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COVER: As crew members secure the X-15 rocket-powered aircraft after a research flight, the B-52 moth-ership used for launching this unique aircraft does a low fly-by overhead. (NASA photo.)



Air Force Historical Foundation
P.O. Box 790
Clinton, MD 20735-0790
(301) 736-1959 Fax (301) 981-3574

E-mail: execdir@afhistoricalfoundation.org
On the Web at <http://www.afhistoricalfoundation.org>

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Publisher
Alfred F. Hurley

Editor
Jacob Neufeld

Technical Editor
Robert F. Dorr

Book Review Editor
Scott A. Willey

Layout and Typesetting
Richard I. Wolf

Advertising
Tom Bradley

Circulation
Tom Bradley

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Address **Letters to the Editor** to:

Air Power History
11908 Gainsborough Rd.
Potomac, MD 20854
e-mail: jneufeld@comcast.net

Correspondence regarding missed issues
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Air Power History
P.O. Box 790
Clinton, MD 20735-0790
Telephone: (301) 736-1959
Fax: (301) 981-3574
e-mail: execdir@afhistoricalfoundation.org

Advertising

Tom Bradley
P.O. Box 790
Clinton, MD 20735-0790
(301) 736-1959; fax (301) 981-3574
e-mail: execdir@afhistoricalfoundation.org

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While many readers enjoyed the “Living Legends” symposium featured in the Winter 2007 special edition, we also received several letters, e-mails, and telephone calls inquiring about Tom Wildenberg’s series on “Howard Hughes and the Air Force,” which began in the Fall 2007 issue of *Air Power History*. The sequence was interrupted by the time-sensitive necessity to publish the Sixtieth Anniversary of the United States Air Force commemorative. Readers will be pleased to find Part II of the Hughes series continued in this issue. It will conclude with Part III this summer.

In his article, “The Things We Are: Air Force Heritage and History in Artifacts,” Jeff Duford first distinguishes between the characteristics of history and heritage and then demonstrates their connectedness through artifacts. Using narrative and photographs, he makes a convincing case for the enduring value of the Air Force’s material culture.

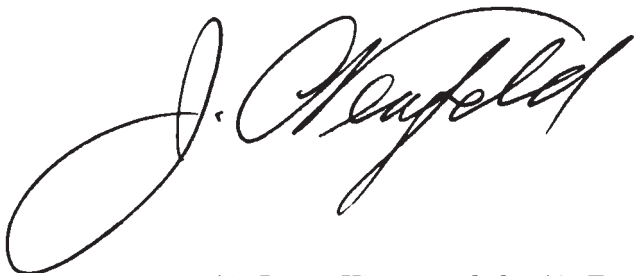
Drawing on archival material from the National Aeronautics and Space Administration and newly-released documents from other sources, Parker Temple examines North American Aviation’s X-15B spaceplane in the context of early orbital human spaceflight. Although the X-15B never left the drawing board, it is interesting to consider “what might have been” had the nation pursued that direction into space.

In the fourth article, drawn from his forthcoming book, test pilot George Marrett describes the thrilling experience of flying chase behind the Mach 3 North American Aviation XB-70 Valkyrie. The story centers on June 8, 1966 and the crash of the XB-70 number two.

Last year, in its enduring quest to demonstrate the relevance of history, the Air Force Historical Foundation created two new awards: The General Carl A. “Tooney” Spaatz Award for individuals who contributed most to *making* Air Force history and the Maj. Gen. I.B. Holley Award for individuals who contributed most to *recording* it. The first honorees were Gen. David C. Jones, USAF (Ret.) and Maj. Gen. (Dr.) I. B. Holley, USAF (Ret.), respectively. The Foundation invites members to nominate candidates for this year’s awards. For nomination rules and criteria, see pages 62-63.

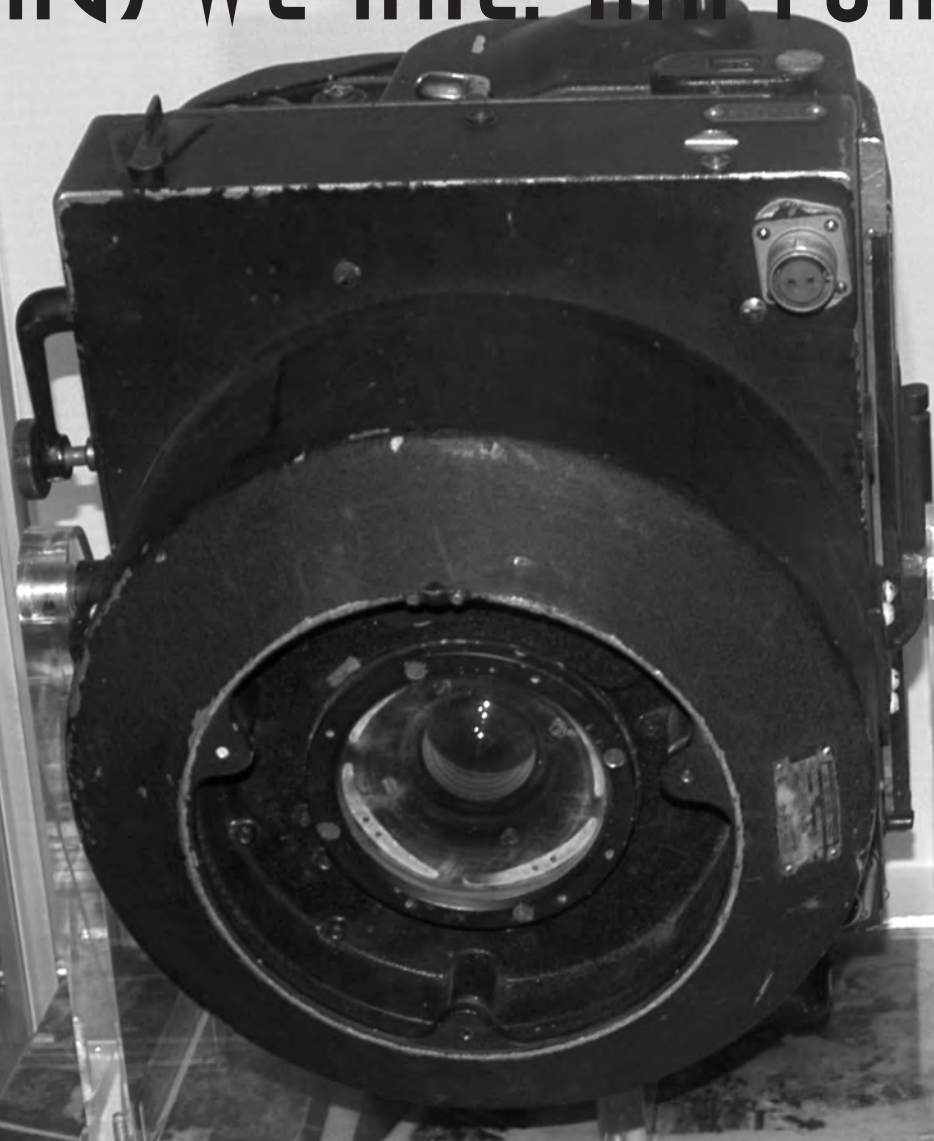
Also, Lt. Gen. Michael A. Nelson, president of the Foundation, invites readers to take up their pens or keyboards and share their ideas concerning the value of history. We intend to publish and post the most compelling ones. See pages 60-61.

The balance of this issue includes our familiar book reviews and departments. Here, too, readers have the opportunity to review a book or submit items of current interest. Applicable addresses and points of contact appear throughout.



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THE THINGS WE ARE: AIR FORCE HE



Scarf worn by Jerry Depew, who flew four RF-86F on reconnaissance missions—one over communist China, one over the Soviet Union, and two over North Korea. The black and yellow checkerboard pattern represents the insignia of the 15th TRS.



1st Lt Jerry Depew wearing the scarf on display. This photograph was taken the day of his last overflight mission in July 1955.



Depew's unofficial 15th TRS patch.

take about 200 exposures on its 9" x 9" format film.

its 9" x 9" format film.

HERITAGE AND HISTORY IN ARTIFACTS

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To BE
REPAIRED

- TO INTERCHANGE SHUTTER
- 
1. WIND A TRIP CAMERA
 2. REMOVE "A" D SCREWS
 3. LOOSEN "B" D SCREWS
 4. SLUR OUT STENCIL "C"
 5. PIVOT "D" D PLATES TO CLEAR SHUTTER
 6. CHECK MAGAZINE LOCK BAR
 7. LIFT OUT SHUTTER
 8. TO INSTALL SHUTTER IT SHOULD BE TRIPPED AND THE REVERSE OF THE FOREGOING PROCEDURE FOLLOWED.

Jeff Duford

(Overleaf) A pair of RF-86F cameras on display.

A LUMP OF COAL IS THE PROVERBIAL EXAMPLE OF SOMETHING WITHOUT WORTH... THIS PARTICULAR COAL BRIQUETTE IS CONNECTED TO A SEMINAL EVENT IN THE AIR FORCE'S HISTORY, AND THEREFORE, IT HAS GREAT VALUE

The recent celebration of the United States Air Force's sixtieth anniversary gives us pause to reflect on its rich heritage and history, which appears in many places and forms. We see it in marching formations and sharp salutes. We hear it in the words of our veterans and in the Air Force Song. We smell it in JP fuel fumes and feel it in the heat and the cold of the global environment where Air Force people operate. We read it in compelling histories and accounts. These all provide connections to those who have come before and to those who are adding to the story of the Air Force now. Yet, there is another powerful form of heritage which is unique and enduring—artifacts. Our heritage and history also reside in the Air Force's national collection of artifacts, which preserves our legacy while educating and inspiring current and future generations.

What are "heritage" and "history?" They are sometimes used interchangeably, but do they really have the same meaning? According to Webster, heritage is "something transmitted by or acquired from a predecessor: inheritance, legacy."¹ For the Air Force, that "something" includes cultural traditions like symbols and values that find their beginnings far in the past. Webster defines history as "a branch of knowledge that records and explains past events as steps in the sequence of human activities."² In a sense, history lays out a series of causes and effects that together explain how we got to where we are today. Though related, heritage is not history and history is not heritage. Both, however, make us feel part of something much bigger than ourselves by adding the element of time. The Air Force today numbers more than 200,000 people, but if you multiply it over time, the Air Force numbers millions. These millions of people share similar values and traditions, and they have served and sacrificed for many of the same ideals over the decades. Objects often embody these values, traditions, and ideals.

