

AIR POWER

FALL 2009 - Volume 56, Number 3
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History



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The Fall 2009 issue begins with the feature story of Frank Luke, Jr., the famed World War I American ace. Best selling author, Blaine Pardoe, follows Luke's military exploits from the time he had acquired the nickname, "wild man in the air," until Luke emerged as the scourge of the German balloonists. Luke's recklessness and courage transformed him into a media sensation and Medal of Honor recipient. In addition, Pardoe also offers a plausible explanation regarding Luke's death.

During 1964, the U.S. Air Force's first-line fighter units in the United States, Germany, and Japan were equipped with the Republic-built F-105B Thunderchief. The Air Force's transition to the "Thud" was beset by numerous accidents that revealed design and manufacturing deficiencies. Caught up in this turmoil was the Air Force's Thunderbirds aerobatic team. Howard Plunkett recounts how the F-105 was selected, the modifications that were applied, the team that performed in the six shows leading to the fatal accident, and the aftermath.

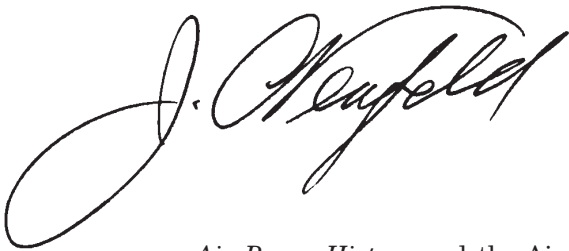
In the third article, Parker Temple and Peter Portanova, tell the story of the deployment of the U.S. Air Force's Thor IRBM—Intermediate Range Ballistic Missile—to the United Kingdom, beginning in 1958. The authors describe Thor's rapid development, the Cold War era imperative to counter the Soviet Union's missile threat, the Cuban Missile Crisis, Thor's obsolescence, and the emergence of the Air Force's Atlas ICBM.

The recent death of former Defense Secretary Robert S. McNamara provides an opportunity to consider his relationship with the U.S. Air Force. Readers will want to turn to the "Readers' Note: McNamara and the Air Force," pages 52-53, where Herman S. Wolk, the former Senior Air Force Historian, and an interviewer of Mr. McNamara, presents an essay on the subject.

Included in this issue are nineteen book reviews and a list of new books received. News items, Foundation Notes, letters to the editor, and the History Mystery appear in their regular places.

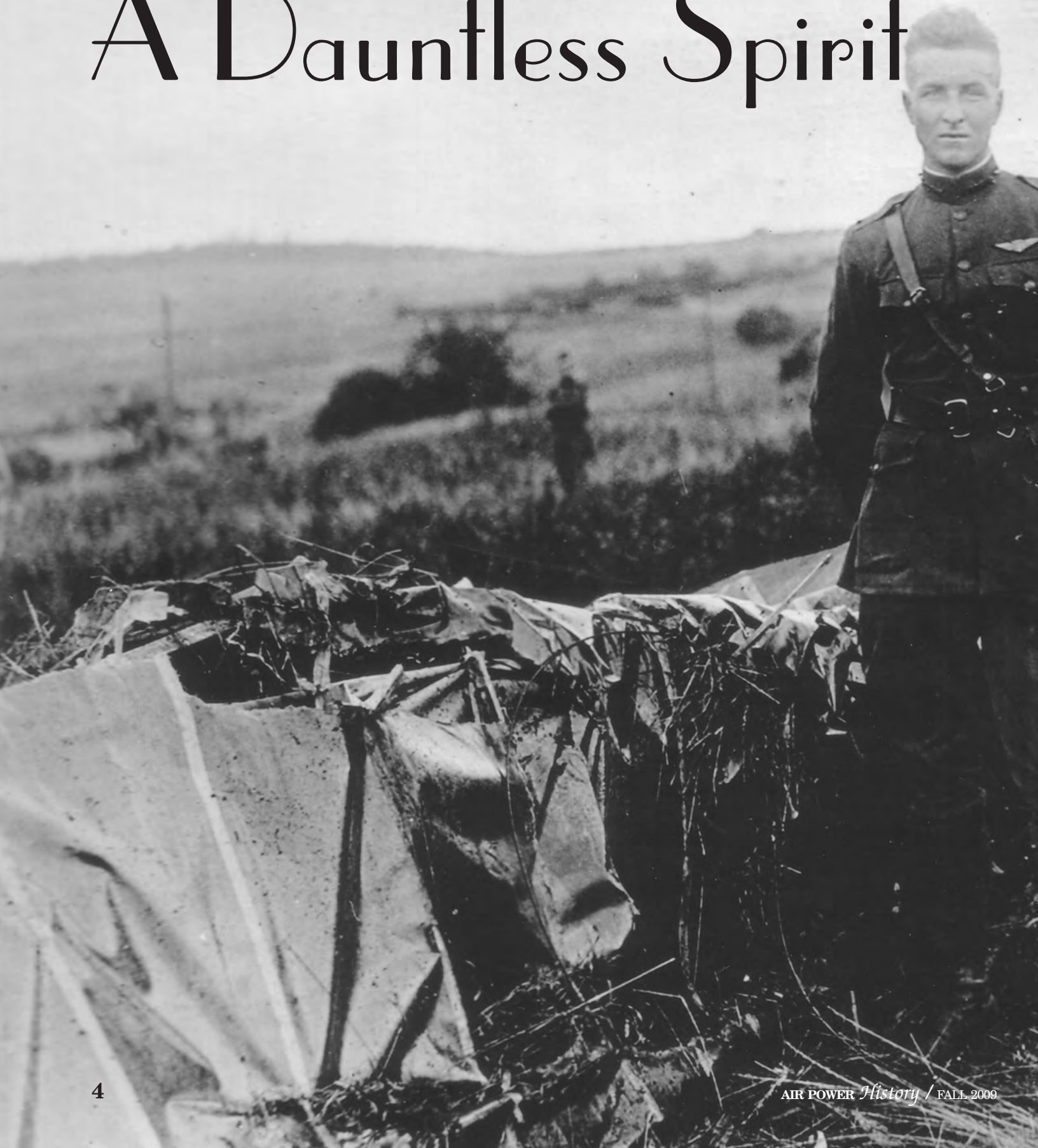
Undoubtedly, the top news item in this issue, concerns the succession of the leadership of the Air Force Historical Foundation. Lt. Gen. Michael A. Nelson, who had announced his retirement effective at the end of 2008, agreed to extend his term for another six months, to permit time to find a successor. That quest ended with the election of Maj. Gen. Dale W. Meyerrose. Brief biographies of the two leaders are presented. (See pages 66 and 67.)

Finally, we urge readers to not delay in signing up to attend the Foundation's symposium on October 8th. (See page 68.) Tickets are going fast for this biennial event, which will feature Gen. Norton A. Schwartz, the present Chief of Staff of the Air Force, and Gen. Michael E. Ryan, the sixteenth chief. On the program are many other operators, historians, and analysts. The Foundation's most prestigious awards will be made during this event.



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Frank Luke Jr.: A Dauntless Spirit





Blaine Pardoe



(Overleaf) Frank Luke stand in front of the wreckage of a balloon he destroyed.

(Above) Frank Luke posing. (All photos courtesy of the author.)

For a man only twenty-one years old, he had accumulated a long list of nicknames. Some of his squadron mates called him “The Arizona Boaster,” while others simply called him, “Yellow.” But after a few brilliant weeks in the air, he accumulated more titles: “The Balloon Buster from Arizona,” “Sausage Cooker,” “Lone Eagle,” “Wild Man in the Air,” and “Arizona War Eagle.” Still others referred to him as “the nut,” more out of awe than derision.¹

In many respects they were all correct. His real name was Frank Luke Jr., and for a time, he was a media sensation around the world. Luke was the first American pilot and the first Arizonan to be awarded the Medal of Honor. His death, as initially reported, had some of the trappings of a modern rendition of the Battle of the Alamo for a public that saw him as representing the last of the wild-west. To this day, his statue stands in front of the Arizona State Capitol building—a monument to Luke’s bravery and audacity.

For many years Luke stood in the shadow of Eddie Rickenbacker, another famous aviator of World War I. History tends to be kind to those fortunate enough to survive the horrors of war, and in the case of Rickenbacker his leadership and record more than helped preserve his image in the minds of many Americans.

Blaine Pardoe is the best-selling author of numerous books including the new and definitive Frank Luke biography, Terror of the Autumn Skies, (July 2008, from Skyhorse Publishing) and The Cruise of the Sea Eagle, (Lyons Press), on the life of Count Felix von Luckner. He is currently writing two books, one on Frederick Zinn of the Lafayette Flying Corps and one on Bert Hall of the Lafayette Escadrille. He can be reached at bpardoe870@aol.com.

The reality is that for two short weeks Eddie was ranked the number two pilot—in terms of enemy kills—behind Frank Luke. Rickenbacker inherited his title “Ace of Aces” only after Luke was shot down. Rickenbacker himself acknowledged the skill of this young boy from the west; “Had Lieutenant Luke lived he would have put me out of business as the leading ace long ago.” Rickenbacker recognized that Luke’s fighting style was all-out and dangerous. “He was a wild man in the air.”²

From the Arizona Territory

Frank Luke, Jr., was born in 1897, a few years before Arizona became a state. He was one of nine children from a devoutly Catholic family living in Phoenix. His father, a tax assessor and part-time land speculator, had come to Arizona in the 1870s and made a tidy sum investing in silver mines. Frank was raised at a different time. He got his first rifle at the age of twelve and spent his idle time horseback riding, hunting, and camping with his friends out in the desert and mountains.

Phoenix was a town of only a few thousand people. There were Indian reservations on the outskirts of the city that still bore the trappings of the “old west.” Frank worked summers in the dusty little town of Ajo, near the Mexican border, working in the mines digging copper. For a short time, he and a friend ran a dance hall in Ajo, teaching the grungy miners how to dance. He boxed in the mining camp, mostly as a form of gambling and cheap entertainment. Most of Phoenix’s streets were still dusty, unpaved lanes, though new technology in the form of the telephone and the automobile was slowly creeping in to drive a nail into the western lifestyle.

The airplane had been invented a little more than a decade before and the Great War had already begun to transform this new technology into an effective tool of warfare. Frank Luke wanted to embrace the future by becoming a pilot. Given his charged personality and lifestyle, aviation seemed a perfect fit. He applied to the Army Air Service, but weeks went by with no response. An impatient Frank wrote the Army, demanding that he be sent to aviation training. The Army apparently acquiesced and on September 29, 1917, he reported for training at Austin, Texas.

Into the Air

Competing against many men who had college degrees, Frank attacked his aviation studies with zeal. The schooling in Austin focused on the basics of aviation and flight as well as on the uses of engines and machineguns. After graduation, Frank

LUKE’S FIGHTING STYLE WAS ALL-OUT AND DANGEROUS. “HE WAS A WILD MAN IN THE AIR.”

UNDER THE TUTELAGE OF EXPERIENCED COMBAT VETERANS AT ISSOUDON AND THE GUNNERY SCHOOL IN CAZAUX, HE LEARNED PURSUIT FIGHTER TACTICS



was sent to Rockwell Field, in San Diego, California, for flight training. Commissioned as a second lieutenant, he finally realized his desire, a chance to fly. In Frank's own words, "I'm a different person when I'm in the air."³

During his time in San Diego, Frank met a young woman, Marie Rapson. He approached romance the way he did everything in life. After knowing the young woman for only a few weeks, Frank proposed marriage. She was enthralled by the young, wild man who had swept her off her feet. Frank would invite her down to the field to watch him fly. After buzzing the field, he would stall the aircraft by flying straight up and letting the gravity-fed motor sputter out of fuel. Diving down right at his fiancé at the last possible moment he would kick the motor back in and roar over her head.⁴

Upon winning his wings, Frank traveled to New York to board a ship that would take him to France and the war. In France, he took advanced combat training at Issoudon. There, the young American airmen tapped the expertise of their French and the British allies, as well as the American members of the storied Lafayette Flying Corps. Under the tutelage of experienced combat veterans at Issoudon and the gunnery school in Cazaux, he learned pursuit fighter tactics.⁵

Although Frank had hoped for immediate assignment to a combat squadron, to his chagrin he was instead posted to ferry pilot duty, where his role was to transport new replacement or repaired airplanes to the front line squadrons. While he chaffed at the role, it gave him valuable time in the air, honing his piloting skills.

In July 1918, after long weeks of ferry duty, Frank Luke was selected to join the 27th Squadron of the American First Pursuit Group, "The Fighting Eagles."⁶ The First Pursuit Group consisted of the 27th, 94th, 95th, 147th, and eventually the 185th squadrons. The young buck from Arizona was finally going to get a chance to prove to the world what kind of pilot he really was.

Rubbed the Wrong Way

Frank's excitable and outgoing personality did not mesh well with the combat veterans of the 27th. The squadron needed replacements for comrades who had been lost recently, including one day's toll of six pilots who had been shot down. Rather than blend in quietly with these seasoned fighters, Frank began to brag about what he was going to do. He was labeled disdainfully as, "The Arizona Braggart."⁷

The 27th was commanded by Maj. Harold Hartney. A Canadian by birth, Hartney had originally enlisted to fight in the infantry, but managed a transfer to the Royal Flying Corps. A skilled combat pilot, he was offered a chance to command a squadron of the newly formed American Air Service. To qualify, Hartney was granted U.S. citizenship and soon turned the 27th into a finely honed unit.⁸ The good-natured Hartney took an immediate liking to Frank Luke.

Because he did not want them to worry, Luke did not tell his fiancé or family that he had transferred to the front. Frank simply neglected to mention his duties in the handful of letters he wrote during this period.⁹

An anti-aircraft machine-gun.

**THE
BALLOONS
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THEY WERE
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CRAFT
BATTERIES...,
MACHINE-
GUNS, AND
EVEN
CANNONS**



Frank's cockiness was not limited to mere words. He developed a tendency to break away from flying formations to go off on his own, always leveraging excuses about "engine trouble," to simply getting lost. Soon, the men of the squadron began to openly question if the "braggart" was fleeing from combat and falling back on flimsy excuses. For a short time Frank was grounded for taking off on his own, though the lesson did not resonate with him.¹⁰

This situation changed on August 16, 1918. Out on patrol with Major Hartney, Frank claimed to have shot down a German aircraft. The details of his actions meshed with what Hartney had seen, but no one had witnessed the kill. While it remained unconfirmed, it seemed to be nothing more than another boast by Frank. Although his squadron mates did not believe him, Hartney did. Moreover, Frank had learned the importance of getting confirmation of his actions. He went so far as to type up a form for witnesses to sign the next time he got a kill.¹¹

One of the few men in the 27th with whom Frank did get along was Joseph Fritz Wehner. A native of Everett, Massachusetts, Joe was in many respects the opposite of Frank. Whereas Frank was excitable and talkative, Joe tended to be quiet and kept to himself. Both young aviators came from German immigrant families. Before the U.S. had declared war against Germany, Joe served with the YMCA in Berlin, helping with war relief efforts.¹² During Joe's flight training a bunkmate had accused him of being a German spy. However, an

FBI investigation turned up nothing incriminating.¹³

While Frank and Joe seemed to have different personalities, they quickly galvanized a friendship that stimulated their performances in aerial combat. Hartney's success with the 27th Squadron led to his promotion to command the First Pursuit Group. Capt. Alfred Grant, a strict disciplinarian, took over command of the "Fighting Eagles." Grant immediately implemented a level of military code that the rough and tumble pilots and mechanics of the 27th had not experienced under Hartney. Grant's strict style was destined to clash with Frank's cavalier attitude.

On September 12, orders came down from Hq., First Pursuit Group for the 27th to provide offensive operations for the St. Mihiel battle.¹⁴ Their target was a line of German observation balloons. Called Drachen (Dragons) by the Germans and sausages by the British, the balloons were filled with hydrogen and tethered to the ground. They were surrounded by anti-aircraft batteries (called Archie), machineguns, and even cannons that fired "flaming onions," burning balls of white phosphorus that could set wood and canvas aircraft on fire. The balloons, poised near the front lines, were used to observe troop movements, direct artillery fire, and report enemy activity via a telegraph in the gondola. Unlike the American pilots of the era, balloon observers were given parachutes, since they were strapped to explosive hydrogen bags.

"Balloon busting"—the practice of attacking observation balloons, was one of the most danger-



A PILOT HAD TO FLY THROUGH A WALL OF ANTI-AIRCRAFT FIRE TO EVEN GET CLOSE TO A BALLOON. ALSO, THERE OFTEN WERE ENEMY AIRCRAFT IN THE VICINITY THAT ROARED IN WHEN AN ATTACKER APPROACHED THE BALLOONS

ous duties that a pilot could undertake. A pilot had to fly through a wall of anti-aircraft fire to even get close to a balloon. Also, there often were enemy aircraft in the vicinity that roared in when an attacker approached the balloons. Pilots had to be able to ignore the deadly risks of anti-aircraft fire, hit the balloon before it could be retracted to safety on the ground, and avoid airplanes dedicated to taking them out during the combat run.

Frank was assigned to attack a balloon near Lavigneulle. There is speculation that he got the assignment mainly because he showed up late for the mission briefing which put the issue of his bravery to the test. Accompanied by Lt. William Hoover, Frank followed his orders to the letter in front of the rest of the squadron. One of the Spad XIII machineguns had been swapped out for a larger caliber Vickers gun equipped with explosive bullets, hopefully to ignite the hydrogen leaking out of the balloon.¹⁵

Ignoring the dangerous hail of anti-aircraft fire, he made three passes on the balloon, as the ground crew attempted to crank it down to the safety of its nest. It was too late, Frank fired and the balloon went up in flames and black smoke. The matter was settled, Frank was not a coward. If anything, he was brave to the point of sheer recklessness.

Frank's plane was badly damaged and he spent the night with an American Balloon Company that could confirm his victory. Driving a motorcycle, he returned to his squadron the next day. As it turned out, Frank's damaged plane was simply the first of five Spads that he flew to the

point where they were unusable without a total overhaul and repair.¹⁶

The Balloon Buster

The victory over the balloon energized him. On September 14, he and Lt. Leo Dawson went up against a German balloon near Moranville. Frank strafed the balloon several times, driving it into its nest. While the balloon had not exploded it had been put out of commission, with numerous tears and holes. Frank then strafed the ground crew that was firing back up at him.¹⁷

In the afternoon, Captain Grant let Frank go up with Joe Wehner as his wingman. Near Buzy, the duo dove in on the balloon—sending it up in a massive ball of fire. As Frank coped with jammed machineguns from his last pass, a German patrol dove in on him. Joe swept in on the eight attacking Fokkers. Stunned by the audacity of the attack, the German planes broke off, letting the pair of Spads escape and make their way to the American lines.

When Frank landed at the 27th Squadron's field at Rembercourt, he called for his machine to be rearmed and refueled. The ground crew was amazed at the damage his Spad sustained. His plane had been so badly blasted by the anti-aircraft fire that it was in tatters. Hartney was tempted to let Frank fly, but complaints by Captain Grant made Hartney hold the anxious young man in check.

On September 15, Joe and Frank were in the air again gunning for the German balloon line.



Frank Luke with a machine-gun.

FRANK AND JOE...CONCOCTED THE IDEA OF STRIKING AT THE BALLOONS IN EVENING TWILIGHT, JUST BEFORE THEY WERE HAULED DOWN FOR THE NIGHT

However, this time it was Joe Wehner who stepped into the limelight, destroying a balloon near Waroq in the morning hours.

In the afternoon, Frank spotted an enemy balloon near Boinville, and drove it to the ground. Rather than turn back to his base, he spied another enemy balloon hovering on its tether near Bois d'Hingry. He bore in on it and with fifty bullets set the balloon aflame.

That evening, Frank and Joe compared thoughts on how to best deal with enemy balloons. They concocted the idea of striking at the balloons in evening twilight, just before they were hauled down for the night. Hitting them at that time would make targeting difficult by the ground-based Archie fire or protecting German pursuit planes. To make their way home, they hoped to use signal flares from the American aerodrome. These tactics posed serious risks as flying at night in unlit cockpits required a great deal of skill to avoid invisible telephone lines or cratered landing fields.

Taking off at 6:50 pm Frank and Joe headed for the German lines. They spotted a balloon near the Dannevoux forest and opened up on it in the near darkness. Ten meters above the ground the balloon erupted and crashed onto its ground crew. In the darkness, Frank could not find the field and risked a dangerous landing on unknown terrain in the dark. The next morning, he made his way back to the 27th Squadron, proof that the new tactic might

just be the trick in dealing with the observation balloons.¹⁸

Hartney was buoyed by the success of the two pilots. He suggested a demonstration of the new tactic for Brig. Gen. William "Billy" Mitchell on the night of September 16. Many pilots of the First Pursuit group, including Eddie Rickenbacker, turned out for the show when Mitchell and some of his staff arrived. Before taking off, Frank told Rickenbacker, "Keep your eyes on these two balloons. You will see the first one out there go up in flames at exactly 7:15 and the other one will do likewise at 7:19."¹⁹

As the crowd of dignitaries watched, Frank and Joe climbed into their Spads and set off for the balloons. Flying in the near total darkness, Joe and Frank stumbled across the balloons and opened fire. Back at Rembercourt, Mitchell expressed his doubts. "Hartney, it's impossible. To get a balloon at all is a feat. To time its demise five hours ahead is beyond reason. And to do it at night is just not in the cards."

Captain Grant shattered the quiet, announcing, "Twenty seconds to go." Across the enemy lines Frank found the first balloon and opened fire. "By God, there she goes!" Mitchell exclaimed. The other officers began to cheer and howl. A few tense moments later they were stunned to see another flash in the air—the second balloon. When the pilots landed there was a riotous atmosphere at the field. Mitchell took his swagger stick and pulled off large pieces of Frank's wing and fuselage canvas, testimony to the Archie fire he had flown through.²⁰

Crescendo

Two days later Frank and Joe took off again in the afternoon for the German balloon line. They came across a balloon and the two of them flamed it. As Frank turned away, the planes of the German Jasta 15 dove in on him. As he had done before, Joe Wehner maneuvered his Spad in to protect his friend and wingman. This time Joe's luck ran out. German ace Georg von Hantelmann had lined up Wehner in his sights and fired with deadly effect.²¹

On his way back to Rembercourt, Frank spotted a German two-seater playing "keep-away" from a pair of French Spads. Frank bided his time and shot down the airplane, killing the pilot and observer. Frank landed near the wreckage and was joined by French and American infantry. Photos taken at the scene showed Frank cutting a souvenir swatch of the fabric from the plane. He did not know at the time that his best friend, Joe Wehner, was dead—and that with his victory—Frank had just become the leading American Ace of Aces.²²

With word that Wehner had gone missing, his fate unknown at the time, Frank was catapulted to near heroic status. His name and story were emblazoned in newspaper headlines across the country. His squadron mates, who only a few weeks before thought he was yellow, threw a party in his honor. Frank received a gift of some cash, donated by the

Piece of aircraft shot down
by Frank Luke.



In the archives of the Smithsonian's National Air and Space Museum is a piece of the aircraft that Frank shot down the day that Joe Wehner died. During the days of the National Aviation Museum, the piece used to be on display but has since been filed away. It is known that Frank recovered a piece of the aircraft that he downed that day. Capt. Paul Coster Jr., saw Frank cut the Iron Cross of the aircraft that he shot down, presumed at the time to be a Halberstadt. After Frank had been declared missing, Captain Grant sent a letter to the family indicating he was sending the Iron Cross that Frank had recovered from the plane he had shot down. For a decade this sample was on display in the Arizona State Capitol and was then deeded to the National Aviation Museum. The location of this piece of fabric was lost for decades only to be rediscovered during the author's research for the book, *Terror of the Autumn Skies*, the story of Frank Luke Jr.²³

TWO OF HIS WINGMEN HAD GONE DOWN, WHILE FLY- ING WITH HIM ...FRANK DID NOT ASK FOR ANOTHER WINGMAN

pilots, and a few days leave in Paris. Hartney hoped that sending him to Paris would give him a chance to cope with the loss of Joe Wehner. It didn't work. Frank returned from Paris early. Idle relaxation was simply not part of his character. With all of the press attention, Frank had decided to tell his parents that he was indeed at the front, although his action was somewhat anticlimactic, given that his triumphs had been announced in the theatres and newspapers in Phoenix.²⁴

Frank was given a new wingman, another native of Massachusetts, named Ivan Andrew Roberts, "Robbie" to his friends. Ivan was a stocky man, deeply respected by the men of the Fighting Eagles. He and Frank buzzed the American troops on September 25, dropping candy and cigarettes to the men fighting in the Meuse-Argonne

Offensive.²⁵ The next day, Roberts went up with Frank on their first balloon-busting mission. He took out another balloon, but had lost track of Robbie in the fight.

Between the villages of Sivry and Consenvoye, along the Meuse River, a German ace, Franz Büchner, had caught Roberts alone and shot him down. An American balloon crew saw Roberts climbing out of his crashed Spad only to be captured by German infantry. His ultimate fate was never fully determined after the war.²⁶

Frank's return to Rembercourt alone cast a shadow. Two of his wingmen had gone down, while flying with him. Among the many nicknames he had gathered was added "Unlucky Luke." Apparently opting to take the risks he faced alone, Frank did not ask for another wingman. He took out another balloon on the following day at Batheville near St. George.²⁷ By now his ferocity and daring were well known. The Germans had even begun to put up empty balloons ringed with extra anti-aircraft guns in an effort to lure Luke and knock him out of combat.

On September 28, Frank went AWOL, heading over to a French squadron for the day. When he returned the next day, Captain Grant, ordered him grounded. Frank ignored the order and took off to the new advanced airfield that the 27th had set up near Verdun. Grant called Lt. Jerry Vasconcells there with orders to hold Frank on the ground until late in the evening, effectively grounding him. Frank tracked down Major Hartney who had



Frank Luke leans on the wing of his aircraft.

just arrived at the field and was unaware that Frank was being punished for his insubordination. Luke coaxed Hartney into letting him take off, before Vasconcells could warn Hartney that Luke had been grounded.

Grant's adjutant asked what he would do next regarding the lone-wolf style of Luke. His response was clear. "I'm going to recommend him for the Distinguished Service Cross. Then, by God, I'm going to court martial him!"²⁸ Frank dropped a note to the nearby American 7th Balloon Company which read, "Watch for burning balloons ahead, Luke."²⁹

Into History

Frank angled his Spad, number 26, towards the German lines and the balloons poised there. He dove on three balloons in rapid succession, flaming them one after another. A stray shot from Lt. Bernard Mangels, Balloon Company 35, went up and hit his radiator, ricocheting into Frank's chest.

Losing blood, low on fuel and ammunition, Frank could have tried for the American lines but did not. He landed his plane near Mangels just outside of the village of Murveaux. It was a near-crash and he was lucky to have survived the impact. Despite his agony, Frank managed to climb out of the cockpit. In one hand he held his pistol. He made his way to a nearby creek. As the German troops approached, Frank dropped dead. Early reports, distorted and exaggerated, indicated that Frank had used his handgun to attack the German ground troops. One newspaper account led with the headline, "Luke Fights off Entire German Army." The iconic image of one of the last of a generation of westerners, fighting off the enemy alone, against hopeless odds, played well with the public and has stuck, despite its inaccuracy.³⁰

Luke died from a shot that forced him to the ground—a single shot to his chest. It is most likely that he was bleeding to death when he landed, crawled out of his airplane, and simply collapsed from his wound.

Frank was officially listed as "missing in action" through the brief remainder of the war. Grant and Hartney nominated him for several awards, including the Medal of Honor. The original nomination did not even take into account his last flight. Frank Luke was not only the first pilot to be awarded the Medal of Honor, he was the only one to win it while technically grounded.

In front of the Arizona State Capitol stands a statue showing Frank Luke standing with his back to the building, appropriately facing away from the symbol of authority, gazing into the skies. His body remained in France with the other airmen who served and fell there. Frank Luke is seen by many as being reckless—he was. While the myth claims he was a loner in terms of his fighting tactics, the truth is that on most of his missions Frank Luke flew with a wingman or as part of a flight on a mission. Only near the end of his brief career did he resort to the lone-wolf tactics that had already been discarded by this stage of the war. The torch passed on to Eddie Rickenbacker, who represented team-combat tactics in the air. ■

NOTES

NARA refers to the National Archives and Records Administration.

1. The sources for Frank Luke Jr.'s nicknames include Hartney, Harold E. *Up and At 'Em*. (New York, 1940), relates that some of the men referred to Frank as "yellow." The moniker "Balloon Buster from Arizona" comes from two sources, Hall, Norman S. *The Balloon Buster*. (New

York, 1966) and Driggs, Laurence La Tourette. *Heroes of Aviation*. (Boston, 1918-1927). The names, "The Sausage Cooker (or Buster)", "The Lone Eagle," "The Wild Man in the Air," and "the Nut" are all attributed to newspaper articles printed at the time of the war or thereafter, as part of the Marie Jackson Collection. "The Arizona War Eagle," is from Theodore Roosevelt Jr.'s article on Frank Luke, syn-

- licated nationally in newspapers, specifically from *The Rocky Mountain News*, July 24, 1927.
2. From article, "Luke, the Greatest Fighter that Went Into the Air," Marie Jackson Collection.
 3. Arizona State Library, Archives and Public Records, History and Archives Division. MG-64 Frank Luke Junior Collection. Excerpt of letter from Frank to his father, January 1918.
 4. Author's interviews with Douglas Jackson regarding stories his mother, Marie, related regarding Frank Luke. April 2005.
 5. National Museum of the United States Air Force, Luke Archival Collection: 1974-D09. Personnel Report: Frank Luke Jr.
 6. Air Force Historical Research Agency (AFHRA), Microfilm 30531 Index 1383. Diary of Corporal Walter S. Williams, 27th Squadron, U.S. Air Service, AEF Diary of Walter Williams. As the historian of the 27th Squadron, Williams referred in several passages to the squadron as "The Fighting Eagles."
 7. AFHRA, Microfilm 30531 Index 1383. Diary of Cpl. Walter S. Williams, 27th Squadron, U.S. Air Service, AEF Diary of Walter Williams. This was found in the postscript section where Walter Williams was attempting to write a formal history of the Fighting Eagles. This account is further substantiated by the writings of Hartney in *Up and At 'Em*. To further validate this, Williams notes: "Luke was sort of a braggart when he arrived but he was no mixer. He was remarking 'I'll get them Germans.'"
 8. Hartney, Harold E. *Up and At 'Em*. Additional information on Hartney's military career is available via the Library and Archives of Canada, World War I Service Records.
 9. Validated through a detailed review of The Arizona State Library, Archives and Public Records, History and Archives Division. MG-64 Frank Luke, Jr. Collection and the Marie Jackson Collection.
 10. The Lafayette Foundation. Ltr. to Cliff Nelson from Frank Luke. Nelson A. Cliff was a flying mate from Rockwell Field, who was also stationed in France at the time. "Was put on the ground for three days for going over the lines alone. My time was up today so guess I will take a ride tonight. That three days has cured me for a while anyway of going over the lines alone"
 11. National Archives and Records Administration (NARA), Gorrell's History of the American Expeditionary Forces Air Service 1917-1919. Series E Squadron Histories, Volume 6, Combat Report Aug. 16, 1918, Lt. Luke.
 12. Justice Department Field Reports, Joseph Fritz Wehner. NARA. Record Group (RG) 65,
 13. Courtesy of Walter Kloss from the Wehner family collection of Joe's correspondence.
 14. NARA, Gorrell's History of the American Expeditionary Forces Air Service 1917-1919. Series E Squadron Histories, Volume 6, Combat Orders, 27th Aero Squadron. The 27th, along with the rest of the First Pursuit Group, were given a variety of targets during the offensive operations. The 27th was to concentrate on enemy observation balloons where tactical, (daily) orders referred to.
 15. AFHRA, Microfilm 30531 Index 1383. Diary of Cpl. Walter S. Williams, 27th Squadron, U.S. Air Service, AEF Diary of Walter Williams. The practice of swapping out to the Vickers machinegun was detailed in Williams post-war summary of the career of Frank Luke Jr.
 16. NARA, Gorrell's History of the American Expeditionary Forces Air Service 1917-1919. Series E Squadron Histories, Volume 6, Combat Report, Lt. Frank Luke. NARA. The evidence of Frank's landing is substantiated by two sources: The Lafayette Foundation, the Royal Frey collection substantiates this account as do the post-war writings of Harold Hartney. The Craig Herbert letter to Royal Frey on June 27, 1952.
 17. NARA, Gorrell's History of the American Expeditionary Forces Air Service 1917-1919. Series E Squadron Histories, Volume 6, Combat Reports for Dawson, Lennon and Luke, Combat Report, Sept. 14, 1918.
 18. NARA. Gorrell's. Combat Report for Hoover, Clapp, Wehner, and Luke, Sept. 15, 1918.
 19. Hartney. *Up and At 'Em*, Pp. 255-61. This account is further substantiated by Library of Congress. The William Mitchell Collection. Billy Mitchell's diary describes his request to have balloons taken out and how Hartney behaved.
 20. NARA. Gorrell's History of the American Expeditionary Forces Air Service 1917-1919. Series E Squadron Histories, Volume 6, Combat Report, Sept. 16, 1918.
 21. NARA. Gorrell's History of the American Expeditionary Forces Air Service 1917-1919. Series E Squadron Histories, Volume 6, Combat Report by Frank Luke. The injuries to Lt. Wehner are confirmed via NARA. Records Group 92, Burial Records. Joseph Fritz Wehner.
 22. Guttman, Jon. *France's Foreign Legion of the Air*. (Windsock International), p. 16.
 23. Smithsonian National Air and Space Museum. A19500169000AER01 and A19500169000AER02. Aircraft material (fabric) cut from airplanes by Frank Luke Jr. Once on display at the National Aeronautical Museum (precursor to the Air and Space Museum) two large pieces of the plane that Frank shot down on September 16 have been placed in storage since the 1960's. The account of the cutting of the piece of the aircraft comes from *The Arizona Republic*. "Luke Remembered." May 10, 1965.
 24. *The Arizona Republican*. "Frank Luke Jr. is Now Ranked As Ace of Air." September 21, 1918.
 25. AFHRA, Microfilm 30531 Index 1383. Diary of Corporal Walter S. Williams, 27th Squadron, U.S. Air Service, AEF Diary of Walter Williams. September 25.
 26. NARA. Gorrell's History of the American Expeditionary Forces Air Service 1917-1919. Series E Squadron Histories, Volume 6, Combat Report, Frank Luke. The confirmation of Büchner's victory is via the NARA. Prussian Fifth Army Records. Kommandeur of the Fliers 5. Army Ia No. 15471. A.H. Qu., the 26. 9. 1918. Mittagmeldung. Additional details regarding Ivan Roberts last mission are available from NARA. Records Group 92, Burial Records. Ivan Andrew Roberts.
 27. NARA. Gorrell's History of the American Expeditionary Forces Air Service 1917-1919. Series E Squadron Histories, Volume 6, Combat Report, Sept. 28, 1918, Lt. Frank Luke.
 28. The Lafayette Foundation. Letter from C.S. Daniel, Adjunct to Captain Grant, to Royal Frey, August 26, 1963. This letter covers the series of events up until Frank's departure. This is further substantiated by the Diary of Russell Pruden, Yale Library.
 29. The Lafayette Foundation. The Royal Frey Collection. Letter from Karl Axater to Royal Frey December 5, 1963. Many accounts of this note have been printed over the years. Royal Frey was able to confirm this as the proper wording from the man that recovered the note.
 30. The Lafayette Foundation. Bernard Mangels Account from a letter to Royal Frey on August 11, 1963 and NARA. Prussian Fifth Army Record. German Field Orders 29 September 1918. The attempts by the American government to clarify the events of Frank's death are substantiated by an interview given by Maj. Frederick Zinn to the *Arizona Republic* newspaper in 1919 (courtesy of the Marie Jackson Collection) where he indicated that the confusion as to the events of Frank's death were further exasperated by the fact that the first U.S. Army Air Service officials on-site did not speak French and may have misinterpreted the responses of the citizens of Murveaux. Frank suffered a single bullet wound, as evidenced by the material in NARA Records Group 92, Burial Records Frank Luke Jr.

When the Thunderbirds
Flew the
Thunderchief





W. Howard Plunkett

(Overleaf) Six of the Thunderbird F-105Bs fly in formation during one of the team's Nellis practices. (All photos courtesy of the author.)

Since 1953, the Thunderbirds aerial demonstration team has been the most dramatic and visible display of the Air Force's public relations efforts. In the fifty-six years that the Thunderbirds have been thrilling audiences at air shows around the world they have demonstrated the power and grace of first-line Air Force jet fighters and the skills of its pilots. Despite occasional accidents over the years, the Thunderbirds continued to play a key role in Air Force public relations and recruiting.

From its inception, the team has flown eight types of aircraft in their precision aerobatic performances. For six air shows in April and May 1964 the Thunderbirds flew Republic F-105B Thunderchiefs. A day before their seventh show one of their planes broke up in mid-air killing its pilot. The team switched to the North American F-100D Super Sabre for the remainder of the 1964 season and never went back to their F-105s.

This article tells the story of this shortest era in Thunderbird history.

