British Western Desert Campaign, supporting the Eighth Army's drive across Egypt and Libya. It flew strafing and dive-bombing missions against airfields, communications, and troop concentrations until the Axis defeat in Tunisia. In the Italian campaign, the squadron supported the British Eighth Army's landing and subsequent operations in Italy. In 1944, the squadron converted to P-47 Thunderbolts and flew interdiction operations against railroads, communication targets, and motor vehicles.

Throughout these campaigns, Lynch kept an unauthorized diary and collected intelligence reports, newspaper stories, souvenirs, pictures, and letters from home. After the war he reminisced with fellow veterans about their experiences and compiled this information into this story about the Black Scorpions. The book is written much like a diary including day-by-day passages describing flight operations, activities of both pilots and support personnel, mission risks and outcomes, funny happenings on R&R junkets, and softball games while awaiting mission aircraft.

The squadron made more than 30 field moves. Ground personnel sailed from Boston, through the South Atlantic, around Cape Horn, and ultimately to Haifa, Palestine. The air echelon went by sea to the Gold Coast of Africa, flying their aircraft from the deck of the USS *Ranger* (CV-4) to Lagos, across Africa's sub-Saharan areas to Khartoum, and then to Haifa. Flight operations began at Edku, Egypt, just east of Alexandria. They moved across North Africa to

Tunisia, and then to Malta, Sicily, and southern Italy. Lynch describes battles with the elements, heat, blowing sand, and scorpions in the desert; and rain, mosquitos, and cold in Italy. Also, many locals resided near some of their bases who always seemed to be short of money and food!

While not a page turner, the book does keep the reader's interest. It is an excellent review of what fighter-squadron ground-support personnel had to go through to keep our boys flying during the Second World War.

Frank Willingham, docent, National Air and Space Museum



Rise of the War Machines: The Birth of Precision Bombing in World War II. By Raymond O'Mara. Annapolis MD: Naval Institute Press, 2022. Photographs. Drawings. Pp. 338. \$49.95. paperback. ISBN: 978-1-68247436-5

During his USAF career, Colonel O'Mara flew the F-15 in both operations and operational test assignments. He retired in 2016 and then worked in commercial aerospace and advanced technology startup companies. He is an independent defense and technology consultant who attended the Massachusetts Institute of Technology to earn his PhD in Technology, Policy, and Engineering Systems.

His first book is well-researched and informative. It examines the development of precision bombing during World War II. O'Mara argues that the rise of precision bombing was a product of the complex interplay between technology, doctrine, and human factors. He traces the history of precision bombing from its early beginnings to its peak during the Combined Bomber Offensive, and he provides a detailed analysis of the factors that contributed to its successes and failures. The book is a repackaging of his 2011 dissertation: *The Socio-Technical Construction of Precision Bombing: A Study of Shared Control and Cognition by Humans, Machines, and Doctrine During World War II*. It can be downloaded for free at <https://dspace.mit.edu/handle/1721.1/67754>.

One of the strengths of O'Mara's work is his focus on the human factors involved in precision bombing. He argues that the success of precision bombing depended on the development of a new kind of human-machine team, one that could coordinate the complex tasks involved in accurately delivering bombs on target. O'Mara provides a detailed analysis of the training and skills that were required for this new kind of team, and he shows how the team's development was essential to the success of precision bombing.

Another strength of O'Mara's book is his analysis of the relationship between technology and doctrine. He argues that the development of new technologies, such as the

Norden bombsight, did not automatically lead to more accurate bombing. Instead, his thesis is that the development of new technologies was shaped by the prevailing doctrine of strategic bombing. O'Mara shows how the doctrine of strategic bombing evolved over time, and he shows how this evolution was influenced by the development of new technologies.

Overall, *Rise of the War Machines* is a painfully dry and sterile analysis of the development of precision bombing during World War II. As I read the dissertation and the derivative book, I was struck with a thought: "experts" write books to share their expertise, while other books are written for the author to gain the status of an "expert." To this reader, O'Mara's book falls in the second category.

Gary Connor, Cortland, Ohio



A Pair of Aces and a Trey: 1st Lieutenants William P. Erwin, Arthur E. Easterbrook, and Byrne V. Baucom - America's Top Scoring World War I Observation Pilot and Observers. By Alan L. Roesler. Havertown PA: Casemate Publishers, 2023. Photographs. Maps. Tables. Illustrations. Notes. Bibliography. Index. Pp. vii, 214. \$34.95. ISBN: 978-1-63624-187-6.