There is an intuitive and nearly universal urge to respect and preserve artifacts that goes far beyond their inherent utility and financial value. How often does someone say, "that should be in a museum?" Moreover, artifacts are certainly appreciated by many as interesting curiosities to look at. But why are they important and how are they useful? There is an entire field of inquiry called material culture studies which seeks to answer these questions.³ Thomas Schlereth, an important scholar of material culture, defines the field as "...the study through artifacts (and other pertinent historical evidence) of the belief systems—the values, ideas, attitudes, and assumptions—of a particular community or society, usually across time." He

also adds, "The common assumption underlying material culture research is that objects made or modified by humans, consciously or unconsciously, directly or indirectly, reflect the belief patterns of individuals who made, commissioned, purchased, or used them, and, by extension, the belief patterns of the larger society of which they are a part."⁴ The study of material culture allows us to better understand who we are and where we came from.

Artifacts have many traits, some unique, that illuminate our heritage and history. First, artifacts provide a direct physical connection with the heritage and history of the Air Force. George Kubler, an art historian, once wrote "...inanimate things remain our most tangible evidence that the old human past really existed..."⁵ Events are transitory, but objects made and used by people during these events have a unique longevity that extends far beyond human lifetimes. Second, artifacts are a physical record of the many varied types of history, such as military, technological, and social history, and they function as primary sources to be studied for information. Third, artifacts can evoke a range of powerful emotions like pride, awe, anger, respect, shock, joy, and surprise. Fourth, artifacts make us ask questions that we might not otherwise ask. Lastly, they can reveal what we believe, both in their material properties, such as how they are made and what they are made of, and in the stories of which they are a part. Sometimes, these traits are so obvious they are easily overlooked. Ultimately, artifacts always lead back to people and their stories, and many objects connected to the Air Force are certainly evocative. This article presents a small selection of objects from the Air Force's national collection which illustrates how artifacts preserve our heritage and history.

Coal Briquette

A lump of coal is the proverbial example of something without worth. Furthermore, it is inherently uninteresting to look at. But this particular coal briquette is connected to a seminal event in the Air Force's history, and therefore, it has great value.

Coal, not food, became a critical bottleneck during the 1948-1949 Berlin Airlift. Bringing enough coal into West Berlin became essential for the United States to win the first major engagement of the Cold War (and the first for the Air Force as a separate service). Without coal for industry and utilities, the Soviet attempt to besiege West Berlin into submission with a land blockade might have succeeded.⁶

Jeff Duford has been an historian/curator at the National Museum of the United States Air Force since 1998. In that time, he curated numerous exhibits (including the Museum's Korean War Gallery), worked closely with the Museum's Restoration Division on several aircraft projects, interviewed for national and international television productions (most recently the History Channel series Dogfights), and helped develop a rationalized aircraft layout and storyline for a substantial recreation of the Museum's exhibit galleries. He is currently working on the restoration of the Memphis Belle and co-curating a major revision of the Museum's Southeast Asia War Gallery. Mr. Duford received a B.A. in history from Madonna University in 1995 and a M.A. in history from Eastern Michigan University in 1997.



(Above) Coal being loaded onto a C-54 at Fassberg Airfield during the Berlin Airlift.

(Above right) Berlin Airlift coal briquette.

This coal was mined in the Ruhr Valley, formed into a 4-inch long briquette, and sent by train to Fassberg Airfield, West Germany. There it was loaded onto a USAF C-54 transport piloted by 1st Lt. Richard Roberts and flown into West Berlin's Tegel Airfield. Though the aircraft were normally swept clean, this piece was overlooked, and Lt. Roberts kept it as a memento. The natural urge to preserve objects is evident in the letter that accompanied his donation of this and other artifacts: "These items have always meant a great deal to me, but after my visit to the museum, I feel they will have a much better home there."⁷ It seems that Roberts felt a responsibility to make these objects available for the others to enjoy, too.

This simple artifact is a tiny remnant of the 1,421,118.8 tons of coal the USAF flew into West Berlin during the Berlin Airlift and an enduring record of a key historical event that has long since passed.⁸

Lieutenant Fraser's A-2 jacket.

Lieutenants Fraser (left) and Hudson (right) in front of an F-82.



A-2 Jacket

First entering service in 1931, the leather A-2 jacket is an iconic symbol of *esprit de corps* for aircrews. One characteristic design feature of A-2 jackets are the front pockets—they do not have side openings, thereby preventing wearers from looking "unmilitary" by standing around with their hands stuffed in the pockets.

Although the Army Air Forces officially replaced the A-2 with the cotton-twill B-10 jacket in 1943, it continued to issue A-2s from existing stocks. The A-2 saw widespread service during World War II, and many wearers decorated their A-2s with artwork, showing the individuality characteristic of American culture (juxtaposing the uniformity of traditional military culture). After the war, the AAF sold some as surplus, and the A-2 also saw combat during the Korean War. The Air Force officially reinstated the A-2 in 1987, and it is still worn as a uniform item today.⁹

This particular A-2 is part of a historical event. First Lt. Carl Fraser, a radar operator on an F-82G, wore it when he and the pilot, 1st Lt. William Hud-





Gee Whizz Test Sled

The Air Force has a tradition of being on the cutting edge of human knowledge, along with prizing “service before self.” The story of this artifact, the *Gee Whizz* test vehicle, highlights both of these values.

In the late 1940s and 1950s, Lt. Col. John Stapp headed a low-budget program to determine the limits of the human body with respect to high g forces in order to design better ejection seats and safety harnesses. The *Gee Whizz*, the program’s first test vehicle, was a rocket-powered sled equipped with very powerful hydraulic brakes that raced along a 2,000-ft track.

This object, like others, leads back to stories about people, and Stapp’s courage and brilliance are truly inspiring. Not only did he head the program, he used his own body as test subject (along with other volunteers) in the *Gee Whizz* and later test sleds. Stapp was not a thrill-seeker; he felt strongly that he should share the program’s risks.

(Above) Colonel Stapp during one of the *Gee Whizz* runs. The enormous strain of the test is evident.

(Above right) Colonel Stapp on the *Gee Whizz*.

(Below) General LeMay being sworn in as the Chief of Staff on June 30, 1961.

(Below right) General LeMay’s service coat.

son, shot down a North Korean Yak-11 to achieve the first kill of the Korean War on June 27, 1950. Interestingly, the patches on the jacket are contradictory. The patch on the left in the photograph expresses individuality and impudence—it is an unofficial patch for his flight with the irreverent phrase “Bite ‘em in the butt.” The patch on the right is the official emblem of his unit, the 68th Fighter Interceptor Squadron, and it represents uniformity and honor.¹⁰





(Above) Lieutenant Dickens wearing the cap just before the first RF-86F overflight on March 22, 1954. On this mission, he flew a backup aircraft and turned around before crossing the Soviet border.

(Above right) Dickens' baseball cap.



1957-1961 he was Vice Chief of Staff of the USAF, and from 1961-1965 he was the Chief of Staff of the USAF. The Air Force places great value on leadership, and this very personal artifact is a direct link to a person who was an exemplary Air Force leader.¹²

Baseball Cap

First Lt. Samuel Dickens, an RF-86 pilot in the 15th Tactical Reconnaissance Squadron in the 1950s, owned this baseball cap. The hat is yellow to reflect the squadron's color, and the hash marks on the brim account for the combat missions he flew in 1953 during the Korean War. Dickens carried this cap in his flight suit pocket or on the cockpit floor on every mission. This provenance alone would make this artifact valuable, but there is more to this story.

Dickens also carried this cap on a highly-classified reconnaissance flight over Soviet airfields near Vladivostok on April 3, 1954.¹³ From 1954-1956, a handful of 15th TRS RF-86F pilots flew over areas in the eastern USSR and communist China on orders from President Eisenhower. These pilots were mainly lieutenants and captains who had a tremendous amount of responsibility for their rank—any mistake might have created a serious international crisis. The photographs they took filled critical intelligence gaps regarding communist strategic military activities in the Far East.¹⁴

Very few artifacts remain from these missions—not surprising considering it was such a small group of people and such a secret operation (the overflights remained classified into the late 1990s). This cap remains a tangible link to the audacity and skill of that small group of young aviators.

Stapp suffered several injuries on the many test runs he took, including concussions, two broken wrists, cracked ribs, lost fillings, and retinal hemorrhages. In 1956, after reaching 632 mph on another test sled, he was ordered to stop taking high-speed runs.¹¹

The knowledge gained from Stapp's program saved countless lives not only in the Air Force, but also in the general public through its incorporation in automobile safety.

Service Dress Coat

This service dress coat from the 1950s/1960s is an artifact that has obvious meaning within an Air Force context. The fact that it is a uniform item worn by thousands of airmen says something about "uniformity" within Air Force culture, which is both inclusive and exclusive at the same time. For instance, those who wear the uniform are part of the military, but the blue color makes it clear they are not part of the U.S. Army. On the service coat is the rank of general, senior pilot wings, and several decorations. The fact that one's rank, abilities, and achievements are worn as part of the dress also reflects an ordered society with defined roles and status for individuals, which of course, the Air Force is.

This service dress coat was worn by Gen. Curtis E. LeMay, a legendary figure who argued forcefully for air and space power and particularly for a strong strategic air and space force. LeMay commanded Strategic Air Command for nearly ten years during a critical period of the Cold War. From

THE HASH MARKS ON THE BRIM ACCOUNT FOR THE COMBAT MISSIONS HE FLEW

Overhead view of the Museum's Hall of Missiles. The Titan II is third from the left.

Titan II being launched from inside a silo on a test shot.



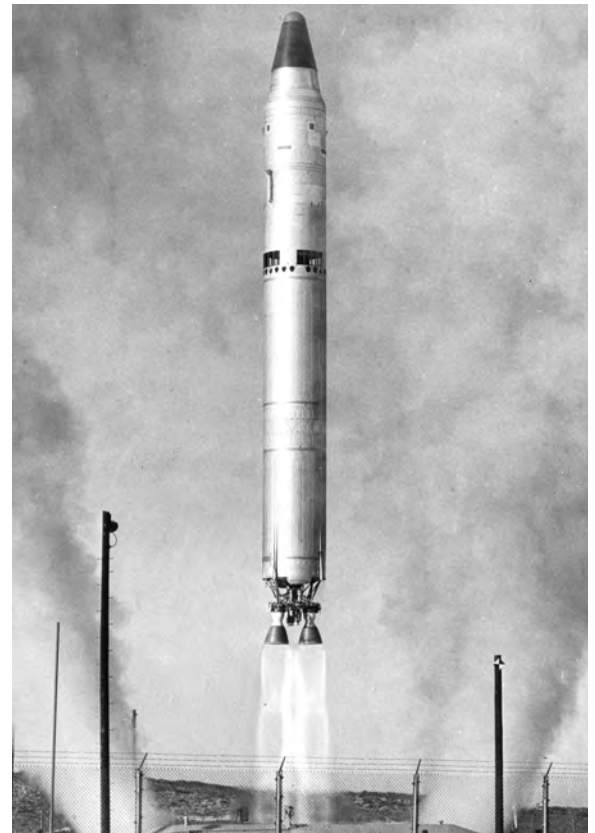
THE TITAN II HIGHLIGHTS THE AIR FORCE'S PARTICIPATION IN MANNED SPACE-FLIGHT [USING] ICBM TECHNOLOGY TO SEND PEOPLE INTO SPACE

SM-68B/LGM-25C Titan II

Declared operational in 1963, the aptly-named Titan II was an intercontinental, liquid-fueled strategic missile with a range of over 9,000 miles.¹⁵ The Museum's Titan II is third from the left in this photograph of the Missile Gallery. An excellent example of the inherent flexibility of air and space power, this artifact represents three important aspects of the Air Force's heritage and history:

The Titan II was a key deterrent against Soviet attack. Nuclear deterrence was the linchpin of U.S. defense during the Cold War. It rightly presumed that the Soviet Union would not strike the U.S. if its own obliteration would result. Serving with Strategic Air Command, the 54 Titan IIs were the U.S.'s first ICBMs with storable fuels and the first to be launched from inside a silo, making them more likely to survive an attack and to launch a rapid response in return.¹⁶

A second aspect of the Titan II highlights the Air Force's participation in manned spaceflight. Gen. Bernard A. Schriever encouraged the application of proven ICBM technology to sending people into space. A modified version of the Titan II successfully flew as a launch vehicle for the Gemini program, and the Air Force provided facilities, launch specialists, and pilots for it.¹⁷



(Right) Fisher's A-1E.