Equipping the Team with Thunderchiefs

The F-105B Thunderchief was the third Republic-built jet that the Thunderbirds flew. For 130 shows in its first two years, from 1953 to 1955, the team flew Republic's F-84G Thunderjet. For their 1955 season, the team switched to the faster, swept-wing F-84F Thunderstreak and switched again a year later to the supersonic North American F-100C Super Sabre. These changes in aircraft reflected the team's role in showcasing the latest Air Force jet fighters. The switch to the Thunderchief in 1964 continued this trend since the F-105 was replacing F-100s in some Air Force fighter squadrons in the U.S., Germany, Japan, and Okinawa.¹

The process of equipping the Thunderbirds with the "B"-model Thunderchief began six years before they flew their first air show with the F-105. In May 1958, the first F-105Bs arrived at Eglin AFB, Florida, from Republic Aviation's factory on Long Island, New York. At Eglin they began Phase II testing (System Development and Evaluation) conducted by the 335th TFS, which had been detached from the 4th TFW at Seymour Johnson

AFB, North Carolina. The 335th was chartered to test the Air Force's newest fighter bomber before the planes were assigned to the 4th TFW, the first combat unit scheduled to receive the F-105. A year later, beginning on June 16, 1959, the first F-105Bs were delivered directly to Seymour Johnson from Republic's factory. These planes equipped the 334th TFS, a second squadron in the 4th TFW.² Over the next eighteen months the 334th worked to become the Air Force's first squadron to become combat ready in the Thunderchief, a goal they achieved on December 31, 1960.³

Within six months, the Tactical Air Command (TAC) was eager to replace the sixty-three "Bs" belonging to the 4th TFW with the more capable F-105Ds, which were now coming off Republic's assembly line. In a secret letter to Hq USAF dated July 6, 1961, Hq TAC stated their goal of fully equipping the 4th TFW with the F-105D and for the wing's current F-105Bs "... to be used in the training program or air demonstration teams." In their response on July 14, 1961, Hq. USAF asked TAC to define the modifications needed to F-105Bs to equip both the Thunderbirds and Skyblazers air demonstration teams.⁴ In their answer to the Air Staff on September 10, 1961, TAC provided a description of the needed modifications for F-105Bs for use by air demonstration teams.⁵

The Skyblazers belonged to the 36th TFW stationed at Bitburg AB, Germany, and flew the F-100C, the plane then being used by the Thunderbirds whose home was (and still is) Nellis AFB, Nevada. The Skyblazers had been formed in 1949 at Furstenfeldbruck AB, Germany, to provide air shows for the United States Air Forces in Europe (USAFE). Bitburg was an F-100 base and its 36th TFW was slated to get the F-105D as the first USAFE unit to receive the newest Thunderchief. However, the plan to convert the Skyblazers to the F-105B was abruptly halted when, in a cost-cutting effort on January 12, 1962, the commander of USAFE, General Truman H. Landon, directed the Skyblazers to disband, much to the disappointment of air show fans throughout Europe.⁶

The Thunderbird conversion to the F-105B almost didn't happen. During 1962, the F-105 depot, the Mobile Air Materiel Area (MOAMA) at

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W. Howard Plunkett is a retired Air Force lieutenant colonel. His twenty-year career as an aircraft maintenance officer began with F-105 Thunderchiefs in 1964. He received a degree in mathematics from Colgate University, was a distinguished graduate from Squadron Officers School, and earned an MS in Logistics Management from the Air Force Institute of Technology. He commanded the Avionics Maintenance Squadron at Kunsan AB, Korea, and the Field Maintenance Squadron at Wright-Patterson AFB, Ohio; was an F-4 Avionics Staff Officer at Hq TAC; a depot inspector on the AFLC IG team; and a division chief at Hq AFOTEC. Since 1983, he has worked in the aerospace industry as a contract reliability engineer on Northrop-Grumman's B-2 stealth bomber and for other companies as a software QA manager, a logistics manager, a technical writer, and in business development. In 1994, he began a continuing study of the operational history of the F-105. His publications include two previous articles in Air Power History, two others in the Friends Journal of the National Museum of the U.S. Air Force, and a book, F-105 Thunderchiefs, A 29-Year Illustrated Operational History, published in 2001 by McFarland, detailing the histories of all surviving F-105s in museums and on static display around the world. He lives in Albuquerque, New Mexico. The author wishes to thank Brigadier General Paul A. Kauttu for providing critical details to and reviewing drafts of this article.

In the Thunderbirds' four-ship diamond formation the stainless steel tail of the slot aircraft became black from the exhaust heat of the leader's F-105B.

THE SQUADRON ENCOUNTERED AN EXCESSIVE AMOUNT OF MAINTENANCE... DUE TO THE DETERIORATED AIRCRAFT WIRING... PLUS THE QUALITY OF WORK DONE BY REPUBLIC ON THUNDERBIRD MODIFICATIONS



Brookley AFB, Alabama, was coping with a series of upgrade modifications to the F-105 fleet under operation "Look Alike." The depot questioned the estimated cost of \$5 million for incorporating "Look Alike" into the F-105Bs for the Thunderbirds since the "Bs" were "... programmed for transfer to the ANG on 1 January 1964". Nevertheless, MOAMA established a conversion schedule of modifying nine F-105Bs for the Thunderbirds beginning in November 1962 with final delivery by September 1963. MOAMA's cost concerns got the attention of the Air Staff. On November 28, 1962, they directed TAC to "... evaluate the performance of the T-38 to determine whether it might be more appropriate than the F-105." In early 1963, TAC's evaluation resulted in their favoring the Thunderchief and the issue was resolved. This decision was not surprising since the T-38 was an Air Training Command trainer and the F-105 was TAC's (and the Air Force's) front-line fighter-bomber.⁷

Once the Air Staff approved the F-105B for the team, TAC selected nine two-year-old F-105Bs from the fleet at Seymour Johnson. Eight of these "Bs" had been production-delivered to the 335th TFS at Eglin between January and August 1959 to support Phase II testing. They had been at the wing's home base at Seymour Johnson since completion of this test program on November 2, 1960. The ninth plane was one of those delivered directly to the 334th TFS at Seymour Johnson in September 1959.⁸

Events delayed the Thunderbird conversion. In 1962, Seymour Johnson pilots ferried the nine F-105Bs to the Republic plant in Farmingdale, New York, where they were to be modified for the Thunderbirds.⁹ However, funds were not yet available for the work and the planes sat on the contractor's ramp for the next nine months. In August 1963, Republic began modifying the airplanes under contract number AF01 (601)50922. By the

end of 1963, they had completed four of the nine aircraft, which were in final inspection and flight test at the factory.¹⁰

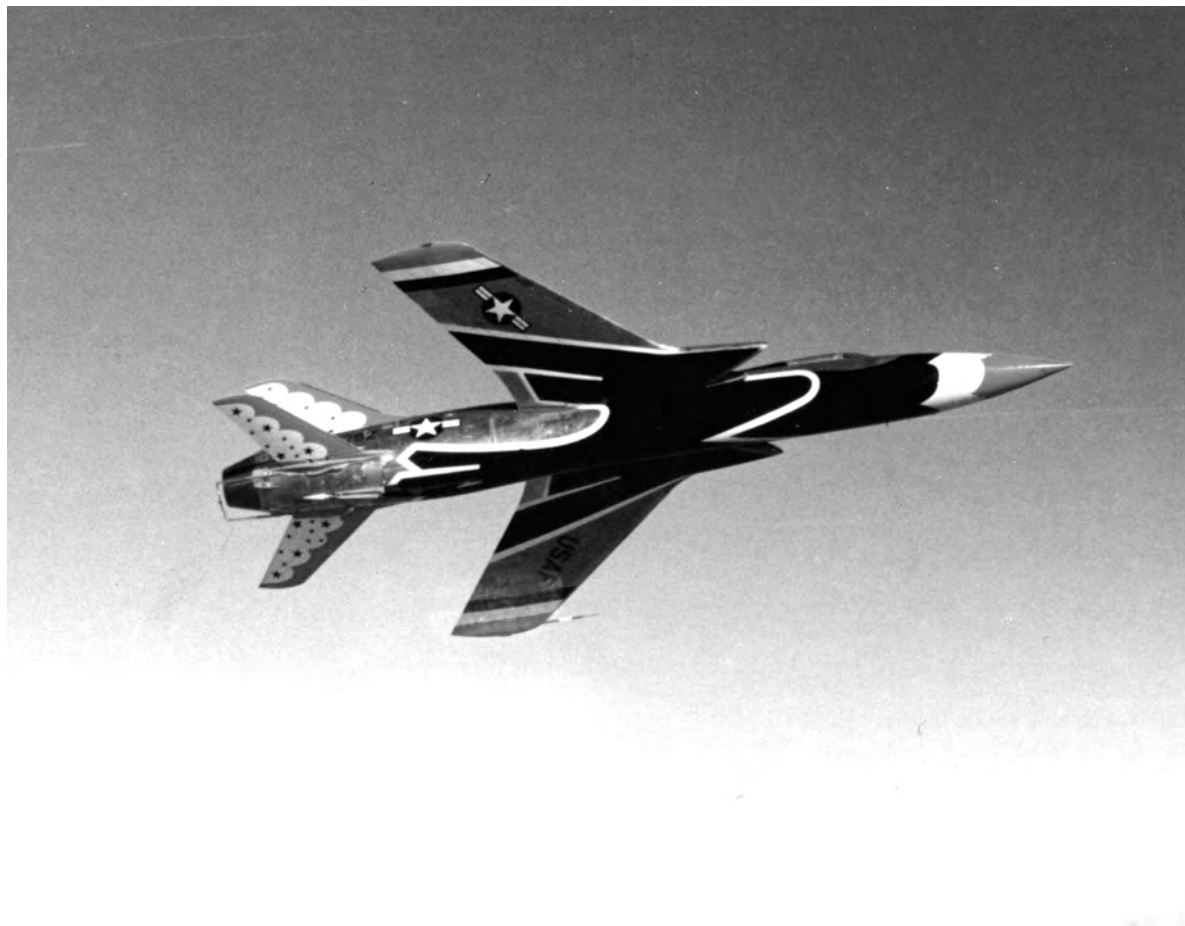
While Republic was modifying their new planes on Long Island, the Thunderbirds flew their 690th and last demonstration in their F-100Cs, which they had been flying since 1956. It was the end of the team's 10th anniversary season and their last demonstration was at Kitty Hawk, North Carolina, during the 60th anniversary of powered flight on December 17, 1963. The team flew two shows that day. They took off from Wright-Patterson AFB, Ohio, flew a demonstration there, then with in-flight refueling headed for Kitty Hawk for their final show. They recovered at Langley AFB, Virginia. The team's eight F-100Cs were then flown to the depot at McClellan AFB, California, where they were demodified and reassigned to other F-100 units.¹¹

On January 25, 1964, the Air Force accepted the first Thunderbird F-105B at Republic and four days later Maj. David A. Tilton, the chief Air Force test pilot assigned to Republic, flew the plane to Nellis where crew chief TSgt. Thural M. Pitts marshaled it into its parking spot. Over the next three months, the rest of the planes trickled in from the factory.¹²

The Thunderbird history reported problems in getting their birds in shape. "The squadron encountered an excessive amount of unscheduled maintenance on all F-105Bs received, a large percentage of them due to the deteriorated aircraft wiring. Other maintenance difficulties encountered can be attributed to the aircraft not flying for an 18-month period, plus the quality of work done by Republic on Thunderbird modifications."¹³

By March 31, 1964, the Thunderbirds had received six of their nine F-105Bs. For team support, they retained one two-seat F-100F from their previous season that they intended to replace by a two-seat F-105F when one became available.¹⁴

In addition to the Thunderbird paint scheme, this photo shows the smoke system tubes installed in the aft end of the F-105B.



REPUBLIC MADE NUMEROUS CHANGES TO THE THUNDERBIRDS' NINE AIRCRAFT FROM THEIR ORIGINAL PRODUCTION CONFIGURATION

Their ninth and last modified F-105B arrived at Nellis on April 15, 1964, eleven days before their first public performance.

F-105B Modifications

Republic made numerous changes to the Thunderbirds' nine aircraft from their original production configuration.¹⁵

1. They removed the Doppler navigation system from its right-side fuselage avionics rack to make room for a pilot's luggage case.

2. Because liquid oxygen was not available at some civilian and overseas show locations, the planes had a dual oxygen system that included a storage bottle and plumbing for high-pressure gaseous oxygen. To make room for the oxygen bottle, the toss-bomb computer and sight amplifier systems were removed from the forward left-side electronics compartment.

3. Republic also installed in the forward left compartment a Collins VHF radio for voice communications with civilian and foreign air traffic control installations that lacked the military-standard UHF systems.

4. To add color to air shows, Republic equipped the planes with a smoke system capable of generating red or blue smoke in addition to the standard white smoke used in Thunderbird planes since the F-84Fs in 1955. The 20-mm Gatling gun and its ammunition drum were removed from the forward

fuselage to make room for two 50-gallon smoke oil tanks. One tank was for white smoke oil and the other for the chemicals that generated colored smoke. A switch on the stick grip selected the smoke color and a tube that exited the aft fuselage and crossed behind the speed brake petals dumped smoke oil into the plane's hot exhaust.¹⁶ The team's intention was for the left and right wingmen to use colored smoke. However, for a couple of reasons, the team never used it. There was a problem in procuring from an American supplier the chemical that produced the colors. Also, one of the chemicals in the mix (carbon tetrachloride) was toxic and too much of a hassle to handle. So for their six shows the team used only normal engine oil that generated white smoke.¹⁷

5. The space vacated by the gun also contained a spare drag chute, which allowed for faster aircraft turnarounds.¹⁸

6. The fuel system was modified for extended inverted flight. The modification included a fuel boost pump in the top of the main tank and an aft vent tank with two boost pumps.

7. For more responsive acceleration, the four speed-brake petals were opened to afterburner position throughout a show thus arming the afterburner igniter circuit. When the pilot selected afterburner with his throttle control, this configuration allowed the afterburner to light in less than two seconds versus the five-second delay that it normally took for the speed-brake petals to open.

8. Four planes had stainless steel skins on their vertical stabilizers. Two planes were for the slot position where the plane's tail flew in the leader's hot exhaust. The other two planes were flown by the opposing solo pilots where the steel was used to withstand the stress of knife-edge passes. During the knife-edge pass the rudder on these planes could travel from their normal restricted movement of 8 degrees to the full 16 degrees left and right.¹⁹

9. The planes were equipped with maneuvering trailing-edge flaps, which allowed pilots to use 4-degree flaps at speeds up to 500 knots instead of the normal 275 knots.²⁰

10. To control the show systems, Republic installed a thunderbird-shaped Show System Panel on the upper left instrument panel. Two switches on the panel controlled the smoke system and wing flap settings. For the two solo aircraft with stainless steel tails, a third switch allowed increased movement of the rudder for knife-edge passes. The panel also had show system caution lights that warned of fuel system, smoke system, knife-edge rudder, and afterburner malfunctions.²¹

11. The flight control linkage was upgraded to the cam-roller design used in the F-105D.²²

12. Republic packed a "retractable debarkation ladder" in the left console. This was a rope ladder to be dropped over the cockpit rail that was intended for emergency exits and for use in locations where there were no normal exit ladders. After the planes arrived at Nellis, the Thunderbirds removed the rope ladders since the pilots preferred to exit the cockpit by walking along the fuselage to the wing and jumping off the wingtip when ladders weren't available.²³

13. Finally, all aircraft were painted in the Thunderbirds' traditional red, white, and blue scalloped color scheme over their polished metal skin. Once the planes reached Nellis, the Thunderbirds modified the original Republic paint scheme during their practice period and modified it once again before their public shows.²⁴

The 1964 Thunderbird Team

Thunderbird pilots began transitioning to the F-105B as soon as they received their first plane from the factory in January 1964. Capt. Waymund C. Nutt was the Thunderbirds' primary F-105 instructor pilot. He was the Operations Officer of the 4523 Combat Crew Training Squadron, one of the three Nellis units involved in F-105 pilot training. All training was at Nellis using the modified "Bs" as they arrived from Republic.²⁵

Most of the 1964 team had previous Thunderbird experience. Seven of the nine primary team members from the 1963 team transitioned to the F-105B. On March 31, 1964, Maj. Edwin D. "Lucky" Palmgren from Wilmington, North Carolina, the flight leader during the 1963 season, replaced Lt. Col. William A. Alden, as commander of the 4520 Air Demonstration Squadron, the Thunderbirds' official name. As a captain, Palmgren had flown the slot position during the 1954 season when the team flew

Republic F-84Gs and Capt Jack Broughton was the leader.²⁶

Maj. Paul A. Kauttu from Ilwaco, Washington, moved from the slot position to flight leader. He was an F-86 pilot during the Korean War where he was credited with shooting down two and a half MiG-15s. He had been a Thunderbird pilot since the 1962 season.

Capt. Jerry M. Shockley from Lafayette, Louisiana, had joined the Thunderbirds in 1963 and moved from left wing to slot. He had flown F-105s at Seymour Johnson and was a second instructor pilot who helped in transition training from the F-100C to the Thunderchief.²⁷

Capt. William G. Higginbotham from Baton Rouge, Louisiana, continued to fly right wing. He had started with the Thunderbirds in November 1962.²⁸

Capt. Ronald E. Catton from Waukegan, Illinois, joined the team in July 1962. He was second solo in 1963 and became first solo for the 1964 team. He had been an instructor pilot in the Fighter Weapons School at Nellis.²⁹

Capt. Clarence I. Langerud from Lake Bay, Washington, who had joined the team in August 1963, flew as opposing solo. Prior to joining the Thunderbirds he had been an academic instructor in the Fighter Weapons School at Nellis.³⁰

Capt. Lloyd Reder, a baldheaded man nicknamed "Curly", from Broadus, Montana, continued as maintenance officer. He had replaced Capt Cameron E. Husdale in August 1963.³¹

Two new members joined the team in 1964. Capt. Eugene J. Devlin from San Diego, California, thirty-one years old, married with three young sons, reported to the Thunderbirds on February 1, 1964, as a spare pilot in training. Devlin had been a test pilot and an instructor at the Fighter Weapons School at Nellis, and had been sent on temporary duty to Florida during the Cuban missile crisis in October 1962. On March 31, 1964, he took over the left wing position replacing Jerry Shockley. He quickly became a favorite with the team and their fans. Paul Kauttu, recalled, "Gene was a publicist's dream and a model Thunderbird. He had a big smile and was always mingling with kids at show sites. He was absolutely dependable and always ready to do more than required."³²

On March 9, 1964, Capt. Russell C. Goodman from Salt Lake City, Utah, replaced Capt. Leonard S. Czarnecki as narrator for the Thunderbirds. Goodman, an F-100 pilot, had been a member of a special Tactical Air Command briefing team.³³

The 1964 team had sixty-seven enlisted technicians to support their Thunderchiefs under the supervision of line chief MSgt. Jack Achenbach. In addition, the Air Force contracted with Republic Aviation for three technical representatives. Mr. Robert Stephens, whose contract was for an indefinite period, provided overall aircraft support. Mr. John Gross supported the communications and navigation systems and Mr. Charles Flynn supported the autopilot. Both of these men were on contracts that ended on June 30, 1964. Most of the techni-



At 6:33 PM on Saturday, May 9, 1964, the F-105B flown by Capt Gene Devlin broke in two during his pitch-up for landing at Hamilton AFB, California.

cians learned to maintain the F-105B by on-the-job training from the three tech reps and from F-105-qualified maintenance troops stationed at Nellis.³⁴

By the time of their first public show, five of the six Thunderbird pilots had accumulated ten hours in the F-105B. Captain Devlin had joined the team after transition training had started and logged fewer hours than the others.³⁵

Thunderchief Shows

The Thunderbirds used six aircraft for their 1964 shows—four that flew in diamond formation and two opposing solo aircraft. The Thunderbirds sequenced 29 maneuvers for their high shows starting with a maximum performance takeoff of the four aircraft in diamond formation followed immediately by the two solo aircraft also flying maximum performance takeoffs then quickly doing opposing rolls.³⁶

The F-105B was nearly four tons heavier than the F-100C but its J75 engine provided 6,000 pounds more thrust than the F-100's J57. With the increased thrust the team added new routines for their 1964 show. A Republic publicity announcement described the purpose of these routines: "Performance of the team in the F-105 will be designed to demonstrate the aircraft's special capabilities for the kind of low-altitude, close formation, slow speed maneuverability associated with TAC's close support mission, as well as the high-speed performance required for surprise attack and the engagement of enemy aircraft."³⁷

The Thunderbird history for the period described how some of these new routines were flown.³⁸

Dual solo high-speed versus low-speed pass: As one solo flies in front of the crowd at approximately 275 mph in landing configuration, the second solo approaches and passes at 700 mph, graphically demonstrating the aircraft's high and low speed capabilities.

Solo slow-speed half Cuban eight: One solo pilot performs a half Cuban eight with entry at approximately 275 mph, lighting the afterburner and going over the top at approximately 3,000 feet, the aircraft literally standing on its tail.

Diamond "five-card" loop: One solo joins with the four diamond pilots to form the five aircraft in positions resembling those of the spots on the five card in a deck of playing cards.

Six-ship wedge: Both solo pilots join the diamond for a flat pass and victory roll in wedge formation.

During their workup in the F-105B, the Thunderbirds flew their first unofficial show before a local audience at Nellis on April 4, 1964. A week later, on April 11, they flew their second home demonstration with Maj. Gen. John C. Meyer, Twelfth Air Force Commander, observing. Capt. Bill Sparks, an F-105 pilot stationed at Nellis, commented on the Thunderbird performances in the F-105B. "I saw two full shows and a lot of practices that short season and it was a spectacular show."³⁹

In an article in the June 1964 *Fighter Weapons Newsletter*, written before beginning their public tour, Jerry Shockley described what the team thought of flying the big Thunderchief: "After a dozen practice sessions and two practice shows here at Nellis, we are almost ready for the road and what do we think? ... We like it." He went on to describe specific features he admired:

The stability of the aircraft at high and low speeds is amazing; power response is great; flies good with stab aug in or out.⁴⁰ ... Low speed handling characteristics are very good (once you learn to use spoilers instead of rudder). ... We are very pleased with the bird and have modified our show slightly from what you remembered in the 100. ... We do go higher over the top - 800 feet higher to be exact. And the solo's point rolls ... pull stab aug and the point will stop as crisp as you'd want. ... Actual figures are 6500 to 7000 feet over the top for the diamond, 3000 feet for the solo slow-speed Cuban."

Shockley went on to list airspeeds for some of the routines:

For the diamond, our average entry speed for looping maneuvers is 430 KIAS and our slowest speed over the top has been 65 KTS (normal 110 to 130 KIAS). ... For the solos - fastest speed slightly over 600 depending on temp, (can't exceed Mach 1), for the opposing hi/lo speed pass and bomb burst vertical rolls. Slowest speed is on the slow speed Cuban - 40 KIAS over the top. ... Entry speed for this maneuver is 275 KIAS.⁴¹

Writing years later, Paul Kauttu told of his delight in flying the F-105B:

Its handling characteristics at both low and high speed were incredible. In close formation at 500 knots on the deck - even in choppy air - she was rock steady. She turned handily and by using the vertical, could match the F-100 maneuver for maneuver ... maybe a little better. Inverted flight capability was amazing All the power you needed and more. Entry speeds at 400. Over the top, sometimes as low

ITS HANDLING CHARACTERISTICS AT BOTH LOW AND HIGH SPEED WERE INCREDIBLE.... SHE WAS ROCK STEADY. SHE ... COULD MATCH THE F-100 MANEUVER FOR MANEUVER... MAYBE A LITTLE BETTER.... ALL THE POWER YOU NEEDED AND MORE

DEVLIN'S PLANE BROKE INTO TWO LARGE PIECES, ONE CRASHING NORTH OF HAMILTON'S CONTROL TOWER AND THE OTHER AT THE NORTH END OF THE RUNWAY. THE REST OF THE TEAM LANDED DESPITE THE DEBRIS ON THE RUNWAY

as 80 ... let 'er float ... and let 'er fall. The loops were very elliptical, allowing us to easily perform two consecutive loops at any show site ... a double loop.⁴²

Despite having only ten hours in their F-105s, the Thunderbird pilots were "show ready" and on April 26, 1964, flew their first public performance at Norfolk, Virginia. They staged from Langley AFB, home of Hq. TAC, and performed under the critical eye of Maj. Wilbur L. "Bill" Creech, the executive aide to TAC's commander Gen. Walter C. Sweeney, Jr. Creech had been a Thunderbird pilot in 1953 and led the Skyblazers in 1956 so his favorable evaluation of this show was essential to the team. Paul Kauttu recalled, "Creech certainly approved highly of the show ... he told me that ... and had to be influential in convincing Sweeney that we were ready to go public."⁴³

This first show took place during the tenth anniversary of Norfolk's famous International Azalea Festival. Miss Gene Zuckert was the Festival queen and her father, Secretary of the Air Force Eugene M. Zuckert, was one of the 40,000 people who saw the Thunderbirds' Thunderchief debut.⁴⁴

Two days later, on April 28, 1964, the Thunderbirds flew their second show in their F-105Bs at Pensacola, Florida, home to the Navy's Blue Angels, where they had an audience of 15,000 people.⁴⁵

Heading west a day later, they flew their third demonstration at Randolph AFB, Texas, over a crowd of 42,000 people, the largest audience that ever saw the team's six F-105B performances.⁴⁶

Returning to the east coast on May 5, 1964, the Thunderbirds flew their fourth show at Patrick AFB, Florida, where their performance was seen by approximately 8,000 people, the smallest public audience that witnessed the team's Thunderchief shows.⁴⁷

Heading up the coast, the Thunderbirds flew their fifth demonstration at Shaw AFB, South Carolina, on May 7, where their performance attracted 10,000 people.⁴⁸

For their sixth F-105B show, the Thunderbirds flew across the country to the northwest coast. On Saturday May 9 at McChord AFB, south of Tacoma, Washington, they performed for 35,000 people.⁴⁹ Due to overcast weather they flew what Paul Kauttu called a "flat show not even a low show".⁵⁰

The Fatal Accident

After their show at McChord, the Thunderbirds filed their flight plan to Hamilton AFB north of San Francisco, 640 miles away. Their seventh show, scheduled for Sunday, May 10, was to be the key attraction of Hamilton's Armed Forces Day celebration. The team's seven F-105Bs and their F-100F took off at 5:00 PM as planned. Capt Shockley air aborted and returned to McChord when he experienced a minor problem. Maj. Palmgren flew the spare aircraft as "Thunderbird 7". Russ Goodman, the narrator, piloted the F-100F with the team's photographer Sgt Robert R. "Bob" Ehlke in the rear seat. The resulting formation of six F-105Bs and

one F-100F flew by Mt. Rainier and the Golden Gate Bridge for publicity photos of their Thunderchiefs with these iconic landmarks in the background.⁵¹

At about 6:15 PM, the flight made a six-ship flyby over Hamilton that was viewed by over 2,000 spectators on the base and in the surrounding Marin County area. The weather was clear as the flight turned onto their initial leg to runway 30. Goodman landed his F-100F first. To line up for their landing, the F-105s flew in a section of three aircraft in V formation led by Paul Kauttu in F-105B 57-5782. Gene Devlin flew 57-5801 on Kauttu's left and Bill Higginbotham in 57-5790 on the right. An element of two aircraft with Ron Catton and Clarence Langerud was a mile behind followed by Ed Palmgren in Thunderbird 7. A fuel check call confirmed that all F-105s had at least 1800 pounds of fuel. Lead called "smoke on" about one mile from the runway as the formation of three descended to an altitude of 100 feet. Major Kauttu did a left break from the V formation with Captain Devlin pitching three seconds later. The official accident report describes what happened next:

A late break was initiated to allow airspeed to decrease to 430 KIAS. The lead made a standard Thunderbird pitch up; i.e. about 6 Gs in a straight pull to about 40-degrees of pitch followed by a sharp turning chandelle to a downwind leg of 1,500 feet AGL and 250 KIAS. As Captain Devlin initiated his pitch-up, the aircraft experienced catastrophic break-up. ... The accident occurred at exactly 1833 PDT. Capt Devlin received fatal injuries.⁵²

Devlin's plane broke into two large pieces, one crashing north of Hamilton's control tower and the other at the north end of the runway. The rest of the team landed despite the debris on the runway. Paul Kauttu recalled, "Hamilton advised us that the field was closed and asked for my intentions. I said we would land there and we did."⁵³

On Sunday, Maj. Gen. Robert F. Worley, Twelfth Air Force Director of Operations, arrived at Hamilton and released the Thunderbird F-105Bs for a one-time flight directly to MOAMA, the F-105 depot at Mobile, Alabama.⁵⁴ Paul Kauttu led the flight. "...12th Air Force directed us to fly the airplanes to Brookley Field...and to 'handle each of them like a crate of eggs.'⁵⁵

Hamilton cancelled Sunday's Armed Forces Day celebration turning back nearly 450 motorists who had not heard of the accident.⁵⁶

On May 13, four days after his death, a memorial mass for Gene Devlin was held at the Nellis chapel. The following day, the entire Thunderbird team attended funeral services in San Diego, Devlin's home town. Later that day, Capt Eugene Joseph Devlin was buried in the Fort Rosecrans National Cemetery at Point Loma, California.⁵⁷

Both Twelfth Air Force Headquarters from Waco, Texas, and the Air Force Safety Center from Norton AFB, California, dispatched teams of investigators to determine the cause of the crash. Local

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newspapers published the investigators' appeal for photos that spectators had taken during the planes' Hamilton flyover.⁵⁸

On May 23, 1964, the Safety Center issued their accident investigation report. "The primary cause of the accident was materiel failure. The initial structural break is undetermined but most probably was located in the fuselage backbone at station 442."⁵⁹

A metal plate on top of the fuselage had failed, causing the plane to break apart just aft of the cockpit. Under Project Backbone, the Air Force inspected the fleet for this defect and had Republic replace the plate with a stronger one.⁶⁰

Due to the work involved, it became obvious that there would be a considerable delay in releasing the F-105Bs back to the Thunderbirds. As Paul Kauttu explained, the team began looking for a replacement aircraft to complete the 1964 season. "We asked for and were granted permission to evaluate the T-38 and the F-4C." The team flew a full show in T-38s at Randolph AFB, Texas, with instructor pilots in the rear cockpits. They then visited Davis-Monthan AFB in Tucson where they flew another trial show over the Arizona desert in F-4Cs, again with IPs in the back. "In both instances we found the aircraft to be very satisfactory. ... Ultimately, the decision was made to return to the F-100."⁶¹

To complete their 1964 season, the team received nine F-100Ds when General Sweeney, the commander of TAC,⁶² made them available from Luke AFB, Arizona. Paul Kauttu commented, "Luke AFB gave us their best F-100Ds, and we were back in business in short order."⁶³

The F-100Ds arrived at Nellis on June 30 and the Thunderbirds began training immediately. The team picked Capt Charles R. Hamm to replace Gene Devlin at left wing. Hamm had applied to the team earlier and was readily available from his temporary detail to Army maneuvers in California.⁶⁴

All the pilots were F-100 qualified and quickly established their new routine. On August 1, one month after receiving their F-100Ds and three months after the loss of the F-105B, the Thunderbirds flew their first public performance with their new mounts at Grand Haven, Michigan, where 15,000 people saw their show. In the remainder of the 1964 season, the team flew 53 demonstrations in F-100Ds finishing on December 18, 1964, with a show at Maxwell AFB, Alabama.⁶⁵

The Thunderbirds intended to return to their F-105Bs in 1965 but by then additional safety modifications were needed for the F-105 fleet. Furthermore, by 1965 the Air Force was giving priority to Thunderchiefs that were supporting the rapidly growing war in Southeast Asia. The Thunderbirds remained with their F-100Ds until adopting the F-4E in 1969.

Aftermath

The Thunderbird crash was the fifteenth F-105 accident in the first five months of 1964. In another

accident on May 13, 1964, four days after the crash at Hamilton, an F-105D from Nellis lost power after takeoff and went down in the Woodland North neighborhood of Las Vegas killing its student pilot and a mother and her three children. The crash destroyed seven houses and two automobiles, and severely damaged ten other homes. The next day the Air Force grounded all 500 F-105s world wide.⁶⁶

The Thunderbird and Las Vegas losses added to a rapid increase in the F-105 accident rate. The surge came as a surprise since in 1961 the F-105D had had the lowest accident rate of any jet fighter in the history of the Air Force.⁶⁷ By 1963 the F-105 accident rate was 14.7 accidents per 100,000 flying hours. However, in 1964 the plane's accident rate more than doubled to 33.7 accidents per 100,000 hours. The weak structural plate⁶⁸ found in the spines of F-105Bs and some early F-105Ds was only one of several F-105 design and manufacturing deficiencies revealed during the June 1964 grounding period.⁶⁹

Aviation Week magazine described the work needed to release the F-105s to flight:

*Air Force has launched an intensive aircraft-by-aircraft inspection of its F-105 fleet as a result of four recent crashes which have killed two pilots and 4 persons on the ground. ... All the F-105's will remain grounded until they successfully complete the inspection which is expected to require 250 M/H per aircraft. The special T.O. [Technical Orders 1F-105-908 and -909] calling for the inspection was issued May 18, 1964, and F-105's will be released for flight following successful completion of the inspection. ... The inspection would involve 'several critical systems, including fuel, flight and engine controls.'*⁷⁰

On May 25, the local newspaper in Colorado Springs announced the schedule of the Thunderbirds for the Air Force Academy graduation. "The Thunderbirds, famed aerobatic team, will make two appearances. They will fly following the graduation parade on [June 2nd] and after commencement exercises on the 3rd. ... On the 2nd also, a flyover of first-line U.S. jet fighters, bombers, and tankers will be seen. ... Air Force Chief of Staff Gen. Curtis E. LeMay will deliver the commencement address."⁷¹ A day later the paper declared the cancellation of the Thunderbirds' performance at the Academy, halting a tradition since the first graduating class in 1959 at the Colorado Springs facility. "Cancellation is due to recent grounding of the F-105 aircraft with which the team is equipped. All Thunderbird demonstrations were cancelled through June 15. The cancellations will not affect any other June Week activities."⁷²

By July 15, 1964, F-105 fleet-wide inspections and repairs were complete and the Air Force lifted their grounding order. The F-105 Program Office and the prime depot at MOAMA determined the structural integrity of the F-105 was "... sound and capable of meeting its design criteria."⁷³

The F-105s were back in business— but not for the Thunderbirds.

ULTIMATELY,
THE
DECISION
WAS MADE
TO RETURN
TO THE F-100

This was one of the Thunderbirds' practice missions at Nellis during their formation takeoff. The tail of the slot aircraft has not yet been blackened from the leader's exhaust.



THE EIGHT REMAINING THUNDERBIRD F-105Bs WERE DEMODIFIED AT BROOKLEY AND RETURNED TO SERVICE

Over the next several months, the eight remaining Thunderbird F-105Bs were demodified at Brookley and returned to service. Some went to Nellis for use by instructor pilots. Others joined the "Bs" from Seymour Johnson that were given to the New Jersey Air National Guard. None has survived:

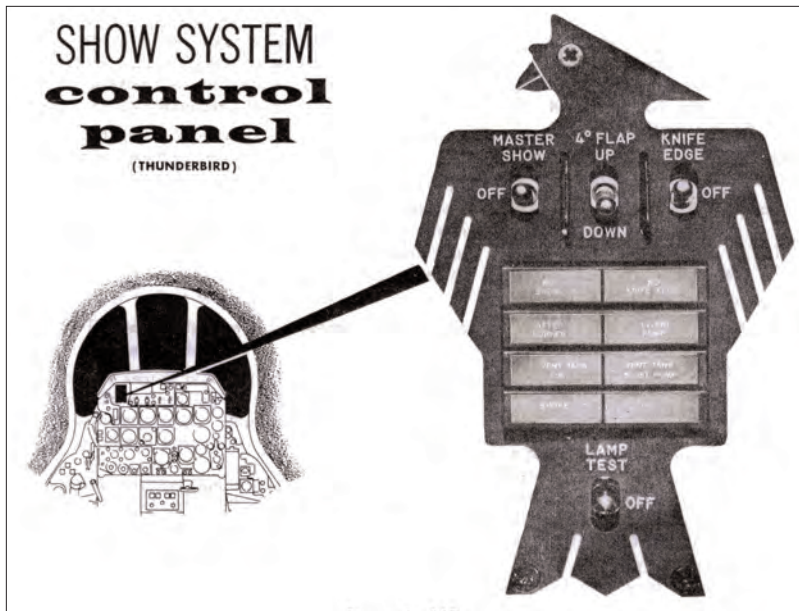
- 57-5782 - Scrapped in the 1990s after use as a target for weapons studies at the New Mexico Institute of Mining & Technology, Socorro, New Mexico.
- 57-5787 - Scrapped in the 1990s after use as a target for weapons studies at the New Mexico Institute of Mining & Technology, Socorro, New Mexico.
- 57-5790 - Crashed February 2, 1971, when it caught fire after taking off for a test flight at McGuire AFB, New Jersey.
- 57-5793 - After retirement from the New Jersey Air National Guard, it was given to the Air Force Museum but was destroyed in the hanger fire at the Yankee Air Museum, Belleville, Michigan, on October 9, 2004.
- 57-5797 - Scrapped in January 1997 at Kelley AFB, Texas, after use for Aircraft Battle Damage Repair training.
- 57-5798 - Crashed on takeoff on June 26, 1975, at Luke AFB, Arizona when the pilot retracted the landing gear too soon.

- 57-5802 - Crashed October 4, 1976, near Shaw AFB, South Carolina, due to a Gatling gun malfunction over Poinsett Gunnery Range.
- 57-5814 - Scrapped in the 1990s due to severe deterioration after being displayed for several years at the airport in Salt Lake City, Utah.

Four pilots of the 1964 team who flew F-105Bs are still living:

- Maj. Paul A. Kauttu - Flight Leader - flew combat missions in Vietnam in F-4s and F-100s and, with over 6,000 flying hours, retired as a brigadier general on June 1, 1971. He lives in Lakewood, Washington.
- Capt. William G. Higginbotham - Right Wing - flew Vietnam combat in F-4s out of Ubon. He retired as a colonel and lives near Eglin AFB, Florida.
- Capt. Ronald E. Catton - First Solo - retired as a colonel after being a Fighter Weapons School instructor and flying F-4s in Vietnam. He lives in Spokane, Washington.
- Capt. Clarence I. Langerud - Opposing Solo - flew 299 combat missions in F-100Ds with the 531 TFS at Bien Hoa AB, South Vietnam. He retired as a colonel and lives in Ventura, California.⁷⁴

One 1964 Thunderbird pilot died in an aircraft



(Above) Republic Aviation Corporation developed a Show System Control Panel for the nine F-105Bs modified for the Thunderbirds.

(Above right) The six Thunderbird pilots pose on one of their F-105Bs. Top to bottom are Maj Paul A. Kauttu, leader; Capt Gene Devlin, left wing; Capt Bill Higginbotham, right wing; Capt Jerry Shockley, slot; Capt Ron Catton, first solo; Capt Clarence Langerud, second solo.

accident and two team members died flying combat in Vietnam:

Capt. Jerry M. Shockley, who flew slot, died June 24, 1965, in an accident at Eglin while flying an F-5A under the "Sparrow Hawk" program.⁷⁵

Capt. Russell C. Goodman, who served as narrator, died February 20, 1967, over North Vietnam in the combat loss of an F-4B from AAA during a Navy exchange tour with VF-96 aboard the USS *Enterprise*.⁷⁶

Lt. Col. Edwin D. "Lucky" Palmgren, the commander, was killed in North Vietnam in the third combat loss of an F-111A on April 22, 1968, during the "Combat Lancer" deployment to Takhli RTAFB, Thailand.⁷⁷



Capt. Lloyd O. "Curly" Reder, maintenance officer, died as a retired colonel at age 65 on July 7, 1995, in Tampa, Florida.