As a new student of World War I in general and World War I aviation in particular, I eagerly seek out works on technology, operations, and personalities of the period. This new work covering three aviators of the First Aero Squadron struck me as very unique among my readings.

The First Aero Squadron was the initial combat-ready aviation unit in the American Expeditionary Forces (AEF). It was commonly called an observation squadron and assigned to various AEF divisions to provide photographic and visual reconnaissance, surveillance of enemy artillery activity, infantry contact patrols, friendly artillery adjustment and control, and special missions for higher-level commanders. Erwin, Easterbrook, and Baucom were drawn from a variety of backgrounds to aviation, becoming comrades in the squadron, and ended up as the unit's most highly decorated members: a total of ten Distinguished Service Crosses and the added oak leaf clusters and bar.

One would expect aces (aviators who have shot down at least five enemy aircraft) to come from pursuit or fighter units, not observation squadrons. However, pilot Erwin scored at least eight aerial victories. His observers, Easterbrook and Baucom, scored five and three confirmed victories respectively. They accomplished this while supporting the fiercest ground combat from July to November 1918 and demonstrated their daring and mission commitment while flying their Salmson 2A2 against German aviators, anti-aircraft machine guns, and ground fire. The detailed mission reports, especially those by former newspaper reporter Baucom, aptly described the sometimes

repetitive, often hair-raising, missions these aviators faced. Readers desiring in-depth and technical details on mission parameters and equipment can consult *Shooting the Front* by Terrence Finnegan and *Eyes All Over the Sky* by Jim Streckfuss for such discussions.

Roesler ends his work covering the efforts of these flyers after World War I. Surviving the dangers of combat aviation, Erwin was lost during the 1927 Dole Air Race from the US to the then-Territory of Hawaii. Baucom passed in a 1928 accident when his DH-4 crashed into power lines following mechanical trouble. Easterbrook survived his comrades, remained in the Army, and retired as a USAAF brigadier general after World War II.

This book is an extensively, exhaustively researched look into an often lightly covered aspect of American military aviation in World War I. It is rich with photographs, some of which appear to be new in print. Several of these and the color illustrations of specifically mentioned aircraft, should appeal to aircraft and diorama modelers. There are, however, several problems with the book. Its maps are in all in dark hues which made details very hard to follow or correlate to the relevant text. Some grammatical issues required re-reading to determine the intent. Once, the text indicated “table below” when the table actually appeared above. The reader could have been better served by color maps and a closer proofreading.

Despite these problems, Roesler’s work emphasizes three interesting individuals with some discussion on technical details and mission parameters. It is a most welcome addition to any aerial reconnaissance collection.

Timothy J. Hosek, USG (Ret)



Luftwaffe Victory Markings 1939-45. By Philippe Saintes. Place: United States and United Kingdom. Publisher: Casemate Publishers, 2021. Photographs. Drawings. Pp. 191. \$39.95. hardback. ISBN: 9781636240909

Keeping score in war seems to trivialize the life and death conflict that is the essence of the ultimate form of political interaction. But given its long, varied, and multicultural roots, keeping score is part of basic human nature. Saintes uses his book to focus on a very narrow niche of score keeping: Luftwaffe aerial combat victories during World War II. The title led me to anticipate a scholarly work on the subject, explaining the evolution of colors, shapes, and content. Providing information that would allow the reader to examine a photograph of a Luftwaffe aircraft which shows victory markings and draw conclusions on the date and location where the shot was taken. But Saintes takes a different, less academic approach. He found photographs of Luftwaffe pilots showing their aircraft, then used the narrative to tell their service history and fate. Saintes is clearly something of a Luftwaffe fan-

boy; his word choice establishes his reverence for his subjects.

That is not to devalue the content of the book. His photo curation is top notch, and his research seems to be complete down to sorties, victories, and losses. There are color profile images to add to the visual interest and keep the reader’s eye engaged. But, at the end of the day, what isn’t said is as important as what is.

For example, most armchair historians would agree that the Luftwaffe had one of the most rigorous victory credit protocols of any World War II combatant. It was not unusual for victory credit to take over a year to be awarded. So, did the aircrew or their assigned “Black Men” wait a year to paint a victory marking or did they apply the mark immediately after the flight and bet on formal award to come later? Saintes talks about how the Luftwaffe arrived at the aircraft rudder as the location for victory award markings, but offers no information on the size, color, or content of the marking itself. At some point, as Eastern Front victories reached astronomical numbers, someone decided to paint a number followed by markings. Three hundred victories might appear as the number “275” with twenty-five awards below. The rudders got even more crowded when the various levels of Knight’s Cross were also applied, but there is no discussion of that addition.