(Below) Majors Fisher (left) and Myers (right) pictured after the daring rescue.

THE
SKYRAIDER
WAS
ORIGINALLY
DEVELOPED
FOR THE U.S.
NAVY



Lastly, the Titan II and later-series Titan III and Titan IV rockets became reliable lift vehicles for many important satellite programs, such as the Defense Meteorological Satellite Program (DMSP), Defense Satellite Communications System (DSCS), Defense Support Program (DSP), Milstar Satellite Communications System, the Wideband Gap-filler System (WGS), and overhead reconnaissance satellites. These satellites provided significant new capabilities to the Air Force and the Nation.¹⁸

A-1E Skyraider

The Skyraider was originally developed for the U.S. Navy in the 1940s, but the Air Force acquired large numbers of them for use in the War in Southeast Asia. This World War II-era aircraft seemed anachronistic in the jet age, but it proved to be an excellent close air support platform that was rugged, could carry a lot of ordnance, and had a long loiter time.

The story of this A-1E Skyraider involves the highest ideals of bravery and intrepidity—a Medal of Honor. It is also an excellent reminder of the loyalty expressed in the Airman's Creed, "I will not leave an Airman behind."

On March 10, 1966, six A-1Es, including this aircraft flown by Maj. Bernard Fisher, were providing close air support to a Special Forces outpost being overrun in the A Shau Valley. After the enemy had taken the airstrip and ringed it with AAA, a Skyraider piloted by Maj. Dafford "Jump" Myers took a hit that shut down the engine. Myers crash-landed on the airstrip, but since the nearest rescue helicopter was 20 minutes away, his situa-

SERGEANT FELTY WORE THIS FLIGHT HELMET ON HIS SEVENTIETH AC-130 COMBAT MISSION



(Above right) Photograph of the damage the SA-7 caused to Felty's AC-130.
(Below) Felty's helmet.



tion appeared hopeless. Incredibly, Fisher landed this A-1E on the strip and taxied up and down looking for him. As he weaved around debris and torn-up steel planking, Fisher saw Myers and stopped. Myers jumped on the wing and Fisher helped pull him into the cockpit, after which they took off, saving Myers from a horrible fate at the hands of the enemy.¹⁹

Flight Helmet

Sergeant Kenneth Felty, an illuminator operator (or IO), wore this flight helmet while on his seventieth AC-130 combat mission in Southeast Asia on May 12, 1972. He and the crew of AC-130E 69-6573 were providing vital support to friendly forces surrounded and besieged at An Loc, South Vietnam, during the communist Easter Offensive.²⁰ Air Force close air support and tactical air resupply proved essential in preventing a total rout, while a new and deadly weapon, the shoulder-fired SA-7 surface-to-air missile, presented a serious threat.²¹ As Felty was bent over the open rear ramp spotting for AAA fire, an SA-7 hit the aircraft a few feet away from him, spraying fragments through the back compartment. Fortunately, his helmet took the brunt of the force.

This artifact certainly evinces an emotional reaction. The blast carried away part of the face mask, and peppered the helmet with about 40 fragments. Three of these penetrated and wounded Felty (thankfully he recovered from these and



(Above) A-4 suit from the King family on display at the National Museum of the USAF.

(Right) Captain Haldane King, Jr during his tour in Southeast Asia (He is not wearing the A-4 flight suit in this photograph).

other fragment wounds). The helmet is a sober reminder of the danger our Air Force personnel face in the performance of their duties.²²

A-4 Flying Suit

The A-4 flying suit was a common summer clothing item made of olive drab gabardine. First issued in 1930, it was officially replaced by the lighter-weight AN-S-31 flying suit in 1943. Even so, the A-4 continued to be used in large numbers after World War II and into the Korean War.²³

This A-4 has an extraordinary story that spans an important change in both the Air Force's and the nation's history. Lieutenant Haldane King, Sr. wore this A-4 while flying a B-25 in the segregated 477th Bombardment Group (Medium). King, along with the other Tuskegee Airmen, had to fight prejudice in order to fight for their country. Three years

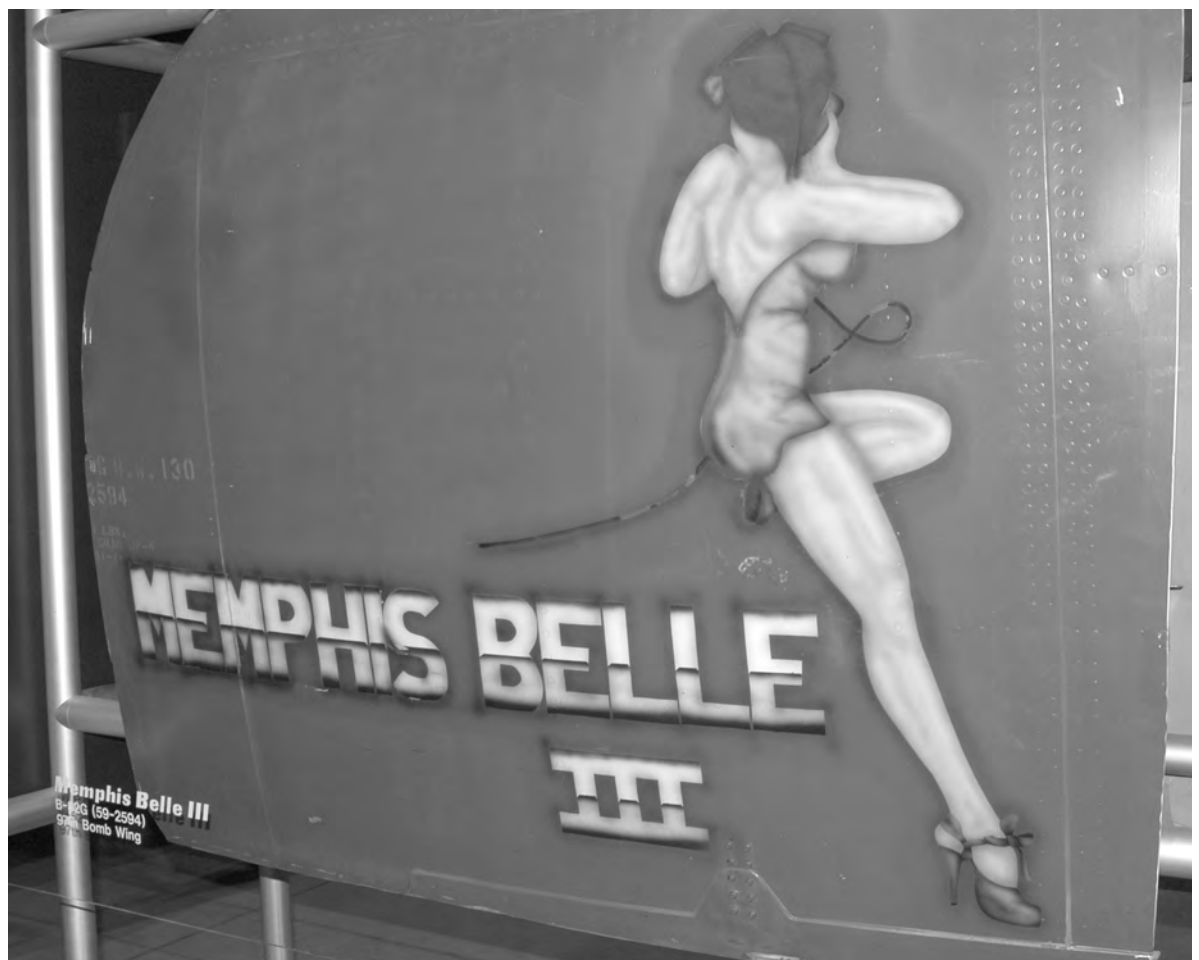


(Right) Nose art on the right side of the original B-17F Memphis Belle. This aircraft is in the midst of a complete restoration at the National Museum of the US Air Force.

(Below right) Memphis Belle III nose art on display at the Museum.



**NOSE ART IS
A TRADITION
THAT GOES
BACK
NEARLY A
CENTURY...
MEMPHIS
BELLE III
...FLEW IN
OPERATION
DESERT
STORM**



after the war ended, the newly-created U.S. Air Force became the first service to integrate. King, Sr. passed on this A-4 to his son, Capt. Haldane King, Jr., who wore it while flying a KC-135 during the Southeast Asia War.²⁴

Tellingly, the suit remained the same, but the society in which it was used had changed around it.

B-52G Nose Art

Nose art is a tradition that goes back nearly a century, and it has a rich heritage in the Air Force. Like artwork on A-2 jackets, it is significant that such overt individual expression is not only approved, but is sometimes even encouraged in spite of the uniformity necessary within the military. Individual pieces of nose art also reflect the things important to Air Force people, like patriotism and loved ones back home.

This piece of nose art, *Memphis Belle III*, was painted on B-52G 59-2594, which flew in OPERATION DESERT STORM in the 97th Bomb Wing.²⁵ The artwork builds upon the legacy of the original *Memphis Belle*, a celebrated B-17F that was the first heavy bomber in World War II to complete 25 missions over Europe and return to the United States. Several Air Force aircraft have carried this artwork

since then, including other B-52s, an F-105D named *Memphis Belle II* (on display in the Museum's Southeast Asia War Gallery), a B-1B and the C-141C *Memphis Belle IV*. We can undoubtedly look forward to future iterations of this wonderful heritage in the years to come.