Despite their unfortunate experience with the F-105B, the Thunderbirds regrouped and pressed on. This episode was the first of two Thunderbird accidents that, for different reasons, resulted in the team adopting another type of plane. Seventeen years later, on January 18, 1982, an accident during a practice session destroyed a formation of four of the Thunderbirds' T-38s killing their pilots. For their 1983 season, the Thunderbirds appeared in public with the new F-16A to continue their mission of demonstrating the skill of Air Force pilots and the capabilities of its front-line aircraft. ■

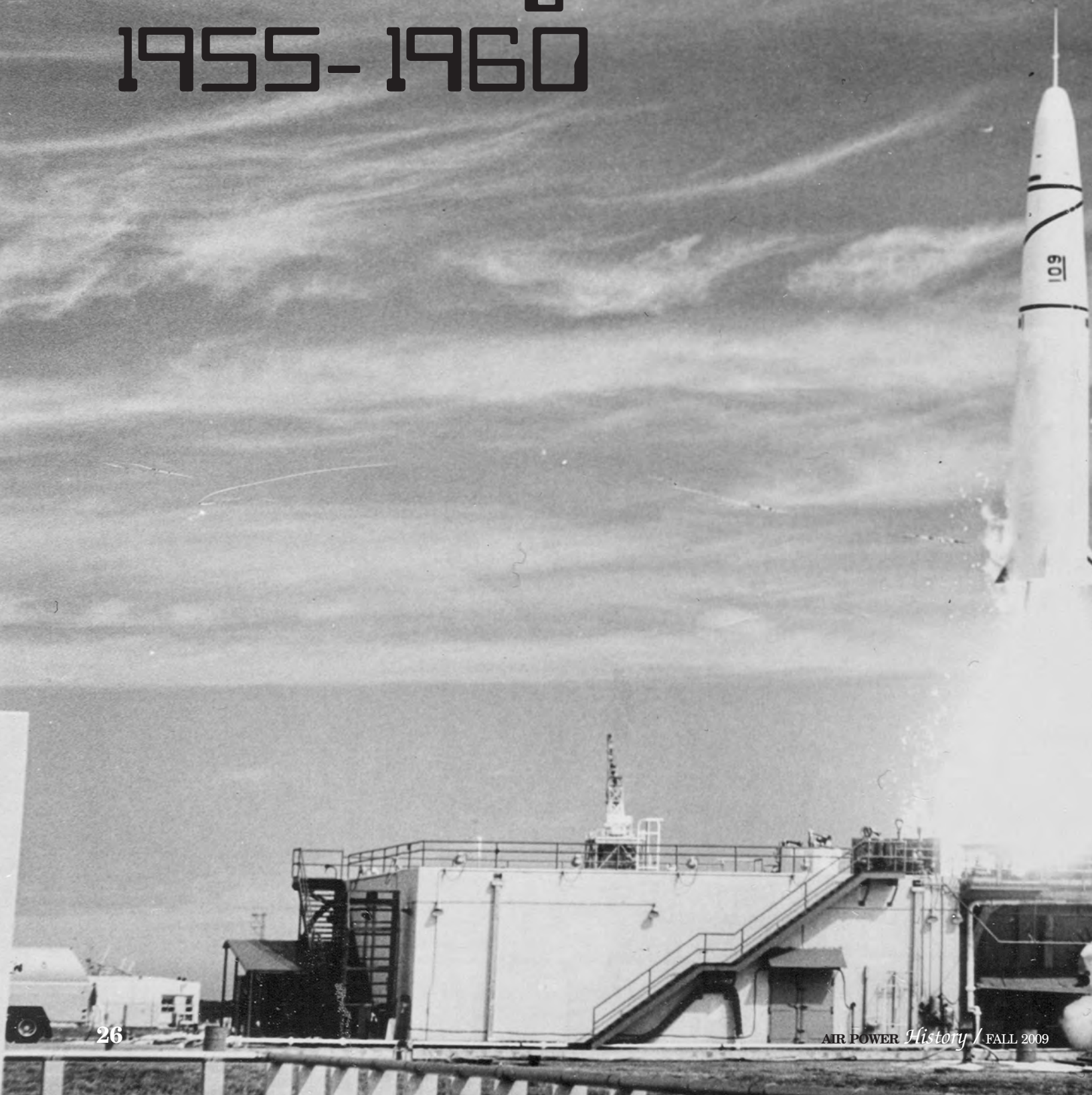
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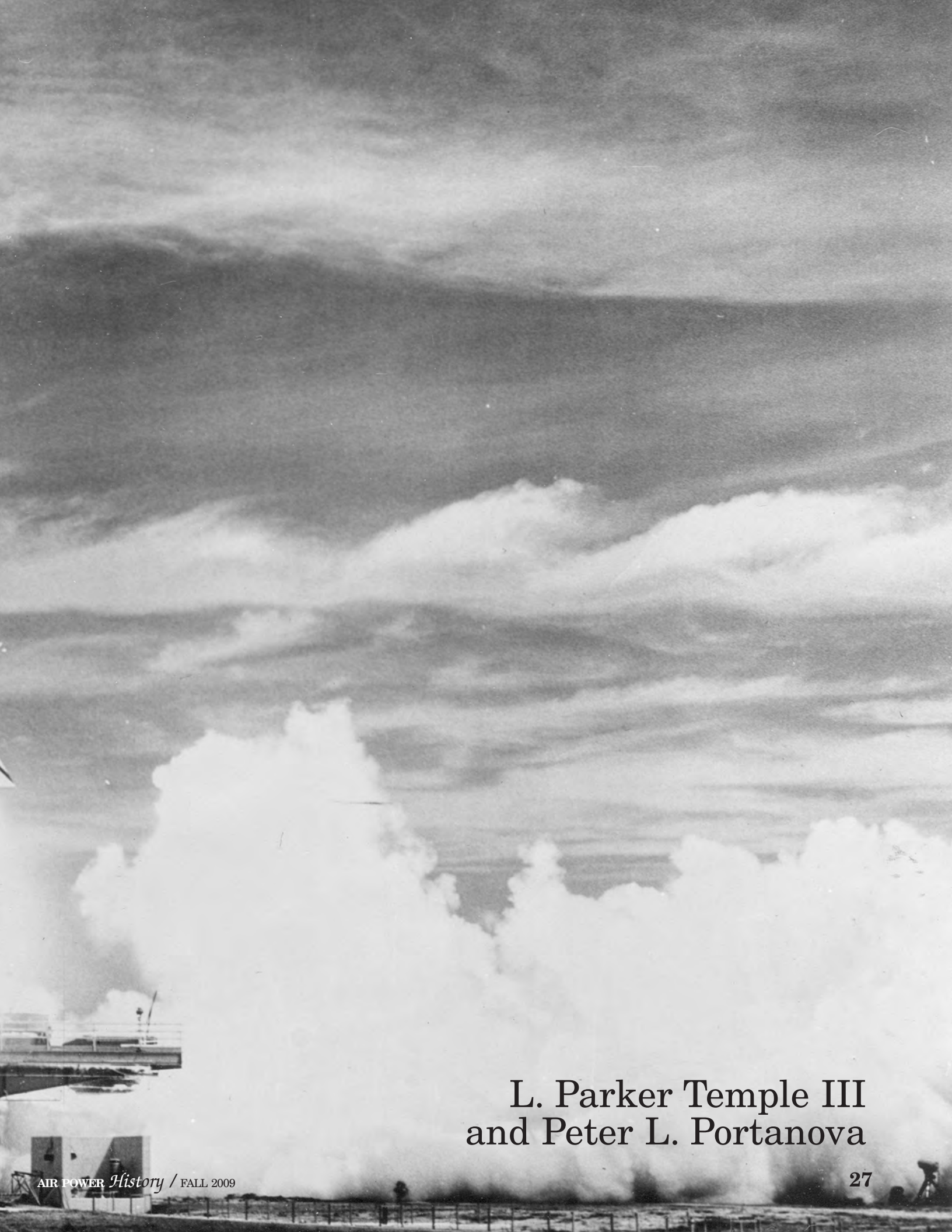
1. "USAF Aerobatic Team To Fly RAC Jet Again", article in Air Force Plant Representative Office (AFPRO), Republic Aviation Corporation, Historical Report, 1 Jan - 30 Jun 1964, Air Force Historical Research Agency (AFHRA) Call # K243.0707-5, IRIS # 0486069.
2. Hist., 4 TFW, 8 Dec 57 - 30 Jun 58 and 1 Jan 59 - 30 Jun 59, AFHRA microfilm MO289.
3. Hist, 4 TFW, 1 Jan - 31 Dec 60, AFHRA microfilm MO290.
4. Hist, Hq. TAC, 1 Jul - 31 Dec 61, Supporting Documents II and Appendix, AFHRA Call # K417.01, IRIS # 00502708, pp 316 - 317.
5. Hist, Hq. TAC, 1 Jul - 31 Dec 61, Supporting Documents II and Appendix, AFHRA Call # K417.01, IRIS # 00502708, pp. 316 - 17.
6. Hist, 36 TFW, 1 Jan - 30 Jun 1962, USAF microfilm MO627, frames 1110 - 1115.
7. Hist, Hq. TAC, 1 Jul - 31 Dec 1962, Volume I, AFHRA Call # K417.01, IRIS # 00502712, pp. 288 - 89. Ironically, in a cost saving measure brought on by the Middle-East oil crisis, the Thunderbirds converted from fuel-thirsty F-4Es to T-38s in 1974.
8. Individual aircraft status records in AFHRA microfilm ACA-79. Serial numbers listed in F-105B Thunderbird Partial Flight Manual T.O. 1F-105B(I)-1, p. 1-3. The nine

9. Hist, 4520 CCTW history, 1 Jan - 30 Jun 1964, Call # K285.54-36, IRIS # 0488620, pp 31 - 32.
10. AFPRO Detachment 5, Republic Aviation Corporation, Historical Report, 1 July - 30 Dec 1963, Call # K243.0707-5, IRIS # 0486068, p. 13 of 17.
11. Hist, 4520 CCTW, 1 Jul - 31 Dec 63, Call # K285.54-35 IRIS # 0488615, pp 54 - 55.
12. AFPRO, Republic Aviation Corporation History, 1 Jan - 30 Jun 1964, Call # K243.0707-5, IRIS # 0486069, p. 12. *Las Vegas Review-Journal Monday*, Feb 3, 1964, p. 17.
13. 4520 CCTW history, 1 Jan - 30 Jun 1964, p. 32.
14. *Ibid.*, pp. 4 - 35.
15. *Ibid.*, pp 32 - 33.
16. F-105B Thunderbird Partial Flight Manual T.O. 1F-105B(I)-1, pp 1-17 - 1-19.
17. Hist, 4520 CCTW, 1 Jan - 30 Jun 1964, pp 34 - 35. Paul Kauttu, e-mail to author, Oct 31, 2008.
18. Article, "USAF Thunderbirds 1964 Version," in *Fighter Weapons Newsletter*, June 1964, by Capt Jerry M. Shockley, in History of the Fighter Weapons School 4525th Student Squadron, Vol 13, 1 Jan - 30 June 1964, Call # K285.54-36, IRIS # 0488621, p. 15.
19. *Ibid.*

20. F-105B Thunderbird Partial Flight Manual T.O. 1F-105B(I)-1, pp. 1-14 - 1-16.
21. Article, "USAF Thunderbirds 1964 Version", in *Fighter Weapons Newsletter*, June, 1964, by Capt. Jerry M. Shockley, in History of the Fighter Weapons School 4525th Student Squadron, Vol 13, 1 Jan - 30 June 1964, Call # K285.54-36, IRIS # 0488621, p. 15.
22. *Ibid.*
23. Hist, 4520 CCTW, 1 Jan - 30 Jun 1964, pp 32 - 33. "You Ain't a Thud Pilot 'til You Go Downtown", by Paul Kauttu, article in *Thunder Rolls, the Thunderbirds Alumni Association Newsletter*, Fall 2002, on line at www.thunderbirdsalumni.org/news/thunder_rolls.cfm.
24. "United States Air Force Thunderbirds A Capsule History" by Larry Davis and Capt "Matt" Mattingley, Thunderbird Executive Officer, in *Replica in Scale*, Vol 3, Number 3, Jan 1976, p. 129.
25. Paul Kauttu, e-mail to author, Oct 19, 2008.
26. Hist, 4520 CCTW, 1 Jan - 30 Jun 1964, p. 35. The separate positions of Commander and Flight Leader began in 1962. It was not popular with the team and was discontinued in 1965. Paul Kauttu, e-mail to author Nov 1, 2008.
27. Paul Kauttu, e-mail to author, Oct 31, 2008.
28. Hist, USAF FWS and 4525 School Squadron, 1 July - 31 Dec 1962, AFHRA microfilm M2198, frame 0348.
29. *Ibid.*
30. *Ibid.*
31. Paul Kauttu, e-mail to author, Oct 31, 2008.
32. Hist, USAF FWS and 4525 School Squadron, 1 July - 31 Dec 1962, AFHRA microfilm M2198, frame 0452. Paul Kauttu, article in *Thunder Rolls, the Thunderbirds Alumni Association Newsletter*, Fall 2002, on line at http://www.thunderbirdsalumni.org/news/thunder_rolls.cfm.
33. Hist., 4520 CCTW, 1 Jan - 30 Jun 1964, p. 35.
34. Hist. 4520 CCTW Vol 1, Jan - Jun 1964, C all # K285.54-36, IRIS # 0488620, p. 34. Paul Kauttu, e-mail to author, Oct 31, 2008.
35. Paul Kauttu, e-mail to author, Oct 19, 2008.
36. "USAF Thunderbirds 1964 Version", article in *Fighter Weapons Newsletter*, June, 1964, by Capt. Jerry M. Shockley, in History of the Fighter Weapons School 4525th Student Squadron, Vol 13, 1 Jan - 30 June 1964, Call # K285.54-36, IRIS # 0488621, p. 12.
37. "USAF Aerobatic Team To Fly RAC Jet Again", article in Air Force Plant Representative Office (AFPRO), Republic Aviation Corporation, Historical Report 1 Jan - 30 Jun 1964, Call # K243.0707-5, IRIS # 0486069.
38. Hist., 4520 CCTW Vol. 1, 1 Jan - 30 Jun 1964, Call # K285.54-36, IRIS # 0488620, pp- 33 - 34.
39. *Ibid.*, p. 36. Lt Col (Ret) Bill Sparks, e-mail to Weasel Net, Apr 14, 2002.
40. Stability augmentation (stab aug) was part of the plane's autopilot that damped pitch and yaw oscillations.
41. "USAF Thunderbirds 1964 Version", article in *Fighter Weapons Newsletter*, p. 12, June, 1964, by Capt. Jerry M. Shockley, History of the Fighter Weapons School 4525th Student Squadron, Vol 13, 1 Jan - 30 June 1964, Call # K285.54-36, IRIS # 0488621.
42. Article by Paul Kauttu in *Thunder Rolls, the Thunderbirds Alumni Association Newsletter*, Fall 2002, on line at http://www.thunderbirdsalumni.org/news/thunder_rolls.cfm.
43. Paul Kauttu, e-mail to author, Nov 19, 2008.
44. Hist., 4520 CCTW Vol 1, 1 Jan - 30 Jun 1964, Call # K285.54-36, IRIS # 0488620, p. 36.
45. *Ibid.* During this period, the Blue Angels flew Grumman's supersonic F-11 Tiger.
46. *Ibid.*
47. *Ibid.*
48. *Ibid.*
49. *Ibid.*
50. Paul Kauttu e-mail to author, Oct 31, 2008.
51. *Ibid.* In a Nov 8, 2008 e-mail, Paul Kauttu wrote, "As I recall, photo shots were not taken because we did not have the full diamond."
52. AF Form 711 USAF Accident/ Incident Report dated 23 May 1964, signed by Maj. Donald G. Page, Investigating Officer. Paul Kauttu remembers that, instead of reducing approach speed, the late break was to reposition themselves in front of Base Operations where his parents were awaiting his arrival and that the standard Thunderbird pitch up was 3 to 4 Gs not 6. Paul Kauttu e-mail to author Nov 8, 2008.
53. Paul Kauttu, e-mail to author, Oct 31, 2008.
54. As vice commander of Seventh Air Force in Saigon, Gen. Worley was killed in the combat loss of an RF-4C on July 23, 1968.
55. Paul Kauttu, article in *Thunder Rolls, the Thunderbirds Alumni Association Newsletter*, Fall 2002, on line at http://www.thunderbirdsalumni.org/news/thunder_rolls.cfm.
56. San Francisco News-Call Bulletin, Mon, May 11, 1964, p. 14.
57. Hist., 4520 CCTW, 1 Jan - 30 Jun 1964, p. 36.
58. *San Francisco News-Call Bulletin*, Mon, May 11, 1964, p. 14. San Francisco Examiner, May 11, 1964.
59. USAF Accident/ Incident Report dated 23 May 1964
60. "F-105 Thunderchief, Workhorse of the Vietnam War", by Dennis R. Jenkins, The Walter J. Boyne Military Aircraft Series, McGraw-Hill publisher, p. 42.
61. Paul Kauttu, e-mail to author, Nov 22, 2008.
62. Hist., 4520 CCTW history, 1 Jan - 30 Jun 1964, pp 36 - 37.
63. Paul Kauttu, article in *Thunder Rolls, the Thunderbirds Alumni Association Newsletter*, Fall 2002, on line at http://www.thunderbirdsalumni.org/news/thunder_rolls.cfm.
64. Paul Kauttu, e-mail to author, Oct 31, 2008.
65. Hist, Tactical Air Command, July - Dec 64, Supporting Documents III, Call # K417.01V.4, IRIS # 00502721, Document 184.
66. AF Form 711 USAF Accident Incident Report 64-5-13-1, dated 27 May 1964, signed by Col John L. Gregory, Jr., Board President., Friday, May 15, 1964, p. 1.
67. Hist., 4520 CCTW History, Jan - Jun 61, AFHRA microfilm MO2195, p. 46.
68. *Aviation Week & Space Technology*, May 18, 1964, p. 38.
69. The fleet-wide inspection for the weak backbone plate missed one early-production F-105D with tragic consequences. On June 15, 1965, Republic test pilot Mr. Carlton B. Ardery, Jr. was killed when his JF-105D 58-1149 (the fourth "D" built) broke apart in a 7.33 G pull-up during a test mission at Eglin AFB. The cause was attributed to the fracturing of the same backbone plate that killed Capt. Devlin. Fairchild Hiller Accident Report.
70. *Aviation Week & Space Technology*, May 25, 1964, p. 31.
71. *Colorado Springs Gazette Telegraph*, Monday, 25 May 1964, Section B - Pg 1.
72. *Colorado Springs Gazette Telegraph*, Tuesday, 26 May 1964, Pg B-1. Falcon News, May 29, 1964.
73. 4 TFW History Jul - Dec 64, AFHRA microfilm MO291.
74. Clarence Langerud, e-mail to author, Nov 20, 2008.
75. AF Form 711, USAF Accident/Incident Report 65-6-24-2 dated 19 July 1965, signed by Col. John A. Sirney, accident board president. Capt. Shockley was flying mock air combat with his wingman when he flew into the ground. The accident was attributed to "operator error". "Sparrow Hawk" was the preliminary evaluation of the F-5A prior to its deployment to South Vietnam under the combat evaluation called "Skoshi Tiger". See <http://www.globalsecurity.org/military/systems/aircraft/f-5c.htm>.
76. CNA Loss/Damage Database, Navy loss 241, microfiche p. E07.
77. CNA Loss/Damage Database, USAF Loss 882, microfiche p. K25.

Project Emily and Thor IRBM Readiness in the United Kingdom, 1955-1960





L. Parker Temple III
and Peter L. Portanova

(Overleaf) A USAF Thor lifts off from the Air Force Missile Test Range, Cape Canaveral, Florida.

A 1951 INTELLIGENCE ESTIMATE BY THE CENTRAL INTELLIGENCE AGENCY... ANNOUNCED "WE BELIEVE THAT THE ULTIMATE SOVIET OBJECTIVE IS A COMMUNIST WORLD DOMINATED BY THE U.S.S.R

Project Emily, whose fiftieth anniversary is being celebrated, was the deployment of U.S. Thor intermediate range ballistic missiles in eastern England. This deployment, as the whole development of the Thor missiles, was conducted under the utmost schedule pressure during the Cold War, motivated by fears that the Soviet Union would develop similar missiles faster than the United States could develop its intercontinental ballistic missiles. The risks accepted by the United States and England using an acquisition process known as "concurrency" are described in this paper, as are the consequences for the fielding and operation of completely new, unprecedented weapons requiring high reliability. This history provides the unique perspective of the American engineers, one of whom is a co-author, describing the deployment and activation of the Thor missile squadrons in England.

Project Emily's Basis in the Cold War¹

This history is driven by the sense of urgency born in the early Cold War, when the United States and its allies faced a closed Soviet Union whose motivations and actions were unknown. The U.S. began sending intrusive aircraft overflights over the heartland of the Soviet Union to understand what that secretive country was doing. A 1951 intelligence estimate by the Central Intelligence Agency displayed typical concern when it announced "We believe that the ultimate Soviet Objective is a Communist world dominated by the U.S.S.R...and that an armed conflict between the [U.S. and its allies] is eventually inevitable."² Estimations of the Soviet Union's intentions rapidly became even more gloomy and dire.

The increasingly pessimistic view of world events reflected what little evidence of Soviet actions the Soviets chose to release. The Soviet

Union detonated its first atomic fission device, which aerial reconnaissance detected on September 3, 1949, years ahead of intelligence estimates. When the Soviet Union moved up to a thermonuclear fusion device on August 12, 1953, they had advanced from fission to fusion faster than the United States and its allies had. That seemed to indicate that the Soviet Union was not only catching up rapidly, but that their rate of advance was faster and accelerating. In the very near future, the Soviet Union would surpass the capabilities of the U.S. and its allies, and once in that strategically superior position, as the 1951 estimate had said, strategic nuclear conflict might become a reality.³

The United States military, and especially President Dwight D. Eisenhower, were committed to preventing another surprise attack like Pearl Harbor, which in a nuclear war would be catastrophic. Fearing the worst, the United States and its closest allies committed to a major increase in strategic nuclear forces. In addition to new bombers, the United States began to pursue land- and sea-based ballistic missiles. When thermonuclear devices became small enough to make a large ballistic missile of feasible size, the Intercontinental Ballistic Missile (ICBM) began development. The U.S. considered the ICBM an area where surely they had a lead over the Soviet Union, which was estimated to be capable of producing such a weapon by 1959.

However, U.S. development of large missiles did not advance as quickly as expected, and by 1955, it was clear that the U.S. might not be able to field ICBMs until the late 1950s. That meant there was a chance that the Soviet Union might beat the U.S. to this capability. Some early capability was necessary. Specifically, shorter-range missiles were necessary to support the Cold War needs of U.S. allies, such as the United Kingdom.⁴

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Dr. Peter L. Portanova has co-authored and presented numerous papers at the American Institute of Aeronautics and Astronautics (AIAA) and the International Astronautical Federation (IAF) on chronicling the genesis of Evolved Expendable Launch Vehicles. He has been working in the missile and space field for fifty-two years holding increasing responsibility in systems engineering / development / integration / operations and management assignments in Thor IRBM, Atlas ICBM, Titan III, Shuttle for Vandenberg Air Force Base, advanced launch vehicle systems studies, Pentagon assignment in the Office of the Undersecretary of Defense (Acquisition & Technology), and Evolved Expendable Launch Vehicle program. Currently he is supporting the National Reconnaissance Office. Prior to joining The Aerospace Corporation, he was an Atlas system analyst at TRW and a design / project engineer at Douglas Aircraft Company, Santa Monica, Calif. He has earned an AS degree from the State University of New York, BS in engineering from Georgia Institute of Technology, MS in engineering from University of Southern California, and Ph.D. from The Drucker School, Claremont Graduate University, Calif.

DR. JAMES R. KILLIAN, JR., THE PRESIDENT'S SCIENTIFIC ADVISOR... SENT A REPORT TO PRESIDENT EISENHOWER ON FEBRUARY 14, 1955, RECOMMENDING THE DEVELOPMENT OF IRBMs

By 1955, Donald A. Quarles had become the U.S. Secretary of the Air Force. His strong support for ICBMs stemmed from his having previously served as the Assistant Secretary of Defense for Research and Development, the office responsible for implementing the missile programs. Quarles had been most influential in the course of the U.S. ICBM programs prior to moving to the Air Force in mid-1955. Before taking over the reins of the Air Force, he had also been deeply involved in another, nearer-term missile project: the Thor Intermediate Range Ballistic Missile (IRBM).⁵

The Thor traced its roots to the meeting of the Office of Defense Mobilization's Scientific Advisory Committee (ODM/SAC) in January 1955. Since 1954, their emphasis had been preventing surprise attack by a combined emphasis on gathering intelligence on Soviet actions and intentions, forming a strategic nuclear force second to no other nation, and a continental defense capability that would exact a high price from any airborne attack.⁶ ODM/SAC had spawned the U-2 spyplane, the Corona spy satellite, and other revolutionary capabilities in the early days of the Cold War.

Consequently, the ODM/SAC urged development of a tactical ballistic missile by the Air Force. Dr. James R. Killian, Jr., the President's Scientific Advisor and a highly influential individual in these formative days, expressed concern that the Soviets might develop an IRBM before the U.S... That was unacceptable in the early Cold War days, so considerable support was behind the development of IRBMs. Killian's Technological Capabilities Panel (of the ODM/SAC) sent a report to President Eisenhower on February 14, 1955, recommending the development of IRBMs for land- and sea-basing.⁷

Bernard A. Schriever, promoted to major general in December 1955, was the head of Air Research and Development Command's Western Development Division responsible for ICBM and reconnaissance satellite development. Schriever initially hesitated because the nation's limited production facilities and qualified engineers had to be devoted to the highest priority systems—the ICBMs. Any IRBM that did not grow naturally out of the ICBMs might divert critical resources from the ICBM developments.⁸

Schriever's concerns about diverting resources were solidly based. Development of the ICBM had such high priority and incredible schedule pressure that an approach to acquisition, known as "concurrency" was being used. Had a "traditional" development approach been used, the first task would have been a prototype missile with associated research and development tasks completed during a development phase. Upon successful completion of the test program, a production phase would have begun. That process would have taken five to seven years, but a capability was needed within three years.⁹

Schriever's "concurrency" idea was to have all the components of the weapon system (the missiles, equipment, crews and launch sites) complete development at the same time. The management approach was to split out activities that could be

made parallel, and then run them concurrently in such a way that their outputs were ready at about the same time. The approach quickly identified those activities that had to be serial, and whose duration could not be made shorter—the "critical path." Concurrent development even lasted into the operational phase, with the first operational units providing feedback to the continued research and development of the missile.¹⁰

The system's goals were set most aggressively, with a first research and development launch by the end of 1956 on a "maximum calculated risk basis." Continuing with that aggressive schedule, a full-range test flight would occur in July 1957, followed by the first combat-configured missile launch in July 1958. On that schedule, assuming no major development problems, a first operational launch by a military launch crew would occur in July 1959.¹¹

Concurrency was neither low cost nor low risk nor efficient. It did get the job done as quickly as possible, which was the reason for its adoption. Making the ICBM development schedule so highly parallel that it absorbed a large percentage of the available engineering resources of the aeronautical capabilities of the U.S. meant any new missile development, by the Air Force or any other service, seemed to threaten the availability of resources.

Schriever's concerns about supporting multiple, competing missile systems surpassed the missiles themselves. Competing with Thor activities in England and elsewhere was another development that used Thors in a different role. The Thor missile was to become the space launch workhorse, which its descendants remain today. At the time, three satellite programs were slated to use Thor boosters and upper stages (aside from those supporting the new civilian space agency, the National Aeronautics and Space Administration). These programs were openly designated as Midas, Samos and Discoverer.¹² Midas was an early warning satellite whose task was to be detection of any missile launches in the Soviet Union. Samos was a series of reconnaissance satellite concepts, most of which would never reach fruition. Discoverer was ostensibly a component research and development program supporting Midas, Samos and other military programs. Discoverer was actually the cover name for the first operational photoreconnaissance satellite, named Corona. Corona was the satellite alternative to the U-2 spy plane, whose operational lifetime over the Soviet Union was rapidly getting shorter. While the Thor program enjoyed a Defense Priority Allocation Systems rating of "DX," the highest national priority rating, not all of that priority derived from its relationship to Project Emily. Corona was easily first-among-equals when it came to the resources necessary to make it work. The problem was that Corona experienced its own set of development issues just like the Thor—the kind of problems due to intense schedule pressure, learning-by-doing and unprecedented engineering challenges. Corona, and to a slightly lesser extent, Midas and Samos, demanded attention on its Thor boosters that had to compete with Project Emily. Discoverer I was

**SECRETARY
OF DEFENSE
NEIL H.
MCELROY...
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THE THOR
AND JUPITER
IRBMS INTO
PRODUCTION**

launched from Vandenberg Air Force Base (A.F.B.), California, on February 28, 1959, and after fourteen attempts, the first satellite image was finally returned to Earth on August 18, 1960.¹³

Counterbalancing Schriever's resource concerns was the U.S. Army's medium range ballistic missile development.¹⁴ Already underway, the Army missile was already getting resources not counted "against" those devoted to ICBM development. The Army missile might be extended to grow into the IRBM niche.¹⁵ At the time, inter-service competition was as fierce as the competition with the Soviets. Consequently, the Air Staff decided in May 1955 that an IRBM was in the Air Force's best interests.¹⁶

On November 8, 1955, Defense Secretary Charles Wilson directed the Air Force to proceed with an IRBM to be called Thor, and the Army to extend its missile (with Navy help) on what was designated the Jupiter IRBM.¹⁷

A month later, on December 27, 1955, the Douglas Aircraft Company received the development contract for Weapon System 315A (Thor).¹⁸ The Thor's performance demands were only slightly less than those of the ICBMs, which were proving considerably difficult. Thor's range of 1,500 miles was considerably less than that of the ICBM, otherwise the IRBM was quite similar.¹⁹ Both the ICBM and IRBM had to be ready to launch instantaneously with high reliability, and then to hit their targets accurately.²⁰ For the Thor, this translated to a requirement to launch fifteen minutes after the start of a countdown.²¹ The short time to erect, checkout and fuel a missile was driven by the simplicity of the launch facility—the sites could not withstand any direct attack, nuclear or otherwise.²² Therefore, they had to be fired quickly. In addition, twenty-five percent of all the Thors had to be ready within that same fifteen minutes.²³

With nearly the same driving requirements, how could the IRBM be delivered faster than the ICBM? Both were using "concurrency." If IRBMs were to fill a period of time until the ICBMs were operational, then it was clear that some of the Thor subsystems had to benefit from ICBM work, but the program was still very challenging.²⁴

Ten months after the contract award, on October 26, 1956, Douglas Aircraft Company delivered the first SM-75 Thor, number 101, to Patrick Air Force Base in Florida.²⁵ Three months later, on January 25, 1957, Thor 101 was erected and launched from the Air Force Missile Test Center at Cape Canaveral Air Force Station, Florida. The first launch missed its goal by one month due to a relay failure during a tie-down flight readiness firing in December.²⁶ One aspect of the risks of concurrency showed up in the first launch, when the missile exploded after the liquid oxygen (LOX) tank ruptured due to a contaminated LOX fill and check valve failed to open. Missile 101 fell back through the launch ring at Pad 17B and exploded on the deflector plate below, with enough damage to delay the second launch until April 1957.²⁷

The pressure-fed LOX system used gaseous oxygen (GOX) as the pressurant in the initial stages

of development. Alternatives such as gaseous nitrogen were considered unacceptable because of concerns about ingestion of nitrogen into the LOX, contaminating the fuel. However, GOX proved to be susceptible to contamination in its own right, leading to several problems and one severe accident. No specific testing programs had been conducted to confirm or refute the concerns about nitrogen, because the schedule did not allow for testing of alternatives.

The program's high risk revealed itself when the first four launches ended in failure. While the second missile, on April 19, 1957, did much better, the third, Number 103, suffered a ruptured fuel tank on the pad five minutes before launch. That incident, on May 21, 1957, caused another refurbishment of Pad 17B, but Pad 17A had in the interim been completed. Thus, the fourth Thor launched from the new launch site on August 30, 1957. While the missile actually flew, it broke in half ninety-three seconds into the flight.²⁸

The fifth flight on September 20, 1957, was the first completely successful launch, which was an understatement.²⁹ Success after five attempts was remarkable and a testament to the ability to overcome the complexity imposed by a short schedule. The first full range test took place with Thor number 109 on October 24, 1957.³⁰

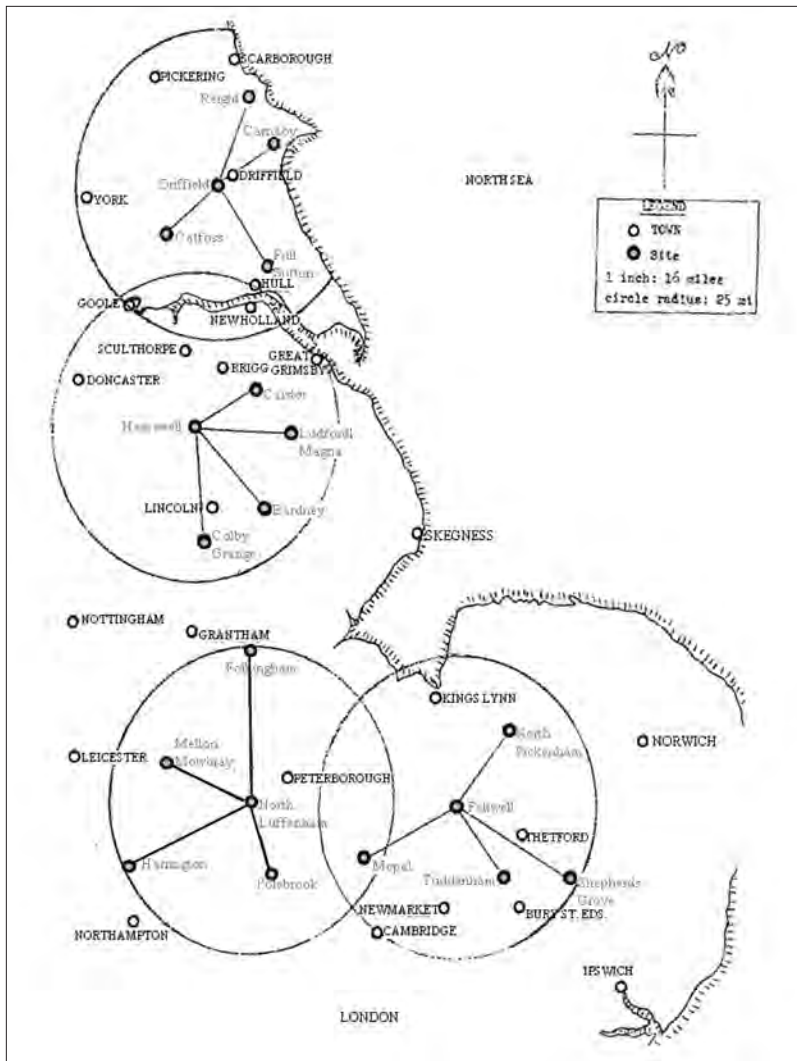
The early rocket program and its urgency allowed situations that later safety restrictions and hard-won lessons learned would never tolerate. For instance, the early Thor missiles had small fins on the aft end, and there was some concern that the launch loads were causing these fins to come off shortly after liftoff. To determine whether that was the case, on the third launch, two Douglas Aircraft engineers, Jay Simmons and Al Ressor, sat in a fox-hole 200 yards downrange of the second successful Thor missile launch. That meant that the missile would launch right over the top of them, but their job on that launch was to determine if the fins stayed on—which they did.³¹

Secretary of Defense Neil H. McElroy, who took over from Wilson on October 9, 1957, ordered the Thor and Jupiter IRBMs into production. He planned to begin deployment in England, mandating December 31, 1958, for combat readiness.³² Security made launch site locations secret until the missiles were actually in place.

And that is where the story of Project Emily began in earnest. The challenge was taking a new weapon system with its missiles, equipment, facilities and crews, and deploying everything operationally in England. That part of the story begins with the selection of the sites.

Project Emily: Construction and Deployment

Project Emily deployed sixty Thor missiles in four squadrons at twenty existing facilities in eastern England (largely in Yorkshire and East Anglia). Short timelines drove the use of existing sites, but further constraints existed. In addition to security concerns, the sites had to be spread apart far



Thor deployment sites
(Source: *Airview News*,
Monthly publication of
*Douglas Aircraft for Project
Emily*, No. 10, Dec. 1959.)

LAKENHEATH ...WAS THE PRIMARY LANDING SITE FOR THE TRANSSHIP- MENT OF MIS- SILES, EQUIP- MENT AND PERSONNEL

enough that they could not be eliminated by a single Soviet nuclear weapon. Sites had to have accommodations and other support infrastructure to avoid building these in addition to the missile sites. Usable runways were also important for delivery of the tons of missiles and equipment.³³ RAF Lakenheath was the primary landing site for the transshipment of missiles, equipment and personnel.³⁴ Initially, the missiles arrived aboard Douglas C-124 Globemaster IIs, but these were replaced in January 1959 by the much larger Douglas C-133 Cargomaster aircraft. The Cargomasters had enough space to ship the missiles mounted on their transporters, greatly simplifying the loading and unloading of the missiles.³⁵ All deployment sites had long associations with the Royal Air Force (R.A.F.), especially as World War II heavy bomber bases when Britain was the “aircraft carrier” prior to the Normandy landings.³⁶

R.A.F. Feltwell, an airfield since 1917, was the first squadron under construction.³⁷ With the first missiles going to Feltwell’s 77 (SM) squadron, the unit’s initial mission also included working out the training and procedures for the rest of the squadrons.³⁸

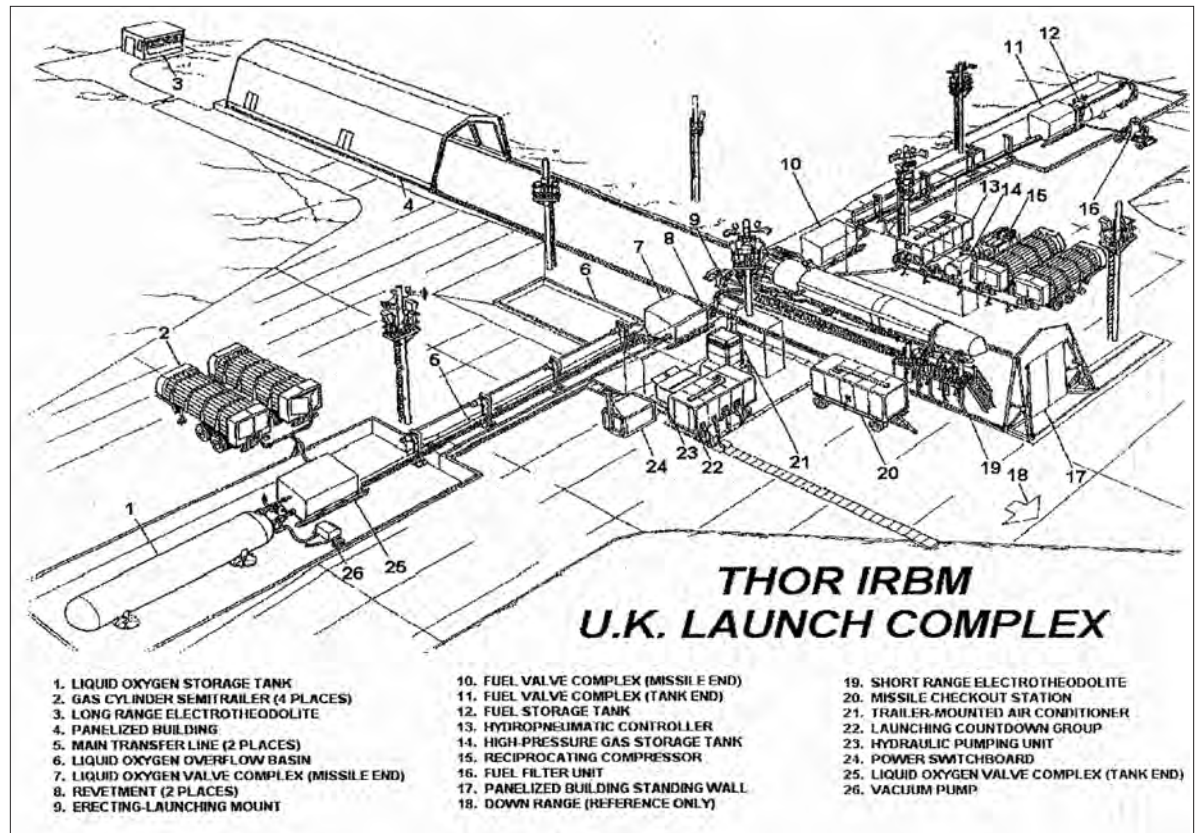
Douglas Aircraft studies estimated 500 civilians would be needed for the construction, checkout

and activation of the four squadrons. That raised the question of quarters. Of the four squadrons only Lakenheath had any U.S. Air Force-controlled housing to quarter civilian bachelors. England was still recovering from the devastation of World War II, so living on the economy would not be a complete solution. In fact, living on the economy in most of the deployment locations would handle only a minority of those required. Hotels from Cambridge to Norwich had to be used. In addition, leases on some mansions had to be taken, and these included Lynford Hall, Northcourt Guest House and Brandon Parks Great House.³⁹ This was neither a satisfactory solution for the occupants or for the local populations, but the solution was needed only temporarily.