Luftwaffe Victory Markings is a pleasant read. The paper is high-quality which shows the images very well. It is worth acknowledging again the quality of the author’s curatorial skills. But there were many opportunities for Saintes to do so much more with the subject, so I was disappointed at the end of the reading.

Gary Connor, Cortland OH



Bader’s Spitfire Wing: Tangmere 1941. By Dilip Sarkar. Barnsley UK: Pen and Sword, 2022. Photographs. Drawings. Pp. 298. \$49.95. ISBN: 978-1-39901705-3

Sarkar is a very well-known author among armchair aviation historians. His body of work is extraordinary, and *Bader* is a worthwhile addition to his resume. Having Bader as his centerpiece ensures the book will garner attention. Including a controversial hypothesis on how Bader’s final sortie ended is only icing on the cake.

Bader was a charismatic figure from his youth. He was destined for the upper echelons of the Royal Air Force until an accident necessitated amputation of his legs. Undeterred, he used prosthetic limbs to fight his way back onto flying status in time for the Battle of Britain where he ignited a controversy with his “Big Wing” tactic. Sarkar picks up Bader’s story after the end of the Battle of Britain, when the RAF began to conduct a “non-stop offensive” against German occupiers in France. Keep in mind, the RAF was ill equipped for such a campaign. Their best fighters, the

Hurricane and Spitfire, were short-range, point-defense weapons. Their best bombers—well, to be honest, the RAF in 1940 didn't have a best bomber.

Bader was given command of the fighter forces based in Tangmere on the southeast coast of England. Sarkar draws heavily from unit war diaries and personal memoirs and logbooks which show that the pace was unrelenting. Bader was at the front on every mission—often two or three times a day. Many were low-level tactical strikes where the liquid-cooled engines of the Spitfires were especially vulnerable. One bullet through the glycol tank or radiator could bring a plane down.

Sarkar makes clear that while many of Bader's colleagues bestow mythic status on Bader, a significant number held him in very low regard. Bader publicly berated officers and enlisted personnel for trivial offences while laughing off his own mistakes and foibles. Sarkar builds a strong case that by August 1941, Bader was mentally and physically exhausted and prone to slow reaction and errors in judgement that eventually cost him his freedom.

Taking a bold step, Sarkar often praises the accuracy of the Luftwaffe's victory credit system and chastises the RAF's penchant for grossly overclaiming victories. The Luftwaffe couldn't determine with certainty who brought down Bader, but Sarkar builds a compelling case that he was brought down by another Spitfire in a friendly-fire incident. He survived the shutdown and spent the rest of the war in German POW camps.

I began this read with some trepidation. I had the honor of serving on an exchange tour with the RAF where Bader is still revered by most and vilified by a few. I placed him in the same group as Montgomery: charismatic, technically proficient, supremely self-confident, and not someone you would care to be around. But once I got past Bader the man and got into the book, I found it a thoroughly enjoyable read. Sarkar is clearly a meticulous researcher who had access to unique materials and memories. He dealt with Bader and other members of the Tangmere Wing honestly and warmly. And he builds his friendly-fire case objectively and with sensitivity. This book is a quality product, printed on high quality paper that shows the myriad photographs in remarkable detail. Most importantly, Sarkar's writing is smooth and effortless. Even with the large amount of quoted text imported from other sources, the narrative clearly flows.

Whether you have feelings about Bader or not, this is an excellent book to gain insight into the summer of 1941 when, ready or not, the RAF went on the offensive.

Gary Connor, Cortland, Ohio



Sixty Squadron R.A.F.: A History of the Squadron from Its Formation. By Group-Captain A. J. L. Scott. Philadelphia: Casemate Publishers, 2016 (reprint). Photo-

graphs. Appendices. Pp. 147. \$29.95. ISBN: 978-1-61200-385-6

In the early days of World War I, aerial combat was virtually unknown. The primary missions were reconnaissance and, occasionally, bombing. As the war progressed and aircraft became more specialized, Sixty Squadron was formed in May 1916 as a fighter squadron in the Royal Flying Corps (RFC). Squadron members were in the prime of their youth, between the ages of 18 and 30, and included some of the RFC's most famous personalities such as Robert Smith-Barry, who would revolutionize flight training, and William Earle Molesworth.