These ten artifacts from the Air Force's history as a separate service represent only a tiny fraction of the thousands of objects in the Air Force's national collection. There are 68,400 at the National Museum of the US Air Force, with another 35,000 on loan to Air Force field museums and other accredited institutions in the US and around the world. The scope of these artifacts runs from Civil War balloon fabric to objects from current operations, and from tiny insignia pins up to the 230-foot wingspan, 85-ton B-36J Peacemaker. Indeed, the Air Force's heritage and history is well-preserved in objects. These tens of thousands of objects in the USAF's artifact collection embody the Air Force's story and the inspirational stories of the individuals who make its history. These artifacts exist in the care of professionals to illuminate those traditions and ideals we hold dear, and they allow us to "touch" the past in a very direct way.

At the core, these artifacts represent the things we are. ■

NOTES

1. Webster's Third New International Dictionary of the English Language Unabridged, s.v. "heritage."
2. *Ibid.*, s.v. "history."
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5. George Kubler, *The Shape of Time: Remarks on the History of Things* (New Haven and London: Yale University Press, 1962), p. 5.
6. Roger G. Miller, *To Save a City: The Berlin Airlift, 1948-1949* (Washington, D.C.: Air Force History and Museums Program, 1998), p. 97.
7. Accession File 1976-184, NMUSAF Collection Division.
8. Miller, *To Save a City: The Berlin Airlift, 1948-1949*, p. 108.
9. Derek Nelson and Dave Parsons, *Hell-Bent for Leather: The Saga of the A-2 and G-1 Flight Jackets* (Osceola, WI, Motorbooks International Publishers & Wholesalers, 1990), pp. 11, 13, 30, 48-49.
10. Accession File 1977-162-1, NMUSAF Collection Division.
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12. Accession File 71-43-5, NMUSAF Collection Division; George M. Watson, Jr., *Secretaries and Chiefs of Staff of the United States Air Force* (Washington, D.C.: Air Force History and Museums Program, 2001), pp. 131-33.
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14. Samuel T. Dickens, "RF-86 Sabre Overflights in Asia," in *Early Cold War Overflights, Symposium Proceedings, Volume I: Memoirs*, ed. R. Cargill Hall and Clayton D. Laurie (Washington, D.C.: Office of the Historian, National Reconnaissance Office, 2003), pp. 79-87.
15. Ernest G. Schwiebert, *A History of the U.S. Air Force Ballistic Missiles* (New York, N.Y.: Frederick A. Praeger, Inc., 1965), pp. 122, 244-45.
16. David Baker, *The Rocket: The History and Development of Rocket & Missile Technology* (New York, NY, Crown Publishers, Inc., 1978), p. 257.
17. Ernest G. Schwiebert, *Air Force Ballistic Missiles*, pp. 151-52.
18. Susan H.H. Young, "Gallery of USAF Weapons" *Air Force Magazine*, May 2006, pp. 167-69.
19. T.R. Sturm, "Into the Valley of Death" *The Airman*, March 1967, pp. 4-7.
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22. Felty, *The Last Flight of Helmet #285*.
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A Visionary Ahead of His Time: Howard Hughes and the U.S. Air Force —Part II: The Hughes D-2 and the XF-11





Thomas Wildenberg

Howard Hughes at controls of the XF-11 minutes before takeoff in the near-fatal crash of July 7, 1946. (Photo courtesy of the Florida Air Museum.)

FAIRCHILD, IN NEED OF CASH TO EXPAND HIS AIRCRAFT BUSINESS, OFFERED HUGHES THE OPPORTUNITY TO PURCHASE AN EXCLUSIVE LICENSE FOR THE DURAMOLD PROCESS

In the summer of 1939, the soaring demand for American airplanes—triggered by the prospect of war in Europe—enticed Howard Hughes for another try at the military aircraft business. Once again, Hughes decided the time was ripe to attempt to secure a contract from the Army Air Corps. He authorized Stan Bell, who had taken over as chief engineer after Dick Palmer resigned in February 1938, to proceed with preliminary design work on a new plane for the Army.¹ At the time, Hughes was negotiating with Sherman Fairchild for the exclusive rights to Duramold, a new aircraft construction material being developed by Virginus E. Clark, a well-known aeronautical engineer who had served as the chief aeronautical engineer for the U.S. Army between 1915 and 1920.

Fairchild, in need of cash to expand his aircraft business, offered Hughes the opportunity to purchase an exclusive license for the Duramold Process.² The process produced a new type of material made from resin-impregnated layers of wood veneer that were molded together under pressure. Named Duramold, it appeared to be an attractive means of reducing the cost of aircraft manufacturing by eliminating the time consuming, and labor intensive riveting method of assembly that had come to characterize aircraft assembly. Because no rivets were needed, the aerodynamic surfaces produced by this process were extremely smooth. This feature must have been of particular interest to Hughes based on his obsession for streamlining.

The agreement was consummated on July 24, 1939.³ For \$170,000, the Hughes Aircraft Division of the Hughes Tool Company obtained exclusive rights to use the Duramold Process for the manufacture of large aircraft defined as having one engine of 1,000 hp or multiple engines with 1,500 or more horsepower. As part of the deal, Hughes Aircraft obtained the services of Virginus Clark, who moved to California shortly after the agreement was finalized.

Motivated by unfettered ambition, zealous determination, and obsession for perfection, Hughes now set out to build an airplane that would have such outstanding performance that the Army would have no grounds for refusing to buy it. Driven to succeed, Hughes decided to build an airplane designed for the military on speculation. He had refused to do this in the past, but was now willing to put his own money into the project.

As soon as the Duramold deal was consummated, Hughes instructed his management team to make an all out effort to recruit engineers and shop personal. By the end of August the number of people employed by the Hughes Aircraft Company had quadrupled. Office space was acquired on the

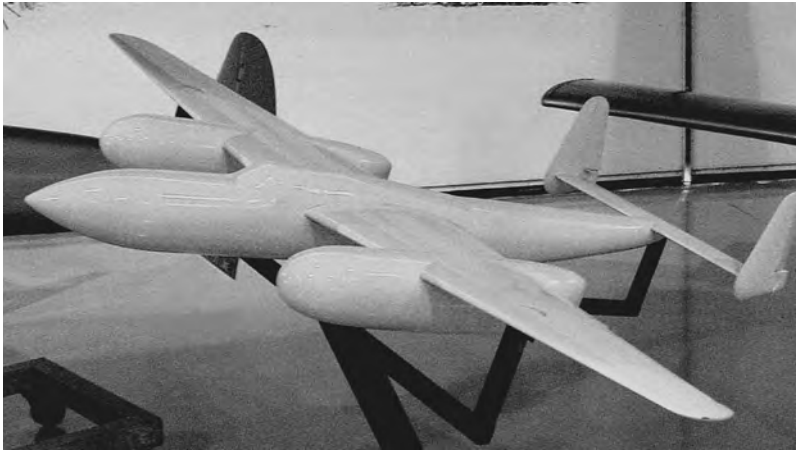
second floor of Hangar No. 3 at the airport in Burbank, where the company was based. Shop equipment was acquired at a fast pace and the space leased by Hughes Aircraft was soon filled with equipment and men working practically elbow to elbow.⁴

On September 16, 1939, Clark visited Wright Field to find out as much as possible on the Air Corps current thinking with regard to interceptor type aircraft.⁵ Because of the press of new design work, the only technical experts available to meet with Clark were the officers and civilian engineers of the Armament and Ordnance Units. Although these men were enthusiastically supportive, they were unable to provide information on the latest developments taking place due to the unclassified nature of the Hughes project.

Nevertheless, Clark obtained information on the latest ideas on armament, bombing, and bomb-sights, and came away from the meeting convinced of the importance of providing defense armament in a 30-degree cone of fire directly to the rear of the aircraft. This concept appears to have led to the idea for a 2-place bomber that could function as a fighter. “If a hot bomber were raising havoc in the war,” Clark explained in a memo to Stan Bell summarizing his visit, “the enemy pursuit *must* attack it—and the bomber’s tail guns may do the trick—making the bomber a fighter ... this all seems to demand that one member of the crew of two can sight to fire to the rear, either directly or by means of a retractable periscope.”⁶ Clark’s thoughts on making the bomber a fighter influenced Hughes’ ideas concerning the design concepts that were to emerge from his company’s drafting boards.

In early December, an official of Hughes Aircraft wrote the chief of the Materiel Division expressing the desire to enter into a contract with the government to provide performance report on the flight characteristics of a new pursuit type that the company was working on.⁷ Although the contract was only worth \$50.00, its acceptance by the Air Corps would enable the company to buy military engines that would otherwise have been unavailable. When Al Lodwick, visited Lt. Gen. George H. Brett a few days later in Washington, D. C., one of the items discussed was the approval to purchase “government furnished equipment,” from commercial firms.⁸ Lodwick, acting on behalf of the Hughes Aircraft Company, met with the assistant chief of the Air Corps to discuss the terms of the contract. General Brett’s boss, General Henry H. “Hap” Arnold had previously approved the project having informed Hughes at the end of October that the Air Corps would cooperate insofar as possible.⁹ As Arnold later recalled:

Thomas Wildenberg is the co-author of Howard Hughes: An Airman, His Aircraft and His Great Flights (Paladwr Press, 2006). He is a former Smithsonian Fellow having served successive terms as a Ramsey Fellow at the National Air and Space Museum in 1998 and 1999. Mr. Wildenberg is the recipient of a number of awards recognizing his scholarship. These include the Surface Navy Association Literary Award, the Edward S. Miller History Award, and the John Laymen Award. The first part of this article was published in the Fall 2007 issue of Air Power History.



One of the wind tunnel models used to design the D-2 that was found in the Howard Hughes Collection, Florida Air Museum. (Photo courtesy of the author.)

The [Hughes] design was highly interesting as a development type since duramold construction was to be used and it presented the premise of improvement in the aerodynamic and structural arts. The high speed of the proposed airplane made it superior to any other design under consideration at the time. At this time there was a great shortage of aluminum. We hoped to find a substitute. This looked like a very promising substitute and had the shortage of aluminum materialized, this might have made it possible for us to have secured quantity production in spite of any shortage.¹⁰

Before the year was out Clark, assisted by Carl Babberger, Hughes' chief aerodynamicist, began conducting tests at 8-foot, high-speed, wind tunnel located at the Langley Research Center operated by the National Advisory Committee for Aeronautics (NACA). According to the official history, this was the only privately-funded testing ever done in Langley's 8-foot tunnel. The most remarkable aspect of this Hughes program, however, was the fact that the test models were not actually representations of the configuration Hughes was designing. To preserve company secrecy, the test models had been designed to answer questions relative to nacelle placement, etc., without revealing the real configuration to NACA engineers.¹¹

Meanwhile, the paper work authorizing the Materiel Division to enter into a contract with the Hughes Aircraft Company slowly worked its way through the bureaucracy. By the time it was formally issued at the end of May 1940, the Hughes DX-2, as it was now being referred to, was a long-range, medium bomber with a five-man crew, a speed in excess of 300 mph, and a gross weight of 37,000 pounds.¹² From the evidence that follows, it is clear that the bomber was only one of several design concepts Hughes's engineers were working on; for when Air Corps personnel visited Hughes Aircraft in March 1941, the bomber design had morphed into a 2-place, 2,600-mile range, 450 mph fighter armed with seven 50-cal. machine guns and powered by two Curtiss-Wright Tornado engines.¹³

As work progressed in the hangar at Burbank, it soon became apparent that a considerable amount of additional space would be needed to fabricate the parts and assemblies for the new air-

plane. At this point Hughes gave the go ahead to build a new plant. Rather than locate the new plant adjacent to the airport in Burbank, Hughes asked Glenn Odekirk to look for a new site that had enough land for an airstrip. Odekirk found an ideal location in Culver City that had enough room for the 9,500-foot airstrip Hughes wanted.¹⁴ Arrangements were quickly made to buy 380 acres of land and plans formulated to construct four buildings with a total floor area of 226,000 sq. ft. Construction started in the spring of 1941 and the first building was completed by the end of June. All the operations of Hughes Aircraft, until then located in Burbank, were moved to the new building in Culver City on the Fourth of July weekend.