Finally, with realistic alternatives exhausted, trailers had to be used. However, English trailers were conceptually different from American ones, and were not intended for full-time living quarters, because they lacked facilities for year-round habitation. Consequently, Douglas Aircraft had British firms build trailers specifically suited to American tastes and needs.⁴⁰

The available quarters for contractors precluded any further influx of Douglas personnel. All the housing for fifty miles around the activation sites was full. Consequently, 250 Air Force, and a good many R.A.F. personnel, became Douglas employees. Under the acquisition rules at the time, this was not completely legal, but it was absolutely necessary to accomplish the program. Project Emily was, in the sense of the times and the fear engendered in the Cold War, something that had to be accomplished whatever the obstacles. Any problems that might arise out of who worked for whom would simply have to be sorted out later, as the mission had to be accomplished. As a testament to those who participated, no objections arose because the “can do” attitude was pervasive.⁴¹

In February, 1958 a joint government agreement called for the U.S. Third Air Force to assist in the construction of the Thor sites and deliver the missiles.⁴² This was presented to Parliament as a white paper “Supply of Ballistic Missiles by the United States to the United Kingdom” covering the topics of the supply system, operational command and control, and control of the warheads.⁴³ The British would build the launch bases based on U.S. blueprints. This alone was a difficult task, as the blueprints called for tolerances on the launch pad of one-eighth of an inch (3 mm) in line and level. Furthermore, the living quarters for the construction crews and the 1,000 R.A.F. maintenance and launch crews at each complex had to be rapidly set up. To illustrate the rate at which things were getting done, after initial sketches were made of the sites in February 1958, more than 300 working drawings for the first complex were completed by April 21, 1958.⁴⁴ Also by mid-September, the first prime contract for R.A.F. Feltwell squadron construction was completed. By mid-September, the first contract for pouring the concrete at R.A.F. Feltwell’s launch pads was completed.⁴⁵



THE WORK TO BE DONE WAS MAINLY THE CONSTRUCTION OF THE LAUNCH COMPLEX... EQUIPMENT

All this was done concurrently with the first combat-configured U.S. sites at Vandenberg A.F.B.⁴⁶ Vandenberg had been an Army disciplinary and tank training facility, and had recently been taken over by the Air Force for the purpose of testing missiles and use as a satellite launching facility.⁴⁷ The first missile launched from Vandenberg was a Combat Training Launch of a Thor, on December 16, 1958. The early test flights were being conducted at Cape Canaveral Air Force Station, launch pad 17, mentioned earlier. Meanwhile, Douglas Aircraft's Sacramento (SACTO) test facilities were developing a Full Demonstration capability including liquid oxygen and kerosene RP-1 propulsion test procedures concurrently with design engineering, development and production activities.⁴⁸

The Thor program development plan called for a series of tests beginning at the sub-system level, then a test of the systems, and finally an integrated systems test. The Douglas Aircraft Long Beach team and their supplier performed the sub-system tests for the electrical control trailers, hydraulic pump units, and other major equipment items. The Douglas Aircraft Santa Monica team accomplished the system test demonstration, which was performed at Culver City, California. The final step was the fully integrated system test performed at the Douglas Sacramento site.⁴⁹

The Sacramento site had a complete launch test complex (one launch emplacement versus three at the England sites) built using the same production line equipment that was being shipped to England. The test complex dirt work was started early in 1958 and the equipment installation was ready for end-to-end test around June of 1958. Following the fully

integrated system test, the program test plan called for a full-up launch complex demonstration. The full-up demonstration test was a project milestone and a major contractor payment point.⁵⁰

The work to be done was mainly the construction of the launch complex and the installation and checkout of the missile-related equipment. Success was measured as a successful missile erection, fuelling and countdown.

Each launch complex required construction of:

- concrete launch pads along with the associated cabling ducts and roads
- storage buildings
- power facilities and crew facilities
- hookups to water and power
- security perimeter fencing
- 45,000 square foot maintenance and technical support hangar at the main base
- full site survey.⁵¹

Beyond the construction, each site had to accommodate a number of other features such as ground support equipment and the rocket's fuelling capabilities (see figure above). Essentially, these additional features included:

- Mobile shelter (Thor missiles stored horizontally; retracted to open position during the countdown sequence; then missile would be raised into vertical for fuelling)
- Missile checkout trailer
- Guidance Theodolite
- Liquid oxygen (LOX) storage tank 13,500 gallons

ACTIVATION OF A MISSILE COMPLEX WAS A SERIOUS LOGISTICAL PROBLEM. IT INVOLVED THE TRANSPORTATION FROM THE U.S. OF ABOUT 6,000 TONS OF MISSILES AND MATERIEL

THE PILOTS... HAD TO LESSEN THEIR NORMAL DESCENT RATES TO ALLOW THE THOR FUEL TANKS TO ADJUST TO THE PRESSURE CHANGES

- Fuel storage tank 6500 gallons Kerosene RP-1
- Air Conditioning unit
- High pressure (5500 pounds per square inch) gaseous nitrogen storage tank
- Compressed gaseous nitrogen cylinder trailers
- LOX and RP-1 propellant and pneumatic transfer systems
- Electrical equipment trailer
- Hydraulic pumping unit
- Connecting ground cables; usually several hundred feet

The job, then, was more than a simple construction effort, and demanded technical understanding of a wide range of equipment, each with unique procedures, all adding considerable complexity. The initial view that this was going to be a straightforward installation of ready equipment proved to be anything but the case.

Gravimetric and geodetic surveys were conducted jointly. The Director of Military Surveys of the British War Office performed surveys outside of the sites. For the first two sites, the U.S. performed these surveys within the boundaries. For the other two sites, the British Air Ministry Works Directorate did the work.⁵²

Each of the main bases included a 45,000 sq. ft. aircraft hangar adapted for receipt, inspection, and maintenance of the equipment and missiles. The English power system had to be adapted to support American power standards to support the U.S.-developed equipment and missiles.⁵³

Activation of a missile complex was a serious logistical problem. It involved the transportation from the U.S. of about 6,000 tons of missiles and materiel. The task of transportation was made even more difficult because it was not simply transshipment involving about 300 flights. The pilots flying the Douglas C-124 Globemaster IIs had to lessen their normal descent rates to allow the Thor fuel tanks to adjust to the pressure changes. The AC Spark Plug inertial guidance units required even greater care, because of their packaging in a lubricant with very tight temperature tolerance ranges. Control of the power for the unit caused the C-124s to keep their outboard engines at 1,200 revolutions per minute (well above idle) at all times after engine start. The units were so sensitive to temperature and power that technicians had to fly along with them to watch gauges and ensure everything remained within acceptable limits.⁵⁴

Douglas Aircraft arranged a weekly charter flight on Pan American World Airways, who, coincidentally, used the Douglas DC-7 airliner. The first chartered flight with the first Douglas engineers landed at Lakenheath on July 24, 1958, just ahead of the first group of missiles.⁵⁵ Peter Portanova and Charles Ordahl arrived at Lakenheath in August 1958. While the early preference was for unmarried deployed engineers, both brought their wives, and the Portanovas even brought their infant daughter.⁵⁶

By that time, Douglas Aircraft engineers Phil Arroya and Ron Spain had monitored launch pad

preparation. The British had completed the concrete construction and were ready for ground equipment installation and checkout at R.A.F. Feltwell. The missile-related equipment installation was the responsibility of Douglas technicians such as Mike Boucher and Bob Shields.

A week after the first engineers landed at Lakenheath, a serious accident occurred at Sacramento. The accident exemplifies the kind of problems encountered in "first time" activities where the only precedents were limited to theory and analysis.

An explosion and fire occurred on July 31, 1958, at Sacramento while performing valve and pressure regulator set-ups of the LOX storage tank end complex. Little information existed on how to handle the large quantities of gaseous oxygen (GOX), and during an initial "wet flow" test, a GOX line ruptured and instantly ignited, badly burning six men. Of these, Oscar Udager, Walter J. Milan and John May later died.⁵⁷ Such tragedies demonstrate the problems of making practical applications of unprecedented nature ill informed by conventional knowledge of chemistry.

The cause of the explosion was traced to the use of high-pressure GOX as the pressurant and its susceptibility to contamination (which may have been related to the problem on the launch of Thor 101). Corrective action taken following the GOX accident included confirmation of the failure mechanism by performance of tests at Long Beach on an identical LOX tank arrangement. The system architect, Arthur D. Little Corporation, had considered any gaseous nitrogen (GN2) absorption in the LOX propellant unacceptable due to potential performance degradation of the missile's engine. They did not favor substitution of nitrogen for oxygen. A series of LOX propellant transfer tests using GN2 for pressurization included sampling of the LOX during transfer for the presence of nitrogen ingestion in the propellant. The tests determined that LOX did not ingest GN2, so using GN2 became acceptable for pressurization of the ground LOX storage tank and pressurization of the Thor's LOX system. The required systems changes were made to replace the GOX pressurant with high pressure GN2.⁵⁸

Blazing these new trails, few had any applied experience with missile systems. A matter of weeks differentiated a seasoned veteran from someone who had only academic knowledge. Portanova learned quickly as he dedicated himself to the urgent job at Feltwell, quickly earning a promotion to Senior Operations Engineer, and then moved on to R.A.F. Tuddenham. To impress the lessons of the LOX accident on his subordinates, he initiated a safety demonstration with Ed White, Douglas chemical process engineer, to reveal the dangers of working with LOX. He used a one-foot diameter dish, processed to be laboratory clean. Portanova would press his thumb in the center of the clean dish leaving only his thumbprint that introduced hydrocarbon onto the dish. He then, carefully poured a small amount of liquid oxygen into the dish. Then, from thirty feet he dropped a small



PICTURE BY EXPRESS STAFF CAMERAMAN ROBERT HASWELL

First published picture of Feltwell launch site. (Source: Pincher, Chapman. *London Express Mail*, "No. 1 rocket site—first picture," undated news article, mid-September 1958.)

THE FIRST THOR IN ENGLAND...ARRIVED AT LAKENHEATH ...ON AUGUST 29, 1958...LESS THAN THREE YEARS FROM THE DECISION TO START THE PROGRAM

weight on to the dish using a string-pulley. The combination of the thumb print hydrocarbon, liquid oxygen and the kinetic energy of the impact produced a dramatic explosion and a lesson well learned.

Recovery from the accident required about three weeks while the SACTO test complex continued the remaining system test. The initial dual propellant flow tests were performed in late August followed by multiple countdown demonstrations. The demonstrations validated the five-phase countdown sequence and set the stage for the full-up demonstration test, which occurred late September 1958. General Schriever and his R.A.F. counterpart were among those who witnessed the full-up test.⁵⁹

Everything was set for shipment of the missiles to their launch sites in eastern England. The first missile was ready by July 18, 1958, and the Air Force had scheduled it to fly out on August 1. However, the Air Ministry in England had not considered everything ready to receive it at the time.⁶⁰

One of the first things that had to be tested was whether the Thor transporter-erector could get from the transshipment point to the deployed launch sites. Captain "Bucky" Walters did this.⁶¹ Early in the deployment effort, association with missiles would raise awareness of the specific locations of the deployed launch sites. The aviation magazine *Flight* had released drawings of the arrangement of the equipment and buildings in its August 5, 1958, issue, but the specific sites, beyond Feltwell, were not openly discussed.⁶² Also, a low profile would avoid demonstrations by pacifists, whether well intentioned or Soviet-inspired, as well as the (then) common "ban the bomb" activists.⁶³ Five of the sites had become well known because of the site preparations underway, so that on August 24, 1958, Mepal had been the scene of a protest march. Thus, considerable effort was put into ensuring visible activities remained as inconspicuous as possible, particularly because the security arrangements still held the exact sites to be secret as the missiles were in transit. The laborers pouring the concrete for the launch pads were told that they were building car

Thor 01 en route to Feltwell. (Source: "Thor, The 'Safe' Missile." Picture courtesy of the Bury Free Press.)



parks.⁶⁴ Discussing the security and English concerns, one newspaper reported that the Russians were not a serious threat, because the restrictions placed on their movements precluded their getting near the sites. However, no such restrictions had been placed on Polish, Hungarian or Czech diplomats, so the sites were to be kept secret as long as possible.⁶⁵ Nevertheless, the number of "navigation failures" by Soviet airliners flying to England strangely favored overflying the area around the selected bases.⁶⁶

To that end, the U.S. Air Force M-52 truck tractor was replaced, after some necessary welding-torch modifications, with an English Morris tractor. However, the original transporter was very long, accommodating the 65 foot long missile—so turns on English town and country roads were problematic. The solution had been to add rear-wheel steering. Using the original M-52 tractor, the new transporter had been tested at Moffett Naval Air Station, near San Francisco, California.⁶⁷ The whole rig was painted R.A.F. blue, concealing all evidence of American insignia and designations since there was no reason to advertise it had anything to do with missiles.⁶⁸

But then the multiple concerned government agencies insisted on escorting the transporter-erector, leaving an indelible impression on the populace. So much for a low profile. It was not uncommon for the Americans who accompanied the rig to be asked if they were "one of the missile people," indicating just how canny the populace was.⁶⁹

The first Thor in England, which was Number 139 and the second production missile, arrived at Lakenheath quietly on board a C-124 on August 29, 1958. The arrival of the missiles began less than three years from the decision to start the program, and just a month after the last research and development missile was launched at Cape Canaveral.⁷⁰ Red letter signs with nine-inch-high letters warned "Sabotage Alert," reflecting the continuing concerns about security of the missiles.⁷¹ The sixtieth and final Thor, destined for R.A.F. Folkingham, arrived in December 1959 or January 1960.⁷²

Construction and concrete pouring at Feltwell's second and third launch pads finished on September 16, 1958. The first Thor, with some pomp and ceremony, was handed over to the RAF. Col. William Delaney, USAF, officially transferred the Thor to Feltwell's commander, RAF Group Captain Frank Willan.⁷³ Attending were Maj. Gen. William H. "Butch" Blanchard, Commander of the Seventh Air Division, the man who wrote the 1945 operations order for dropping the first atomic bomb,⁷⁴ and Air Vice-Marshal K.B.B. Cross, Air Officer Commanding Third Bomber Group.⁷⁵

Douglas engineer William "Bill" Stitt achieved the first major milestone when he, drawing on his experience at Cape Canaveral pad 17, successfully erected the first Thor at Feltwell on Thanksgiving Day, 1958. In this, his progress was greatly aided by the experience of Douglas propulsion engineer Thomas B. "Tom" Rehder, who had come from the Sacramento facility, and oversaw the propellant



Portanova greeting visitors to Tuddenham. (Left to right) Group Captain F. A. Willam, Chief Air Marshal Sir Harry Broadhurst, Flt. Lieutenant Crane, and Peter L. Portanova. (Source: Personal collection of Peter L. Portanova.)

flow systems.⁷⁶ This accomplishment took a great deal of effort. The biggest challenge and primary objective was conducting a successful countdown following operational procedures.

An amusing clash of cultures occurred after Portanova left R.A.F. Feltwell and moved to R.A.F. Tuddenham. On arrival at Tuddenham, he reported to Flight Lieutenant Crane and informed him that he (Portanova) was the Douglas Senior Operations Engineer responsible for the installation and checkout, and the Chief Test Conductor for the successful five-phase automatic countdown. Flight Lieutenant Crane was a little puzzled, because his chain of command had told him to expect a Douglas Missile Scientist. This was not a normal Douglas title, so Portanova explained that there was no Douglas Missile Scientist scheduled to visit Project Emily. After a few days of continuing to expect this missile scientist, Crane had checked for the name of the person to find out what had happened to him. Crane got his answer by message from Seventh Air Force, and informed Portanova that the name of the missile scientist was Peter L. Portanova. As the Flight Lieutenant went on, he explained that an engineer in England was someone who repaired automobiles as a mechanic or technician, and if you had graduated from a technology university or college, you were a scientist. Portanova, recently graduated from Georgia Institute of Technology, was indeed the Douglas Missile Scientist.

The operational Thor IRBM had to be able, after receiving an authenticated launch order and upon initiation by the R.A.F. Launch Control Officer, to follow an automatic five-phase sequence:

1. After a necessary data check, the countdown was begun.
2. Shelter retracted and missile erected. Targeting data sent to missile.
3. Missile fueled. Systems checked.
4. Missile functions switched to internal power and LOX was topped off if necessary.
5. Launch codes received. Keys turned and engines ignited.⁷⁷

During the checkout and activation of the earliest sites, however, it became clear that the Thor sys-

tems were not ready for an immediate run-through of the operational sequence. Therefore, the site activators took the approach that when one phase was successfully completed, activity focused on proceeding to checkout the next phase, and so on until all five phases were tested. This took several months due to inexperienced engineers with incomplete drawings and test procedures using “trial and error.”

The lack of documentation created an early and immediate problem, even for those people who had some familiarity with the Thor. No configuration control existed for the drawings, so there was no telling which drawings had the latest information and changes.⁷⁸ Some of the drawings and checkout procedures were incomplete and some unavailable. Poor or no coordination coupled with the lack of configuration control between Design Engineering and the test sites at Cape Canaveral, Vandenberg, and Sacramento compounded the documentation problem. Changes done in the field at the individual sites might get into the documentation, but might also be conflicting with changes at another site. For those in the field, in England, this became a serious problem.

As the earliest checkout procedures were being run in England, the electrical systems revealed “sneak” circuits—that is, unintended electrical paths had inadvertently been created. No one working with the equipment at the time could find all the sneak circuits, which by definition was not something created intentionally; and therefore, very hard to figure out what mistake had been made. During an all-hands meeting at R.A.F. Feltwell, Grant L. Hansen,⁷⁹ a Douglas Santa Monica chief engineer, recognized that nothing that had been tried was working. Using trial and error to find a sneak circuit was time consuming. Hansen asked if anyone among his assembled engineers and technicians had a better idea on how to proceed. Chuck Ordahl, an engineer who had come over with Portanova, had had the foresight to collect the latest drawings and had hand carried them over. He immediately responded that he had a box full of the latest electrical drawings. Hansen responded, “OK, go to work and fix it,” and got Ordahl working on the sneak circuit problem. Three electrical engineers, Dick Holsinger, Jerry Riggs, and Chuck Ordahl transformed what was in the Ordahl’s box into Douglas Engineering Orders (EO) that authorized the engineers and technicians to redesign the electrical relay circuits. This was a very important accomplishment that finally allowed the launch complexes to proceed through checkout. The difference between a field change in England and any back in the U.S. was that the changes in England were rapidly propagated throughout the other sites, which were little more than clones of the initial sites. This meant that a workable solution existed in England and could affect all the subsequent activations. In a real sense, this helped save Project Emily.⁸⁰

The process of creating Engineering Orders on the spot for any successful change necessitated by

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AS THEY WERE TO FIND OUT, CONCURRENCY WAS ANTITHETICAL TO HIGH INITIAL RELIABILITY

the actual conditions in the field was used across all the subsystems. As Senior Operations Engineer, whenever Portanova successfully went through one phase of the countdown, he would create an EO for any changes required for the next launch complex, ensuring the lessons were captured for all levels of the integrated systems activation. For the most part, this level of activity was beyond the personal on-site scrutiny and observation of senior officials. While they were present for major events, they could not and should not have been involved in each of the multitude of problems cropping up in the earliest site activations.

However, Ordahl recalled one episode of high-level interest during work on the sneak circuit problem. One night while working with a technician in the electrical trailer at R.A.F. Feltwell, Ordahl felt the presence of someone behind him and turned around. The man said, "How are things going?" He is not sure how he replied, but he believes he said, "We are having some redesign problems." The man was the U.S. Deputy Secretary of Defense, Donald A. Quarles, who had left the Air Force and taken his new position in May 1957.⁸¹

Ordahl returned to work that evening. With a technician he started the countdown and in the middle of it, he encountered the sneak circuit again. He thought there must be an incorrect circuit; then, he saw an extra wire to a critical relay. He said, "Cut the wire." The technician cut it, and that solved the problem. Of course, he normally should not have cut a wire during a countdown. But he had solved the problem, and told management the next morning. Ordahl became an instant hero of sorts because this was a major breakthrough for successful countdowns.⁸²

In addition to the Douglas engineers and technicians, the launch complexes were supported by AC Spark Plug/General Motors, Rocketdyne/North American Aviation, General Electric, and Sandia Corporation personnel as well as cadres of qualified technicians of the U.S. Air Force and Royal Air Force enlisted personnel. The engineers assisted by technicians were responsible for the Installation and Checkout of all trailers, ground tanks, and equipment for a successful countdown sequence demonstration.⁸³

Coordination of the American contractors, U.S. Air Force units and R.A.F. units on the project came under the control of Col. George C. McDowell, a recent graduate of the U.S. Industrial College of the Armed Forces. McDowell actually moved into a newly created position as the assistant for ballistic missiles on the staff of the Seventh Air Division, reporting directly to General Blanchard. McDowell's man in the field was to be Maj. Frederic D. Selbie, Jr., a former B-29 pilot.⁸⁴

The overall schedule quickly became an issue. With the distributed nature of the program, with program management separated from missile development and launch site construction and activation widely dispersed, on-site management representatives were necessary. Such a team would include program office representatives, and would

typically include a specialist in ground support equipment and the equivalent in the missile's systems. Usually, other management process-related people would accompany the team to ensure fast response in the case of a particular need. One such team spent four days looking at the progress in England to see what kinds of things could be done to the schedule to recover lost time and prevent delays in the future. This was the detailed end of the concurrency approach, where even the best estimation of allocatable time in the program office and contractor schedules met reality. At that level of detail, the same process of seeing what activities could be broken out and handled in parallel rather than serially was repeated on the spot. The program office members of the team would then pass their observations along to all the other sites to improve performance overall.⁸⁵

As they were to find out, concurrency was antithetical to high initial reliability, increasing the chances that when everything came together, modifications and changes would be necessary. While the major components arrived on time, the devil was in the details—where the engineers putting the missiles on launch stands found that not everything matched up. For instance, most of the ground interconnecting cables between the three dry pads and the launch control were short in length, e.g., a 200-foot cable was short by 25 to 50 feet.⁸⁶ The environment also meant differences, since these cables initially were buried under ground causing many electrical shorts due to moisture. The corrective action consisted of laying cables above the ground and potting each connector. Prior to this, potting electrical connectors was not always a requirement. These are just a couple of the kinds of small details that faced real life site activators.

Another was the initial assumption at the Thor program office that everything would be ready to install the equipment, erect and checkout the Thor missiles. Therefore, initially, only Douglas Field Service Representatives were assigned to the first Squadron to be activated, R.A.F. Feltwell's 77 Squadron (SM) launch complex one. The Douglas design engineers were told to stay away and remain in the administrative offices, to be called only when required. After about a month, reality set in that the system was not working and major redesign was imperative.⁸⁷

At that point, the engineers were given authority to work on R.A.F. Feltwell's three launch complexes and do whatever necessary to get it to function.⁸⁸ Portanova was the Senior Operations Engineer, and was assigned to launch complex #3. Ordahl, Dick Holsinger and Jerry Riggs were the three key engineers to checkout all of the electrical equipment, especially the electrical trailers located on all launch complexes. They all realized that the biggest challenge and primary objective was to conduct a successful fifteen-minute automatic five-phase countdown sequence (described above).⁸⁹

These illustrations represent the kinds of problems created at the very lowest level of detail when the schedule to produce was such a driving priority.

MANY, IF NOT MOST, OF THE DOUGLAS PERSONNEL WERE IN THEIR EARLY 20s, MANY DIRECTLY FROM COLLEGE

They also illustrate that completing a full count-down with operational procedures completing each phase without problems or aborts was an awesome challenge. However, final checkout resulted in “test as you fly,” as well as a learning experience. Most importantly, once one site was checked out, virtually some of the same issues were faced at the subsequent sites, so at least some of the activity could be learned and applied later. However, the first squadron (fifteen missiles) was truly an engineering program. That made the subsequent squadrons’ activations more efficient, but hardly less susceptible to incredible schedule pressure.

As the inefficiencies of the first checkouts were ironed-out and the lessons learned, the hours in each workday and the frenzy of activity did not decrease. Ordahl, in recalling the activation of the third squadron at RAF Driffield, said he was so very busy walking in and out of launch complex trailers that he was unable to take time off to replace his worn-out boots.⁹⁰

After several months, the first of the program office teams sent to investigate progress and problems included Maj. Jamie Wallace for the ground support equipment, Maj. Richard Randall for the Thor systems, and Col. Charles Woodward who was the Strategic Air Command (SAC) liaison to the program office. Their report was very severe. In essence, at the lowest level of detail, the severity of the problems had been grossly underestimated. Moreover, they had been wrong about the character of the problems that would be faced. Major Wallace realized, and duly reported that a key underlying assumption in the development of the deployment was that the problem in England was essentially one of production. He pointed out that, on the contrary, it was an engineering problem. Among other things, that meant that the kinds of people who had been hired to do the work were the wrong kinds of people. At the time, Thor testing revealed considerable problems, which had been expected because the missiles were still in research and development. What Wallace and the others found was that the preparation for the operational launches in England was no less research and development.⁹¹

This meant that the Douglas Aircraft Company had been asked to approach the problem incorrectly. At the Douglas home plant, a Design Engineering and Inspection (DEI) full-scale model of a Thor missile and its equipment layout at the A-2 Douglas Engineering parking lot in Culver City, CA, provided some familiarization, advanced information and data for the deployment.⁹² Although there was some familiarization and training prior to the first unit’s activation, it was not sufficient because the installation and checkout of the Thor was considered to be relatively standard work for the Douglas Field Service representatives. Initially, especially at the first squadron, the personnel were handicapped due to lack of complete data, information, drawings and checkout procedures. It was quickly assessed that the deployment was not progressing as scheduled due to the technical problems, but more so, the lack of technical experience. This was the situation

that Wallace summed up in his report. Independently, General Schriever sent his right-hand man and expeditor, Col. Richard K. Jacobson, to observe. Jacobson’s job title of Test Operations, at the time a contradictory title, was meant by Schriever to allow him access to wherever problems existed and to clear the way for solutions and get the Thors to operational status. He immediately assessed the problem as production mentality versus a research and development environment.

The Douglas Aircraft personnel from the plant in Long Beach were excellent at setting up production lines, and they were responsible for the design and manufacturing of the ground support equipment being installed at the sites. What Jacobson saw was the need for engineers to solve engineering problems with the ground support equipment. One of the Senior Operations Engineers, after arriving in December 1958, got his first taste of what was going on when he visited a ground support equipment checkout trailer (see figure on page 38). He stepped inside, and instead of seeing the racks of equipment neatly stacked on either side, saw white jumper cables running from one drawer to another, and even some stretching across from one side of the trailer to the other. It was, he said, a mess. Jacobson wanted to get the production people out and bring in NASA research and development people in to get this sort of thing straightened out.⁹³

As a result, five Douglas engineers were assigned to the launch complexes as Senior Operations Engineers.⁹⁴ Their responsibilities included all the activities at the launch complexes, including their becoming the Chief Test Conductor during the countdowns. These Senior Operations Engineers were, in effect, systems engineers, required to understand and deal with engineering and activation problems starting with a bare launch pad through to the final demonstration of simultaneous countdowns following operational procedures at their respective launch complexes. The Senior Operations Engineers drew as needed on the pool of engineering specialists in the various disciplines such as electrical, mechanical, hydraulics and propulsion. The five Senior Operations Engineers were Portanova, Bernard Terry, James Ritter, Kit Myers and eventually Jay Simmons (who arrived in December 1958 and would eventually accept the 58th, 59th and 60th Thors of Project Emily). All five were supported as needed by the engineering specialists throughout Project Emily as part of the “Can Do” culture, and led frenzied lives for the rest of the activation of all sixty of the Thor missiles launch sites.⁹⁵

For the Douglas personnel assigned to Project Emily, the challenges were many. Many, if not most, of the Douglas personnel were in their early 20s, many directly from college. While this meant they had no preconceived notions about how missiles ought to be developed and deployed, so that they were then very flexible in their learning, it also meant that their basis in experience was very low. With the difficulties in the Thor test program, these young engineers had concerns that the system



A Thor covered by canvas for shipment to launch site. (Source: Personal collection of Peter L. Portanova.)

might not work even when they got all the facilities and equipment ready. They learned as they made mistakes or experienced mishaps. If there were no mistakes or mishaps, they felt that there was no learning and no progress. Since all the Thor sites in the U.S. and England were in approximately the same state of development and learning, even a few weeks of schedule was an advantage. Fortunately, the people at the Eastern Test Range, Vandenberg and Sacramento shared all their accumulating knowledge and experience with those in England responsible for completing the deployment of the first Thor squadron.

The kinds of problems that cropped up reflected the crushing schedule pressure and its effect on engineers dealing with the lack of complete procedures and documentation. During a mock countdown using actual propellant flow, the fuel flow counter meter malfunctioned, spilling RP-1 fuel all over the pad area. Errors such as this, or blowing out a gaseous nitrogen pressurization system by putting 2000 psi into a 135 psi line are examples of the kinds of things that actually occurred. While projects that have adequate technical documentation can still occasionally display such problems from human error, Project Emily had this problem to a much greater extent.

Another example was a mechanical switch in the wrong position prevented the shelter from opening during a countdown sequence, allowing the Thor to begin erection while the shelter roof was still closed. The damage to the nose cone and shelter that resulted was not the only instance, as another missile got bent in a similar situation.

As evidence that not everything had been thought through during development, the air conditioning trailer required continuous monitoring, which could only be done at the trailer. Since the trailer was about a hundred feet from the launch vehicle, there was little choice for the engineer during the countdown but to run out and check the trailer occasionally during the 15 minutes to launch.

The clamps holding the Thor to the transporter erector sometimes did not release, which would

cause a launch abort if not corrected. On more than one occasion, an engineer would take a tall ladder out to the pad, set it against the missile, climb up, release the clamp and keep the checkout going. Clearly such actions were not safe, but the urgency of attaining success and the “can do” attitude of the Douglas engineers led to perhaps foolhardy but mission-oriented and well-intended actions.

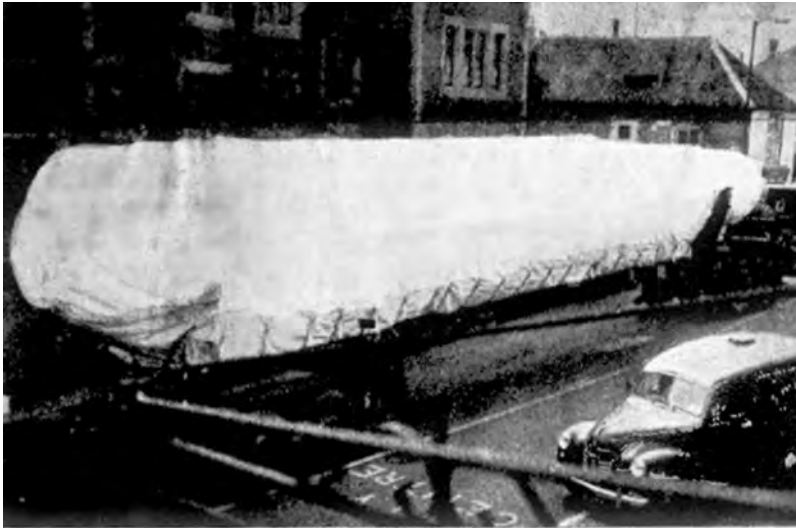
By November 1958, as the first Thor was being sent to the first launch site, the number of missed milestones increased. Most program schedules show when a decision point is going to be missed, but the concurrency approach amounted to many parallel projects all of which had to produce something to support the final operational readiness of the Thors. Schriever reviewed these schedules every Friday, and by December 1958, Jacobson’s input to these revealed the project was not going to meet schedule and British expectations. The momentum of the program appeared to be slowing due to the ripple effect of a few missed milestones affecting many more subsequent milestones. Top management attention was necessary. Jacobson called Thor program chief, Jack Bromberg and asked him to set up a meeting involving Donald Douglas, Sr., Donald Douglas, Jr., Douglas Vice President Leo Carter. In advance of the meeting, Schriever called the senior Donald Douglas and told him to listen to Jacobson’s concerns. Major Wallace went back to England with Carter and Bromberg for the meeting. They felt enough problems existed at Feltwell to warrant a higher level of on-site management. Jacobson suggested sending either Jack Goodman from Douglas, then working the Thor effort in Sacramento, or William L. Duval, the senior Douglas representative at the Cape Canaveral Field Station overseeing the Thor testing.⁹⁶

Bad timing led to press suspicion that “Douglas Aircraft’s chief rocket expert in Europe was secretly replaced on December 19.” Erroll M. Neff was replaced due to ill health, but the press insisted that the replacement had to be motivated by his being seen as a cause of the program’s problems, which were further stated to be homesick workers, working too long and lack of discipline. Of all these suspected ills, the only one that actually rang true was the long hours, but that reflected dedicated people who were doing whatever it took to get the job done.⁹⁷

What Carter and the others did was select Duval to take over the project in the field. Duval’s experience meant he had seen pretty much everything about the Thor, good and bad.⁹⁸

In December 1958, the first of the four IRBM facilities (Feltwell) was declared completed. For political reasons, McElroy’s goal of combat readiness by December 31, 1958 was considered to have been accomplished. However, that was misleading, because a successful launch was only achievable in an emergency (which of course, an operational launch would be). That is, as Duval learned upon arrival at Feltwell, a missile could be launched only if the process included the civilian Douglas engineers. The missile’s chance of hitting its target was put at only 50 percent.⁹⁹

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Keeping a low profile through an English town. (Source: "A Lengthy Load of Deterrent," *The Cambridgeshire Times*, Apr 7, 1959. Picture courtesy *Cambridgeshire Times*.)

MEN WILL WORK UNDER POOR CONDITIONS—IF THEY HAVE SOME IDEA [OF] WHAT THE HELL IS GOING ON

By that date, all fifteen of the launch complexes were completed, but not fully populated with ground support equipment.¹⁰⁰ Also, when Tom Rehder arrived on 2 January 1959, he still had work to do on the propulsion systems at Feltwell.¹⁰¹ Rehder moved to Shepherds Grove in mid-February 1959. So, the exact time when the facilities achieved a practical state of readiness remains difficult to state specifically.

Duval further proved his value in holding the schedules because of his experience with remote work sites. One of his strengths was his deep understanding of what fieldwork was like, and what it took for a project to succeed in the field. In his view, Project Emily would fail miserably if it continued to be thought of as a "factory-at-home" environment. That is, the job and the schedule required a fundamentally different attitude than putting in one's time on a job and then leaving work and fellow workers behind to go home. Fieldwork has a very different character, as workers leave, eat, sleep and play together. To Duval, that meant the job demanded more than people with top engineering talents. As Duval explained it, "You can take the finest engineer, the finest technician, the finest inspector in the world; if he can't get along with people he's no good on a project like this."¹⁰²

In January 1959, Duval discussed the problems of expanding the workforce from 500 to 1,000 in the near future with some of his top aides. These additional people were to be mostly experienced check-out and test engineers from Cape Canaveral Air Force Station, Vandenberg and the Douglas Sacramento (SACTO) test facilities. One way they had been able to deal with the demands to that point had been to emphasize bringing primarily

Feltwell about the time of operational status. (Source: "When Will Thor, H-Bomb Rocket.")



bachelors to the job. Bachelors occupied less space in accommodations, had fewer distractions, and could devote the time necessary to meet deadlines. In the initial cadre, if men were married, Douglas had wanted their wives to be able to work as well in clerical and secretarial jobs. Last priority among those hired had been men with families including children. That had to change when the workforce expanded. First of all, Douglas had run out of bachelors. But more importantly, perhaps, the work demanded highly talented individuals, so Duval's plans had to accommodate families.¹⁰³

Furthermore, as the construction and activation weather conditions worsened, Duval knew more was needed. He said, "men will work under poor conditions—of weather, transportation, housing, and everything else—if they have some idea [of] what the hell is going on. One of the things you have to do more than ever, on a project such as this, is to feel the pulse of the employee out there on the job, and make sure he is given enough information as to where he stands and what is happening."¹⁰⁴

Weather notwithstanding, Portanova's efforts resulted in the first simultaneous erection of two Thors at Tuddenham's launch complexes 1 and 2 in February 1959. The fact that he had gained experience at Feltwell, and had moved to Tuddenham in just a matter of months indicates the speed with which events were moving. In June 1959, Kit Myers oversaw the first triple Thor erection at RAF Mepal.¹⁰⁵ Also in June, the first squadron of fifteen missiles was delivered to RAF command.¹⁰⁶

An RAF crew from the 98th (SM) Squadron at Driffield performed the first RAF launch at Vandenberg on August 16, 1959.¹⁰⁷ The launch, fitting code name of "The Lion's Roar," was observed by RAF dignitaries including Air Vice-Marshal W. Sheen and G.A. Walker, as well as the senior RAF officer at Vandenberg in charge of the R.A.F. trainees, Group Captain R.T. Frogley. Squadron Leader Peter G. Coulson headed the launch team, and included Chief Technician Roy M. Carpenter and Master Pilot Maurice H. Sloan.¹⁰⁸

The first Strategic Missile Station was R.A.F. Feltwell, which, in addition to being home to a strategic missile squadron of three Thors, also oversaw the operations of four additional squadrons of three missiles, also called satellite stations. The next Strategic Missile Station set up was at RAF Hemswell, followed in rapid order by RAF Driffield and finally RAF Luffenham in January 1960.¹⁰⁹

Everything was finally ready for open publicity. During the week of February 15, 1960, at RAF Feltwell, the press was invited to watch the simultaneous erection of three operational Thors by RAF personnel using the operational procedures. While the event took twenty minutes instead of the fifteen required in the specifications, the show was a success. Only sixty-seven U.S. Air Force officers and some fifty Douglas Aircraft engineers were present, representing all that remained of the nearly 1,400 who had been present during the activation process. By the time of the demonstration, nearly 1,600 RAF officers and enlisted personnel had been trained for



RAF Thor on a Vandenberg AFB launch pad. (Source: RAF photo of the RAF Combat Training Launch on March 2, 1960.)