On April 1, 1918, the Royal Air Force (RAF) was formed, combining the RFC and the Royal Naval Air Service (RNAS). By the time the Armistice was signed, there were over two hundred service squadrons in the RAF including 35 frontline squadrons, the bulk of which were stationed in France. Sixty Squadron was one of the most highly-decorated: one Victoria Cross, five Distinguished Service Orders (one Bar), thirty-seven Military Crosses, and five Distinguished Flying Crosses. The squadron is credited with downing 274 Triple Alliance aircraft during approximately 1500 distinct air engagements.

First published in 1920 by the squadron's fourth commanding officer, the book details the squadron's actions and losses from its commissioning at Gosport to its final days in France and demobilization. From its arrival at St. Omer, France, to the signing of the Armistice in November 1918, the squadron saw action at the Somme, Arras, Passchendaele, and the 1918 March offensive. Losses were heavy: 35 pilots were lost during the eight weeks between the last week of March and the last week of May 1917. Replacements from England had absolutely no experience in frontline aircraft and had to be trained "on the fly" during operational missions.

Throughout the squadron's history, many new weapon technologies and tactics were introduced by both sides. Scott provides some description of the Le Prieur rockets and tracer ammunition that were used to down German observation balloons. He well describes the "Compass Call" missions, during which British compass stations intercepted wireless transmissions from German spotter aircraft and directed British interceptors. Additionally, he discusses German countermeasures to fighter and bomber aircraft. One of these was "Flaming Onions"—balls of fire fastened together and shot to fall over the attacking Allied aircraft to bring them down in flames.

I first found this book while researching three distant cousins who fought for the British Empire as members of the New Zealand armed forces. Two of them were wounded at Passchendaele, and I was looking for anything that would provide me with a description of what they endured for several days wallowing in the mud waiting to be brought home to friendly lines. The original book is available in PDF format on several open-source websites. There

are several differences between the latest edition and the original. The original includes two maps and an index; the current edition does not. But the current edition provides an introduction and a biography of the author as well as two additional appendices: combat claims and a brief history of the squadron from 1920 to 1990.

I would recommend this book to anyone looking for a quick and enjoyable first-hand account of the experiences of RAF pilots, their aircraft, and the tactics they employed against German fixed-wing and lighter-than-air craft during The Great War.

John F. "Jack" Keane, LCDR, USN (Ret)



The Air War in Vietnam. By Michael E. Weaver. Lubbock TX: Texas Tech University Press, 2022. Illustrations. Photographs. Maps. Notes. Bibliography. Pp. 640. \$49.95. ISBN: 978-1-68283085-7

Michael E. Weaver is an Associate Professor of History in the Department of Airpower at the USAF's Air Command and Staff College. He specializes in aviation, Cold War, and American history and is the author of *Guard Wars: The 28th Infantry Division in World War II* as well as numerous journal articles.

This volume examines the effectiveness of US air power during the Vietnam War. Weaver describes how the expected limited conflict escalated into a major war because of a series of policy goals and decisions made by the Johnson and, later, Nixon administrations. He reviews how the US was competing against the aggression of the Soviet Union and China.

The strategy for dealing with their agendas was to contain, not roll back, efforts to expand their power and influence. However, the military had failed to develop limited war and counterinsurgency capabilities and, thus, were not intellectually or doctrinally oriented to wage war against the communist insurgency.

Weaver goes on to present the fallacy of assertions that air power had failed to win the war. He states that Vietnam was not a failure of air power or ground power or a failure of counterinsurgency or conventional warfare. It was a failure of war. Senior leaders never executed the war in a manner related to the complexity of southeast Asia. He suggests that US Air Power was about as successful as it could have been, given the character of the war. Weaver presents a view made by others, that while losing the Vietnam war, the US achieved important geopolitical goals and gave many other nations of southeast Asia, including Japan, South Korea, Thailand, and the Philippines time to outgrow the communist threat.

The book is arranged in three major sections:

Air superiority and national policy: aerial refueling, air su-

periority, weapons technology, and air power organization and management.

Air support and air power effectiveness: photo reconnaissance, airlift effectiveness, and air strikes against ground forces.

Coercion and interdiction: air interdiction, restrictions and rules of engagement, bombing accuracy, and conclusions.