On October 1, 1941, unidentified representatives of the Hughes Company called on the Chief of the Materiel Division, Brig. Gen. Oliver P. Echols, at his office in Washington, D.C., to solicit a support for the Hughes D-2. Echols wisely declined to make any commitment to purchase the new plane citing a lack of knowledge about the airplane due to the secrecy surrounding the project and the limited number of people who had been allowed to inspect their work.¹⁵ After meeting with the representatives from Hughes, Echols wired Brig. Gen. George C. Kenney, the assistant chief of the Materiel Division located at Wright Field requesting information on the airplane and its possible procurement.

General Kenney responded two days later with a four-page letter summarizing what was known about the DX-2 and its status within the Materiel Division.¹⁶ Attached to General Kenney's letter was an unfavorable report prepared by the Aircraft Laboratory at Wright Field stating that the airplane's design did not meet the Army Air Forces specifications for pursuit load factors and was not equipped with armor plate or self-sealing fuel tanks. The laboratory's engineers were also against the use of Duramold, which they considered an improper material for the primary structure of high performance tactical aircraft.

The chief of the Experimental Engineering Section, Lt. Col. Franklin O. Carroll, undertook the distasteful task of notifying Hughes Aircraft of the Air Forces' decision. On November 7, 1941, he informed the company by letter that the DX-2 could not be made into a satisfactory military airplane and the best interests of the Government would not be served by its procurement.¹⁷ As a conciliatory gesture, Colonel Carroll suggested that the company consider redesigning the plane as an escort to protect bombers in accordance to detailed set of the military characteristics laid out in another section of his letter.

The importance Hughes placed on the project is indicated by the zeal with which his company responded. Within a week, Stan Bell and Ken Riley, two Hughes Aircraft engineers, were back at Wright Field to discuss the design changes mandated by the Army. They agreed to make a study of an airplane constructed out of Duramold that would meet the military characteristics for escort-

THE MOST REMARKABLE ASPECT OF THIS HUGHES PROGRAM, HOWEVER, WAS THE FACT THAT THE TEST MODELS WERE NOT ACTUALLY REPRESENTATIONS OF THE CONFIGURATION HUGHES WAS DESIGNING



The D-2 photographed at Harper Lake. One of only two photos of the aircraft known to exist. (Photo courtesy of the Florida Air Museum.)

HUGHES HAD "FRIENDS IN HIGH PLACES," HOWEVER, AND WAS NOT OPPOSED TO USING HIS MONEY OR INFLUENCE IN WASHINGTON

ing bombers up to a range of 2,000 miles. It would have a pressurized cabin, a laminar flow wing, and be armed with two 4-gun turrets.¹⁸ When Lt. Col. M. S. Roth, chief of the Research and Development Section, visited Hughes Aircraft in early January 1942, the company's 500 employees with its 75 engineers were all working on the DX-2. Stan Bell and his designers were also in the process of preparing specifications for another new design, which Roth described as a "Duramold duplicate" of the Lockheed XP-58.¹⁹

Neither Colonel Roth nor boss, Frank Carroll, now a full colonel, was impressed with the Hughes operation. "It is the opinion of this office," Carroll wrote in an internal memorandum highly critical of Hughes and his operation, "that this plant is a hobby of the management and that the present project now being engineered is a waste of time and that the facilities, both in engineering personnel and equipment, are not being used to the full advantage in this emergency."²⁰

From the foregoing, it is evident that the engineers at Wright Field were not enamored with Hughes Aircraft or its Duramold airplane. Hughes had "friends in high places," however, and was not opposed to using his money or influence in Washington. There is no evidence to suggest that Hughes used his influence directly with General Echols, who was involved with both the XP-2 and the twin engine pursuit projects noted in Part I (of this series), but it is interesting to note that the decision not to procure the DX-2 was reversed during a conference at Wright Field that Echols attended. Echols along with Gen. Arthur W. Vanaman and members of the Experimental Engineering Section concluded that the DX-2 held "sufficient promise of improvement in the aerodynamic and structural arts to warrant its procurement by the Air Forces."²¹ Echols' recommendation was forwarded to General Arnold via Echols' chief of staff, Brig. Gen. Bennett "Benny" E. Meyers, whose covering memo provides additional insights into the reasons for the Air Forces' change of mind.²² "This airplane," Meyers wrote, "offers the first really good opportunity to find out just what can be done in the medium airplane field when combining nearly one-hundred percent wooden construction with high output power plants."²³ Arnold, against his better judgement and the advice of his staff, quickly approved the project.

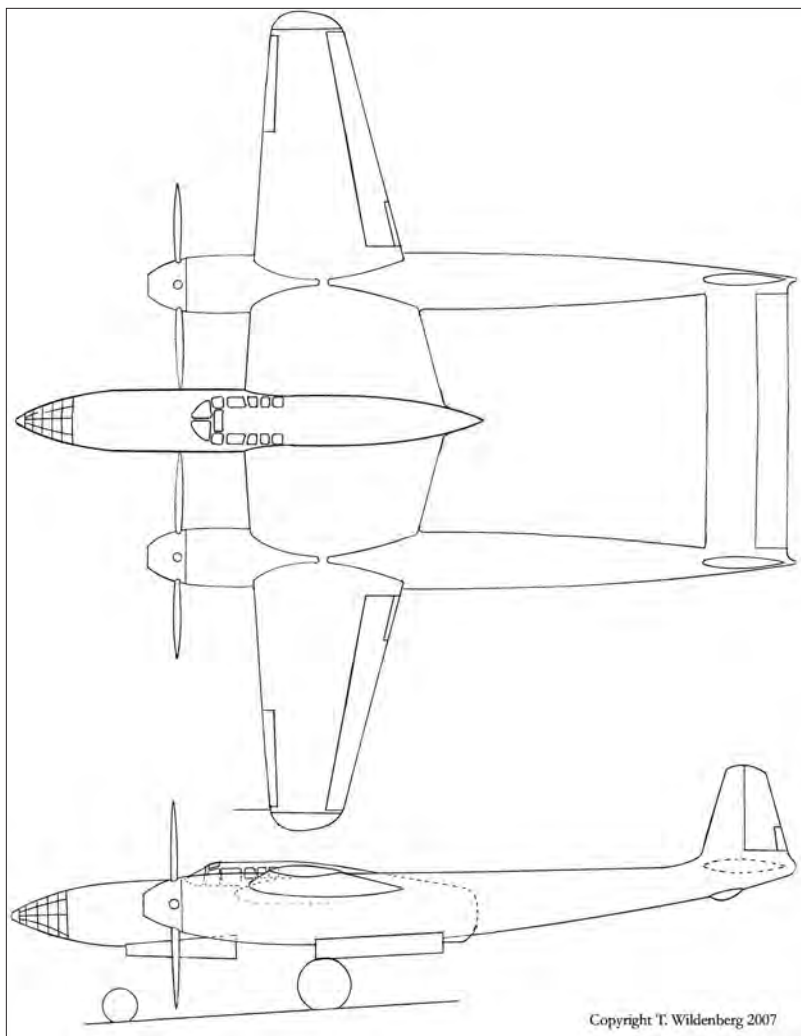
While the contract was being formalized, Howard Hughes took steps to make sure that there would be no foul ups along the way. In mid June, he sent an emissary to Secretary of Commerce Jesse H. Jones with instructions to extol the virtues of the D-2 so that Jones might put in a good word for the project with President Roosevelt.²⁴ Jones, a friend of the Hughes family and fellow Texan, wielded so much power and influence in Washington that the press had dubbed him "Empire Jones." On June 17, 1942, Jones spoke with the President privately at the White House. What was said is not known, but Jones left the president a two-paragraph statement about Hughes and the design for his new airplane. The President forwarded it to Arnold. Scrawled across the top was FDR's hand-written note: "What is there in this?"²⁵ General Arnold answered the next day stating that the air force has been in close touch with Howard Hughes and was negotiating to see if they could arrive at a price agreeable to both parties.²⁶

The problem that Hughes now faced was how to recoup his investment. He had poured over \$3,000,000 into the D-2, but the Army was only willing to purchase it for \$500,000.²⁷ Hughes decided to wait until after the plane's first flight in the hope that its performance would be so spectacular that the Army would offer a production contract that would enable him to recover his original investment.

No further action was taken by the Army Air Forces until June of the following year. By then, combat experience in the African and European theaters had indicated the need for a long-range, high altitude photoreconnaissance plane. On June 27, 1943 General Arnold unexpectedly re-endorsed the D-2 project when it became apparent that "we [the Army Air Forces] could not get all the Mosquitoes that we needed for our night fighters and reconnaissance needs."²⁸ By then Hughes had made the first flight in the D-2. The airplane's flight characteristics proved disappointing. The laminar flow airfoil chosen for the wing had never been used before. It created instability problems with the ailerons that were never completely solved, even though the Hughes team tried everything they could do to correct the problem.²⁹

The design problems with the D-2's wing did not stop Hughes's quest for an air force contract. As an alternative he proposed to design and build the D-5A. It would have the same tail boom, same landing gear, same fuselage, and the same engine mounts as the D-2, but would have an entirely new wing based on the NACA Series 66 airfoil.³⁰ Specifications for the new plane were listed as follows:

Gross Weight	36,400 lbs.
Take Off Distance	2,570 ft.
Take Off Over 50 ft. Obstacle	3,040 ft.
Rate of Climb at Sea Level	2,040 ft. per min.
Rate of Climb at 25,000 ft.	1,585 ft. per min.
Service Ceiling	37,000 ft.
Top Speed @ 30,000 ft.	488 mph



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General arrangement drawing of the D-5. Note the similarity to the Northrop P-61. (Photo courtesy of the author.)