TWO OTHER COUNTRIES RECEIVED THE JUPITER IRBM: ITALY AND TURKEY

the Thors, which stood, according to one article, only seventeen minutes away from Red Square in Moscow.¹¹⁰

Project Emily was the only European deployment of Thors, but not the only deployment of U.S. IRBMs. Two other countries received the Jupiter IRBM (under Air Force aegis, by that time): Italy and Turkey. For the key dates in the deployment of Thors in England, see Table 1.

Of course, the whole purpose of Project Emily was to move sixty Thors into operation under the control of the RAF. That required another joint effort among the American military, contractors and the RAF. That part of the story began with a focus in Tucson, Arizona and Vandenberg AFB, California.

Project Emily: Into Operations

As Cooke Air Force Base (which became Vandenberg AFB on October 4, 1958) was transferring from ARDC's Ballistic Missile Division to Strategic Air Command, Douglas Aircraft set up a Thor training facility in Tucson.¹¹¹ With a technical faculty of 100 people, the training facilities were used to train the first two squadrons of RAF Thor missile crews. They studied missile theory, con-

struction and operation, and an introduction to the Thor's ground support equipment.¹¹² These crews would actually finish training before launch facilities were ready at Vandenberg, so that they could not perform their "graduation" missile firing. Some crews were in England following the construction of the launch sites, and would return to Vandenberg for their firing exercise when subsequent crews were ready to rotate out with them.¹¹³

The normal plan was for crews completing training at Douglas' Tucson "university" to go to the 1st Missile Division at Vandenberg A.F.B., where the 392nd Missile Training Squadron provided more detailed training on operational equipment.¹¹⁴

The Seventh Air Division also set up the new 672d Technical Training Squadron, to maintain the first RAF squadron until the British personnel could take over. The 672d would continue to operate thereafter as custodian for the warheads. The 672d was unique, in that it was charged with performing functions, and training others on functions, that the unit itself had not yet fully figured out. This became very much a "learn by doing" enterprise, which also characterized much of the positive, mission-oriented, "get the job done" attitude of the entire Emily project.¹¹⁵

The arrangement on command of the missiles was almost as complex as their development. While the British would own the missiles, facilities and launch and maintenance crews, and were the only ones who could fire the Thors, the warheads remained under the control of the U.S. Significantly, targeting of the missiles was a joint concern between the U.S. Strategic Air Command and Britain's R.A.F. Bomber Command.¹¹⁶ The British were responsible for determining when a squadron was operationally ready, which was paced by crew training.¹¹⁷

An Air Ministry spokesperson claimed of the unique chain of command for the warheads, "Not since the days of Nelson will commanders be so directly linked with the Prime Minister in the implementation of the Government's foreign policy."¹¹⁸

Each Thor complex was manned by about 1,000 officers and enlisted personnel. Normally, a Group Captain in charge of the base had three Wing Commanders for operations, technical and administration. Below that level, the command and operational structure differed from other R.A.F. units, especially the flying units. As the U.S. Air Force came to understand, operating a missile squadron was essentially shift work. While the operations and technical staffs made sure the weapons were maintained and ready for launch, the administrative staff made the rest of the base function.¹¹⁹

At the tail end of the operational chain was the individual launch crew responsible for three missiles. The head of the team, known as the Launch Control Officer (and usually with the rank of an R.A.F. Flight Lieutenant), was in charge of various technicians, and accompanied by a U.S. Air Force officer (usually a captain) who was the authentication officer responsible for the operation of the nuclear warhead.¹²⁰



Erecting a Thor.
(Source: Personal collection of Peter L. Portanova.)

AN OPERATIONAL LAUNCH REQUIRED AN R.A.F. OFFICER TO START A COUNT-DOWN, BUT LAUNCH COULD ONLY HAPPEN AFTER A U.S. AIR FORCE OFFICER ARMED THE WARHEAD

An operational launch required an R.A.F. officer to start a countdown, but launch could only happen after a U.S. Air Force officer armed the warhead. This ungainly process was required by U.S. laws on the control of warheads, but also to satisfy mutual concerns over the veto power on the launch.¹²¹

Eventually, by the end of 1959, Thors were taken every four months from operational status in England at random, returned to Vandenberg A.F.B. along with their R.A.F. crews, and then launched. This was in part for crew proficiency, but it also served as an operational test and evaluation of the Thors themselves. Such tests further enhanced the Thor's growing reputation for reliability.¹²² (After the Thors of Project Emily had transitioned to operations, starting in April 1961, all the launches from Pad 17A at Cape Canaveral were performed by Royal Air Force personnel.¹²³)

In May 1960, following the loss of Frances Gary Power's U-2 near Sverdlovsk in the Soviet Union, the order was given to put the warheads on all the missiles. When that crisis passed uneventfully, a lower readiness state was ordered for the missiles in July, requiring that two-thirds of the total Thor force be placed on 30-minute launch alert. This was the operational status until the Cuban missile crisis in 1962, discussed below.

Spare parts for the Thors were kept in the U.S.. While the resupply system was intended to be responsive, when McNamara told the British that the U.S. would no longer support the missiles after 1964, it was the same as shutting down the supply system.¹²⁴

The deployment and brief operational history of Project Emily were both accomplished against the backdrop of politics. This story began with an overview of the political, and to an extent, emotional climate of the Cold War that led to deploying the Thors. Next, we will look at how the political climate played out.

The Political Start and End of the Story

No technical project such as Emily ever existed

in the absence of a larger political context. The Cold War was nearing its height, and politics were intense. To complete the story of Project Emily and understand it in its political context, it is necessary to step back a bit in time one last time.

In January 1957, Defense Secretary Charles Wilson proposed Thor deployment to British Defence Minister Duncan Sandys. Sandys ardently supported ballistic missiles. At the time, Britain was deeply engaged in the development of an indigenous IRBM, the Blue Streak. The Thor was well ahead of the Blue Streak, offering an operational capability years earlier. Thor then became an interim missile to both British and American eyes—to the ICBM in the American view, and to the Blue Streak to the British.¹²⁵

Harold Macmillan, new British Minister but long time friend of President Eisenhower, warmed to the suggestion of Thor deployment for very different reasons from his Defense Minister. U.S.-British relations had been strained when the two allies ended up on different sides of the Suez crisis in 1956.¹²⁶ Anti-American feeling in the U.K. was at a post-World War II high over the crisis.¹²⁷ Agreement in principle was not sufficient to act, and details had to be ironed out. The Thor deployment marked the beginning of a new era in the West's deterrent posture, as indicated by the achievement of an operational capability two years after signing the Inter-Government Agreement.¹²⁸ Project Emily was to be the world's first ballistic missile defense against potential Soviet aggression.¹²⁹

Both parties were interested in achieving a quick and positive outcome. At the joint conference of Eisenhower and Macmillan in Bermuda in March 1957, the two leaders nailed down the final agreement. The U.S. offered to pay for the cost of the site construction, but only if the sites were manned by U.S. crews.

The proposal was for the British to fund only the site preparation and launch crews, with the R.A.F. providing the latter personnel. Macmillan felt the tide of British public opinion would be strongly against that. He knew that the Socialists, especially, would raise concerns about some "trigger happy" Americans with their fingers on buttons all over eastern England, possibly involving England in a war with the Soviet Union without British approval. Consequently, Macmillan wanted the trigger in British hands. In return, Eisenhower wanted two concessions. First, the British Government would fund the construction and manning. That stipulation overlooked the necessity for American engineers and site activation personnel to verify the construction and any necessary modifications. While ARDC was responsible for the rocket development and the ground support equipment, SAC would have other responsibilities. That was part of the second concession, under which the British Government would have to accommodate American control of the nuclear warheads. Macmillan accepted. They issued a joint communiqué on March 25, 1957 representing the final agreement clearing the way for the deployment.¹³⁰

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On April 1, 1957, Macmillan told Parliament about the terms of the agreement. He explained, "The rockets will be the property of Her Majesty's Government, manned by British troops who will receive their prior training from American experts. The rockets can not be fired by any except the British personnel, but the warhead will be in the control of the United States - which is the law of the United States- and to that extent the Americans have negative control; but it is absolutely untrue to say that the President and not the British Government will decide when these missiles will be launched and at whom. So long as we rely upon the American warheads, and only so long, that will remain a matter for the two Governments."¹³¹

The British Government set aside £10,000,000 for the construction of the sixty launch sites and other attendant facilities. A further commitment of £300,000 per year went to initial training of the RAF crews.¹³²

Project Emily initial construction was being done against a backdrop of potential, and perhaps imminent, super-power conflict, as unrest seemed to be widespread. In Hungary, former Premier Imre Nagy was executed in retaliation for the 1956 Hungarian revolt. Arab nationalists seized the Iraqi government and assassinated King Faisal II. The U.S. deployed marines to Lebanon at that government's request after threats of an overthrow sponsored by the Soviet Union and the United Arab Republic. Also, Communist China began shelling the Nationalist islands of Quemoy and Matsu.¹³³

When President Eisenhower and Prime Minister MacMillan agreed to base IRBMs in England, they had only the barest understanding of the specific issues they had set in motion for their people to deal with. The technical issues have already been discussed, but the ramifications continued to roll on. The impacts on local economies, on peoples' lives, protection of the missiles and their warheads, and many other details had to be ironed out. Once the national leaders had agreed, these details were left to those who had suddenly been made responsible for the success of the venture.

However, it would be an overstatement to assume that agreement of the national leaders simply left technical issues to be solved. By no means were either the U.S. Congress or the British Parliament united behind the effort.

For one thing, placing IRBMs in England made them targets for the Soviets. This was all too familiar to those who had survived World War II, and the ability to defend their nation was important. But opposition groups became most vocal about making England a target, and much was made of this in Parliament, the media and at protests.¹³⁴ Communist-inspired groups, intellectually committed socialists, anti-war, and anti-nuclear activists all had their agendas, and these influenced British politics. In the England of the late 1950s, the acronym of DAC meant two very different things. For Project Emily, of course, its immediate meaning was Douglas Aircraft Company. It also stood for the Direct Action Committee (more properly, Direct

Action Committee Against Nuclear War), one of the "ban the bomb" groups.¹³⁵

The urgency pushing Project Emily to attaining operational status for the Thors moved up several notches in the minds of the British public when the Soviet Union launched Sputnik in November 1957. While Sputnik was of little importance by itself, it demonstrated that the Soviet Union had succeeded in its development of the ICBM, and could now hold the U.S. and British homelands at risk. Project Emily's Thors were "the West's only ballistic answer to the 5,000 mile range Russian rockets."¹³⁶ The extent of that threat became a major focus of the U-2 spyplane's flights over the Soviet interior.

Countering the public's anxiety were pressures from within the R.A.F. to *delay* declaring the Thors operational. The missiles threatened the RAF's procurement of the British V-bombers Valiant, Victor and Vulcan) because they were perceived to offset the numbers of the aircraft needed. The longer the delay of the Thors' operational status, the less threat they were to the number of V-bombers being procured.¹³⁷

Press reports raised public awareness of the apparent vulnerability of the Thor sites, where it was "admitted that a 'soft' site like Feltwell where the Thors are stored above ground cannot be safe from attack."¹³⁸ This concern was not helped by the statements of an influential visiting U.S. senator, W. Stuart Symington, the following April, when he said, "The people of England were lulled into a false sense of security because they were not given the facts...The entire installation was literally a sitting duck for sabotage."¹³⁹

In addition, early testing of the Thor missiles had not gone smoothly. Successive failures became a hallmark of the first missile and space projects, reflecting the unrelenting schedule pressures, learning-by-doing, and testing for the purpose of understanding how the state-of-the-art was improving. On the inside, these failures were extremely valuable to iron out the technical problems, and aided in the rapid advance of the technology. But at the time, and from the outside, the testing problems of the Thors seemed to indicate severe flaws in the system. To a public ill-prepared for the numbers of successive failures, and to the politicians responsible for finding the money to finance these programs, each successive failure became more worrisome.

Debate in Parliament came to focus on what kind of deal had been made with the Americans, as the early Thors were having development troubles and being lost in the test launch phase. British newspapers reported the views of some R.A.F. personnel at Vandenberg who looked from the outside at the apparent chaos inside concurrency, and perceiving no orderliness, wrote "We consider that our Government has unwisely accepted this far from reliable missile."¹⁴⁰ As the U.S. congress became interested and held hearings, similar concerns were being expressed on the other side of the Atlantic, but from the standpoint of what they had gotten themselves into and whether they had acted too hastily. In Parliament and the English press, ques-

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tions arose about whether the Thor would work, or whether the U.K. had become part of a project to produce “just junk.” To his credit, General Schriever was less worried about problems in the press than about whether the necessary lessons were being learned.¹⁴¹

A major “red letter day” occurred on December 16, 1958. Thor number 151 erected and launched following what were considered the operational procedures flew for its full range. A spectator, Senator Case of South Dakota, very aware of concerns in England about the viability of the Thor, told the press, “This should be reassuring to Great Britain that the weapon they are going to get works.”¹⁴² Furthermore, because a military launch crew from the 392d Missile Training Squadron had handled the whole operation, and not factory experts and contractor technicians, the launch put to rest concerns about the system’s complexity exceeding the abilities of all but civilian experts. The first long-range operational ballistic missile launched by an entirely military crew in the Free World was also the first missile launched from Vandenberg Air Force Base.¹⁴³

In March 1959, the British public, if not the Government itself, came to understand the rest of their funding commitment. Beyond the funds necessary for the site construction and crew training, the manning of the sites required four shifts per day to maintain the necessary state of readiness. This state of “permanent emergency” had not been appreciated earlier, and threatened to further sour the support for Project Emily.¹⁴⁴

By April 1959, the tide had turned on whether the Thor would work. A respected writer for the *London Daily Express*, Chapman Pincher, toured Vandenberg AFB, the Douglas Santa Monica plant, and other program-related sites, and reported that he viewed “the suspect Thor in an entirely different light. Far from being ‘just junk’ as the Socialists have claimed, I can testify that the Thor is now a highly reliable weapon.”¹⁴⁵ Pincher had covered the entire project from its earliest days, and was most influential. Gaining his support had been an important political milestone.

While Pincher was touring Thor-related sites in the U.S., an American senator was touring the Thor sites in England, and coming away with an entirely different picture. A former Secretary of the Air Force, Senator Stuart Symington knew that Thor would work. But what he saw made him gravely concerned about the state of readiness in England. At the base he said was “nearest to completion,” which was Feltwell, though he did not mention its name for security reasons, he found “nothing ready to go. There was nothing which met operational standards. There was nothing adequately dispersed.”¹⁴⁶

With so many lines of converging activity, that which appeared disorderly and incomplete on one day would change within days to have everything ready to go. The activity indeed remained frenzied under extreme time pressure, but Senator Symington saw only a single moment in time, and

took away a very different impression than the British military held.

On December 9, 1959, the British Secretary of State for Air announced to the House of Commons that the Thor was part of the RAF’s operational front line.¹⁴⁷

Deployment of IRBMs in England, including the Jupiters in Italy and Turkey had to force some response by the Soviets. The sites in Turkey were capable of reaching far into the Soviet Union beyond the Urals. These missiles provoked Soviet Premier Nikita Khrushchev to decide to deploy Soviet IRBMs to Cuba in an attempt to force removal of the Turkish missiles. Also, more recent evidence has indicated that the Soviet Union’s deployment of the SS-7 ICBM was suffering severe development problems, during which the Soviets would have no long-range missile retaliatory capability.

Closing Down

The politics of Project Emily and its Thors changed remarkably with the election of 1960. John F. Kennedy campaigned on a number of popular criticisms of the Eisenhower Administration. Among these were the apparent “gaps” in U.S. versus Soviet capabilities, particularly regarding bombers and missiles. Initially, Kennedy was offered, but turned down, intelligence briefings on the facts of the matter.

Had he accepted the briefings, he would have known that the U-2 overflights of the Soviet Union had shown the inferior number of bombers then in the Soviet inventory. On the first flight of what would eventually become only twenty-four overflights of the Soviet Union, on July 5, 1956, Carmine Vito’s flight over Moscow captured the status of the Soviet’s Long Range Aviation base at Saratov-Engels airfield. With one picture, afterwards dubbed the “million dollar photo,” his flight put an end to the concerns over a bomber gap. The U.S. was definitively ahead of the Soviets. The Soviets’ claim of 100 Bison strategic jet bombers proved to be no more than thirty, if all were even fully mission capable. This allowed President Eisenhower to reduce the furious expenditure rate on U.S. bombers. But cutbacks at the time of a public concern over a “bomber gap” made bad politics, despite its being the responsible action to take. Similarly, as the Soviets deployed their first generation of ICBMs, the U.S. leadership knew that no missile gap existed.¹⁴⁸ But in both cases, the highly secret U.S. overflights and their intelligence products did not allow public disclosure of what was known. Defense Secretary McElroy inadvertently fuelled the missile gap controversy just after the launch of Sputnik in 1957, just days before he arrived in office, by saying that it was “rather obvious that we are behind the Russians.” Of course, he was speaking strictly about the fact that the U.S. had not yet launched a satellite, and the Russians obviously had done so. Coming from such an authority, however, such comments were taken to the extreme to prove the U.S.

MCNAMARA INFORMED BRITISH DEFENCE MINISTER PETER THORNEYCROFT ON MAY 1, 1962, THAT THE U.S. WOULD NO LONGER SUPPORT THORS AFTER OCTOBER 31, 1964

was behind in missiles overall, not just launching satellites.¹⁴⁹ Eisenhower chose to take the criticism to protect what he and the other national leaders knew. But this only fuelled the political issues supporting claims that the Eisenhower Administration had not met the Soviet challenge, and (then) faced a serious missile gap.¹⁵⁰

But Kennedy did not come to fully know this until he sat where Eisenhower had, and realized that the U.S. was well ahead. The Kennedy Administration continued to advance the strategic strength of the U.S., but its new Secretary of Defense, Robert S. McNamara, had to deal with competing priorities that did not favor retention of the early missile systems. As he oversaw the deployment of the Minuteman missile in hardened silos, the Atlas, Thor and Jupiter missiles became obsolete very quickly.

McNamara informed British Defence Minister Peter Thorneycroft on May 1, 1962, that the U.S. would no longer support Thors after October 31, 1964. The reason was simple, but not welcome to the British. In just a few short years, the Thors had become obsolete, and the U.S. was no longer interested in keeping them around. This did not take into account the considerable national expense the British had invested in these missiles, something for which they felt they had an obligation as a good ally. Thorneycroft announced the inactivation plan to Parliament on August 1, 1962, saying all operational status would be terminated by September 30, 1963, with the final removal of facilities and equipment by December 21, 1963. The timing coincided with the operational status of the U.S. ICBMs for which the Thors had only been gap fillers when originally acquired, and the deployment of the British V-bombers carrying the air-launched Blue Steel missile.¹⁵¹

An intervening crisis and short memories caused some to believe the British inactivation of the Thors in 1963 to be a natural and understandable consequence of a quid-pro-quo arrangement among the superpowers of the U.S. and Soviet Union.

The crisis arose suddenly. On September 3, 1962, U-2 overflight photography of Cuba revealed only old MiG-19 fighters. Two days later, though, the advanced MiG-21 was found in shipping crates, newly arrived from the Soviet Union. Then, even more seriously, on September 8, 1962, the Soviet freighter *Omsk* delivered the first Soviet medium range ballistic missiles to Cuba, the discovery of which ignited the Cuban Missile Crisis. In October 1962, fifty-nine of the total Thor force in England were placed on fifteen-minute launch readiness (as opposed to the thirty-minute status most had been placed on in 1960).¹⁵²

While the Crisis may tie back to a Soviet response to the deployment of Thors and Jupiters in Europe, McNamara's decision to withdraw support preceded the Soviet actions by several months.¹⁵³ Also, Thorneycroft's announcement of the inactivation schedule forced by McNamara's decision also predated the Cuban Missile Crisis.¹⁵⁴ Many histo-

ries of the IRBM withdrawals claim that the action's basis was a secret agreement between Kennedy and Khrushchev ending the Missile Crisis, but the dates and other evidence do not support this. While the two superpowers may have agreed that they would withdraw, and the Crisis may have accelerated the timelines, this is not provable from existing documentation.

Nearly as quickly as they had been deployed, the Thors of Project Emily were turned to other purposes before the end of 1963. The last of the Thors went off operational status on August 15, 1963, and the last of the equipment was removed on December 20 of that year. All three Thor launch pads at Vandenberg AFB used to train RAF personnel were promptly unbolted, dismantled and taken by Douglas Aircraft Company to support a variety of Thor launch programs at Johnston Atoll in the Pacific. Some of the Project Emily semi-portable launch equipment supported Operation Fishbowl, which was a high altitude nuclear detonation investigating the effects of such a blast in space.¹⁵⁵

Six of the Thor missiles went to support the Aerothermodynamic/Elastic Structural System Environmental Test program, while the other fifty-four were turned over to the Johnston Atoll Project 437 nuclear anti-satellite effort and other research and development efforts.¹⁵⁶ Missile Number 139, which had been the first to arrive at Lakenheath and then at Feltwell, went back to Patrick AFB, Florida, where it became part of the base static display.

Lessons Carrying over to the Space Program

The Douglas Aircraft Company's history of the Thor described Project Emily as "one of the most difficult tasks of all time."¹⁵⁷ While that may have been the case in 1962, it pales in comparison to sending people to the Moon and safely returning them. And yet, the APOLLO Program and all other space programs in the U.S. (and many elsewhere), owe a debt to the members of Project Emily for blazing the trail, learning the lessons and passing them on to subsequent generations of rocket and space engineers.

Of course, in this article we have examined a missile program, and missile programs are not space programs. Nevertheless, for the vast majority of the history of the space program, most launch vehicles had a military rocket heritage. As that began to change at the end of the last century, it is important to recall that what was being learned in the missile developments beginning in the 1950s impacted and structured the early space program. The Thor itself was described from the very earliest days for its potential as the "workhorse" space launch vehicle, acting as the first stage to a host of successively larger and more powerful launch vehicles.

From a personal level, the early deployment of the missiles and the early space efforts were very much learning from the ground up. The concurrency approach often left engineers in the field with missiles, facilities, equipment, but without the draw-

Table 1
Key Events in the History of Project EMILY

Site	Squadrons	Launch Pads	Activation Date	Thors Received 1st on 19-Sep-58	Completion Date	Turnover to the RAF	Operational Date	Inactivation Date(1)	Operational Status Declaration (3)	Thors Off Alert	Earlier Heritage
RAF Feltwell*	77(SM)	3	1-Sep-58		00-Dec-58	22-Jun-59	15-Jun-59	10-Jul-63			No. 7 Training Depot Station, WWI
RAF Shepherds Grove	82(SM)	3	22-Jul-59		00-Dec-58		30-Jun-60	10-Jul-63	22-Jul-59 (2)		3 Group RAF, WWII
RAF Tuddenham	107(SM)	3	22-Jul-59		00-Dec-58		30-Jun-60	10-Jul-63	22-Jul-59 (2)		No. 90 Squadron, Bomber Command, WWII
RAF Mepal	113(SM)	3	22-Jul-59		00-Dec-58		30-Jun-60	10-Jul-63	22-Jul-59 (2)		No. 75 Squadron, Bomber Command, WWII
RAF North Pickenham	220(SM)	3	22-Jul-59		00-Dec-58		30-Jun-60	10-Jul-63	22-Jul-59 (2)		Bomber Command, WWII
RAF Henswell*	97(SM)	3	1-Dec-59		30-Apr-59 (4)	11-Sep-59		24-May-63	11-Sep-59	15-May-63	Royal Flying Corps night landing base, WWI
RAF Colby Grange	142(SM)	3	22-Jul-59		30-Apr-59			24-May-63	22-Jul-59 (2)		RAF Fighter Command, WWII
RAF Ludford Magna	104(SM)	3	22-Jul-59		30-Apr-59			24-May-63	22-Jul-59 (2)		No. 101 Bomber Squadron, WWII
RAF Bardney	106(SM)	3	22-Jul-59		30-Apr-59			24-May-63	22-Jul-59 (2)		WWII
RAF Caistor	269(SM)	3	22-Jul-59		30-Apr-59			24-May-63	22-Jul-59 (2)		Advanced Flying Training, WWII
RAF Driffield*	98(SM)	3	1-Aug-59		29-Sep-59	22-Dec-59		18-Apr-63	1-Aug-59 (2)	1st 29-Nov-62, Last 18-Apr-63	C flight, 33 Squadron, RAF, WWI
RAF Full Sutton	102(SM)	3	1-Aug-59		29-Sep-59			27-Apr-63	1-Aug-59 (2)	Last 27-Apr-63	No. 4 Group, Bomber Command, WWII
RAF Carnaby	150(SM)	3	1-Aug-59		29-Sep-59			9-Apr-63	1-Aug-59 (2)		WWII emergency landing site, Bomber Command
RAF Cottesloe	226(SM)	3	1-Aug-59		29-Sep-59			9-Mar-73	1-Aug-59 (2)		World War II Training Base
RAF Brighton	240(SM)	3	1-Aug-59		29-Sep-59			8-Jan-63	1-Aug-59 (2)		No. 1 Group, Bomber Command, WWII
RAF North Luffenham*	144(SM)	3	1-Dec-59		28-Jan-60	29-Apr-60		23-Aug-63	by 31-Dec-59 (2)	Last Sep-63	Bomber Command, WWII
RAF Polebrook	130(SM)	3	1-Dec-59		28-Jan-60	29-Apr-60		23-Aug-63	by 31-Dec-59 (2)	15-Aug-63	WWII airfield
RAF Harrington	218(SM)	3	1-Dec-59		28-Jan-60			23-Aug-63	by 31-Dec-59 (2)	15-Aug-63	US Army Air Force field in WWII
RAF Fellingham	223(SM)	3	1-Dec-59		28-Jan-60			23-Aug-63	by 31-Dec-59 (2)	15-Aug-63	
RAF Melton Mowbray	254(SM)	3	1-Dec-59		28-Jan-60			23-Aug-63	by 31-Dec-59 (2)	15-Aug-63	No. 44 Group Transport Command, WWII

* These were Strategic Missile Stations, as well as home to a strategic missile squadron. The distinction being a Station oversaw the activity of 5 squadrons, four of which were also called satellite stations.

(1) Sources differ on these dates, with some indicating that Feltwell inactivated on 1 July 1963, Henswell on 15 May 1963, Driffield in April 1963, and North Luffenham in September 1963.

(2) Jackson, Robert. "Strike Force - The USAF in Britain since 1948," (Northamptonshire: Harrington Aviation Museum Society).

(3) Neufeld, Jacob. The Development of Ballistic Missiles in the United States Air Force, 1945-1960 (Washington, D.C: Office of Air Force History, US Air Force, 1990), p. 226. Other sources claim operational status for Squadrons No. 97(SM), 130(SM), 14

(4) Confusion over terminology causes an alternate date of Jan 1960 to appear in some sources.

THE THORS HAD BECOME OBSOLETE, AND THE U.S. WAS NO LONGER INTERESTED IN KEEPING THEM AROUND

ings necessary to know how they fit together, and what was or was not a proper fit.

Access to experts on the systems became a critical linchpin in the deployment of the Thor missiles. In the space program as well, there was considerable "reach-back" to plant experts and engineers. A whole new discipline emerged, known at the time as systems engineering and technical direction. Concurrency needed engineers who could go beyond their specific disciplines, work with other specialist engineers, and could then make sure that requirements, schedules, processes and the "ilities" (maintainability, manufacturability, reliability, etc.) were being properly applied. Concurrency drastically shortened timelines, but raised the complexity of project development.

Some examples can serve to illustrate the lower level problems for which the concurrency approach accepted the risk, some of the sites had concrete poured that later had to be chipped away or re-poured because of issues of compliance with exacting specifications. This was especially true at R.A.F. Feltwell in mid-May 1958.¹⁵⁸

Also, while the English dubbed the deployment Operation Emily, the U.S. Ballistic Missile Division labeled all materials with the title "Operation Go Away." Consequently, some urgently needed materials were not delivered after arrival in England,

because the equivalence of the project names was not recognized.¹⁵⁹

The first combat-configured sites were being constructed simultaneously at Vandenberg, Sacramento, and RAF Feltwell. The coordination and communication of problems from one to the other became a time-consuming, but highly important task. As something was discovered at one, there was a very high probability that the other two sites were nearly at the same point and would need to know of necessary changes.¹⁶⁰

Learning-as-you-go can be well illustrated by considering the handling of large quantities of liquid oxygen, or LOX. While chemistry courses prepared most engineers to know a bit about oxygen and pure oxygen environments, and possibly the handling of cryogenics, nothing prepared them for handling the quantities necessary to fuel rockets, the rapid flow of LOX necessary to meet the missile launch timelines, the effects of LOX's pervasiveness in clothing and other materials from normal boil-off, or the occasional but extremely serious spills. The Thor system required three serial events related to the LOX loading during a countdown. In order, these were chill down, rapid, and then fine loading. A malfunction during any one event could terminate the countdown. Inexperienced engineers quickly learned to respect the handling and trans-

Table II History of Thor Missile Launches							
Manufacturer Sequence Number	USAF Serial Number	Model	Program	Launch Date	Location	Result	Remarks
101	56-6751	DM-18	R&D	25-Jan-57	AMR	M	
102	56-6752	DM-18	R&D	19-Apr-57	AMR	PS	
103	56-6753	DM-18	R&D	21-May-57	AMR	M	
104	56-6754	DM-18	R&D	30-Aug-57	AMR	PS	
105	56-6755	DM-18	R&D	20-Sep-57	AMR	S	First completely successful launch
106	56-6756	DM-18					Missile not fired. last known to be at Chanutte AFB
107	56-6757	DM-18	R&D	3-Oct-57	AMR	M	
108	56-6758	DM-18	R&D	11-Oct-57	AMR	PS	
109	56-6759	DM-18	R&D	24-Oct-57	AMR	S	Complete range demonstrated
110	56-6760	DM-18					Static fired at Sacramento
111	56-6782	DM-18					Static fired at Edwards AFB
112	56-6783	DM-18	R&D	7-Dec-57	AMR	PS	
113	56-6784	DM-18	R&D	19-Dec-57	AMR	S	First use of AC Sparkplug Inertial Guidance system
114	56-6785	DM-18	R&D	28-Jan-57	AMR	PS	First launch from an operational launch mount
115	56-6786	DM-18	R&D	4-Jun-58	AMR	S	Wind shear mission
117	56-6788	DM-18	R&D	6-Aug-58	AMR	S	
120	56-6791	DM-18	R&D	28-Feb-58	AMR	PS	First missile to use copper heat-sink nose cone
121	56-6792	DM-18	R&D	19-Apr-58	AMR		
122	56-6793	DM-18	R&D	13-Jun-58	AMR	S	Nose cone data capsule recovered
123	56-6794	DM-18	R&D	13-Jul-58	AMR	PS	
124	56-6795	DM-18	R&D				Used for monument at Norton Air Force Base
125	56-6796	DM-18	R&D				Scrapped at Sacramento
126	56-6797	DM-18	R&D	26-Jul-58	AMR	PS	Last R&D launch
138	57-2646	DM-18A	IOC	5-Nov-58	AMR	M	
139	57-2647	DM-18A					Used for monument at Patrick Air Force Base.
140	57-2648	DM-18A	IOC	26-Nov-58	AMR	S	141 at SACTO, CA for ILC
142	57-2650	DM-18A					First Training missile. Bent - not launched.
145	58-2256	DM-18A	IOC	5-Dec-58	AMR	PS	
146	58-2257	DM-18A	IOC	16-Dec-58	AMR	S	
147	58-2258	DSV-2S	Burner I	30-Mar-66	WTR	S	UK IRBM Conversion Missile
149	58-2260	DM-18A	IOC	30-Dec-58	AMR	M	
150	58-2261	DM-18A					Air Force Museum exhibit at Wright-Patterson AFB
151	58-2262	DM-18A	CTL	16-Dec-58	PMR	S	First ballistic missile from Vandenberg. First CTL by an Air Force Combat Crew
152	58-2263			27-Mar-70		S	UK IRBM Conversion Missile
153	58-2264	DSV-2U	Burner IIA	24-Mar-72	WTR	S	UK IRBM Conversion Missile
154	58-2265	DM-18A	IOC	30-Jan-59	AMR	PS	
157	58-2268	DM-18A					Used for monument at SAMSO Headquarters
158	58-2269	DM-18A	IOC	21-Mar-59	AMR	S	
159	58-2270	DSV-2U	Burner IIA	14-Oct-71	WTR	S	UK IRBM Conversion Missile
161	58-2272	DM-18A	CTL	16-Apr-59	WTR	S	First Thor launched by an RAF crew; large target error due to miss-set guidance
162	58-2273	DM-18A	IOC	26-Mar-59	AMR	S	
164	58-2275	DM-18A	IOC	25-Apr-59	AMR	S	
165	58-2276	DM-18A	CTL	6-Sep-61	PMR	S	
166	58-2277	DSV-2J					UK IRBM Conversion Missile assigned to Project 437
167	58-2278	DSV-2U	Burner II	15-Sep-66	WTR	S	UK IRBM Conversion Missile
169	58-2280	DSV-2U	Burner II	8-Feb-67	WTR	S	UK IRBM Conversion Missile
171	58-2282	DSV-2U	Burner II	29-Jun-67	WTR	S	UK IRBM Conversion Missile
172	58-2283	DSV-2U					Stored at Mira Loma. UK IRBM Conversion Missile assigned to Burner II
173	58-2284	DSV-2U	Burner II	28-Oct-68	WTR	S	UK IRBM Conversion Missile
175	58-2286	DM-18A	CTL	3-Aug-59	PMR	S	Quality assurance missile. 3rd RAF training launch

176	58-2287	DM-18A	IOC	24-Apr-59	AMR	S	
178	58-2289	DM-18A					Blew up during static firing at Vandenberg AFB, Apr 9, 1959
181	58-2292	DM-18A	CTL	12-Nov-59	PMR	S	
182	58-2293	DSV-2U					Stored at Mira Loma. UK IRBM Conversion Missile assigned to Burner II
183	58-2294	DSV-2U					Stored at Mira Loma. UK IRBM Conversion Missile assigned to Burner II
184	58-2295	DM-18A	IOC	22-May-59	AMR	S	
185	58-2296	DM-18A	CTL	14-Dec-59	PMR	M	
186	58-2297	DM-18A	CTL	11-Oct-60	PMR	S	2nd missile returned from UK for CTL launch at Vandenberg
187	58-2298	DM-18A	IOC	15-May-59	AMR	S	
189	58-2300	DM-18A					Langley AFB "Hangar Queen"
190	58-2301	DM-18A	CTL	14-Aug-59	PMR	PD	4th RAF training launch
191	58-2302	DM-18A	CTL	16-Jun-59	PMR	M	
194	58-2305	DM-18A	IOC	29-Jun-59	AMR	PS	
197	58-2308	DSV-2U					UK IRBM conversion missile assigned to Burner II
198	58-2309	DM-18A	IOC	25-Jun-59	AMR	S	
201	58-2312	DSV-2J					UK IRBM conversion missile assigned to Project 437
202	58-2313	DM-18A	IOC	24-Jul-59	AMR	S	
203	58-2314	DM-18A	IOC	21-Jul-59	AMR	M	
204	58-2315	DM-18A	IOC	14-Aug-59	AMR	S	
207	58-2318	DSV-2U					UK IRBM conversion missile assigned to Burner IIA
208	58-2319	DM-18A	IOC	5-Aug-59	AMR	S	
210	58-2321	DSV-2U	Burner II	8-Jun-71	WTR	S	UK IRBM conversion missile Used for monument outside Los Angeles Space Museum
211	58-2322	DM-18A					UK IRBM conversion missile
213	58-2324	DSV-2S	Burner I	9-Sep-65	WTR	S	
214	58-2325	DM-18A	CTL	5-Dec-61	PMR	S	
215	58-2326	DM-18A	CTL	21-Jan-60	PMR	S	Last RAF training flight
216	59-2337	DM-18A	IOC	27-Aug-59	AMR	S	
217	59-2338	DM-18A	IOC	12-Sep-59	AMR	S	
220	59-2341	DM-18A	CTL	21-Oct-59	PMR	S	
221	59-2342	DM-18A	IOC	10-Oct-59	AMR	S	
222	59-2343	DM-18A	IOC	22-Sep-59	AMR	S	
224	59-2345	DSV-2S	Burner I	18-Jan-65	WTR	S	UK IRBM conversion missile
228	59-2349	DM-18A	CTL	17-Sep-59	PMR	S	5th RAF training launch
229	59-2350	DM-18A	CTL	19-Mar-62	PMR	M	
230	59-2351	DM-18A	IOC	28-Oct-59	AMR	S	
232	59-2353	DSV-2F	ASSET	18-Sep-63	AMR	S	UK IRBM conversion missile
233	59-2354	DM-18A	CTL	22-Jun-60	PMR	S	1st missile returned from UK for launch at Vandenberg AFB
235	59-2356	DM-18A	IOC	6-Oct-59	AMR	S	
238	59-2359	DM-18A	IOC	3-Nov-59	AMR	S	
239	59-2360	DM-18A	CTL	6-Oct-59	PMR	S	
240	59-2361	DSV-2G	ASSET	24-Mar-64	AMR	S	UK IRBM conversion missile
243	59-2364	DM-18A	CTL	29-Mar-61	PMR	S	
244	59-2365	DM-18A	IOC	19-Nov-59	AMR	S	
247	59-2368	DSV-2F	ASSET	9-Dec-64	ETR	S	UK IRBM conversion missile
248	59-2369	DSV-2G	ASSET	22-Feb-65	ETR	S	UK IRBM conversion missile
249	59-2370	DSV-2U	Burner II	16-Feb-71	WTR	S	UK IRBM conversion missile assigned to Burner II
250	59-2371	DSV-2G	ASSET	23-Jul-64	AMR	S	UK IRBM conversion missile
251	59-2372	DSV-2S	Burner I	6-Jan-66	WTR	S	UK IRBM conversion missile
254	59-2375	DM-18A	IOC	1-Dec-59	AMR	PS	
255	59-2376	DM-18A	IOC	17-Dec-59	AMR	S	
260	59-2381	DSV-2F	ASSET	28-Oct-64	AMR	S	UK IRBM conversion missile
264	59-2385	DSV-2U					Disassembled for parts. UK conversion missile
265	59-2386	DM-18A	CTL	1-Dec-59	PMR	S	
266	59-2387	DSV-2U	Burner II	22-Aug-67	WTR	S	UK IRBM conversion missile
267	59-2388	DM-18A	CTL	13-Dec-60	PMR	S	
268	59-2389	DSV-2U	Burner II	11-Oct-67	WTR	S	UK IRBM conversion missile
269	59-2390	DM-18A	CTL	18-Jun-62	PMR	S	Last CTL launch
272	59-2393	DM-18A	CTL	2-Mar-60	PMR	S	
273	59-2394	DM-18A					Used for Thor-Delta display at New York World's Fair

PROJECT EMILY WAS A MICROCOSM OF THE OVERALL MISSILE EFFORT, AND PRESAGED A NATIONAL SPACE EFFORT WHERE "FIRST TIME" ACTIVITIES BECAME THE NORM

274	59-2395	DSV-2J						UK IRBM conversion missile assigned to Project 437
275	59-2396	DSV-2U						UK IRBM conversion missile assigned to Burner II
276	59-2397	DM-18A	CTL	20-Jun-61	PMR	S		
277	59-2398	DSV-2U	Burner II	22-May-68	WTR			UK IRBM conversion missile
278	59-2399	DSV-2J						UK IRBM conversion missile assigned to Project 437
279	59-2400	DM-18A	Burner II	22-Jul-69	WTR	S		UK IRBM conversion missile
280	59-2401	DM-18A						Used by NASA for vibration test and destroyed
282	59-2403	DSV-2S	Burner I	20-May-65	WTR	S		UK IRBM conversion missile
284	59-2405	DSV-2J						UK IRBM conversion missile assigned to Project 437
285	59-2406	DSV-2J						UK IRBM conversion missile assigned to Project 437
287	59-2408	DSV-2U	Burner II	22-Feb-70	WTR	S		UK IRBM conversion missile
288	59-2409	DSV-2U	Burner II	2-Sep-70	WTR	S		UK IRBM conversion missile
291	59-2412	DSV-2U						UK IRBM conversion missile assigned to Burner IIA
292	59-2413	DSV-2J						UK IRBM conversion missile assigned to Project 437
294	59-2415	DSV-2U						UK IRBM conversion missile assigned to Burner II
304	59-2425	DSV-2U						Stored at Mira Loma. UK IRBM conversion missile assigned to Burner II
306	59-2427	DSV-2S	Burner I	17-Mar-65				UK IRBM conversion missile
Terms:								
AMR= Atlantic Missile Range					M= Malfunction			
CTL= Combat Training Launch					PMR= Pacific Missile Range			
DM= Douglas Model					PS= Partial Success			
DSV= Douglas Space Vehicle					RAF= Royal Air Force			
ETR= Eastern Test Range					S= Success			
IOC= Initial Operational Configuration missile					WTR= Western Test Range			
IRBM= Intermediate Range Ballistic Missile					UK= United Kingdom			

ferring of LOX, including cleanliness requirements. Of the primitive measures necessary to operate the early Thors, few rival the method of detecting the opening and closing of the LOX load valves. Headphones were temporarily attached near the valves so that the engineer could detect the audible sound of the valve operation (this was not per standard operating procedure). The LOX vent valve had to be open during loading and then closed or cycling upon completion of fueling. A malfunction could destroy the Thor. The whole LOX fueling system held flanges, gaskets, and relief valves that could malfunction, yet none of them had sufficiently well thought-out monitoring capabilities, leading to a variety of accidents and problems, such as the LOX explosion in July 1958. One outcome of the accident investigation showed that use of gaseous nitrogen was compatible with LOX, and that same lesson applied to even larger amounts of LOX used in space launch vehicles.