Weaver presents a narrative to support his analysis. He analyzes air power effectiveness from the tactical level of war to the level of national security policy. Weaver goes beyond simply relating what took place in the war. He examines, for example, the effectiveness of operations, such as close air support, in terms of ground-force enablement; bombing missions in terms of responsiveness and bombing accuracy, especially operations against North Vietnamese supply lines; airlift operational consequences and benefits; contributions of photographic reconnaissance missions; technological requirements and barriers; gaining air superiority over enemy territory; and aerial tanker enablement and indispensability.

There is something in this book for several audiences: diplomatic historians, air power advocates and critics, military historians, and historians of technology and aviation. Each chapter is thoroughly researched and well documented. Weaver includes many vignettes to provide exciting backgrounds for his main points. This is an excellent, but not a weekend. Read. It is an excellent source book for all phases of air operations throughout the entire period of the war.

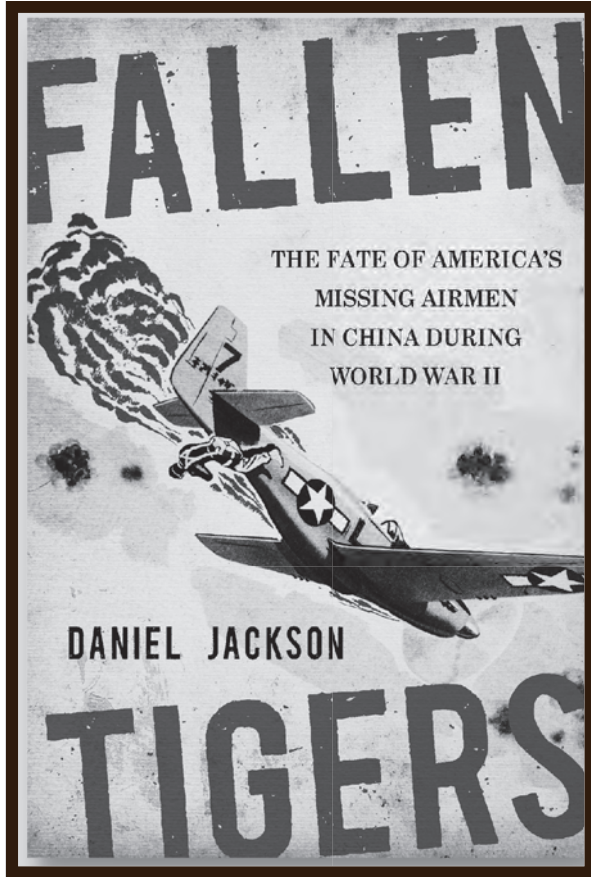
Frank Willingham, Docent, National Air and Space Museum



D-Day, Arnhem & The Rhine: A Glider Pilot's Memoir. By Robert F Ashby. Yorkshire UK: Pen and Sword, 2022. Photographs. Drawings. Notes. Bibliography. Pp. 177. \$34.95. ISBN: 978-1-39908-818-1

Almost all major World War II combatants fielded some form of glider assault force. The successful German attack on the Eben Emael fortress in May 1940 was noted worldwide and set the model for the rest of the war. However, the glider's heyday was short-lived. The rapid evolution of helicopters, with greater operational capability and flexibility, put a quick end to gliders. But for a brief period, glider pilots such as Sgt Ashby took their unpowered and relatively flimsy aircraft into harm's way to achieve operational surprise. Unfortunately, operational limitations and tactical blunders often bought success at a very high price.

Ashby's work is a memoir, written 40 years after the events. Jonathan Walker edited the book and offers an introduction to each of its main segments. Walker's contribu-



The University Press of Kentucky
congratulates **Daniel Jackson** on
receiving the inaugural
**Air Force Historical Foundation
Book Prize**

"Moving and brilliant. From the very first page, this account of American airmen fighting in the skies of World War II China grips readers and never lets them go."

—Rana Mitter, author of *China's Good War: How World War II Is Shaping a New Nationalism*



tions are italicized; he clearly wants Ashby's words to stand on their own. Ashby explains how he came to be a glider pilot and then addresses each major operation he participated in. A librarian by trade, his writing is clear, concise, and very British. Where unsure of a particular fact or situation, he says so. If he was expressing his opinion (as he frequently does), he makes that clear. The book is very readable.

Ashby is very proud of his contributions and those of the glider force to D-Day. The British 6th Airborne Division, including the glider force, masterfully secured the

northern flank of the invasion. But that positive high was to be short-lived.