HUGHES HAD A KNACK FOR PULLING A RABBIT OUT OF A HAT

Hughes proposal failed to sway the engineers at Wright Field who had been against the D-2 from the start. They were not impressed by the D-5's performance, which appeared to be overly optimistic in comparison to Lockheed's XP-58, which was much further along and proffered by the engineers at Wright Field.³¹ They continued to lobby against the use of Duramold and recommended against its further development.³² Their recommendations were approved by the chief of the Air Staff, Maj. Gen. George E. Stratemeyer. On August 21, 1943, he directed—with General Arnold's concurrence—that no further action be taken encouraging the development of or diversion of facilities to the DX-2 project or its outgrowth, the D-5.³³ It looked as if the engineers at Wright Field had finally killed the D-2 project, but Howard Hughes had a knack for pulling a rabbit out of a hat. He had an innate talent for finding just the "right" contacts and adroitly exploiting them to achieve his ends. In the case of the D-2, that contact proved to be the President's second son, Col. Elliot Roosevelt.

That summer, Colonel Roosevelt, who had formally commanded a reconnaissance unit in Europe, had been assigned chairman of a committee of experienced photo-reconnaissance officers to survey aircraft plants in order to recommend the best source to fill the photo-reconnaissance needs of

the Army Air Forces. When the Roosevelt mission reached Los Angeles on August 8, 1943, Hughes assigned his favorite public relations man, John W. Meyer, to take the President's son under his wing.³⁴ Roosevelt and his entourage were wined and dined by Meyer, who escorted them on guided tours of the Hollywood studios. At Warner Brothers, Meyer introduced Elliot to actress Faye Emerson, leading to a romance that culminated in their marriage four months later.

Hughes personally led Roosevelt and his fellow officers on a tour of the Hughes Aircraft plant in Culver City before flying them to Harper Lake, a dry lakebed a hundred miles north of Los Angeles, where Hughes was secretly testing the D-2. Although the D-2 was partially disassembled in its air-conditioned hangar, the entire party enthusiastically clustered around the plane admiring its smooth lines. Commander D. W. Stevenson, a much-decorated Royal Air Force pilot who was accompanying Roosevelt, told Hughes, "I have never seen anything more magnificent that could do a better job."³⁵

On August 31 Colonel Roosevelt informed General Arnold that the DX-5 was the only airplane already designed that was suitable for photographic purposes. General Arnold immediately issued verbal orders directing that steps be taken to get Hughes a contract.³⁶ As he later explained, "It was the Hughes plane or nothing."³⁷

Frank Carroll, now a brigadier general, continued to raise objections to the Hughes airplane pointing out that there were no engineering reasons for its procurement. "The Air Service Command," he wrote in a memorandum addressed to the Commanding General, Materiel Command, "have gone on record as stating they do not desire to have any more wooden aircraft due to the maintenance difficulties involved. In addition, the Lockheed XP-58 has been engineered for production, whereas the Hughes airplane has to be materially redesigned for production."³⁸ Despite these concerns, an Authority for Purchase was issued on October 6, 1943, covering a cost-plus, fixed fee contract for the procurement of 100 D-5 aircraft plus spare parts. Total estimated cost, including spare parts was estimated at \$56,581, 200.

When the detailed set of specification for the D-5 was received by the Materiel Command eight days later, it continued a totally unsatisfactory provision for the power plant/propeller combination. The company had selected a reduction gear and contra-rotating propeller that did not exist for the R-2800 that they had planned to use. The Materiel Command then proposed three alternate engines, which could be made available in time to meet the proposed initial delivery date in November 1944. Hughes design team selected the Pratt & Whitney R-4360 with a .331 reduction gear, together with fifteen-foot Hamilton Standard, eight bladed super hydromatic contra-rotating propellers.³⁹

The Engineering Division at Wright Field once again raised the issue of using wood (Duramold) in the aircraft's structure. On January 5, 1944,

The first Constellation parked in front of one of the Lockheed hangars.



GENERAL CARROLL, STILL CHIEF OF THE ENGINEERING DIVISION, BELIEVED THAT HUGHES' CONTENTION THAT THE D-2 WAS A PROTOTYPE FOR THE F-11 WAS "RIDICULOUS"

Colonel P. H. Kemmer, chief of the Aircraft Laboratory, sent an inter-office memorandum to the Chief of the Production Engineering Section, recommending "that steps be taken to eliminated the use of wood or plywood from all portions of the flight structure."⁴⁰ Hughes was having a running battle with Grover Loening at the time over the use of Duramold in the troubled HK-1 design that he and Henry Kaiser were furiously trying to keep alive. Hughes still strongly favored wood, according to the comments that he made in front of the War Production Board on October 21, 1943, but he wisely heeded Colonel Kemmer's advise when told about the Air Forces' strenuous objection to the use of wood.⁴¹ Within a few days of their conversation, Howard Hughes called Wright Field to advise the Production Engineering Section that the airplane would be constructed entirely of metal.

Although Hughes Aircraft had received a letter of intent to build one hundred D-5 (AAF Model F-11) airplanes in mid October, a formal contract had yet to be agreed upon. In mid- January 1944, two representatives of Hughes Aircraft were sent to Wright Field to discuss the terms of the contract, which would include provisions for Hughes to recover the \$3,650,000 dollars that he had invested in the D-2.⁴² Hughes claimed that the \$3,650,000 represented development work on the F-11 and asked to be reimbursed for that amount. Included in this amount were costs incurred for: studies on alternate engine installations; the Allison engine project that was abandoned in 1940; development cost and license for the Duramold process; depreciation and insurance on his Boeing Stratoliner during 1940; and research and work done on the cabin pressurization of the Stratoliner would be used on

the F-11.

Neither the Production Division nor the Materiel Division approved of this arrangement. General Carroll, still chief of the engineering division, believed that Hughes' contention that the D-2 was a prototype for the F-11 was "ridiculous."

We might just as well say the B-17 is a prototype of the B-29 or that the BT-8 is a prototype of the P-47.

In addition to not being a prototype, the D 2 is not an experimental version of the F 11 Airplane. Aside from the general geometric shape and a few details, such as the throttle handle, mixture control, flap controls, etc., they are two separate and distinct flying machines. The contention that the flying characteristics will be identical or even a similar is too fare fetched for further comment. The F 11 is not a scaled up version of the D 2 in that the weights are different, the airfoil section is different, the percentage of control area is different, and many other differences exist too numerous to mention.⁴³

When the dispute over the D-2 development costs was not resolved to his satisfaction, Hughes let it be known that his firm could not lose \$3,500,000 and continue with the F-11 project. On March 21, 1944, General Meyers discussed the ongoing contract problems with General Echols.⁴⁴ After discussing the matter, General Echols directed the supervisor of the Western Air Corps Procurement District, Brigadier General Branshaw, to comply with the basic memorandum of October 16, 1943, as approved by General Arnold stating "that the development costs of the D-2 airplane be included in the contract with Hughes." General Branshaw met with Hughes the next day



Howard Hughes with Gen. Henry H. "Hap" Arnold exiting the Constellation while it was being shown off in Washington.

GENERAL ARNOLD WAS FURIOUS AT THE PUBLICITY GARNERED FOR THE AIRLINE

and advised him that a separate item would be included in the contract for previous development costs.⁴⁵ While the details were being worked out, Hughes took time from his busy schedule to set another transcontinental flight record.

During his second record-setting transcontinental flight in the H-1 Racer on January 20, 1937, Hughes had experienced a lot of trouble with his oxygen system at high altitude. He had flown for several hours on the verge of unconsciousness. The experience gave him an idea. He dreamed of an airplane that would permit passengers to fly at the same high speed and at the same altitude, but with a difference: the flight would be in perfect comfort. He kept thinking about what could be done if an airline put enough effort into such an ambitious project.

Hughes got the chance to go act on this vision after he acquiring a controlling interest in the Transcontinental and Western Airline (T.W.A.) in the early part of 1939. In April 1939, Hughes, decided to develop a new high speed, super-deluxe, four-engined airliner with transcontinental range for the airline.⁴⁶ It would have a pressurized cabin, fly at 20,000 feet, and be able to carry 57 passengers and 6,000 pounds of cargo nonstop across the country. The new airliner would be T.W.A.'s secret

weapon against all other competing airlines. The airplane, which was later named the Constellation, was developed in great secrecy by the Lockheed Aircraft Corporation under the Model 049 designation.

When the production of commercial airliners was suspended at the outbreak of World War II, the Constellation program was turned over to the Army Air Forces for series production as the C-69 transport. During the negotiations with the Army, Hughes astutely worked out an ingenious agreement that gave T.W.A. jurisdiction over the first airplane off the production line so that the airline could conduct shakedown flight for the airline before turning it over to the Army.⁴⁷ The deal gave Hughes the opportunity to orchestrate a great publicity event for T.W.A., while setting yet another transcontinental flight record.

At 3:56 a.m. on April 17, 1944, Howard Hughes and Jack Frye, T.W.A.'s president, took off from Burbank and headed for Washington, D.C. Frye was in command, with Hughes as the copilot. At exactly the halfway point they changed places so that Hughes would have the honor of landing the airplane in Washington when they touched down.⁴⁸ They set a new transcontinental speed record for a commercial transport of 6 hours 58 minutes. To the chagrin of the Army brass, the airplane was dressed in the airline's distinctive color scheme, bearing the T.W.A. logo on its nose, and the airline's slogan, "The Transcontinental Airline" prominently displayed in the center of the fuselage.

The *New York Times* hailed the flight as an "outline of the shape of things to come."⁴⁹ General Arnold was furious at the publicity garnered for the airline. He was not pleased either, when Hughes spent several more days demonstrating the Constellation to high government officials—including the entire Civil Aeronautics Board—instead of transferring the C-69 immediately to the Air Forces, as stipulated in the contract.

Three weeks after the flight, on May 5, a contract was finally signed between the United States government and the Hughes Tool Company for the production of a high speed reconnaissance airplane. The fixed-fee contract provided for the procurement of two XF-11s, one static test model, and ninety-eight production airplanes.⁵⁰ Although the purchase of the D-2 was not explicitly authorized, a sum in excess of three million dollars was allowed for D-2 development under the condition that a committee would be appointed to determine the amount applicable to the F-11. In November, the board convened for this purpose approved 57.5 percent of this amount permitting Hughes to recover \$1,906,826.13—the money he had invested in the D-2.⁵¹

By the time the contract was signed, the delivery schedule for the first F-11 had already been pushed back. The delay had been caused by indecision on a number of major design components including the wing, powerplant, nacelles, and landing gear. The biggest impediment to the project, according to Lt. Col. E. W. Dickman, was Howard



The D-2 in front of its air-conditioned hangar a Harper Lake. The aircraft was destroyed one day when the wooden hangar mysteriously caught fire and burned to the ground. (Photo courtesy of the Florida Air Museum.)

Hughes.