The whole of Project Emily was a microcosm of the overall missile effort, and presaged a national space effort where "first time" activities became the norm. The kinds of lessons learned were incremental, based on both successes and failures, and were the only way to push forward the state-of-the-art.

Concurrency was a brilliant response to the imperatives of the Cold War and the need to

respond to the perceived threat of the Soviet Union, but it was not without problems that needed to be avoided in space systems. Thors, as any missile, performed a crucial mission of deterrence, but they also had to be ready to go without fail. The Thor had to be ready to go in less than fifteen minutes, and it was understood that a small percentage might not be ready, or might not work once launched. The missile programs introduced the demand for high reliability parts that eventually enabled the development of space-qualified or "class S" parts that would allow satellites to operate for years without fail. The loss of an individual Thor, whether in testing or in continuing launch exercises at the various test ranges, did not have the same impact as the loss of a Thor as a space launch vehicle. Of course, loss of a Thor warhead would have been extremely serious, but loss of satellites meant often crucial capability was lost for some extended period of time to come. Concurrency was not the best approach for space launch vehicles, where deliberate care had to be taken at each step to build in the kind of reliability necessary to avoid operational outages of space missions. When intense parallel schedule pressure re-emerged in the 1980s, it contributed to the loss of seven lives and a valuable national asset due to subordination of all activity to a relentless launch schedule. Project Emily showed what concurrency—

acquisition and operations under extreme schedule pressure—could and could not be expected to do. But lest we leave the impression that concurrency was bad, we emphasize the genius to create and manage the complexity that was the early missile programs.

Lessons learned from projects such as Emily taught that the high cost and reliability of space programs demanded the closest attention to detail from the point when the first parts are acquired through their assembly into boxes, sub-systems, systems, and finally fully-integrated space vehicles. Thorough testing throughout the development is just as important. The legacy of experience that started at the time of Project Emily is also an essential element of success for the space age.

All these lessons are no doubt important, but they are lessons in the abstract. Perhaps the most important kind of lesson was of a different sort. In the late 1980s, Chuck Ordahl was in a position to be talking to members of the U.S. Congress, trying to convince them to fund the space station. Often he got asked how he could assure them that the nation would get a return on its money. A direct return, of course, was difficult to pinpoint. But his Project

Emily experience came back to him. First, he would say it is often hard to see in advance the full payoff of investment in technology. Then he would relate his story about Thor and Project Emily and the technology involved. The investment was for deterrence and protection of the nation. It did that job well, but the investment also did something else that few could foresee at that time. And what was that? Many of the engineers took the technology they had learned and used it to build the rockets, such as Thor's evolution into the Delta, which were then used to launch the communications satellite constellations that started going into orbit in the 1970s. Next, he would explain everyone benefits every time they turn on a TV or make a long distance phone call. He then implied that one could also expect future yet unforeseen benefits of current investments in space technology. Usually by that point the congressman or senator would shake his or her head in a positive way, and he would go on his way having accomplished what he had wanted to do. In the final analysis, the most valuable result of Project Emily had little to do with the Cold War, neither was it any specific technology, but the lessons learned *by doing*.¹⁶¹ ■

NOTES

1. This work and any opinions contained herein are solely those of the authors and do not necessarily represent or reflect the work or opinions of The Aerospace Corporation. Portions of this history were previously published as "Preparing for the Space Age," IAC-06-E4.1.04, in the proceedings of the International Astronautical Congress, Valencia, Spain, 1986, and are authorized for use here by the International Astronautical Federation. Other portions to be published by the American Astronautical Society are used by permission of the AAS.
2. "Probable Soviet Courses of Action to Mid-1952," *National Intelligence Estimate* 24, Aug 2, 1951, p. 1; Temple, L. Parker. *Shades of Gray: National Security and the Evolution of Space Reconnaissance*. Reston, Virginia: American Institute of Aeronautics and Astronautics, 2005, pp. 23-30. [Hereafter, Temple, *Shades of Gray*.]
3. "Likelihood of the Deliberate Initiation of Full-Scale War by the Soviet Union," *National Intelligence Estimate* 48, Jan 8, 1952.
4. Neufeld, Jacob. *The Development of Ballistic Missiles in the United States Air Force, 1945-1960*. Washington, D.C.: Office of Air Force History, 1990, pp. 121, 143. [Hereafter, Neufeld, *Ballistic Missiles*.]
5. *Ibid.*, p. 126.
6. Killian, James R., Jr. *Meeting the Threat of Surprise Attack - Report of the Technological Capabilities Panel of the Scientific Advisory Committee*, President's Scientific Advisory Committee, 14 February 1955. [Hereafter, Killian, *TCP*.]; Temple, *Shades of Gray*, pp.70-71.
7. Killian, *TCP*.
8. Neufeld, *Ballistic Missiles*, p. 121.
9. Arms, W.M. *Thor - The Workhorse of Space - A Narrative History MDC G3770*. Huntington Beach: McDonnell Douglas Astronautics Company-West, 1972, pp. 2-6. [Hereafter, Arms, *Workhorse of Space*.]
10. *Ibid.*
11. *Ibid.*
12. Samos would later move its vehicles to Atlas boosters. At first, the Discoverer series used the Thor-Agena combination of a Thor booster and Agena upper stage.

Later, the Thor evolved by stretching to accommodate longer fuel tanks, eventually adding strap-on boosters.

13. Temple, *Shades of Gray*, p. 173; Greer, Kenneth E. "Corona," *Studies in Intelligence*, Supplement 17. Washington, D.C.: Central Intelligence Agency, Spring 1973.

14. The terminology of tactical ballistic missile, medium range ballistic missile, and intermediate range ballistic missile were at one time interchangeable, and certainly remained overlapping for much of the 1950s and early 1960s. The terms referred to missiles with ranges of 500 to 2000 miles, and covered the early cruise missile programs such as the Army developments such as Redstone and Jupiter, the Air Force's Matador and Navaho, as well as the subject of this article, the Thor.

15. Temple, *Shades of Gray*, pp. 181-90.

16. Neufeld, *Ballistic Missiles*, p. 121.

17. Wilson, Charles E. "Clarification of Roles and Missions to Improve the Effectiveness of Operation of the Department of Defense," Memo for Members of the Armed Forces Policy Council, Pentagon, Washington, D.C., Nov 26, 1956; Jay Simmons, telephone conversation with author Temple, Apr 1, 2009. [Hereafter, Simmons Interview.] Wilson's direction to the Army lasted less than a year. In this memorandum, Wilson realized his mistake in fostering inter-service rivalry on IRBMs, and took the Jupiter away from the Army, giving the Air Force control of all land-based IRBMs. Although both missiles used the same engine and had the same requirements for performance, the Thor's chemically-milled propellant tanks were lighter and stronger, allowing earlier pitchover and robustness in performance. The designation of the Thor within the Air Force also revealed much about the thinking of such weapons. Originally designated B-75, the Thor was placed in the same category as bombers. This later became SM-75, for strategic missiles, and this was later evolved to PGM-17A in 1963, just before their retirement. The latter designator stood for a soft-pad (P) surface attack (G) guided missile (M), indicating an obvious vulnerability of the above ground launch sites for the Thor.

18. Ripley, James J. *The Thor History Douglas Report SM-41860*. Santa Monica, California: Douglas Aircraft Company, May 1962, p. 1. [Hereafter, Ripley, *Thor History Douglas Report*.]
19. Neufeld, *Ballistic Missiles*, p. 121.
20. *Ibid.*
21. Ripley, *Thor History Douglas Report*, p. 1.
22. Arms, *Workhorse of Space*, p. 3-7.
23. Neufeld, *Ballistic Missiles*, p. 161
24. *Ibid.*, pp. 162, 201.
25. Arms, *Workhorse of Space*, p. 3-2.
26. *Ibid.*
27. Cleary, Mark C. *The 6555th Missile and Space Launches Through 1970. Cape Canaveral, Florida: Patrick Air Force Base, Florida: 45th Space Wing History Office, 1991, p. 66; [Hereafter, Cleary, *Space Launches through 1970*]; Ripley, *Thor History Douglas Report*, p. 4.*
28. Cleary, *Space Launches through 1970*, p 66; Jackson, Robert, *Strike Force- The USAF in Britain since 1948*, London, England: Robson Books, Ltd., 1986, p. 93. [Hereafter, Jackson, *Strike Force*.]
29. Ripley, *Thor History Douglas Report*, p. 4.
30. Arms, *Workhorse of Space*, p. 3-4.
31. Simmons Interview.
32. Trask, Roger R. *The Secretaries of Defense, A Brief History, 1947-1985*. Washington, D.C.: OSD Historical Office, 1985, p. 23. [Hereafter, Trask, *Secretaries of Defense*.]
33. Facts released by the Information Division, Air Ministry, Whitehall London.
34. Jackson, *Strike Force*, p. 95.
35. Boyes, John. *Project Emily - Thor IRBM and the RAF*. Stroud, England: Tempus Publishing, 2008, p. 65. [Hereafter, Boyes, *Thor and the RAF*.] Boyes' work is the principal reference for information about the operational phase of Project Emily from the RAF perspective. Jackson, *Strike Force*, p. 95.
36. Boyes, *Thor and the RAF*, p. 55; Jackson, *Strike Force*, p. 96.
37. Hartrt, Julian. *Mighty Thor - Missiles in Readiness*. New York: Duell, Sloan and Pearce, 1961, p. 174. [Hereafter, Hartrt, *Mighty Thor*.]
38. Jackson, *Strike Force*, p. 95. The RAF used former squadron designations and re-designated them with the SM suffix as Strategic Missile squadrons. This distinction was the only such time RAF units were so designated.
39. Hartrt, *Mighty Thor*, p. 174.
40. *Ibid.*, p. 175.
41. *Ibid.*, p. 185.
42. Arms, *Workhorse of Space*, p. 3-5; Jackson, *Strike Force*, p. 94.
43. Jackson, *Strike Force*, p. 94.
44. Information Division, Air Ministry.
45. Hartrt, *Mighty Thor*, p. 174.
46. Arms, *Workhorse of Space*, p. 3-7.
47. Boyes, *Thor and the RAF*, p. 50.
48. Thomas B. Rehder, interview with author Portanova, El Segundo, California, Feb 23, 2006. [Hereafter, Rehder Interview.]
49. *Ibid.*
50. *Ibid.*
51. Information Division, Air Ministry.
52. *Ibid.*
53. *Ibid.*
54. Hartrt, *Mighty Thor*, pp. 243-44.
55. *Ibid.*, p. 176.
56. Charles Ordahl, interview with Dr. Peter L. Portanova, El Segundo, Calif, Feb 23, 2006. [Hereafter, Ordahl Interview.]
57. Hartrt, *Mighty Thor*, pp. 179-80.
58. Rehder Interview.
59. Rehder Interview.
60. Boyes, *Thor and the RAF*, p. 87.
61. Hartrt, *Mighty Thor*, p. 174.
62. Boyes, *Thor and the RAF*, p. 94.
63. Hartrt, *Mighty Thor*, p. 172.
64. Thomas, Gordon. "I see first missile base," newspaper article, undated.
65. Pincher, "No. 1 rocket site."
66. Boyes, p. 88.
67. Boyes, p. 81.
68. Hartrt, *Mighty Thor*, p. 172; Boyes, p. 90.
69. Hartrt, *Mighty Thor*, p. 173.
70. Jackson, *Strike Force*, p. 95; Arms, *Workhorse of Space*, p. 3-7. Boyes, *Thor and the RAF*, p. 87. Except for Boyes, these sources give the date of arrival as September 19. However, a project chronology at the time of the deployment gives the arrival date as September 6, with movement to the first site at Feltwell on September 19. The timing of arrival and later deployment is consistent with newspaper articles at the time as well. See *The Bury Free Press*, "When Will Thor, H-Bomb Rocket Arrive In Feltwell?" On Sept 12, 1958, for example, in which an RAF spokesperson admitted that the rocket had already arrived, but he was not allowed to give details. The media were watching all movements intently, and reported an unspecified delay between arrival and deployment. Boyes' access to RAF records, however, seems to be the most reliable source for the specific arrival date. The rocket, Number 139, was apparently held in storage at Lakenheath until the transport routes were clear and the site was ready to accept it.
71. Pincher, "No. 1 rocket site."
72. The key Douglas personnel at Folkingham were Jay Simmons, Senior Operations Engineer, Cliff Mishler and Mike Olszewski, Production General Foreman, and Frank Farmer, Production Foreman.
73. Pincher, "No. 1 rocket site."
74. Hartrt, *Mighty Thor*, pp. 155, 177.
75. Pincher, Chapman. *London Daily Express*, "The armed alert," Sept. 20, 1958; *The Bury Free Press*, "Thor, The 'Safe' Missile, Arrives at Feltwell," Sept. 26, 1958.
76. Rehder Interview.
77. Jackson, *Strike Force*, p. 97.
78. The Emily effort caused few changes to the Thor vehicle itself. Jay Simmons, Douglas propulsion engineer and later Senior Operations Engineer, recalled that most of the changes were to the electrical trailers, and few to the missile itself. Most of the research and development on the Emily activation effort was associated with Squadron 1, so that by the time of Squadron 2's work, most of it was a cookie-cutter effort with little additional research and development.
79. Temple, *Shades of Gray*, p. 476.
80. Ordahl Interview; Rehder Interview; Dr. Peter L. Portanova interviews with author Temple, March-July 2006.
81. Ordahl Interview; Neufeld, *Ballistic Missiles*, p. 325; Watson, pp. 157-63.
82. Ordahl.
83. *Ibid.*; Rehder Interview; Portanova Interviews.
84. Hartrt, *Mighty Thor*, p. 177.
85. *Ibid.*, p. 182.
86. Ordahl Interview; Portanova Interviews.
87. *Ibid.*
88. The compressed schedule and urgency results in a time sequence that varies by the perspective of the source. Some recall the design engineers being assigned first, but others (on-site) recall that the Field Service representatives were first. The difference is only a matter of hours and days.
89. Portanova Interviews.
90. Ordahl Interview.
91. Hartrt, *Mighty Thor*, p. 182.
92. Ordahl Interview; Portanova Interviews.
93. Simmons Interview. The Thors themselves were not the source of the problems. These were built by the Douglas Aircraft Company plant in Santa Monica, whereas the equipment was from Long Beach. Simmons

related that: "The GSE was built by aircraft-oriented folks and got way behind. They needed to get the GSE requirements from the rocket program, and it was hard for the aircraft folks to respond as fast as the changes were coming in the first group." For unknown etymological reasons, Jacobson was known as "Jake the Snake," and was credited by many of the early senior operations engineers as having been the source of the rapid response on the corrective actions.

94. Portanova Interviews.

95. *Ibid.*

96. Harrt, *Mighty Thor*, pp. 187-88.

97. *London Daily Mail*, "Delays in building the British Bases," January 10, 1959.

98. Harrt, *Mighty Thor*, p. 216-17.

99. Pincher, Chapman, *London Daily Express*, "U.S. speeds H-rockets to British bases," Mar 20, 1959.

100. Harrt, *Mighty Thor*, p. 218.

101. Rehder Interview.

102. Harrt, *Mighty Thor*, p. 219.

103. *Ibid.*, p. 221.

104. *Ibid.*, p. 220.

105. Ordahl Interview; Portanova Interviews.

106. Neufeld, *Ballistic Missiles*, pp. 162, 224. The Air Force's missile program directive of Mar 5, 1957, was for the first missiles to ship out to England in March 1959, and become operational in July 1959. While missing the ship date slightly, the first launch site was ready for launch well ahead of schedule. However, the turnover to the RAF of the first squadron was six months behind schedule. Despite having missed the deadline, the short time in which all was accomplished was still remarkable.

107. Jackson, *Strike Force*, p. 95.

108. Harrt, *Mighty Thor*, pp. 235-37.

109. The actual progress versus projected schedules, under intense time pressure, resulted in confused after-action reporting of actual dates. Sources vary widely, mixing terms of completion, turnover, activation, checkout and operations in such a way that the resulting dates are contradictory and confusion. The summary in Table 1 provides the best available summary drawn from generally reliable sources, but the actual dates are probably lost forever.

110. "17 Minutes to Red Square," *Time*, Feb. 22, 1960: 17.

111. Neufeld, *Ballistic Missiles*, p. 177.

112. Jackson, *Strike Force*, p. 95.

113. Harrt, *Mighty Thor*, p. 163.

114. Jackson, *Strike Force*, p. 95.

115. Harrt, *Mighty Thor*, p. 178.

116. Jackson, *Strike Force*, p. 96.

117. Neufeld, *Ballistic Missiles*, p. 224. As it turned out, the least adequate part of the concurrency in the Thor program was the time allotted to crew training. When the first site was turned over to the RAF, the British immediately put it into training status, not operationally ready.

118. Harrt, *Mighty Thor*, p. 178.

119. Jackson, *Strike Force*, p. 97.

120. *Ibid.*

121. *Ibid.*

122. Harrt, *Mighty Thor*, p. 248.

123. Cleary, *Space Launches through 1970*, p. 68.

124. Jackson, *Strike Force*, p. 97.

125. *Ibid.*

126. *Ibid.*; Boyes, *Thor IRBM and the RAF*, p. 46.

127. Boyes, *Thor IRBM and the RAF*, p. 46.

128. Jackson, *Strike Force*, p. 94.

129. Harrt, *Mighty Thor*, p. 170.

130. Jackson, *Strike Force*, p. 94; Boyes, *Thor IRBM and the RAF*, p. 47; Pincher, Chapman. *London Daily Express*, "The defence of our way of life depends on this one piece of delicate machinery-that's which I have flown out here to get the truth about it for you," Mar 25, 1959. Pincher blamed the British Government for letting stand the mistaken impression that the U.S. "offered to arm the R.A.F.

with rockets then withheld the warheads, passed on the bill for the launching pads and imposed a veto on their use. As a result and effective weapon, which will bridge the four-year gap before Britain's own Bluestreak is ready, has been brought into disrepute and the public has been misled over an issue vitally affecting its security."

131. Jackson, *Strike Force*, p. 94.

132. Pincher, Chapman. *London Daily Express*, "New Demand By U.S. Will Raise Cost of Missile Plans," Mar 19, 1959.

133. Harrt, *Mighty Thor*, p. 181.

134. *East Anglian Daily Times*, "East Anglia Is 'Sitting Target,' Peer on 'Extreme Peril' on Nuclear Attack," Feb 12, 1959.

135. Harrt, *Mighty Thor*, p. 242; Boyes, *Thor IRBM and the RAF*, p. 83.

136. Pincher, Chapman. *London Daily Express*, "U.S. speeds H-rockets to British bases," Mar 30, 1959.

137. Pincher, "U.S. speeds H-rockets."

138. Pincher, "The armed alert."

139. *London Daily Express*, "'Sitting Duck' in Britain-by a senator," Apr 29, 1959.

140. Pincher, Chapman, *The London Daily Express*, "H-Rocket Secret Is Ours," Sep 19, 1958.

141. Harrt, *Mighty Thor*, p. 180.

142. *Ibid.*, p. 215.

143. Arms, *Workhorse of Space*, p. 3-15.

144. Pincher, "New Demand."

145. Harrt, *Mighty Thor*, p. 232-33.

146. *London Daily Express*, "Sitting Duck."

147. Jackson, *Strike Force*, p. 96.

148. Temple, *Shades of Gray*. McDonald, Robert A. *Corona - Between the Sun and the Earth - The First NRO Reconnaissance Eye in Space*. Bethesda, Maryland: The American Society for Photogrammetry and Remote Sensing, 1997: 215. The U-2 imagery was suggestive, but not conclusive that the missile gap was not real. The proof came after the vastly larger coverage provided from the Corona photo-reconnaissance satellites began in August 1960. It was not actually until June 1961, that the Corona caught the first Soviet ICBM complex. Some sources claim that it was Corona imagery that convinced Kennedy to stop his rhetoric about the missile gap - but that could only be after he had been elected. Prior to that, the U.S. intelligence was based on U-2 imagery.

149. Trask, *Secretaries of Defense*, p. 24.

150. Temple, *Shades of Gray*, p.70.

151. Jackson, *Strike Force*, p. 97.

152. Facts on the history of RAF Folkingham, No. 223 (SM) Squadron, released by the Information Division, Air Ministry, Whitehall London.

153. Boyes, *Thor and the RAF*, p. 134. Withdrawal of the Jupiters from Turkey was, in fact, tied to the Kennedy-Khrushchev agreement and part of a quid-pro-quo for removal of the Soviet missiles from Cuba.

154. McCone, John A. "Soviet MRBMs in Cuba," CIA Memo, Langley, Va., Oct 31, 1962, in McDonald, J.K., editor, *The Secret Cuban Missile Crisis Documents*. New York: Brassey's, 1994, p. 9; Temple, *Shades of Gray*, p. 362; Beschloss, Michael R. *The Crisis Years: Kennedy and Khrushchev, 1960-1963*. New York: Edward Burlingame Books, 1991, p. 423.

155. Arms, *Workhorse of Space*, p. 3-18; Smith, Harold S. "The Thor at Johnston Atoll," unpublished manuscript, 2009, in the collection of Peter L. Portanova.

156. Arms, *Workhorse of Space*, p. 3-18; Smith. Operation FISHBOWL is the collective name for the Thor and other missile tests also called DOMINIC I, which were nuclear tests from both Christmas Island and Johnston Atoll.

157. Ripley, *Thor History Douglas Report*, p. 10.

158. Harrt, *Mighty Thor*, p. 179.

159. *Ibid.*

160. *Ibid.*

161. Charles Ordahl, e-mail to the authors, Mar 14, 2006.

READERS' NOTE

McNamara and the Air Force

By Herman S. Wolk

Robert S. McNamara was well aware of Forrestal's frustration as Secretary of Defense and McNamara wanted to avoid such a fate. His Secretary of the Air Force, Eugene M. Zuckert, had observed Symington's tenure firsthand. Zuckert would have liked to have had responsibilities equal to Symington's. However, by the end of 1961, Zuckert had become painfully aware of the consequences of the several defense reorganizations and of McNamara's idea of the role of Secretary of Defense. In fact, in December 1961, Zuckert seriously considered resigning.¹ McNamara vigorously implemented the Reorganization Act of 1958. Unlike Forrestal, he would not act as a "referee;" and unlike the first Secretary of Defense, he had the statutory power to avoid being caught in the middle. McNamara would make decisions, but he would not accept service protestations about how their statutory functions were being usurped.

Zuckert stayed on and subsequently came to accept—even applaud—McNamara's operation. "I came to realize," Zuckert noted retrospectively, "that the Defense Department and the nation had found a man who had the courage and acumen to sweep out the stables of vested service rights."² Air Force Chief of Staff Gen. Curtis E. LeMay never accepted the way McNamara ran the Department of Defense.³ LeMay had directed the B-29 offensive against Japan in 1945 (as an Air Force officer, McNamara had worked on B-29 statistical analysis) and had commanded the Strategic Air Command (SAC) from 1948 to 1957, building it into the major instrument of U.S. nuclear deterrence.⁴ He was not prepared for the Kennedy administration's strategic philosophy and its view toward the manned bomber. To McNamara, the 1950s strategy of "massive retaliation" was no longer credible, since both the United States and the Soviet Union could destroy each other.⁵ In this situation, the Kennedy administration was determined to revise U.S. strategy away from massive retaliation. The new concept of "flexible response" (influenced by Gen. Maxwell D. Taylor's ideas) emphasized conventional war forces.

Though the Kennedy administration moved to expand the ICBM force, LeMay saw the B-70

bomber, which he supported, terminated and the Skybolt air-to-ground missile program abruptly cancelled. Also, McNamara opposed both the Navy and the Air Force by going ahead with his "commonality" approach to the TFX (to become F-111 and FB-111). The TFX decision angered LeMay and the Air Staff, who felt that the FB-111 was forced upon them. SAC never considered it a strategic bomber because it lacked adequate range and payload. In LeMay's view, it was "no goddam good as a strategic bomber, it wasn't a strategic bomber and that's a fact."⁶ Despite General LeMay's opinion, McNamara chose General Dynamics' design rather than Boeing's, which the Air Force preferred.

Secretary McNamara emphasized the Navy's Polaris and Air Force's Minuteman missiles as the strategic weapons of the future. When the last B-52H and B-58 were produced in the fall of 1962, there was no strategic bomber in or near production for the first time since 1945. Yet, bombers played an important role in resolving the Cuban Missile Crisis, when increased alert and dispersal of SAC bombers clearly showed that President Kennedy meant business. Nonetheless, McNamara did not consider bombers essential.

Evolution of the doctrine of "assured destruction" (retaliatory force primarily targeted against enemy cities and industry) was an important milestone in the role of the bomber in nuclear deterrence. The missile's high probability of survival and its penetration capability made it the ideal assured destruction weapon. The manned bomber was considered less "cost effective" and more vulnerable than the missile for the same mission. Critics contended that assured destruction was merely a euphemism for finite deterrence.

LeMay mistrusted McNamara's assumptions and calculations, preferring a combination of counterforce and assured destruction.⁷ LeMay wanted superiority and flexibility, stating it was impossible to know exactly how war would start and what its character would turn out to be. He favored a mixed force of missiles and bombers. To those like McNamara, who denigrated the bomber's ability to penetrate enemy defenses, General LeMay replied

ZUCKERT NOTED RETROSPECTIVELY, "THAT THE DEFENSE DEPARTMENT AND THE NATION HAD FOUND A MAN WHO HAD THE COURAGE AND ACUMEN TO SWEEP OUT THE STABLES OF VESTED SERVICE RIGHTS."

Secretary of Defense Robert S. McNamara works at his desk in the Pentagon. (Photo by MSgt Frank Hall, March 17, 1961.)



EXPERIENCE,
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TIONS THAT
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that with proper tactics and penetration aids the bombers would be able to attack their targets successfully. "Experience," he noted, "is more important than some of the assumptions that you make."⁸

Editor's Note: This article is extracted from Mr. Wolk's paper, "Independence and Responsibility: USAF in the Defense Establishment," in *Evolution of the American Military Establishment since World War II*. Lexington, Va.: A George C. Marshall Research Foundation Publication, 1978, pp. 57-72. It is reprinted with permission of the Marshall Foundation.

1. Eugene M. Zuckert, "The Service Secretary: Has He a Useful Role?" *Foreign Affairs*, Apr 1966, p. 465. The first Secretary of Defense was James V. Forrestal (1947-1949); the first Secretary of the Air Force was W. Stuart Symington (1947-1950).

2. *Ibid.*, p. 468.

3. Interview, Herman S. Wolk with Gen. Curtis E. LeMay, Nov 14, 1974, Washington, D.C.

4. LeMay was Vice Chief of Staff of the Air Force, under Gen. Thomas D. White, from 1957 to 1961.

5. In 1961, McNamara told Gen. Thomas S. Power, the SAC Commander, that the SAC war plan was a spasm reaction because it could not respond with gradations. (Interview, Herman S. Wolk with Col. D. P. Jones, Directorate of Plans, SAC, Dec 16, 1961, Omaha, Nebraska.)

6. Interview, Wolk with LeMay, Nov 14, 1974.

7. In May 1962, at a NATO meeting in Athens, Greece, and in June 1962 at Ann Arbor, Michigan, McNamara had suggested the possibility of a city-avoidance or counterforce strategy, declaring major military objectives in general war "should be the destruction of the enemy's military forces, not of his civilian population." However, once ICBMs became operational in significant numbers, McNamara turned to assured destruction. Moreover, the Kennedy administration thought that the cost of counterforce would have been prohibitive. Also critics assailed counterforce as being a first-strike strategy.

8. U.S. Senate, 88th Cong, 1st Sess, *Military Procurement Authorization Fiscal Year 1964*, pp. 948-49 (cited in Robert F. Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the U.S. Air Force, 1907-1964*, Maxwell AFB, Ala.: Aerospace Studies Institute, Jun 1971, Vol. II, pp. 365-66).

The War That Never Ends: New Perspectives on the Vietnam War. David L. Anderson and John Ernst, Eds. Lexington: The University Press of Kentucky, 2007. Photographs. Maps. Illustrations. Index. Notes. Pp. viii, 368. \$35.00 ISBN: 0-8131-2473-5

The editors amassed a wide ranging collection of essays on the Vietnam War, ostensibly to explain why the Vietnam conflict remains so prevalent in the American psyche, as well as to honor eminent Vietnam War scholar Dr. George C. Herring. They offer their appreciation to Herring's mentorship in the book's dedication, and many of the contributors trace their academic lineage to him.

This collection contains sixteen different essays, ranging topically from journalism in Vietnam, to women serving the North Vietnamese cause, to various diplomatic facets of the conflict. Unfortunately, some of the essays fall short or do not seem to fit at all. Several of the authors use their opportunity to present scholarship on the Vietnam War as a soapbox to oppose the current Global War on Terror. Instead of explaining the Vietnam War in its own context, the subject matter is used as a lens to analyze the United States' current conflict. Howard Zinn's piece stands out as the most glaring of these. His contribution cannot even be qualified as an essay. Instead of an essay, he contributed a letter—written in the voice of one of President Lyndon B. Johnson's elementary school teachers—that he used previously in a book he wrote in 1967. The letter is introduced with some comments written for President George W. Bush to bring the troops home, and comes complete with a photo of Zinn hobnobbing with the North Vietnamese premier in the 1960s. The piece does not offer scholarship on the Vietnam War, unless it stands solely on its own as an example of protest writing. In that case, it becomes the only primary source in the book. Unfortunately, Zinn's contribution simply does not fit in with the rest of the material.

In contrast, several of the other essays are thoughtful, well-considered pieces that actually aim to convey something to the reader other than a polemic position. One good example of this is Clarence Wyatt's article on the evolution of American journalism during the Vietnam War. Instead of simply supporting or criticizing the media for their support or opposition to the conflict, Wyatt explains how the media changed its reporting methods first based on restrictions by the U.S. government and then—for a while—serving as a supporting tool as the government realized that media support could help undermine opposition

and protest at home. Another worthwhile article is the contribution by Robert Topmiller on the Buddhist antiwar movement in Vietnam. Topmiller does not attempt to compare the war in Vietnam to the current war on terror. Rather, he examines the Vietnamese Buddhist movement in its own right, thereby avoiding a quagmire of anachronism that some of the other authors face. Among these are Zinn and Marilyn Young, whose piece seems to be a not-even-thinly disguised protest against the George W. Bush administration.

Readers desiring to learn more about the Vietnam War may be well advised to steer clear of this one. It cannot serve as a good introductory volume on this period in American history, nor was it ever intended to. While some articles do stand out for their scholarly, informative quality, at least a third of them are simply politically motivated polemics.

Mr. David J. Schepp, Seventh Air Force Historian, Osan AB, Republic of Korea



The Hellish Vortex: Between Breakfast and Dinner. By Richard M. Baughn. Charleston, S.C.: BookSurge, 2006. Pp. 370. \$20.99 ISBN: 1-4196-4767-9

The Hellish Vortex is a historical novel focused on a young World War II P-51 Mustang pilot flying combat missions from England between 1943 and 1945. Unlike most writers of historical fiction the author truly "knows of what he speaks." Retired USAF Brig. Gen. Richard Baughn served as a P-51 pilot with the Eighth Air Force during World War II. As he says in his preface, General Baughn wants to tell the real story of young American airmen fighting the air war over Europe. Following his combat in World War II, General Baughn went on to fly F-105s over North Vietnam before retiring in 1975 with over 7,000 hours of flying time and numerous awards, including the Silver Star and Distinguished Flying Cross.

The novel chronicles the experience of Lt. Robb Baines, a nineteen-year-old fighter pilot assigned to the fictional 345th Fighter Group based at RAF Goxhill in England. Arriving in England in late 1943, Robb Baines is thrust into combat during the winter of 1943-1944, and experiences the great aerial battles of 1944, as the Eighth Air Force fights the German Luftwaffe for air supremacy over Europe. In the process of telling Robb's story, General Baughn provides the reader with a vivid and detailed account of aerial combat as seen from the cockpit of a P-51 and insight into the daily routine experienced

by pilots and ground crews on the ground in England.

In addition to telling a great aviation story, General Baughn provides historical background on the air war over Europe by weaving through the book excerpts from an Armed Forces Staff College thesis supposedly written by Robb Baines ten years after World War II. The thesis examines the struggle within the American military establishment over the role of aviation both during and after World War I, as exemplified by General Billy Mitchell's crusade to make air power the first line of American defense. General Baughn pulls no punches when it comes to describing how ill-prepared America was at the beginning of World War II and the military blunders and American/British political considerations that resulted in many unneeded combat and training deaths.

General Baughn has written a well researched and exciting story that takes readers into the cockpit of a P-51, helping them understand the amazing victory achieved by American air power during World War II. In addition, the reader will gain an appreciation of the sacrifice made by so many brave Americans during the air war. *The Hellish Vortex* is highly recommended for anyone interested in aviation history or simply looking for a great adventure story.

Maj. Jeffrey P. Joyce, USAF (Ret.), Docent, NASM's Udvar-Hazy Center



Malaula: The Battle Cry of Jasta 17. By Julius Buckler; Norman Franks, Editor; Adam Wait, Translator. London: Grub Street Press, 2007. Photographs. Appendixes. Index. Pp 190. \$39.95 ISBN: 1-9049-4380-2

Originally published twenty years after the end of World War I, *Malaula* is the combat memoirs of ace and final unit commander Julius Buckler. Re-translated and edited, it represents one of the few books written from the German point of view of the first air war available in English.

Buckler was the son of a skilled, but poor, master roofer in Mainz, Germany. After an adventurous youth, he joined the army and served on the Western Front during the early days of World War I. He tells the reader about flight training after he volunteered for flying duty and details his early assignment of flying an observation aircraft. Lured by the desire to fly fighters and the desire to shoot down aircraft, Buckler is transferred to Jasta 17.

Buckler rose from the enlisted ranks

to command this unit, score 36 victories, and be wounded five times. A theme that emerges from the text is the haphazard nature of World War I aerial combat. Buckler preferred to hunt alone, flying a plane not equipped with a compass, searching for any enemy aircraft. Combat was often at close deadly quarters of 10 to 20 meters. Unfortunately Buckler often gave sparse-to-no details about his air-to-air victories.

An interesting note is that the book was initially written after the Nazis came to power. Thus, like many World War I memoirs, it had an underlying nationalistic purpose. This is very evident when reading the original forward to the book; it reads more like a propaganda speech.

Franks and Wait diligently remain true to the original text. They specifically highlight how they minimally edited the text to improve readability. Two such examples are decreasing the original amount of italicized text and removing non-applicable, overtly nationalistic, anti-Semitic passages (which were common to memoirs from this time). They also readily note observations of World War I air war historians: "As a story it makes for exciting reading. As a history, it is to be taken with the proverbial grain of salt." The book appears to have been written from memory without even reviewing a log book or a wartime diary. To overcome this flaw from the original text, Franks supplements the text with notes to correct Buckler's error in fact and to provide needed additional detail. Franks' in-depth research is readily apparent when he matches Buckler's kill descriptions to the correct squadron, airplane and aircrew. Where possible, and when available, Franks included testimony from Buckler's prey. These passages greatly enhance the text.

Despite the book's varying from documented facts, it is worth reading. Buckler provided valuable insight into the air war and what it was like to be a German fighter pilot during the First World War. It is far from being a definitive history of either the German Air Service or Jasta 17. It was, however, never meant as such; and the Franks wisely didn't attempt to make it such. Put on your flight helmet and leather coat. *Malaula* is an easy and very enjoyable book that deserves a spot in your library.

Lt. Col. Daniel J. Simonsen, USAF, Commander AFOTC Detachment 305, Louisiana Tech University, Ruston, La.



Decision at Strasbourg: Ike's Strategic Mistake to Halt the Sixth Army

Group at the Rhine in 1944. By David P. Colley. Annapolis, Md.: Naval Institute Press, 2008. Maps. Photographs. Illustrations. Notes. Bibliography. Index. Pp. xii, 320 \$34.95 ISBN: 1-59114-133-4

The front flap states: "Until now, few have ever heard about this lost opportunity . . ." Actually, there has been mention of the possibility in a number of works, although this may be the first account to concentrate on the disputed decision. Most of us who were in Sixth Army Group at the time couldn't help being aware of the planned crossing and were puzzled when it was canceled. Rumors abounded—some quite accurate—about the reasons. I finished my combat in the ETO in the G-3 Section of VI Corps and learned the details of the disappointing event. It wasn't a tightly held secret.

In addition to several missed opportunities, and other cases of questionable employment of the Sixth by SHAEF (read Eisenhower), this is a good, concise history of this Army Group's operations—which have not been covered as much as 12 and 21 Army Groups to the north, or even 15 Army Group in Italy. The commanders of those Groups (Bradley, Montgomery, Alexander, and Clark) have received far more attention than Devers. Another change of 6AG plans required by higher headquarters was the switch from the key Belfirt Gap to the Vosges to help Patton's right flank (something he didn't really need). The Vosges was like the Huertgen Forest to the north or the Argonne in World War I—a nasty piece of terrain. It lingers in my mind, as the tin pot I wore until retirement twenty-eight years later had a crease from a German bullet there.