Arnhem was clearly a very emotional topic. It is safe for the 21st Century armchair historian to note that *Market Garden* was a debacle. It is very different when a participant describes why it was so. When Ashby describes the retreat/rout of the British forces, he exposes his own fear and loss. He was separated from his co-pilot during the night evacuation and describes how his comrades shed uniforms, discarded weapons, and abandoned any semblance of an organized withdrawal. Ashby recognizes his fragile

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emotional state in drawing out those memories and makes clear that he believes he was experiencing what we now call PTSD. It seems that he was willing to endure the memory of the debacle so modern readers would know the “truth” of the failure of Montgomery’s plan and the cost that failure required Ashby’s comrades to pay.

After the powerful Arnhem segment, the glider crossing of the Rhine comes across almost as an afterthought. After Arnhem, losses among the glider pilots were so severe that RAF pilots were involuntarily transferred to gliders so there would be enough for the operation. Ashby talks about the effects this personnel decision had on morale for both glider veterans and RAF pilots.

It seems that Ashby wasn’t willing to end the story. In “Epilogue and Reflections,” he again recounts the *Market Garden* debacle in even more detail. He bitterly notes that despite extensive service in three of the most critical European actions, he received no recognition, award, or decoration. His service record reads much like that of a truck mechanic in the Royal Service Corps. After his description of Arnhem, his writing takes on an unbearable sadness and loss. While he built a very successful post-war career and family, he never escaped the sense of betrayal the Army placed on his shoulders. His ability to communicate these emotions throughout the book makes reading it even more worthwhile. I highly recommend the book.

Gary Connor, Cortland, Ohio



The Archaeology of The Royal Flying Corps: Trench Art, Souvenirs, and Lucky Mascots. By Melanie Winterton. Havertown, PA: Pen & Sword, 2022. Photographs. Illustrations. Tables. Notes. Bibliography. Index. Pp. vii, 155. \$39.95. ISBN: 978-1-39909-726-0

Admittedly, the main title made me expect discovery of lost airfields, crash sites, and the like through application of new remote sensing and analytic techniques. Instead, I was treated to a fascinating discussion of the emotional and psychological aspects of World War I combat aviation and their most personal manifestations in items such as souvenirs and lucky charms. Winterton obtained a Ph.D. in modern conflict archaeology at the University of Bristol in 2019. She is semi-retired from the publishing field and is now an independent researcher with a life-long interest in aviation.

Winterton’s work first establishes common frames of reference with the reader so that we may understand her anthropologically-oriented examination. Combat aviation in World War I was an entirely new sensory experience: engagement of the aviator with the aircraft, the airspace he was moving through, and weather.

She interrogated diaries, memoirs, official reports, photographs, and previously-recorded personal interviews

with World War I aviators to establish what was required to become a Royal Flying Corps aviator in World War I—the pioneering days of training and combat. She then established multi-sensorial haptics (perception of objects by non-language communication or meaning through physical contact), as the foundation of her inquiry and the source for the creation of rituals, talismans, and lucky charms.

Learning to fly at that time was not easy. It required reforming the mind and body to deal with the new environment. The pilot had to learn the skills and develop the experience to treat the airplane as an integral part of himself. He experienced a new sense of bodily movement when flying—something Winterton experienced and described herself when she flew. This was further complicated with the need to engage in observation, photography, air combat, ground support, or other assignments. Winterton addresses the sources of fear and anxiety among these aviators and the strategies they developed in the form of rituals, omens, and objects endowed with hope of survival.

An interesting aside in the book comes during the discussion of several mass-produced lucky charms, souvenirs, and talismans sent from families at home to aviators at the front—impersonal objects until imbued with meaning by the family or significant other.

Winterton’s work is an extensively researched look into a new and unique aspect of combat aviation in World War I. The book is rich with photographs and plates which complement the discussions very well. Her work emphasizes the physical, emotional, and psychological engagement of aviators with the new theater of warfare, the air, and everything required for them to become combat aviators. The personal artifacts developed as coping mechanisms for stress and fear, along with artifacts such as pieces of crashed aircraft, connected the living with the dead emphasizing personal and communal aspects of the memorabilia; and are probably why they are still emotionally charged today. Winterton’s book is a good introductory effort on the haptic environment of World War I aviators and their personal artifacts. Likewise, it could provide material and human context to collectors of such artifacts and memorabilia.