*The main trouble seems to be that Mr. Hughes personally with the best of intentions, insists upon making numerous detailed technical decisions, which normally would be left to competent subordinates. Mr. Hughes has many other interests that he is not in a position to direct his full attention to the F 11 project and as a consequence, the development is proceeding much more slowly than if things were handled in a business like manner.*⁵²

In addition to his the troubles with the F-11, Hughes was fighting to save the HK-1, which was in even worse shape from a production-engineering standpoint. In an attempt to rectify the company's problems, Hughes reorganized Hughes Aircraft under the leadership of Charles W. Perelle, who was hired to take over the ailing company. Perelle, who had been vice-president in charge of production of the Consolidated-Vultee Aircraft Company, was known as the "boy wonder" of aircraft production.

When Perelle took over, some of the completed engineering drawings were so poor they had to be thrown out. Relations with Wright Field were the worst that he had encountered in his fifteen years of production experience. According to his later testimony, the problems with the F-11 stemmed mostly from "a complete lack of experience in the design and construction of airplanes in general."⁵³ Despite Perelle's management skills, the problems continued; lack of engines, engineering differences with the Army, labor troubles, and difficulties with subcontractors, all took their toll.

By February 1945, serious questions arose within the Materiel Command as to the advisability of continuing the production contract. A Bureau of Budgets report indicated that the cost of the Hughes airplane was excessive in comparison with others of similar size and usefulness. There was also growing doubt that the F-11 would be produced in time to be of value to the war. On May 26, 1945, the order for 98 production airplanes was cancelled. Only the two experimental versions would be completed.

Hughes Aircraft continued to encounter a vari-

ety of problems that delayed delivery of the first XF-11 until the spring of 1946. Although the first taxi tests were conducted in mid-April, it took several more months to work out all of the bugs before the aircraft was ready for flight. The Army had intended to conduct a flight test program from the air base at Muroc, California, but it was cancelled when Hughes decided to conduct the flights himself from the field at Culver City.⁵⁴

Hughes decided to make the first test flight on Sunday, July 7, 1946. He arrived at the Culver City airport that morning and spent a good part of the day making taxi runs, checking the airplane, and discussing the flight plan with the company's flight-test engineer. Late in the day, as the ground crew prepared the airplane for flight, Hughes instructed them to load the XF-11 with 1,200 gallons of high-octane gasoline—double the amount specified in the approved flight plan. He obviously expected to fly the ship longer than the forty-five minute time originally allotted in the approved flight plan. It was after 5 o'clock when Hughes climbed into the cockpit, warmed up the engines and taxied to the end of the airstrip. At precisely 5:20 p.m., he pushed the throttles of the XF-11 forward and roared down the runway, eased back on the control stick, and was airborne. As the runway dropped away, Hughes retracted the landing gear. This was another deviation from that flight plan, as it was standard procedure to leave the gear down during the first flight. As he climbed away from the field the landing gear warning light stayed red indicating that the gear was not locked. It wouldn't go out until he pushed sharply on the control stick.⁵⁵

An hour and fifteen minutes into the flight—well beyond the forty-five minutes allocated—the XF-11 abruptly pitched to the right. To Hughes it "suddenly felt as if someone had tied a barn door broadside onto the right-hand wing."⁵⁶ Hughes explained what happened next:

I unfastened my seat belt, got up, and looked quickly out all the windows of the cabin. I wanted to see if any large part of the airplane, such as a section of the wing, tail, or landing gear door, might possibly have been torn loose and swung by the wind into a broadside position.

With this last thought in mind, I lowered and raised the landing gear, hoping to break completely loose from the airplane any landing gear door which might have jammed into a broadside position.

*I could not see anything which was holding the plane back, yet it felt as if some giant had the right wing of the airplane in his hand and was pushing it back down.*⁵⁷

Hughes returned to his seat and increased the power on both engines, cut both back, and then increased the power only on the right engine. Nothing worked. The XF-11 was losing altitude so fast that Hughes was forced to make an emergency

IT FELT AS IF SOME GIANT HAD THE RIGHT WING OF THE AIRPLANE IN HIS HAND AND WAS PUSHING IT BACK DOWN

Hughes taxis the XF-11 at the Culver City airstrip as he prepares for the first test flight on Sunday, July 7, 1946. (Photo courtesy of the Florida Air Museum.)



IN A DEVASTATING BLOW TO HUGHES' EGO, THE BOARD CONCLUDED THAT THE ACCIDENT WAS AVOIDABLE AND ATTRIBUTED THE CRASH TO PILOT ERROR

landing on the only open space he could see, the golf course belonging to the Los Angeles Country Club. He never made it.

The XF-11 struck the roof of a home at 803 North Linden Drive, in Beverly Hills. The aircraft sliced into the house next door, sheared off a utility pole, before coming to rest in an alley. Hughes crawled out of the cockpit and collapsed onto the burning wing before he was pulled to safety by a nearby bystander. He was lucky to be alive.

The crash nearly killed the 41-year-old test pilot. It crushed his chest, fracturing nine of the ribs on his left side and two on his right; displaced his heart to one side of his chest cavity; punctured his lung in six places causing it to collapse; and severely burned his right hand. Less critical injuries sustained by Hughes included second degree burns over his chest and buttocks, and a broken nose. He also suffered numerous cuts, bruises and abrasions over his entire body.

While Hughes was recovering in the hospital, he received a telegram from General Carl Spaatz, the commanding general of the Army Air Forces expressing his concern and wishing him a speedy recovery.⁵⁸ On the morning of August 1, 1946, in an unusual show of support, planes from the Twelfth Air Force while on a mass flight commemorating the 39th anniversary of the U.S. Army Air Arm, circled Good Samaritan Hospital.

As for the crash, an air force investigating board concluded that the right rear propeller had lost oil, reversed pitch, and created a drag on the right side of the airplane. But in a devastating blow to Hughes' ego, the board concluded that the accident was avoidable and attributed the crash to

pilot error. It criticized Hughes for not using the special radio frequency that had been set aside for the test flight, for not being fully acquainted with the emergency operating procedures for the propellers, for retracting the landing gear in violation of the approved plan, and for failing to consider an emergency landing.

Hughes felt that he had been "unduly discriminated" by the investigating board's report.⁵⁹ This was only to be expected from a man of his reputation and personality who would not admit that he had made a mistake. In order to redeem himself "in the eyes of the Army and public at large" he wanted to fly the second XF-11 when it was ready for flight. Much to Hughes' chagrin, Wright Field asked Hughes Aircraft to furnish the name of a test pilot other than Howard Hughes.⁶⁰

Hughes decided to appeal his case personally to top command. He flew to Washington, D.C., where he called on Lt. Gen. Ira C. Eaker, deputy commanding general of the Army Air Forces, at his residence in Fort Meyer, Virginia. Hughes tried to convince Eaker that it would be "much safer" for him to fly the XF-11 than another pilot since he was already familiar with the airplane.⁶¹ When this didn't work, Hughes promised to "pay the government \$5 million if the plane crashed with him at the controls."⁶² That decision was up to his boss, explained Eaker, who immediately phoned General Spaatz, who lived nearby, to ask him if he could drop over to discuss the matter. Spaatz had no objections to Hughes flying the XF-11 under those conditions and told both men that he would issue the necessary orders.⁶³

On April 5, 1947, nine months after his near-

The second XF-11 being prepared for flight. (Photo courtesy of the Florida Air Museum.)



FOR HUGHES, THE XF-11 WAS A COMMERCIAL FAILURE THAT COULD HAVE MARKED THE END OF HIS AIRCRAFT COMPANY

fatal crash, Hughes climbed into the second XF-11 and prepared the aircraft for takeoff. Noticeably absent from the aircraft were the counter-rotating propeller blades that had caused the accident that had nearly taken his life. In their place were standard four-blade propellers. The dramatic take-off was staged in front of some 500 Hughes Aircraft employees who had come out to watch their boss. Hughes spent ninety minutes in the air over Culver City before landing. He emerged from the cockpit smiling and was greeted by a round of applause from the spectators.

Before the AAF would accept delivery of the XF-11, a number of test flights had to be flown in order to satisfy the terms of the government's contract. Most of these were conducted by Hughes himself. These continued until November when it was formally accepted. The AAF then conducted its

own flight test program, for although Hughes was very good at providing information on how the airplane felt and handled, but he was too much of an individualist and too undisciplined to provide the kind of data needed for quantitative analysis of the aircraft's performance characteristics.

The XF-11 was one of the last high-powered piston engined aircraft produced for the Air Force. Its performance was impressive, but it was obsolete by the time it flew having been eclipsed by the new jets and was soon scrapped. For Hughes, the XF-11 was a commercial failure that could have marked the end of his aircraft company, but like the mythical Phoenix that rose up from the ashes, Hughes Aircraft was destined to achieve success. Through Howard Hughes' vision, it would become the Air Force's primary supplier of airborne radar, fire control systems, and air-to-air guided missiles. ■

NOTES

Note on Sources: Much of the previously published information concerning the events associated with the D-2 and FX-11 were culled from the transcripts of the Senate War Hearings conducted in 1947. Many of the statements made during these hearings appear at odds with the information contained in the records of the official case history.

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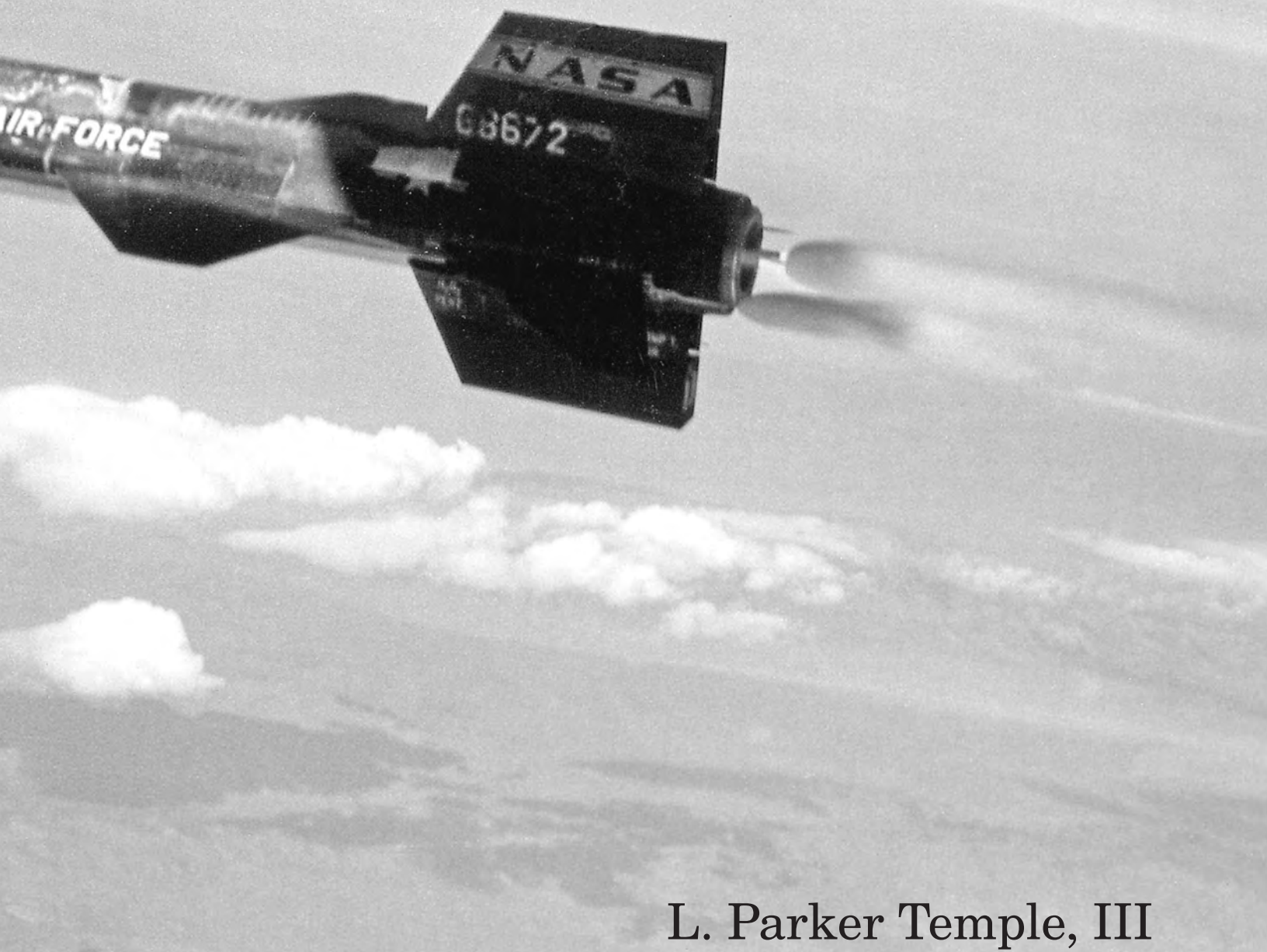
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X-15B: Pursuit of Early O