Colley writes well about other things accomplished by Devers and Army Group. Such a headquarters is normally between Theater and Army and doesn't have logistical responsibilities, but during Operations Anvil/Dragoon, 6AG performed miracles in getting Marseilles/Toulon ready for the southern thrust. The failure of Montgomery to get Antwerp open on time made this critical. The crises at the Colmar Pocket and Strasbourg are well described, though the author leaves out Churchill's involvement in the latter. He ends with "finally" the Rhine and the National Redoubt.

There is a good summary of some of the criticisms of Devers and some possible reasons why he and Ike were so incompatible. The latter doesn't come across well in this version. He seems indecisive and overly cautious—fixated on the broad front approach, set on physical objectives such as the Saar and the Ruhr rather than the sounder enemy army, and prejudiced

against Devers and his ideas. What distinguished a great leader from a competent one is the willingness to take chances and to change plans to take advantage of opportunities.

No one can tell if the war could have been ended sooner if Ike had listened to Devers, but there seems a fair chance—and Colley makes a strong case for this. A good book, it is written in a style suitable for a broad audience.

Brig. Gen. Curtis Hooper O'Sullivan, ANG (Ret.), Salida, Calif.



Hell Hawks: The Untold Story of the American Fliers Who Savaged Hitler's Wermacht. By Robert F. Dorr and Thomas D. Jones. Minneapolis, Minn.: Zenith Press (an imprint of MBI Publishing), 2008. Maps. Photographs. Notes. Appendices. Bibliography. Index. Pp. 336. \$24.95 ISBN 978-0-7603-2918-4

Hell Hawks! is the story of the 365th Fighter Group of the United States Ninth Air Force who flew their Republic P-47 Thunderbolts on air-to-ground combat support missions with the advancing allied armies from the Normandy invasion to the liberation of Europe in 1945.

Almost three decades have passed since the first book (now long out of print) on the group was written by one of their own, 365th veteran crew chief Charles Johnson. This latest work updates the unit's history based on more than one hundred interviews and years of research. Gratitude goes to authors Bob Dorr (a former senior diplomat whose professional body of work includes *Air Combat*, *Korean War Aces*, and *Air Force One*, and is no stranger to readers and enthusiasts of military aviation), and Dr. Tom Jones (a former NASA Astronaut and B-52 navigator as well as an aviation author) for bringing us this impressive tome.

The book is divided into twenty chapters, commencing with the group's combat sorties over the beaches of Normandy during D-Day and tank busting operations in France against German Tigers and Panthers. Subsequent chapters cover topics such as the group's operations during the Battle of the Bulge and a Luftwaffe attack on the 365th's base at Metz, Belgium. A few pages further on, the authors chronicle the unit's first engagement with the new Messerschmitt Me 262 jet fighter. The end chapters cover the pilots who were lost during the closing days of the European conflict and conclude with the group's last mission before the surrender of Germany.

Hell Hawks! is well written and researched. It is fast moving and action packed as the reader encounters dogfights with Bf 109s, attacks on armored trains, or other combat operations on nearly every page. The traits of leadership, friendship, patriotism, and determination are well infused in the book's narrative. Everyone is given credit for mission success from the group commander to the armorers. Throughout the book, the story of the 365th is supplemented with vignettes of information on the overall view of the war. Valuable additions to the text are three maps, an organizational chart of the Ninth Air Force, and 16 pages of photographs.

This book is a fascinating tribute to the pioneers of air-to-ground combat, tactical air controllers, and the ubiquitous P-47 Thunderbolt. The authors have provided a new perspective and outlook for the younger generation of what their grandfathers and other relatives had done to preserve the freedom that we enjoy today. The work is a commendable contribution in the air-war literature of the Second World War specifically, and military and aviation history in general. *Hell Hawks!* is highly recommended.

Mark R. Condono, Commander, Philippine Coast Guard Auxiliary



Flying the SR-71 Blackbird: In the Cockpit on a Secret Operational Mission. By Richard H. Graham. Minneapolis, Minn.: Zenith Press, 2008. Illustrations. Photographs. Appendices. Index. Pp. xv, 288. \$25.95 ISBN: 0-7603-3239-9

This book is not fiction. It is a detailed description of the SR-71 aircraft which uses a step-by-step examination of the pilot's flight checklist items as a means to present new information on this remarkable aircraft. Blackbirds routinely flew at speeds in excess of three times the speed of sound (Mach 3+) at altitudes in excess of 80,000 feet, and they flew reconnaissance sorties in parts of the world that most of us visit only when reading travel magazines. Graham tells the story of this remarkable aircraft from the perspective of the men who actually flew the jet and presents this information in sufficient detail to satisfy the curiosity of the most inquisitive reader. While this book offers some new insights into the SR-71 program from its inception in the 1960s through its termination in the 1990s, the real thrust of the book is new and detailed factual information describing its unique flight capabilities. It is enriched by flight-related stories from several pilots who flew operational reconnaissance sor-

ties. These contribute further to understanding what it was really like to fly the jet.

The book is more than just a mundane list of checklist steps. It immediately captures the reader and whisks him into the realm of these spacesuit wearing, operational reconnaissance heroes. It is well worth the time to read from the novice arm-chair aviation enthusiast to the most seasoned military, private, and commercial aviators who desire to know new details on how the SR-71 aircraft was flown during its operational life. Of special note, Graham clearly refutes several myths concerning the SR. Exposure of these previously assumed capabilities does not diminish any allure from the jet's mystique. Rather, it explains further why the jet is truly an innovative air vehicle.

Not only is the aircraft performance section of the checklist addressed as well, but also the pilot's abbreviated Section 3 "Emergency Procedures." Through these pages, a careful eye can glean additional detailed information on the performance capability (and limitations) of this air vehicle. Additionally, there is a copy of the computer-manufactured pilot's flight plan and a section of a normal training route of flight map used by the aircrews when flying training missions from Beale AFB, California. All this material gives the reader a detailed perspective of this fantastic reconnaissance aircraft and insights into the lifestyle of the aircrews.

Colonel Graham is an experienced combat pilot who flew the F-4 Phantom in Vietnam and amassed hundreds of hours in the SR-71 as a pilot, instructor pilot, and flight examiner. Additionally, he was Commander of the 9th Strategic Reconnaissance Wing (home to the SR-71) during its final operational days. While an individual who invested so much time in the SR program might feel somewhat bitter about the Air Force decision to cancel the program, Graham comes across as an unbiased author proud to write about this unique aircraft and the missions it flew. This is his third book on the SR-71.

I would definitely recommend this book to all who want to know the details of Mach 3+ flying and read what it really was like to be part of this elite group of flyers. This book tells a story that it is a celebration of the skills, experiences, and talents of many people associated with the history of American air power. While the wisdom of the decision to terminate the SR-71 program may be debated, the very existence and capabilities of the jet that flew these sorties cannot be disputed any longer.

Col. Joe McCue, USAF (Ret.), Springfield, Va.



The Arnold Scheme: British Pilots, the American South, and the Allies' Daring Plan. By Gilbert S. Guinn. Charleston, S.C.: The History Press, 2007. Photographs. Pp. 559. \$39.99 Paperback ISBN: 1-86227-446-0

The so-called "Arnold Scheme of 1941," was hatched between President Franklin D. Roosevelt and the Chief of the Army Air Corps (USAAC, Army Air Forces as of May 1941), General "Hap" Arnold, with the blessing of the Army Chief of Staff, General Marshall. Britain's need for pilots and observers to man the flood of new aircraft ordered since 1938 that was to be further multiplied by passage of the Lend-Lease Act of March 1941 was seen as a way of getting the USAAC the infrastructure it needed. Up until then the isolationist-minded Congress had been stingy.

In April 1941, Arnold flew to London and proposed to the Air Ministry the training of 4,000 RAF cadets in the U.S. where new schools would become available in June. This was accepted and the personnel pipeline and administrative machinery were established.

Soon six primary flying schools in the Sun Belt and the Pan American Airways Navigation School began to receive cadets. Early tensions rose because of the orders which required RAF cadets to conform to U.S. standards and discipline since half of the trainees at each school were USAAC personnel.

Having briefly set that background, Guinn, an emeritus professor at Lander University, has had a long professional interest in the RAF in the U.S., having in 2007 published *British Naval Aviation in World War II* (the Towers Scheme). This latest book, a massive, detailed, and well-illustrated work, is solidly based on archives on both sides of the Atlantic and upon contacts with more than 650 of the former British cadets. Thus, it is enriched with personal experiences and observations, some from diaries, and many informal photographs (which are, unfortunately, inadequately captioned).

Most of the cadets first went to Toronto's No. 1 Manning Depot and later to No. 231 Personnel Depot at Moncton, NB. They then proceeded to the U.S. schools dressed in civilian clothes because, until December 7, 1941, the U.S. was a neutral nation. Once on course, the cadets found the hazard of washouts (25 percent of the initial 4,000) and had to return to Canada to be remustered.

Professor Guinn provides a great deal of detail which will enable those wanting to know how the RAF training system functioned to educate themselves. It also contains many lessons of the mixing of two

cultures. The history of each school is exposed along with its customs and traditions and its ultimate demise.

The epilogue provides a description of the closing of the program in 1943, after thirteen classes. By that time, there was a surplus of pilots available primarily because of less-than-predicted operational losses.

On the whole, this is a very interesting, very detailed and thorough work that is well worth an extended reading.

*Dr. Robin Higham, Professor Emeritus,
Kansas State University*



NATO'S Air War for Kosovo: A Strategic and Operational Assessment. By Benjamin S. Lambeth. Santa Monica, Calif.: RAND Project Air Force, 2001. Maps. Notes. Photographs. Illustrations. Glossary. Bibliography. Pp. xxxiv, 276. \$28.00 Paperback www.rand.org ISBN 0-8330-3050-7

If journalism is the first rough draft of history, what is the second? In Washington, D.C., that role is often filled by think-tank studies, a peculiar genre of writing that has arisen out of the needs of bureaucracy to occupy the twilight space between the professional realms of the reporter and the historian. The RAND Corporation is possibly the preeminent producer of such documents for the Air Force, and Lambeth is one of the most successful practitioners of this style of writing. His look at NATO's air war in the Balkans crisis initiated by the Serbian repression of Kosovo stands as a good example of his art.

By a good example, I mean that it fully represents both the strengths and weaknesses of this kind of writing. The prose is clear and easy to follow but lacks either the compact depth of a practiced journalist or the contextual exposition of a seasoned historian. Similarly the analysis is objective and, seemingly, fair, devoid of the political bias and sensationalism sometimes found in both news reports and formal histories. Anyone desiring a primer from scratch on Operation Allied Force and the other military activities with regard to NATO and Serbia in the late 1990s would be pleased and well-served by this work.

Yet, a primer is essentially all it is. As is often the case with white papers, contract studies, and other such products, areas of enormous import are eluded. Lambeth mentions the political and diplomatic tensions within the NATO alliance many times but never fully explores them.

These are of enormous, in fact indispensable, import to anyone trying to fully grasp the complex and often frustrating process of decision-making that went on during Allied Force. Similarly, important personalities, such as Gen. Wesley Clark and President Bill Clinton, appear as ciphers, yet they were making decisions on which the lives of literally thousands of people turned. The situation is hardly better with regard to Slobodan Milosevic. One section attempts to argue for a model of Milosevic's thinking during the crucial days of the air war (particularly with regard to whether air power or the threat of a ground invasion finally brought Serbia to heel), but the lack of an in-depth examination of Milosevic himself, or of the culture and politics of Serbia, renders the attempt doomed from the very beginning.

Lambeth is better at technical issues which can be approached at some distance from the political and psychological milieu. His discussion of targeting and response, surveillance and reconnaissance, and command and control are particularly worthwhile. Yet even here, the treatment is lifeless and, one suspects, rather shallow, without a feel for the complexities, shifting requirements, and variable demands placed on the people fighting this war.

The objection might be made that all the matters I have mentioned are beyond the scope of this particular kind of writing—that just isn't what a RAND study is supposed to do. It would be a fair observation, as far as it goes. But the weaknesses of a genre are inherent in all the members of the genre. Lambeth has provided a good second rough draft of history. The rest remains to be done.

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The Art of Command: Military Leadership from George Washington to Colin Powell. By Harry S. Laver and Jeffery J. Matthews, Eds. Lexington: University Press of Kentucky, 2008. Maps. Tables. Diagrams. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. xv, 270. \$32.50 ISBN: 0-8131-2513-8

The title is catchy and certainly caught my attention, but the end product was disappointing. The editors chose nine leadership qualities they consider to be central to effective American military leadership. Enumerations such as twelve steps, nine principles of war, and the five paragraphs of

a field order are good *aides memoire* but not a substitute for thought. Continuing learning is the key to leadership development. It cannot be spoon-fed. Self-study is the true mark of a professional, a lesson I learned when I took the oath as a cadet in 1936—inspired by the life-long example of my father. I was privileged to have formal education from basic to several war colleges, but I knew that my individual effort was required to make a difference.

Using nine leaders to illustrate the qualities chosen here requires shoe-horning complex individuals into tight boxes. Washington had integrity, but that was not the characteristic that made him great. I have considered him truly "First in War, First in Peace, and First in the Hearts of his Countrymen." The emphasis here on his desire for respect merely makes him look vain and diminishes his stature.

Too many have misread Grant's tenacity. It doesn't equate with foolish stubbornness. It may take more courage, imagination, and flexibility to withdraw or change the direction of attack than to blindly attack or resist. "Determination" must be for the ultimate victory rather than for any specific course of action where there may be a pride of authorship.

The "institutional" box for Marshall seems appropriate. We'll never know what kind of a strategist he might have been if given SHAEF. Actually, that command called for only a few broad strategic decisions, and we don't know if his would have been any better than those where Eisenhower missed an opportunity.

"Allied" rather "Cross-Cultural" might have been a better category title for Ike, but he is a good example for some such box—given the shortcomings in that role.

Chesty Puller was a good choice for the charismatic leader and Hap Arnold for the visionary. Few appreciate what Arnold did to win the war and earn the right to an independent air force.

I can only think of Lt. Gen. Leslie Groves as another example for technology and leadership, but Adm. Hyman Rickover covered a longer period. I'm not sure if his style of management could (or should) be used by anyone else, but the innovative features are worth studying.

The essay on Adaptive Leaders differs in several respects. Harold G. "Hal" Moore was only a lieutenant colonel battalion commander at the time of the account (though he retired as a lieutenant general). He is well known as the co-author (with Joe Galloway) of *We Were Soldiers Once . . . and Young* and the just-published *We Are Soldiers Still*. The Battle of Ia Drang Valley is a classic, in which Moore certainly displayed "adaptive" leadership, among a number of other professional abilities. I was reminded

of an admonition that I learned early: "Do something, even if it's wrong." Delay, hesitation, equivocation are usually worse.

We all have to follow at some point, but how "exemplary" Colin Powell was in his followership while Chairman of the Joint Chiefs under President Clinton is open to question.

The vignettes in these essays are interesting. The authors have assembled good material in support of their theses. However, dividing the art of command in this fashion is not my idea of how to learn more about that art.

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Les Materials de l'Armee de LAire #6: Dassault Mirage F1, Tome 2. Mirage F1CR et CT. By Frédéric Lert. Paris, France: Histoire & Collections, 2007. Photographs. Pp. 66. 14.95 Paperback ISBN: 2-35250-027-8

As with previously reviewed books in the *Les Materials de l'Armee de LAire* series, *Dassault Mirage F1, Tome 2. Mirage F1CR et CT* is written in French and obviously targeted at the French market. In 1982, as an outgrowth project to the successful Mirage F1 fighter, Dassault developed a dedicated reconnaissance version and followed it with a dedicated ground-attack version.

The F1 differed from its delta-wing predecessors by having traditional horizontal stabilizers. As the second of Histoire & Collections books on the Mirage F1, this book focuses on three versions: reconnaissance (F1CR), ground-attack (F1CT) and export.

This volume outlines in detail the development, capabilities and combat operations (Desert Storm, Operation Allied Force) of these three major variants. For the export versions, Lert provides individual specifics for the eleven countries that fly the Mirage F1: Greece, Spain, Morocco, Qatar, Jordan, Kuwait, Iraq, South Africa, Ecuador, Gabon, and Libya. In addition to purchase numbers, Lert briefly describes any unique capabilities and also explains the nomenclature logic used in naming each export variant. For example, Libyan Mirage F1s are FLAD variants, as the D commemorates Libya's Independence in December of 1951.

The strengths of this book are the photographs and drawings. Even though the book is only sixty-six pages long, there are over 100 very-high-quality color photographs and thirty-two detailed color aircraft profiles. Most of

the photographs are air-to-air shots. Included in the photographs are all major paint schemes applied to the F1. These include those used on export versions as well as some special or commemorative schemes such as that used for the NATO Tiger Meet.

While written in French, the book is easily translated to English either via any online translation websites or with a basic knowledge of French from a high-school French class. While focusing on details, the details are not excessive to the point of making the book boring. *Dassault Mirage F1, Tome 2. Mirage F1CR et CT* is the sixth in a growing series of books focused on the aircraft of the *l'Armee de LAire* (French Air Force). If nothing else, the book is a fantastic photographic reference for aircraft modelers. For the NATO or Mirage fan, this book is worth including in your collection.

Lt. Col. Daniel J. Simonsen, USAF, Commander AFOTC Detachment 305, Louisiana Tech University, Ruston, La.



No. 501 (County of Gloucester) Squadron 1939-1945: Hurricane, Spitfire, Tempest. By David Watkins and Phil Listemann. Boé Cedex, France: Philedition, 2007. Photographs. Appendices. Maps. Pp. 138. \$29.95 Paperback ISBN: 2-95263813-5 and **No. 457 (R.A.A.F) Squadron 1941-1945: Spitfire.** By Jim Grant & Phil Listemann. Boé Cedex, France: Philedition, 2007. Photographs. Appendices. Maps. Pp. 90. \$29.95 Paperback ISBN: 2-95263812-8

First flying Hurricanes, then Spitfires, and finally the Tempest, No. 501 (County of Gloucester) Squadron, Royal Auxiliary Air Force, set a high standard for performance and heroism as part of the Royal Air Force (RAF) during the Second World War. The squadron was created as one of seven RAF Reserve Squadrons in 1929. As part of the RAF Expansion Plan in 1936, it became an Auxiliary squadron. This change resulted in the squadron becoming known as County of Gloucester, having previously been known as City of Bristol. This was a result of the RAF practice of giving Auxiliary squadrons a name associated with their location in addition to their number designation.

At the start of World War II, the unit deployed to France, participating initially in the Phony War and then the Battle of France. The authors detail operations day by day including combat operations during the fevered Battle of Britain and culminating with defending England against V-

1 attacks. With Battle of Britain aces "Bunny" Carrant and "Ginger" Lacey as members, a majority of the squadron's 201 kills came when it flew Hurricanes. The unit is recognized as the Hurricane squadron with the second highest kill total during the Battle of Britain: Sergeant "Ginger" Lacey was the top British Ace from the battle.

Listemann has taken on the task of creating very detailed studies of famed squadrons of the RAF. This, the fifth in the series, is written with Watkins and is divided into two main and very distinct sections. The first is the narrative history of the squadron throughout the war. Easily read, the chronological narrative often mixes in individual victory and defeat accounts of the unit's actions. Inset passages specifically explain aircraft capabilities, aircraft serial numbers, and mission types. A solid strength of the book is the 113 well-captioned photographs and color aircraft drawings. One thing this book does not lack is detail.

The second and larger portion of the book contains twelve appendices, which are an absolute treasure trove of information. Examples include a daily breakout of the number of sorties flown; aircraft and pilot losses, awards received, individual listing of all air-to-air kill claims, and a mini-biography of every pilot who flew as part of the squadron. The mini-biographies are the premier strength of the appendices.

The second book finds the United Kingdom, seeing the storm clouds of World War II approaching, asking Commonwealth countries to provide assistance in the form of troops and aircraft squadrons to defend the UK. Squadrons would be deployed by the Royal Air Force with the countries providing the forces retaining oversight of the units. With manning intended to come from the respective country, squadrons would retain some national identity by including a national title in their designation. Australia provided two such squadrons: No. 452 and No. 457.

As fate would have it, when compared with her sister squadron, No. 452, No. 457 (R.A.A.F) would see very little activity while stationed in the United Kingdom and would score only nine kills. With Australia at risk of being invaded by the Japanese, No. 457 was deployed back to Australia to serve in her defense. Here the unit became part of the "Churchill Wing" led by Australian ace Clive "Killer" Caldwell. Finally, flying Spitfires sporting sharks teeth, the unit racked up a total of 46.5 kills. While the total is low when compared to other

units, the total reflects the turning tide of events in the Pacific theater.

Listemann—this time teamed with Jim Grant—has provided the first book written specifically about No. 457 (R.A.A.F) Squadron. It is organized along the same lines as the No. 501 Squadron book. Unfortunately, the books are targeted for a European audience; availability in the U.S. is limited and pricey. Occasionally readers may note some awkward wording implying the author's original language is French (Listemann lives in France); however, the desired meaning of the text is relatively easy to understand. The books will appeal to both the casual reader as well as those looking for great detail. Model builders will find ten color profiles very valuable. Both books are sure fire good volumes for any reader wanting to know more about RAF fighter squadrons during World War II.

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Contrails over the Mojave: The Golden Age of Jet Flight Testing at Edwards Air Force Base. By George J. Marrett. Annapolis, Md.: Naval Institute Press, 2008 Photographs. Notes. Glossary. Bibliography. Index. \$29.95 ISBN: 1-59114-511-0

Contrails centers on the “golden age of jet flight testing” at Edwards AFB during a time when experimental aircraft entered the stage of supersonic flight. It was the time when speed and altitude records were waiting to be broken, and men with boyhood dreams—Yeager, Crossfield, Anders, White, Marrett, and many others—accepted the challenge to push the envelope and become the heroes of an entirely new generation. Marrett caught the flying bug during World War II when he and a friend took a flight in a Piper J-3 Cub. The hook was set; from that day forward Marrett decided he would become a pilot.

The book has eleven chapters that chronicle Marrett's start with the Air Force until his tour with the Flight Test Center at Edwards. He begins with a history of the Flight Test Center from its official designation on June 25, 1951. It was that same year that the USAF Test Pilot School had moved from Wright Field to Edwards with a curriculum that focused on traditional performance testing along with the rising new field of stability and control that “had suddenly assumed critical importance with the dramatic increas-

es” due to the new turbojets.

Marrett then describes his experiences at primary flying school at Bainbridge, Georgia, where Southern Airways held the contract to train undergraduate pilots in the Beechcraft T-34 Mentor. After only thirty hours of flying, Marrett progressed to the Cessna T-37 and had finally become a “jet pilot.” Following primary, he headed west to Webb AFB, in Big Springs, Texas, for basic flying school, where he learned to fly the Lockheed T-33. Reassigned to Georgia—this time at Moody AFB—he flew the North American F-86L in advanced flying school. Having won his wings, Marrett received his assignment to the 84th Fighter Interceptor Squadron at Hamilton AFB, Calif., where he flew the McDonnell F-101B Voodoo.

In 1963, Marrett was selected for Class 63A at the Test Pilot School, took a five-day physical examination, and arrived at the school in December with Class 64A. Colonel Chuck Yeager served as commandant and had changed the curriculum and even the name of the school to the Aerospace Research Pilot School, commonly referred to as “Yeager's Charm School.”

Following graduation, Marrett was assigned to the Fighter Branch of Flight Test Operations where he would fly the latest fighter aircraft and fly chase to other test aircraft as they set world speed and altitude records. Most interesting is chase work with the North American XB-70A Valkyrie. Because of its many mechanical problems, chase pilots nicknamed it “Cecil, the Seasick Sea Serpent.” Marrett tells the story of one sad flight in June 1966, when his regular T-38 mission was changed because the number two Valkyrie had crashed north of Barstow. After getting airborne, he was instructed to look for another downed aircraft, a NASA Starfighter flown by Joe Walker. Walker had collided with the B-70 as he was attempting to form up on its right wing for a “photo op.” He and the B-70's copilot were killed.

As Maj. Gen. Robert White stated in the Foreword, this work speaks about the aircraft that were flown at Edwards but, more specifically, it speaks more on the “people, their lives, their families, their hopes and dreams, and the courage with which they faced the possibility of death on any given day.” The book is a must for any aviation enthusiast interested in the early days of jet aircraft testing. Marrett's writing places the reader in the cockpit racing along the contrails and tells the exciting story of being a test pilot for the greatest air force in the world.

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Operation Plum: The Ill-fated 27th Bombardment Group and the Fight for the Western Pacific. By Adrian R. Martin and Larry W. Stephenson. College Station: Texas A&M University Press, 2008. Maps. Photographs. Notes. Appendices. Bibliography. Index. Pp. xv, 364. \$29.95 ISBN: 1-60344-019-6

Perhaps no story of World War II is more tragic, ironic, or honorable than that of the 1,209 officers and men of the 27th Bombardment Group (Light), an A-24 dive-bomber unit that reached the Philippine Islands on November 29, 1941, barely three weeks before the attack that plunged the U.S. into World War II. *Operation Plum* recounts the history of young men sent to war poorly prepared and ill-equipped. “Pitch forked” into combat, they performed heroically, but most ultimately paid a terrible price for America's chronic lack of preparedness.

Activated in February 1940 at Barksdale Field, Louisiana, the 27th consisted of newly-trained volunteers and recent West Point graduates blended with a few veterans. These inexperienced young men spent their first months learning to be soldiers and airmen, ferrying aircraft to Barksdale, and participating in pre-war maneuvers. In November 1941, they deployed to the Philippines, joining the 19th Bombardment Group (H) and 24th Pursuit Group to form the Far East Air Force (FEAF). The words of welcome they received were prophetic: “Men, you are not a suicide squadron yet, but you are damned close to it.”

The next few months saw almost unremitting defeat and retreat. Without their aircraft—sent by ship—the 27th could do little to counter Japanese air attacks or amphibious landings. The majority of the men retreated to the Bataan Peninsula where they served as infantry or tried to keep the few aircraft available flying. The survivors ultimately surrendered, endured the Bataan Death March, and went to prison camps. Some were shipped to Japan on “hell ships” where they served out the war as slaves. Those who survived endured years of torture and brutal mistreatment.

Another group of pilots was sent to Australia to find their aircraft. Still others escaped the Philippines and lived to fight in Java. Absorbed into other groups, they defended Australia, sought to save the Philippines, and helped defeat the Japanese in New Guinea. They eventually

saw the tide turn in the Pacific, though many had died before victory was in sight.

Through use of extensive interviews with 27th veterans and personal letters and documents, *Operation Plum* is at its best when examining the war through the eyes of several of the young pilots including Frank "Pete" Bender, James McFee, and John Davies. Especially, it recounts the story of pilot Lt. Glen Stephenson who grew up on a hard-scrabble farm during the Great Depression, turned hobo in 1938, graduated from West Point, and married just days before the 27th deployed. Co-author Stephenson is his nephew. Along the way, the reader meets such great Army Air Forces leaders as Edward Backus, Ralph Royce, Paul "Pappy" Gunn, and Harold L. "Hal" George. The book is less original or useful when discussing larger issues of the war. The authors read the standard works of William Bartsch, Walter Edmonds, Louis Morton, Michael Shaller, John Toland, and rarely deviate from their descriptions and conclusions.

The jacket claims that "The 27th and other such units were pivotal in delaying the Japanese timetable for conquest . . .," but that claim goes beyond the truth. Regretfully, nothing the 27th accomplished delayed or seriously interfered with the Japanese advance. But, then, nothing should detract from the heroism or devotion to duty these young men displayed under horrendous conditions.

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In Their Own Words: True Stories and Adventures of the American Fighter Ace. By James A. Oleson. Lincoln, Neb.: iUniverse, 2007. Photographs. Tables. Appendices. Notes. Glossary. Bibliography. Pp xxvi, 361. \$24.95 Paperback ISBN: 0-595-47116-4

In Their Own Words: True Stories and Adventures of the American Fighter Ace is a compendium of thoughts, recollections and remembrances of American fighter aces. Oleson presents the personal experiences of more than 100 American aces from all services. To do so, he divided the book into three sections: personal combat experiences; details of and the aces' thoughts about various fighter aircraft; and exhaustive appendixes to statistically quantify various details concerning aces, their aircraft, and their foes.

The general arrangement of the per-

sonal experiences appears to be in no particular order or theme other than a short section focused on carrier operations. It provides the reader with natural break points throughout the text, but it doesn't lead to a smooth flow of text. Ultimately, this seeks to reflect Oleson's desire to present the aces' words exactly as they are, without editing. The goal to include as many of the aces' recollections as possible results in some passages being absolutely fabulous, while others are mundane at best.

Oleson's details about specific aircraft are well thought out without being overly bogged down with excessive minute facts. He complements the section with candid passages from the aces. For example, Maj. William H. Allen, who gained five victories with the 55FG, noted, "I was 6'2" when I flew the P-39 and instead of getting in I put it on. Not the most comfortable airplane I ever flew."

The book's twenty-two appendixes are exhaustive. Oleson covers a large swath of both statistical ground (e.g., numbers of aircraft shot down by squadron, numbers of aircraft produced) and listings of ace specifics (e.g., names of "Aces in a Day," unique accomplishments, nicknames of the aces). The most inspiring appendix contains the Medal of Honor citations for all the World War II and Korean War aces. The reader cannot help but marvel at the courage and self sacrifice these men demonstrated without regard for their personal safety. The text absolutely highlights the truly heroic nature of these and all other American fighter aces.

Oleson perfectly describes the nature of his book: "These recollections consist of true accounts from their combat careers. Sometimes exciting, sometimes humorous, sometimes tragic, but all are from the heart and gut." This describes the true strength of the text, which is its raw unpolished nature. There is no space for misinterpretation; rather, the book gives the reader a good look into the metal we call the American fighter ace. Taken as a whole, *In Their Own Words* gives the reader a firm understanding of the aces' experiences. A solid, well meaning tribute to these men, this book is worthwhile reading for aviation enthusiasts.

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John Warden and the Renaissance of American Air Power. By John Andreas Olsen. Washington, D.C.: Potomac Books,

2007. Photographs. Notes. Appendices. Bibliography. Index. Pp. xvi, 349. \$32.95 ISBN: 1-59797-084-6

The application of theory to practice plagues all professions. Connoisseurs of military history are very familiar with this fact, along with the often vicious arguments put forth by advocates of one conceptual system or another. All this is perhaps best (or at least most famously) illustrated in the tension between the theories of Jomini, with his preference for chess-game strategy and set-piece planning, and those of von Clausewitz, who emphasized the uncertain, confusing nature of war, the art of making decisions based on imprecise and incomplete information, and the constant need to refer actions taken in war to their ultimate political ends. In our own day, modern theoreticians have plumbed some of these same wells, as Olsen reviews in his intellectual biography of Col. John Warden, the father of the famous "Five Rings" model of air warfare that guided, at least to an extent, the USAF in Operation Desert Storm.

Olsen traces the development of Warden's ideas, revealing them to be much more subtle and complex than often appreciated. He grounds them solidly in the Cold War era, explaining how Warden turned against the prevailing model of AirLand Battle, which he saw as land-centric and dominated by concerns for Close Air Support and other tactical uses of air power, and how Warden turned to ideas of strategic air warfare that had once been at the very root of arguments for an independent air force. He does an excellent job of illustrating some aspects of Warden's thought that seem surprising in view of later events, for instance his early fascination with large air battles and wing-sized operations, and explaining how these interests grew out of the Cold War challenges and the perceived problems of combating the Soviet Air Force.

But in art, as in life, the meeting of elegant ideas and turbid realities makes for confusion and disappointment. Olsen expertly lays out how Warden's theories, which as he says owed a great deal to Jomini by way of such figures as J.F.C. Fuller, fit only approximately the harsh requirements and chaotic demands of an actual air campaign. He does a poorer job in explaining how this mismatch between idea and reality may have shaped Warden's career and the subsequent influence of his models. Olsen does speak, in fact sometimes at length, of how Warden's personality and behavior fit poorly with accepted norms in the Air Force, and of how his theories cut against many institutional trends and cultural shibboleths. But

these parts of the discussion are curiously flat and passive, as if Olsen's heart really isn't in it.

A better, and admittedly much longer, book might have probed more deeply into Warden's own life story. Admittedly, this is dangerous, as the atrocities sometimes committed in the name of psychohistory show. But a closer look at Warden's own attitudes and personal development, particularly in the context of the Air Force culture, might have yielded great riches. Similarly, a closer and more nuanced explanation of the Air Force culture itself, and the imperatives under which it had developed, would have greatly deepened an understanding of why Warden's theories proved so controversial, and why they proved by turn prescient, naïve, and frustrating to those who encountered them.

The set piece thinking of Jomini is attractive precisely because of its neatness and clarity. Olsen's book is neat and clear, like a Jominian battle analysis. It lays out the lines of Warden's thought and dispassionately reviews its internal development and the results of its application. But the problem with Jomini is that life isn't a chess game, any more than is war. In biography, as on the battlefield, the wise person acknowledges and adapts to the Clausewitzian fog of war. This book sheds much light and little fog. That is attractive and useful, but I suspect, ultimately misleading.

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Kamikazes, Corsairs, and Picket Ships: Okinawa, 1945. By Robin L. Rielly. Philadelphia: Casemate, 2008. Maps. Tables. Diagrams. Illustrations. Photographs. Notes. Appendices. Bibliography. Index. Pp. xii, 435 \$34.95. ISBN: 1-932033-86-1

Those steeped in the many World War II movies dealing with the Pacific, have seen plenty of scenes about Kamikaze attacks on the fleet off Okinawa. Often they show destroyers on radar picket duty and give an idea of the punishment inflicted on these ships and their crews.

It turns out that is only part of the story. Rielly spent years researching this little reported facet of the Navy's participation in the Pacific. The list of primary sources he sifted through is impressive. What comes from his work is a very detailed story of what took place off Okinawa's shores from the first of April

through mid-August 1945. What will probably surprise most readers is that destroyers weren't the only types of ships engaged in the very hazardous duty of providing warning of impending air attack to the bulk of the fleet and the troops ashore. In addition to several classes of destroyers (and destroyer minesweepers and escorts), there were also patrol gunboats and several types of large landing craft. While not well suited for the duties assigned to them, they had antiaircraft guns and added to the screening force. Their crews went through the same hell as those of the destroyer types.

The first hundred pages provide excellent coverage of the nature of the duty at the picket stations, the types of ships and Navy/Marine/Army aircraft involved on the American side, the Japanese air forces arrayed against the U.S., and an overall picture of the Okinawa campaign. These chapters are well done as is the eighth and final chapter which summarizes and analyses the combat actions that took place. The appendices are also superb. It's the 225 pages in between chapters two and eight that get tedious. In his preface, Reilly says, "I have tried to avoid a journalistic style in my writing; however . . . it was sometimes necessary." The five chronologically arranged chapters in the middle are almost totally journalistic in style. For example: "Patrolling on RP [radar picket] Station # 3 were *Daly, Henry A. Wiley, LCS(L) 81, 111, PGM 10, and PGM 17. LCS(L) 111* left the station at 0505. A RPP [radar picket patrol] of two VMF-224 Corsairs flown by Maj. R.C. Hammond, Jr. and First Lieutenant Van Salter flew over the station. At 0625 a bogey was spotted on the *Daley's* radar screen. She vectored the two Corsairs out to intercept it and at 0630 they splashed the Val five miles astern of the destroyer. Major Hammond was credited with the kill." A reader comes away thinking that Rielly wanted to make sure every fact he uncovered was passed along.

Of the nearly 3,000 casualties taken on the picket stations, over 1,300 were Killed in Action (KIA). Fifteen of the 206 ships that served in this role were sunk and another fifty were damaged—many severely. The crews were at nearly constant battle stations. The horror was nearly unimaginable. But a few of the best stories and some better summations would have served the reader better than the style the author selected while still presenting the story.

Rielly packed the book with photos and diagrams. The one map he failed to provide, however, was the location of the nearly twenty radar picket stations. The

entire book keys on these, but I have no idea where they were! Other than the style problem, that is one of the book's few failings. Make no mistake, I think this is a terrific book about a subject that has hitherto received only scant coverage. To understand what the thousands of sailors and airmen faced off the shores of Okinawa, this is a must read.

Col. Scott A. Willey, USAF (Ret.), Book Review Editor



Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery. By Terri Tanielian and Lisa H. Jaycox, Eds. Arlington, Va.: RAND Center for Military Health Policy Research, 2008. Tables. Diagrams. Illustrations. Notes. Appendices. Glossary. Pp. xliii, 453. \$55.50 Paperback ISBN: 0-8330-4454-9

Tanielian and Jaycox are study directors for The RAND corporation, a non-profit research organization providing objective analysis and effective solutions that address the challenges facing public and private sectors around the world. RAND conducted a comprehensive study of the post-deployment health-related needs associated with post-traumatic stress disorder (PTSD), major depression, and traumatic brain injury (TBI) among Operations Enduring Freedom and Iraqi Freedom (OEF/OIF) veterans. The study looked at the health care system in place to meet those needs, gaps in the care system, and the costs associated with these conditions and with providing quality health care to all those in need. It was conducted jointly under the auspices of the Center for Military Health Policy Research, a RAND Health center, and the Forces and Resources Policy Center of the National Security Research Division. This monograph presenting the study results was funded by a grant from the Iraq Afghanistan Deployment Impact Fund, administered by the California Community Foundation.

PTSD, depression, and TBI are not new. All three have been recognized for decades. However, none of these three conditions is well understood. Unlike very visible physical injuries such as amputations, PTSD, depression, and TBI are the psychological and cognitive injuries: the invisible wounds of war. This publication is extensive and the results are consistent, providing a firm basis from which to project the likely consequences of these conditions for service members returning

from the current conflicts. In general, the review described here reveals those consequences to be severe, negative, and wide-ranging, affecting not only multiple domains of life for affected veterans and service members, but also their spouses, partners, children, and society as well. The predictions are not optimistic; however, the negative outcomes may be alleviated, attenuated, or prevented with early, accessible, evidenced-based, high quality, and careful interventions. These are discussed comprehensively in this publication.

Since October 2001, approximately 1.64 million U.S. troops have been deployed in Afghanistan and Iraq. Early evidence suggests that the psychological toll of these deployments—many involving prolonged exposure to combat-related stress over multiple rotations—may be disproportionately high compared with the physical injuries of combat. This monograph and the study on which it is based focuses on PTSD, major depression, and TBI not only because these injuries are disproportionately high compared to physical, visible injuries, but also because, unlike the physical wounds of war, these conditions are often invisible, unrecognized, unacknowledged, undiagnosed, and, even if diagnosed, often not treated with high quality, evidenced-based treatments.

Key study findings are presented comprehensively. The editors presented not only the numbers of each type of injury but also looked at the wide array of consequences and outcomes of each injury. Evidence-based treatments and recommendations for each condition are presented. Critical gaps in the health care delivery system are identified. Cost is a major thread woven throughout—the costs of treatment, long-term consequences of these injuries, unmet needs, and tremendous personal suffering, and the costs to the military and society.