Timothy J. Hosek, USG (Ret)



<p style="text-align: center;">PROSPECTIVE REVIEWERS</p> <p>Anyone who believes he or she is qualified to substantively assess books for the journal should contact our Book Review Editor for a list of books available and instructions. The Editor can be contacted at: Col. Scott A. Willey, USAF (Ret.) 46994 Eaker St Potomac Falls VA 20165 Tel. (703) 409-3381 e-mail: scottlin.willey@gmail.com</p>
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Coming Up



Compiled by
George W. Cully

August 14-18, 2023

The **International Committee for the History of Technology** will hold its annual meeting in Tallinn, Estonia. The theme of this year's meeting is "Interdependencies: From Local Micro-stories to Global Perspectives on the History of Technology." For registration and other information, see the Committee's website at Annual Meeting (icohtec.org).

August 24-26, 2023

The **Tailhook Association** will hold its annual gathering at the Nugget Casino in Reno, Nevada. For additional information, see the Association's website at <https://www.tailhook.net/>

September 9-13 September, 2023

The **Air and Space Forces Association** will hold its annual National Convention and Symposium immediately followed by its annual Air, Space and Cyber Conference and Symposium at the Gaylord National Resort in National Harbor, Maryland. For registration and other information, see the Association's website at AFA National Convention | Air & Space Forces Association.

September 15-19, 2023

The **Air Force Historical Foundation** will hold its Annual Symposium and Air and Space Museum Conference at the Hyatt Denver and Wings Over the Rockies Museum. Further information will be forthcoming at www.afhistory.org/events/.

September 27-30, 2023

The **Society of Experimental Test Pilots** will host its 67th annual Symposium and Banquet at the Grand Californian Hotel in Anaheim, California. Additional information can be found at the Society's website at Annual Symposium & Banquet | Symposium/Meetings <https://www.setp.org/>

October 9, 2023 – January 31, 2024

The **American Society of Aviation Artists** will present its 35th annual International Aerospace Art Exhibition at the Pima Air & Space Museum in Tucson, Arizona. For more information, see the Society's website at ASAA 2023 Call for Entry – The American Society of Aviation Artists (asaa-avart.com).

October 18-21, 2023

The **Oral History Association** will hold its annual meeting at the Hyatt Regency Baltimore Inner Harbor in Baltimore, Maryland. This year's theme is "Oral History As/And Education: Teaching and Learning in the Classroom and Beyond." For registration and other details, see the Association's website at 2023 Call for Proposals | Oral History Association.

October 25-27, 2023

The **American Astronautical Society** will host its 16th annual Wernher von Braun Memorial Symposium at the University of Alabama at Huntsville in Huntsville, Alabama. For more details as they become available, see the Society's website at Wernher von Braun Memorial Symposium | American Astronautical Society.

October 25-29, 2023

The **Society for the History of Technology** will hold its annual meeting at the Hyatt Regency Long Beach Hotel in Long Beach, California. For more details as they become available, see the Society's website at News – Society for the History of Technology (SHOT).

October 27-28, 2023

The **National WWI Museum and Memorial** will host a symposium at the Museum in Kansas City, Missouri. For more details as they become available, see the Museum's conference webpage at News | National WWI Museum and Memorial (theworldwar.org).

October 28-29, 2023

The **League of World War I Aviation Historians** will offer a symposium at the National WWI Museum and Memorial in Kansas City, Missouri. For further information, contact the League's president, Dan Polglaze at dpolglaze@comcast.net.

November 9-12, 2023

The **History of Science Society** will hold its annual meeting in Portland, Oregon. For more details as they become available, see the Society's webpage at History of Science Society (hssonline.org).

December 7-9, 2023

The **National World War II Museum** will host its 16th annual International Conference at the Museum in New Orleans, Louisiana. For registration, see the Museum's website at 16th International Conference on World War II | The National WWII Museum | New Orleans (nationalww2museum.org).

December 11-13, 2023

The **Association of Old Crows** will hold its 60th Annual Symposium and Convention at the Gaylord National Resort & Convention Center in National Harbor, Maryland. For more information, ping a Crow at AOC 2023 (crows.org).

January 18-19, 2024

The **NASA History Office** and the **National Air & Space Museum** will jointly sponsor "Discover@30 and New Frontiers@20: a Symposium on NASA's Discover and New Frontiers" space exploration programs. This event will be held at the National Academy of Sciences Building, 2101 Constitution Ave, Washington, D.C. For details visit the web site at www.nasa.gov.

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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History Mystery Answer



Gen. Nathan F. Twining



Gen. George S. Brown



Gen. David C. Jones



Gen. Richard B. Myers

Since 1949, four Air Force Generals have served as the Chairman of the Joint Chiefs of Staff. Upon confirmation, General Charles Brown will be the 5th Air Force General to serve as the Chairman of the Joint Chiefs of Staff and the first Air Force General in over 18 years. General Nathan F. Twining was the first Air Force General to be appointed as the Chairman of the Joint Chiefs (Aug 1957 – Sept 1960), when he was confirmed as the 3rd Chairman in 1957. General George S. Brown was the second Air Force General to serve as Chairman (Jul 1974 – June 1978). President Nixon appointed General Brown as the 8th Chairman of the Joint Chiefs in July 1974. General David C. Jones (June 1978 – June 1982) became the 9th Chairman of the Joint Chiefs. Generals Brown and Jones as chairman was the only time two Air Force Generals served back-to-back as Chairman. Most recently, General Richard B. Myers became the 15th Chairman of the Joint Chiefs, (Oct 2001 – Sept. 30, 2005). General Myers was the first Air Force General to serve as the Chairman, who had not served during World War II/Korean War.

Use the following links to learn more about the following topics;

General Charles Brown's nomination:

<https://www.safia.hq.af.mil/IA-News/Article/3417599/biden-nominates-top-notch-strategist-as-next-joint-chiefs-chairman/>

Biographies of all the generals can be found at:

<https://www.af.mil/About-Us/Biographies/>

The Early history of the Chairman of the Joint Chiefs of Staff

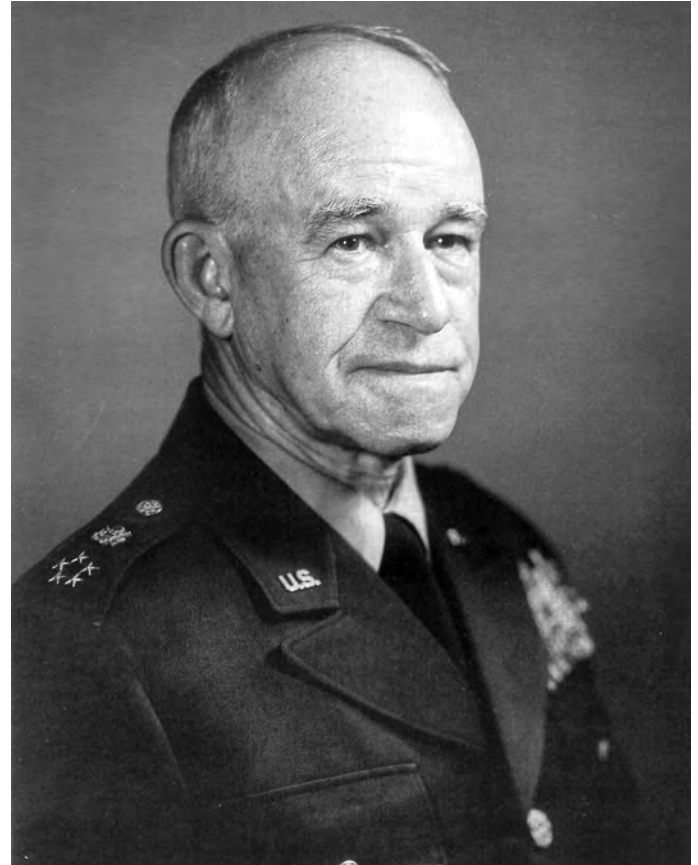
The Chairmanship Of The Joint Chiefs Of Staff 1949–2016 by Nathan S. Lowrey, <https://apps.dtic.mil/sti/citations/AD1021305>

The current role of the Chairman of the Joint Chiefs of Staff ;

<https://www.jcs.mil/About/The-Joint-Staff/Chairman/>



General Charles Q. Brown



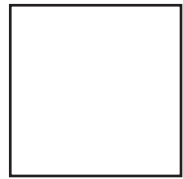
General Omar N. Bradley



This Issue's Quiz: Question: This past May, President Biden nominated the current and 22nd Chief of Staff of the Air Force, General Charles Q. Brown to serve as the Chairman of the Joint Chiefs of Staff. Upon confirmation, General Brown would become the 21st Chairman of the Joint Chiefs. The position of Chairman of the Joint Chiefs was initially created in 1949 with General of the Army Omar Bradley serving as the first Chairman of the Joint Chiefs. Per the Goldwater-Nichols Act of 1986, the Chairman is the senior ranking member of the Armed Forces and serves as the principal military adviser to the President. In a three-part question, how many Air Force Generals have served as the Chairman of the Joint Chiefs of Staff? Can you name them? Which one was not a World War II/Korean War veteran?



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