This work is extremely thorough, and the findings and recommendations are highly applicable to the general U.S. population. It is a monumental and valuable resource for life-care planners, mental-health providers, rehabilitation professionals, and health-policy makers. It should be mandatory reading for DoD and Veterans Affairs personnel.

Lizabeth A. Drury-Zemke, RN, MS, CCM, CLCP; Nurse Case Manager; Cert. Life Care Planner, and Amputee Liaison; Member of CA Brain Injury Assoc, CMSA, and Int'l Association of Rehabilitation Professionals. Fresno, Calif.

“Flak” Houses then and Now: The Story of American Rest Homes in England During WW II. By Keith Thomas. Essex, UK: After the Battle Publishing, 2007. Photographs. Pp 80. \$32.95 ISBN: 1-870067-66-5

In 1942, recognizing the need to provide aircrews effective rest and relaxation, the USAAF established combat Rest Homes. Operated by the US Army Service Command with the assistance of the Red Cross, the combat Rest Homes, known as ‘flak’ houses, offered aircrew the opportunity to take a break in as civilian-like an environment as possible. This short term break, usually taken midway through an airman’s combat tour, provided the necessary rejuvenation to allow crews to effectively continue the air war against Germany.

The term “flak” house is gallows humor, with the term “flak” being slang for German anti-aircraft fire. While visiting a “flak” house, airmen wore civilian clothes (provided as necessary). The only uniform worn was a service dress for dinner. This was done to keep the environment as non-military as possible and, thus, maximize relaxation. Red Cross girls helped entertain the airman via activities such as tennis, horseback riding, skeet shooting, and dancing. Meals were often served in bed; and all meals included fresh, well-cooked food.

Thomas documents the sixteen official rest homes as well as four informal rest homes set up by individual wings. He details the particulars of the property such as its size, amenities, and location and also notes whether the site was used for officers or enlisted personnel. Mixed in with details of each house are anecdotal stories from previous guests. These stories help to bring the book to life and provide more meaning than would a simple repetition of facts.

The pages of the book are filled with black and white photos of each ‘flak’ house and its aircrew guests. In keeping with the After the Battle publishing focus, there are photos of how the various locations appear today, as well as details about the houses’ current functions. Unfortunately, the photos tend to be small. Interestingly, the differences between the “then” and “now” photos is only minor in most cases, even sixty years after the war.

“Flak” Houses is an import and may be difficult to find. Also, because it is a limited import book, the price is a bit steep. While the book obviously targets a specific niche market, it does give the reader a small glimpse into the lives of World War II American airmen and details about the “flak” houses that are often mentioned in American airmen’s memoirs.

Lt. Col. Daniel J. Simonsen, USAF, Commander, AFROTC Detachment 305, Louisiana Tech University, Ruston, La.



Air Power in the New Counterinsurgency Era: The Strategic Importance of USAF Advisory and Assistance Missions. By Alan J. Vick. Santa Monica, Calif.: Project Air Force, 2006 [RAND]. Notes. Tables. Appendices. Glossary. Bibliography. \$22.50 Paperback ISBN: 0-8330-3963-6

Since that dreadful day, September 11, 2001, insurgencies have become a priority of the United States government largely due the link between Islamic insurgents and global jihadist groups. The authors state that whether the U.S. achieves its goals in the Middle East or not, it “can ignore insurgencies only at its own peril.” They argue the only way to defeat threatening insurgencies is to “develop a broad strategy that is sensitive to risks and mixes military, law enforcement, intelligence, and other instruments of power to undermine and ultimately end support for the insurgents.”

The book has three goals. First, it seeks to become a primer on the problem of “insurgency, counterinsurgency principles, and the role of air power in countering insurgencies.” Secondly, it stresses the need for the demand for advisory assistance. Finally, it seeks to give senior Air Force leaders a “way ahead” in developing increased capability without losing the Air Force’s edge in major combat operations. Within these goals, the authors pose four major policy questions based on more than forty years of experience: threats modern insurgencies pose to the United States; strategies the U.S. should use to counter the threats; the military’s role in defeating these threats; and contributions the U.S. Air Force can make towards counterinsurgency.

The authors begin by looking at the lessons learned from counterinsurgency from the Cold War to Afghanistan and Iraq. They point to the current conflict as the dawn of a “third counterinsurgency era” where irregular adversary forces display “flexibility, lethality, resilience, and operational depth,” all of which have frustrated some of the world’s most formidable armed forces. Through these lessons, they offer four principles national security planners must keep in mind when developing strategies, forces, and technology in combating counterinsurgencies. 1) One must understand the adversary. As in any armed struggle, a combat force’s success in



Books Received

Brown, J.D. [Ed. by David Hobbs.] *Carrier Operations in World War II*. Annapolis, Md.: Naval Institute Press, 2009. Maps. Tables. Photographs. Appendices. Index. Pp. 304. \$72.95 ISBN: 978-1-591141-0-82

Griehl, Manfred. *Last Days of the Luftwaffe: German Luftwaffe Combat Units, 1944-1945*. Barnsley, S. Yorkshire, UK: Frontline Books [Imprint of Pen & Sword Books], 2009. Photographs. Illustrations. Index. Pp. ix, 262. £25.00 ISBN: 978-1-8483-2511-1

* Handleman, Philip. [Illustrated by Craig Koder] *A Dream of Pilots*. Gretna, La.: Pelican Publishing Co., 2009. Illustrations. Index. Pp. 126. \$14.95 ISBN: 978-2952-638159-805-70-5

Hao, Yufan, C.X. George Wei and Lowell Dittmer, Eds. *Challenges to Chinese Foreign Policy: Diplomacy, Globalization, and the Next World Power*. Lexington: The University Press of Kentucky,

2009. Notes. Index. Pp. 377. Paperback \$29.95 ISBN: 978-0-8131

* Kozak, Warren. *LeMay: The Life and Wars of General Curtis LeMay*. Washington, D.C: Eagle Publishing, 2009. Pp. 354. \$27.95 ISBN: 1596985-6-90

Shanle, Leland. *Project Seven Alpha: American Airlines in Burma, 1942*. Barnsley, S. Yorkshire, UK: Pen & Sword Aviation, 2008. Pp. vii, 246. £19.99 ISBN: 978-1-8441-5826-3

Wakelam, Randall T. *The Science of Bombing: Operational Research in RAF Bombing Command, 2009*. Toronto: University of Toronto Press, 2009. Maps. Tables. Diagrams. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. ix, 347. \$55.00 Paperback ISBN: 978-0-8020-9629-6

* Already under review

PROSPECTIVE REVIEWERS

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

Col. Scott A. Willey, USAF (Ret.)
3704 Brices Ford Ct.
Fairfax, VA 22033
Tel. (703) 620-4139
e-mail: scottlin.willey@gmail.com

counterinsurgency requires a “full appreciation of the adversary’s strengths, weaknesses, and goals.” This requires a police and intelligence system capable of collecting and analyzing this information to establish future collection priorities. 2) Build a state capacity and presence to face the insurgency. 3) Control the population which plays a critical role in insurgencies as the people serve as “an invaluable resource base, both material and political.” 4) Keep use of force to a minimum—the cardinal tenet of modern counterinsurgency doctrine.”

The book’s key chapter is number six. The authors say air power is usually “taken for granted” when the topic of counterinsurgency is raised in military circles for two reasons: insurgents lack the vulnerability to classic air campaigns, and insurgencies do not present “opportunities” for an overwhelming application of air power. However, they argue that the “unique advantages of air power” have made it “integral to counterinsurgency operations.” Wide-area surveillance and the ability to destroy massed forces in the open have

denied insurgents the ability to escalate to conventional phases while limiting the options of neighboring countries who might be “tempted to intervene in the conflict.”

To help countries combat internal threats, the U.S. Air Force used its 6th Special Operations Squadron (SOS) to assist partner nations use of air forces in counterinsurgency. The current mission of the 6th SOS is to “assess, train, advise, and assist foreign aviation forces in air power employment and sustainment and integrate these assets into joint, multinational operations.” Each of the training packages is specifically tailored for the situation. Instructions are provided in the host country’s language, and training is done with their equipment. The authors found during their analysis that approximately ninety-two of the world’s 191 United Nations members are beset by some sort of insurgency; thirty-five of those are beset by militant Islamism. Current analysis shows that the United States today has some sort of security assistance with roughly 80 percent of the states affected by insurgencies.

The authors present a well-written and thought-provoking book, but air power is not introduced to the reader until chapter six. However, U.S. Air Force members need to review this work to gain an understanding of how air power is being used to combat what has been termed Fourth Generation Warfare. As Thomas Hammes stated in 2005, every potential opponent has observed US successes and understands that “if the United States is provided clear targets...those targets will be destroyed.” Hammes continued that they have also studied the success of the Somalis and Sandinistas and are absorbing the lessons of Bosnia, Afghanistan and Iraq. It is the work of the 6th SOS, by advising and training partner nations, that will make a difference in combating the insurgencies we face. Professional airmen must stay current on world events and be able to evolve as times change.

R. Ray Ortensie, Staff Historian, HQ Air Education and Training Command, Randolph AFB, Tex.



THE AIR FORCE HISTORICAL FOUNDATION
ELECTION AND ANNUAL MEETING
NOVEMBER 18, 2009

Notice to Foundation Members:

The Air Force Historical Foundation will conduct its annual membership meeting and election for the Board of Directors on Wednesday, November 18, 2009. The meeting will be held in the Board Room of the Air Force Association, fourth floor, 1501 Lee Highway, Arlington, Virginia, at 11:00 am. Luncheon will be served during the meeting.

The Board of Directors consists of 18 members of the Foundation, elected by the membership. The Board is divided into three classes of six members each to avoid massive changeover in any given year. The then-President and Chairman of the Board, Lt Gen Michael A. Nelson, USAF (Ret), appointed Lt Gen Charles A. May, Dr Diane Putney, and Col Ken Moll, USAF (Ret), to a Nominating Committee to nominate candidates for election to the Board. General May's letter to General Nelson, dated May 22, 2009, stated:

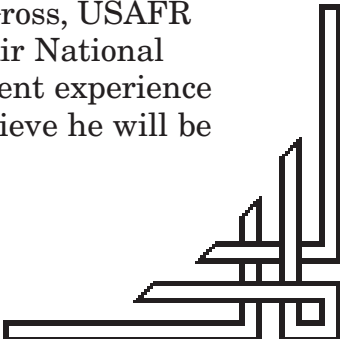
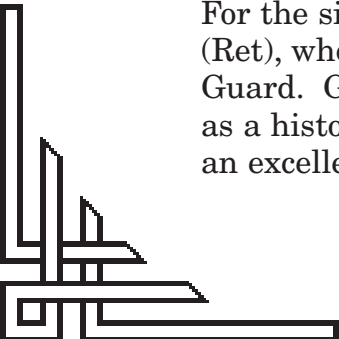
22 May 2009

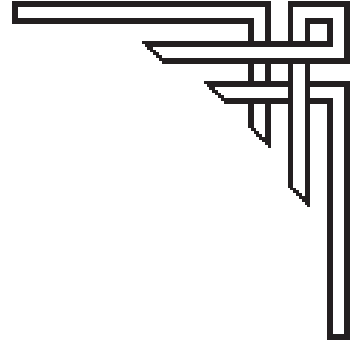
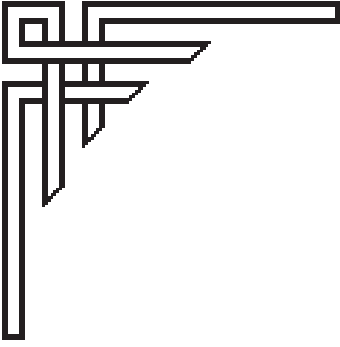
Dear General Nelson,

As Chairman of the 2009 Air Force Historical Foundation Nominating Committee, I am pleased to present to you our slate of candidates for election to the Board of Directors. After careful consideration, my fellow committee members – Diane Putney and Ken Moll – join me in the unanimous recommendation that five of the six departing Board members be selected for a second term and a new candidate be selected to join the Board.

The current Board members that we recommend be re-elected are: John Shaud, Ron Fogleman, Si Johnson, Al Hurley and Jack Neufeld. According to our information, these five gentlemen have been active and enthusiastic members of the Board for one term and all have agreed to serve a second term.

For the sixth vacancy, we recommend Colonel Charles J. Gross, USAFR (Ret), who currently serves as the Chief Historian of the Air National Guard. Given his extensive military background and current experience as a historian as well as his sincere desire to serve, we believe he will be an excellent addition to the Board of Directors.





In conclusion, it has been an honor and a pleasure for Diane, Ken, and myself to serve on the Nominating Committee. We are proud members of the Foundation and believe support for our recommended slate of directors will continue the positive momentum achieved under your leadership. We wish you well in future endeavors and thank you for your outstanding service to our organization.

Charles A. May Jr.
Lt Gen USAF (Ret)
Chairman, Nominating Committee

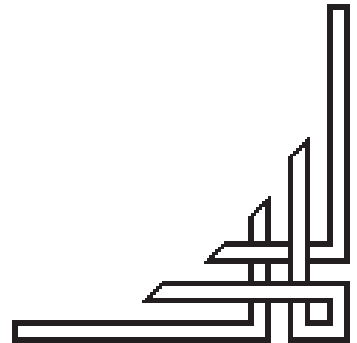
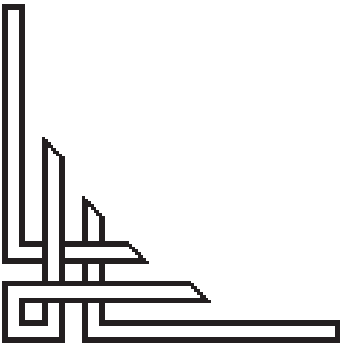
All Foundation members are encouraged to vote using the card attached inside this issue of *Air Power History*. Members may vote for or against each candidate, and they may write in votes as well. The card should be signed by the member and mailed to the Air Force Historical Foundation, P O Box 790, Clinton, MD 20735-0790, in time to be received by November 17.

Please let us know by email (execdir@afhistoricalfoundation.org) or telephone at (301) 736-1959 if you intend to attend the annual meeting. Parking at the Air Force Association building is free. We want to know how many will attend so we can plan seating, luncheon, and document distribution requirements.

The letter from Lt Gen Charles May explains the nominations, but the Board and staff of the Foundation want to take this opportunity to thank the Board member who will not seek re-election. Lt Gen Richard E. "Tex" Brown has served well during his term in office, including service as Treasurer and Chair of the Finance Committee, and we appreciate his willingness to take on this task during a time of change for our Foundation. He has given tremendous time and effort to the Foundation, for which we thank him. He asked for relief to work harder at his demanding day job.

Warm regards,

Tom Bradley



Air Force Historical Foundation's



Lt Gen Michael A. Nelson served for 35 years in the USAF, retiring in 1994 as Commander, Ninth Air Force, and Commander, Central Command Air Forces. He served as president of The Retired Officers Association (now Military Officers Association of America) from 1995 to 2002, and he is a past president of the National War College Alumni Association.

General Nelson earned his commission through AFROTC at Stanford University, later receiving a master's degree at the University of Arizona. He completed pilot training in Class 61B at Laredo AFB, entered F-100 training at Luke AFB, and for the rest of his career, interspersed fighter operations (F-100, F-105, A-7, F-4E, F-15, and F-16) with operational command, staff, and professional education assignments. He completed his last single-seat sortie just prior to retirement. From 1967 to 1968, General Nelson worked on fighter electronic warfare tactics and flew F-105s in 100 combat missions over North Vietnam while assigned to the 333rd Tactical Fighter Squadron of the 355th Tactical Fighter Wing. His commands include the 357th Tactical Fighter Squadron, 21st Tactical Fighter Wing at Elmendorf AFB, 313th Air Division at Kadena AB, Japan, Thirteenth Air Force at Clark AB, the Philippines, Sheppard Technical Training Center, and Ninth Air Force. He is a graduate of the Squadron Officer School, the Air Command and Staff College, and the National War College.

General Nelson served almost six years as President of the Foundation. During his tenure, he built on the successes of his predecessors by spearheading major changes in the Foundation bylaws and governance structure under an 18-member Board of Directors; expanding the awards program to include the new General Carl "Tooney" Spaatz Award and Maj Gen I. B. Holley Award; overseeing the publication of two new books, *US AIR FORCE: A Complete History* and *WORLD WAR II: A Chronology of War*; stabilizing and reordering the finances of the Foundation; initiating a new corporate sponsorship program; starting a new membership campaign, including both outreach to active and Reserve members of the Air Force and a direct-mail campaign to attract members from the general public; reinvigorating the symposium program and committing to a biennial event; producing an awards banquet as an annual event; and supporting the Foundation financially through a Directors' Challenge program. He was first attracted to membership in the Foundation years ago by the quality of the journal *Air Power History*, which he describes as the Foundation's flagship program. He is a committed member of the Foundation who remains supportive of its programs and active in its events. The Nelsons live in Clifton, Virginia.

Changing of the Guard



Maj. Gen. Dale W. Meyerrose served for over thirty years in the United States Air Force, retiring in 2005, as Director of Command Control Systems, Headquarters, North American Air Defense Command (NORAD), and Director of Architectures and Integration, Headquarters, U.S. Northern Command, Peterson Air Force, Colorado. He also served as Commander, Air Force Element, and Chief Information Officer for both commands. General Meyerrose ensured that the Commander of NORAD had the command and control systems necessary to safeguard the sovereignty of North America. As part of the initial cadre, General Meyerrose helped establish U.S. Northern Command in the aftermath of the September 11, 2001 attacks on the United States. He created information sharing and integrated solutions to support the command's mission to "deter, prevent, and defeat" threats to the homeland.

Born in Indianapolis, Indiana, General Meyerrose entered the Air Force in 1975, after graduating from the USAF Academy with a degree in economics. During his military career, he served as a Director and Chief Information officer at Headquarters, U.S. Air Forces, Europe; Headquarters, Air Combat Command; and Headquarters, Air Force Space Command; three Unified Commands; and a deployed Joint Task Force; Director of Communications in Southeast Asia. He commanded two major Air Force communications units, both with distinction.

General Meyerrose is a Distinguished Graduate of both the Air Force Communications Officer School, Keesler AFB, Mississippi and Squadron Officer School, Maxwell AFB, Alabama; earned an MBA from the University of Utah; and is a graduate of the National War College. He attended the Senior Information Warfare Applications and Joint Flag Officer Warfighting Courses at Maxwell AFB. He also attended the Program for National and International Security, John F. Kennedy School of Government, Harvard University; and the U.S. Navy Executive Business Course, Haas School of Business, University of California at Berkeley, at the Naval Post Graduate School, Monterey, California.

His awards and decorations include the Distinguished Service Medal, Defense Superior Service Medal, two Legions of Merit, and two Defense Meritorious Service Medals, among others. He wears the master communications badge and is a master parachutist.

Shortly after his retirement, General Meyerrose was appointed by President George W. Bush as the first Senate-confirmed Chief Information Officer and Information Sharing Executive for the U.S. Intelligence Community. In January 2009, the Harris Corporation, an international communications and information technology company named General Meyerrose to the newly created position of vice president and general manager, Cyber and Information Assurance.

THE AIR FORCE HISTORICAL FOUNDATION SYMPOSIUM

The Air Force Historical Foundation will sponsor its biennial symposium on Thursday, October 8, 2009, on the theme *The Balkans Air Campaigns in the 1990s and Their Influence Since 2001*. The symposium will take place at the Sheraton Crystal City Hotel, 1800 Jefferson Davis Highway, Arlington, Virginia. The guest speaker for the awards banquet that evening will be **General Norton A. Schwartz**, Chief of Staff, USAF, and the luncheon speaker will be **General Michael E. Ryan**, USAF (Ret.), who as 16th Air Force Commander was responsible for air operations in Bosnia, and who was Chief of Staff from 1997 to 2001. (All speakers named are confirmed.)

The morning keynote speaker will be **Dr Benjamin Lambeth** from the RAND Corporation. The morning panel will address air campaigns in Bosnia, 1995, and in Kosovo, 1999. The panel will be chaired by Mr Dick Anderegg and will feature papers presented by Major William A. March, CD, MA, of the Candian Armed Forces; Dr Daniel Haulman, and Mr Chris Mayse, the latter two civilian historians in the U.S. Air Force history program.

The afternoon keynote speaker will be **Maj Gen Charles J. Dunlap, Jr.**, USAF. The afternoon panel will consider air operations since 2001. The afternoon panel, chaired by Dr Timothy A. Keck, will include papers presented by Dr Rebecca Grant of IRIS Independent Research and the Air Force Association's Mitchell Institute; Lt Col Erik Rundquist, an active Air Force officer and scholar-warrior experienced in special operations in Iraq; and Col Mike Isherwood, a combat veteran of Operation DESERT STORM and now an analyst with the Northrop Grumman Corporation.

The awards banquet will include the address by General Schwartz and the presentation of two prestigious awards. The third annual **General Carl "Tooe" Spaatz Award** will be presented to **Lt Gen Thomas P. Stafford**, USAF (Ret). It is awarded to an individual for a sustained, significant contribution to the making of Air Force history during a lifetime of service, and is named for the first President of the Foundation and first Chief of Staff of the Air Force. Past recipients include General David C. Jones and Maj Gen John R. Alison, both USAF (Ret).

The Foundation also will present its third annual **Major General I. B. Holley Award** to **Mr Herman S. Wolk**, a distinguished career Air Force historian, for making a sustained, significant contribution to the research, interpretation, and documentation of Air Force history during a lifetime of service. It is named for the distinguished professor who taught military history at Duke University for over six decades, served as an active and reserve Air Force officer, and influenced several generations of military historians. Past recipients include General Holley and Brig Gen Alfred F. Hurley, both USAF (Ret).

REGISTER ONLINE NOW at www.afhistoricalfoundation.org. Tables, continental breakfast, breaks, and the reception are available for corporate sponsorships. Further information is available by contacting Tom Bradley at execdir@afhistoricalfoundation.org or by calling (301) 736-1959.

REGISTRATION FEES		
The symposium registration fees depend upon military status and membership in the Air Force Historical Foundation (AFHF). Members of the military in uniform, and civil servants, from any service and from any nation, are charged lower prices, as are members of the Foundation.		
ACTIVE MILITARY OR ACTIVE CIVIL SERVICE (ANY SERVICE, ANY NATION)		
	FOUNDATION MEMBERS	NON-MEMBERS
Presentations and Luncheon	\$80	\$100
Luncheon	\$40	\$50
Banquet with Reception	\$80	\$100
Presentations and Both Meals	\$140	\$190
CIVILIAN (INCLUDING RETIRED MILITARY, CIVIL SERVICE, OR CURRENT CONTRACTOR)		
	FOUNDATION MEMBERS	NON-MEMBERS
Presentations and Luncheon	\$120	\$150
Luncheon	\$60	\$75
Banquet with Reception	\$120	\$180
Presentations and Both Meals	\$225	\$350
DISPLAY TABLE	Members: \$50	Non-Members: \$100
If you wish to register by mail, we have included a reply card inside the back cover.		

Letters

Last Word on the “Best Plane Controversy”

I am sorry to disagree with Bob Dorr, my friend and mentor, but in my opinion both the F4U Corsair and P-51 Mustang were far superior to the P-47 Thunderbolt as fighter-bomber aircraft.

Most of the criteria for “the best” have already been discussed in these pages. I would add (1) kill-to-loss ratio and (2) payload—guns, bullets, bombs, and rockets. In both areas I would “vote” for the F4U and P-51 over the P-47. The F4U could operate from aircraft carriers—even the smaller escort or “jeep” carriers. And, in 1944 a hook-fitted P-51D successfully flew trials from a carrier. P-47s were catapulted from transport carriers, but they could not be modified to come back aboard.

And, I don’t believe that being able to fly from Britain to Malta is a criterion for judging combat aircraft performance. An F4U and P-51 could also fly that far. And a C-47 Dakota could do it, too, while carrying troops or cargo.

Interestingly, production of the three aircraft was roughly the same: 15,056 Corsairs, 14,819 Mustangs plus 273 P-82 Twin Mustangs, and 15,683 Thunderbolts. But by the end of the war in Europe all but one AAF fighter group was flying the P-51; the P-47s were gone while the air opposition, although small in numbers, was high in quality.

Also significant, after World War II the AAF junked the P-47s. The F4Us and P-51s flew into the 1950s, both seeing action in the Korean War. F4Us—flown by Navy and Marine pilots—operated from escort carriers as well as from shore bases. After the Korean War ended F4Us and modified AU-1 Corsairs flew in French markings in the Indochina War.

F4U production continued through January 1953—the last piston-engine fighter produced by the United States. Not bad for an aircraft that first flew in 1940. Thus, by most criteria the F4U and P-51 could pass the P-47.

Norman Polmar, author, Ships and Aircraft of the U.S. Fleet

Technology Not Realized

Lt. Col. Cahill has done an excellent job of describing the failure of radar to prevent the disastrous attacks on Pearl Harbor and Clark Field that are rarely discussed or mentioned in World War II

histories. [“Technology Not Realized: AAF Radar Employment in the Early Pacific War,” *Air Power History*. Vol. 56, No. 2, Summer 2009, pp. 14-27.] With respect to the debacle at Pearl Harbor, it should be emphasized that on December 7, 1941, the Signal Corps, and not the Army Air Forces, was still in charge of the radar installations on Oahu.

Missing from Col. Cahill’s discussion is any reference to Lt. Cmdr. William Taylor, a naval officer experienced in radar intercepts loaned to the Army to assist in setting up the Air Defense Information Center at Fort Shafter. I wrote about Taylor in the Fall 2001 issue of *Air Power History* [Vol. 48, No. 3], “An Eagle With Wings of Gold: The Remarkable Career of Bill Taylor, pp. 26-33.” Taylor’s comment to the Joint Committee investigating the attack on Pearl Harbor sheds additional light on the Hawaiian Department’s failure to implement the new technology of radar on a timely basis. “At no time before December 7, 1941,” he stated, “did this Command furnish either the authority or impetus badly needed to get the work or organization [of the air warning system] properly started.”

Thomas Wildenberg, Burtonsville, Maryland

News

Robert S. McNamara (1916-2009)

Robert S. McNamara, the Secretary of Defense (1961-1968) under Presidents John F. Kennedy and Lyndon B. Johnson, died on July 6, 2009. He was ninety-three.

During World War II, the cerebral Captain McNamara was an analyst in the Army Air Forces. At the time of his appointment to the Defense post, McNamara was president of the Ford Motor Company, where he had earned a reputation as a policymaker with a penchant for statistical analysis. He served in the DoD for seven years, longer than anyone since the job’s creation in 1947. McNamara was a key figure in both the disastrous Bay of Pigs invasion of April 1961 and the Cuban missile crisis of October 1962. However, he will be best remembered as the architect of the disastrous and unpopular Vietnam War, which ended with America’s withdrawal.

After leaving the Pentagon in 1968, on the verge of a nervous breakdown, McNamara became president of the

World Bank and devoted his energies to improving life in developing countries. For several years he declined to write his memoirs, to lay out his view of the war, and his side in his quarrels with his generals. In 1991, he told *Time* magazine that he did not support the bombing of North Vietnam, but went along with it “because we had to try to prove it would not work.”

In 1993, after the Cold War ended, he undertook to write his memoirs. McNamara’s book, *In Retrospect: The Tragedy and Lessons of Vietnam*, published in 1995, revealed that by 1967 he had deep misgivings about Vietnam. The number of U.S. casualties—dead, missing and wounded—sky-rocketed from 7,000 to over 100,000. The Iraq war, with its similarities to Vietnam, at times brought up McNamara’s name, in many cases in comparison with another unpopular defense secretary, Donald H. Rumsfeld.

McNamara served as the World Bank president for twelve years. He tripled its loans to developing countries and changed its emphasis from grandiose industrial projects to rural development. After retiring in 1981, he championed the causes of nuclear disarmament and aid by the richest nations for the world’s poorest.

Wings Club 2009 Distinguished Achievement Award

On October 23, 2009, the Wings Club will honor Mr. Wolfgang Mayrhuber, Chairman of the Executive Board & CEO of Deutsche Lufthansa AG, with the 2009 Distinguished Achievement Award, acknowledging his outstanding accomplishments in the field of aviation.

Mr. Mayrhuber joined the company in 1970, as an engineer at the engine overhaul facility in Hamburg. He held a variety of management posts, serving at Lufthansa for more than thirty-five years. In the early nineties, he led the rehabilitation team charged with engineering Lufthansa’s recovery and was subsequently elected Chairman of the Executive Board of Lufthansa Technik AG when it became an independent company in 1994. After six successful years in that position, he was appointed to the Executive Board of Deutsche Lufthansa AG on January 1, 2001 with responsibility for the passenger airline business. On April 1, 2002, he was elected Deputy Chairman of the Executive Board and proceeded to take up the position of Chairman of the Executive Board and CEO of Deutsche Lufthansa AG on June 18, 2003.

Born in Waizenkirchen, Austria, on

March 22, 1947, Mr. Mayrhuber studied mechanical engineering at the Technical College in Steyr, Austria, and at the Bloor Institute in Canada. In the fall of 1990, he completed an Executive Management Training course at the Massachusetts Institute of Technology (MIT) in Boston. Past recipients of the Distinguished Achievement Award include Astronaut Neil Armstrong, Senator John Glenn, former President George H. W. Bush, Brig.Gen. "Chuck" Yeager, Steven Udvar-Hazy as well as twelve present and former airline CEO's including Fred Smith, Bob Crandall, Herb Kelleher, Gordon Bethune, Sir Colin Marshall, and Sir Richard Branson.

The Wings Club, founded in 1942, is dedicated to preserving aviation, the Club provides a forum for discussion and debate on aeronautical and aviation issues. It serves nearly 1,100 members including industry leaders, pilots, professionals in related service organizations and students of aviation.

Lt. Gen. Howard W. Leaf, USAF (Ret.), 1924-2009

Lt. Gen. Howard W. Leaf, USAF (Ret.) died on April 25, 2009, of congestive heart failure at his home in Acquasco, Maryland.

Born in Menominee, Wisconsin, he was graduated from the Colorado School of Mines in 1950, and earned a master's degree in geophysics from St. Louis University in 1955. General Leaf served in the Army Air Forces in World War II. He joined the Air Force in 1950, and was a fighter pilot in the Korean War and the War in Southeast Asia. Among his decorations are the Distinguished Service Medal, two awards of the Silver Star, two of the Legion of Merit, two Distinguished Flying Crosses, the Meritorious Service Medal and sixteen awards of the Air medal.

From 1961-194, he served in the Office of Scientific Research. During the 1970s, he was deputy chief of staff for requirements at Langley AFB, Virginia, and directed weapons testing at Kirtland AFB, New Mexico. General Leaf was the Air Force Inspector General from 1980-1983. In 1984, he was the Assistant Vice

Chief of Staff of the Air Force.

After retirement he worked for an engineering company in McLean, Va., and from 1991-1997 served as a civilian director of Air Force Test and Evaluation in the Pentagon. General Leaf is survived by his wife of fifty-three years, Madonna Ronan Leaf, six children, eleven grandchildren, and a sister.

Ernest R. May (1928-2009)

Ernest R. May, eighty, a distinguished historian of world wars, intelligence, and international relations, died of complications of cancer surgery on June 1, 2009, at a hospital in Boston.

Born on November 19, 1928, in Ft. Worth, Texas, May was graduated from UCLA with BA and PhD degrees. In 1954, after serving in the U.S. Navy Reserve and working as a historian for the Joint Chiefs of Staff, he joined the Harvard University faculty. Dr. May taught at Harvard for fifty-five years. A prolific writer, he often collaborated with other eminent historians. In 1965, May, John Hope Franklin, and John w. Caughey wrote *Land of the Free*, a controversial



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textbook that examined slavery and the denial of civil rights in the U.S. In 1986, May and Richard Neustadt wrote *Thinking in Time*, which used case studies to demonstrate the utility of history. In *Strange Victory: Hitler's Conquest of France* (2000), May posited the idea that France's faulty military strategy was responsible for its defeat in World War II. With Philip Zelikow, May edited the presidential tapes of John F. Kennedy. He also worked with Zelikow on the 9/11 commission report (2004).

His marriage to the former Nancy Caughey ended in divorce. He is survived by his wife of twenty years, Susan B. Wood, three children from his first marriage, and three grandchildren.

Eduard Mark (1943-2009)

Eduard M. Mark, sixty-five, a Cold War historian died June 2, 2009, of hypertensive and arteriosclerotic cardiovascular disease.

Since 1982, Dr. Mark had worked in the Office of Air Force History in Washington, D.C. Born on June 8, 1943, in New Jersey, he grew up in Mystic, Connecticut.

He received BA, MA, and PhD degrees from the University of Connecticut. During the Vietnam War, he served in the U.S. Army in South Korea.

He published numerous articles in *Foreign Affairs*, the *American Historical Review*, the *Journal of American History*, *Intelligence and National Security*, and the *Journal of Cold War Studies*. In 1994, his book *Aerial Interdiction in Three Wars*, was published by the Center for Air Force History. He researched and wrote the official account of Just Cause, the Panama invasion. Several more books that he wrote or contributed to were pending publication or declassification review. Dr. Mark presented papers worldwide, most recently at the Woodrow Wilson Center in Washington on the infamous Alger Hiss.

He is survived by a brother, Richard Mark, and three nieces.

World's Fastest Airplane, the X-15, Marks Fiftieth Anniversary

On June 8, 1959, North American Aviation test pilot Scott Crossfield piloted the fifty-foot X-15 on its first glide flight landing on Rogers Dry Lake at Edwards

AFB, California. The X-15 was dropped from under the wing of a B-52 bomber at 38,000 feet over Edwards. The historic flight lasted five minutes and ten seconds, landing at 200 mph on the lakebed. Crossfield's next flight, powered by two four-chamber rocket engines, attained Mach 2. The test program continued for the next ten years, making 199 flights, setting speed and altitude records in the process of collecting hypersonic research data and exploring the challenges of manned flight.

On October 16, 2009, the Flight Test Historical Foundation—which supports the Air Force Flight Test Center Museum at Edwards AFB, California, and the Blackbird Airpark in Palmdale—will host a "Gathering of Eagles," in Lancaster, California, to celebrate the fiftieth anniversary of the first flight of the X-15.

Stuart I. Rochester

At press time, we learned of the death of Dr. Rochester, the Historian of the Office of the Secretary of Defense. We will publish an obituary in the Winter 2009 issue of *Air Power History*.

Guidelines for Contributors

We seek quality articles—based on sound scholarship, perceptive analysis, and/or firsthand experience—which are well-written and attractively illustrated. The primary criterion is that the manuscript contributes to knowledge. Articles submitted to *Air Power History* must be original contributions and not be under consideration by any other publication at the same time. If a manuscript is under consideration by another publication, the author should clearly indicate this at the time of submission. Each submission must include an abstract—a statement of the article's theme, its historical context, major subsidiary issues, and research sources. Abstracts should not be longer than one page.

Manuscripts should be submitted in triplicate, double-spaced throughout, and prepared according to the *Chicago Manual of Style* (University of Chicago Press). Use civilian dates and endnotes. Because submissions are evaluated anonymously, the author's name should appear only on the title page. Authors should provide on a separate page brief biographical details, to include institutional or professional affiliation and recent publications, for inclusion in the printed article. Pages, including those containing illustrations, diagrams or tables, should be numbered consecutively. Any figures and tables must be clearly produced ready for photographic reproduction. The source should be given below the table. Endnotes should be numbered consecutively through the article with a raised numeral corresponding to the list of notes placed at the end.

If an article is typed on a computer, the disk should be in IBM-PC compatible format and should accompany the manuscript. Preferred disk size is a 3 1/2-inch floppy, but any disk size can be utilized. Disks should be labelled with the name of the author, title of the article, and the software used. Most Word processors can be accommodated including WordPerfect and Microsoft Word. As a last resort, an ASCII text file can be used.

There is no standard length for articles, but 4,500-5,500 words is a general guide.

Manuscripts and editorial correspondence should be sent to Jacob Neufeld, Editor, *c/o Air Power History*, 11908 Gainsborough Rd., Potomac, MD 20854, e-mail: jneufeld@comcast.net.



Our Summer 2009 mystery aircraft was the Navy's Grumman XF5F-1 Skyrocket twin-engine fighter of World War II.

The U.S. Navy ordered a prototype Skyrocket in 1938, a twin-engine, carrier-based fighter with an odd feature: The forward part of the plane's fuselage did not extend forward of the wing.

The XF5F-1 (bureau number 1442) made its first flight on April 1, 1940, with Grumman's venerable Robert L. "Bob" Hall at the controls. Initially plagued by engine cooling problems, the aircraft underwent changes in configuration, receiving redesigned propeller hubs and a new exhaust system. Eventually, the Skyrocket underwent a complete rebuilding that included a nose extension.

A similar U.S. Army plane, the Grumman XP-50, came and went while the XF5F-1 continued flying. Hall had to bail out of the sole XP-50 near Long Island, New York, ending the program. Both planes demonstrated the folly of risking everything on a single prototype of a new aircraft.

The Skyrocket was never right for carrier operations. The bulk of the XF5F-1's engine nacelles impeded the pilot's lateral visibility. Engineers had

difficulty deciding on a proper armament fit, although two 23 mm Madsen cannons were belatedly installed.

On February 3, 1942, the sole Skyrocket suffered a main landing gear collapse under conditions on land far kinder than those aboard any carrier. By the time of a second belly landing on December 11, 1944, any prospect of an operational F5F had been bypassed: Grumman's mighty F6F Hellcat was decimating the Japanese naval air arm. After the second mishap, the XF5F-1 was scrapped.

The XF5F-1 was powered by two Wright XR-1820-40/42 Cyclone nine-cylinder, radial air-cooled engines. It had a forty-two-foot wingspan, and was said to have a top speed of 383 miles per hour. Never successful in "real life," it was a hit in the Blackhawk comic books, where it equipped the Blackhawk squadron of Nazi-hunters and crime fighters.

During the slow summer season, twenty-four readers submitted entries in our contest. All identified the XF5F-1. Our random "History Mystery" winner is Michael LeGendre of Chaparral, New Mexico. He'll receive as his prize a copy of the book "*Hell Hawks!*," which is reviewed on page 55.

In response to several requests to make our "name the plane" challenge a little easier we've given everyone a break with our new challenge for plane-savvy readers. When you try to identify this issue's "mystery" aircraft, remember the "History Mystery" rules:

1. Submit your entry on a postcard. Mail the postcard to Robert F. Dorr, 3411 Valewood Drive, Oakton VA 22124. Entries may also be submitted via e-mail to robert.f.dorr@cox.net.

2. Name the aircraft shown here. Include your address and telephone number. Entries not accompanied by both an address and a phone number will be disqualified.

3. A winner will be chosen at random from among correct entries and will receive an aviation book.

And please pitch in to help, if you can. Do you have a rare photo of a little-known aircraft? We'll return any photos sent by readers for use on this page.

This Issue's Mystery Plane





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The brave men and women who serve in our armed forces protect our freedom and the freedom of the world. We honor their courage and their unselfish commitment to duty.

 **BOEING**

Photo: Department of Defense