Orbital Human Spaceflight



L. Parker Temple, III

The North American X-15 hypersonic research aircraft was among the most successful of all the X-series. A cooperative research program among the U.S. Navy, Air Force and the National Aeronautics and Space Administration (NASA), the X-15 exceeded all expectations as it expanded the known flight envelope. When the program ended after 199 flights, the U.S. was well along the path towards operational space vehicles and human spaceflight.

An orbital version, variously called the Advanced X-15, Orbital X-15, or X-15B, began in part with the original proposals for the X-15 calling for a two-seat version. The concept endured at a low level for several years, reaching a peak of interest in 1958-1959. When mentioned at all subsequently, the X-15B has been relegated to little more than a footnote, and understood as the logical progression for much of the X-series aircraft pushing higher, faster and farther.¹

Justifying the X-15B as simply pushing the flight envelope outwards is as misleading as making the same argument for MERCURY. Higher, faster and farther might be felt as an imperative or a characterization of aviation's evolution, but it was not the end in itself. The orbital X-15 answered very different motivations.

The Role of Human Presence - 1950s Style

The U.S. space program began in the military long before NASA's 1958 creation. The military developed the *sine qua non* of any space program: the launch vehicles. The military also had all the plans, concepts and strategies receiving any funding (however meager) in the early 1950s. "Artificial moons" were so radical that many of the senior military leadership only vaguely understood them. Especially in the Air Force, experience with robotic aircraft colored any understanding of robotic spacecraft.

Tenuous attempts in World War II using robotic (now called unpowered) aircraft showed serious limitations. Lessons learned from these attempts exposed the real bias: human presence caused operational utility. This remained the military consensus for decades after World War II. Robotic aircraft of the 1950s, such as the SNARK, REGULUS, MATADOR and MACE, were akin to but far less capable than today's cruise missiles. All suffered from rudimentary technology inadequate to the senior military leadership demands for effective and reliable weapons. Progress was erratic. These early programs indicated to the military leadership that they held some interesting ideas, but were hardly reliable or operational.

On October 5, 1954, the National Advisory Committee on Aeronautics' (NACA) High-Speed Flight Station executive committee faced the final decision to proceed with a hypersonic research aircraft. Lockheed's Clarence "Kelly" Johnson alone favored robotic aircraft to explore the flight regimes proposed for the X-15. He firmly believed in human presence for operational (that is, practical application) missions, as opposed to purely aerodynamic research. At the time, he was developing the U-2 spyplane and thinking ahead to hydrogen-fueled hypersonic reconnaissance aircraft.² Perhaps he thought a robotic aircraft could answer specific questions related to hypersonic aircraft sooner than a piloted aircraft, facilitating the development of operational aircraft he had in mind. Everyone else believed human presence was mandatory.³ NACA's associate director for research, Gus Crowley, summed up the majority view: the successful X-1 program owed much to its pilots, whose performance allowed accomplishment of things robotic aircraft could not do.⁴ This reveals the mindset that truly useful and operational capabilities required human presence.

This was the mindset, then, in the earliest days of the military's (and hence the nation's) space program. Robotic devices were so limited, based on experience with robotic aircraft, that human presence would inevitably be needed to achieve any operational military capability.

What benefits might human presence provide? A contemporary list simultaneously contrasted perceived benefits of human presence versus robotic spacecraft technological shortfalls. Since human presence counteracted robotic spacecraft shortfalls, the list was considered a standard against which to measure military space progress in the 1950s:

Decision Making Capability

Robots cannot perform "rapid and accurate decision making...by 'on the spot' assessment of the situation."

Command Control Capability

Humans understand and react faster than robot computational speeds.

Determination of Vehicle and Payload Status

Humans monitor the spacecraft's status *in situ*, whereas robots require relay to the ground for processing.

Post-Launch Changes in Mission Plan

Humans perform more flexibly and readily adapt to new missions.

Payload Redundancy

Humans can "augment certain payload func-

A COOPERATIVE RESEARCH PROGRAM AMONG THE U.S. NAVY, AIR FORCE AND NASA, THE X-15 EXCEEDED ALL EXPECTATIONS

Dr. L. Parker Temple works on space programs as a systems engineer, but also has a second career as an historian. He was a career Air Force officer, combining a career of flying, promulgating space policy and space systems acquisition. Recently, he was honored by his election as a Fellow of the American Institute of Aeronautics and Astronautics, and was the author of AIAA's best selling book, Shades of Gray, National Security and the Evolution of the National Reconnaissance Office. He currently lives in Virginia.

tions...in the event of payload subsystem breakdowns.”

Mission Data Redundancy

Remote, unobserved sensors might not report accurately; human presence can verify or deny sensors’ reports.

Mission Data Augmentation

Robotic sensors are specialized with limited capacity for recording data. Humans can take inputs from many sources and integrate a complete picture of a situation.

Recovery of On-Board Payload Data

For a spaceplane, the ability to choose a landing site is crucial to returning the mission’s data. Pilots routinely do this.

Early Mission Termination and Recovery

Humans can determine *when* to return or extend the orbit. Robots might suffer, at any time, “mission termination based on on-board programming.”

Accomplishment of Mission Details

Humans can adjust sensors to “optimize the gathering of mission data.”

Subsystem Complexity

Humans are “a general-purpose subsystem with a general-purpose compute capability to store and analyze events.”⁵

These claims about the value of human presence reflected Air Force doctrine drawn from decades of atmospheric flying. Air Force Headquarters personnel, lacking any basis for judgment without actual human spaceflight experience, accepted these claims. Artificial moons might provide important interim capabilities, but as was the case with the robotic aircraft, only human-piloted spaceplanes had operational utility.

Clearly, the bias towards human presence that also anticipated robotic spacecraft would not be very capable was soon overturned as the U.S. devoted considerable resources and its best minds to the space program. The bias, however, is important to consider when judging the initial push for making the X-15, or any piloted vehicle, into an orbital spacecraft.

With this contemporary expectation of the value of human presence, and to really place the X-15B in context, we next need to understand the context itself: the flurry of activity surrounding spaceplanes in the mid-1950s.

Higher, Faster and Farther?

Although interest in spaceplanes was long standing, serious studies of orbital spaceplanes and high-speed rocket aircraft skimming across the upper edges of the sensible atmosphere began right after World War II. These studies extrapolated the first operational rocket planes flown by the Germans during the war. Each of the Services had some variation under study at a very low level.

For instance, the Navy received a proposal from Douglas Aircraft for a third generation of its D-558 series of research aircraft in 1953. That rocket plane, later part of the Douglas proposal for

the X-15 competition, was to achieve one million feet altitude and nearly orbital speed, later scaled back to a more modest 750,000 feet and Mach 9. However, the project remained a paper study eventually yielding to the X-15.⁶

Bell Aircraft Corporation submitted a seminal proposal to Wright Air Development Center (WADC) on April 17, 1952. The premier X-series aircraft developer had hired Walther Dornberger as a rocketry consultant. The World War II commandant of Peenemunde for development and launch of the V-1 and V-2 rockets, Dornberger had been Wernher von Braun’s former superior officer. He pushed for manned hypersonic rocket-launched gliders based on the pre-World War II ideas of Eugen Sänger and his wife Irene Bredt.⁷

Bell examined air launch of its X-series aircraft to achieve orbit, and proposed a new operational manned **bomber-missile**, BOMI. WADC offered Bell a one-year study to advance the concept, and asked for two examinations—a suborbital, hypersonic version and an orbital version. Bell combined both into a phased development from suborbital to orbital flight. A year’s effort showed little progress. Dornberger’s constant lobbying kept BOMI alive. By his estimate, he eventually gave some 900 presentations to all sorts of audiences on BOMI and successor spaceplanes.⁸ His politicking worked, because in April 1954, Bell received another small contract to study an advanced reconnaissance bomber concept, designated MX-2276. This version of BOMI resembled the suborbital vehicle of the first phase in the original WADC study. Like its more famous successor, the DYNA-SOAR—for its suborbital (**dynamic soaring**) flight regime—MX-2276 was a nuclear weapon delivery system that could do its own post-strike reconnaissance.

Reconnaissance was critically important at the time. Closure of the Soviet Union’s borders created a desperate need for Western intelligence about Soviet intentions.⁹ President Dwight D. Eisenhower chartered a Technological Capabilities Panel to examine preventing a Soviet surprise nuclear attack. Throughout 1954, this effort identified a number of critically important steps the nation had to take. Among these were the developments of the Lockheed U-2 spyplane and the CORONA satellite reconnaissance system. These programs were covert; that is, not merely classified but hidden with their existence unacknowledged.

Meanwhile, the threat of surprise attack remained palpable, and the Services went about trying to solve the problem. On January 4, 1955, Air Research and Development Command (ARDC), anticipating the release of a General Operating Requirement (GOR) then in final coordination, released System Requirement 12 for an advanced reconnaissance aircraft with 3,000 nautical mile range and a ceiling of 100,000 feet. A month later, Air Force Headquarters released its equivalent, higher-level GOR 12, to proceed under Weapon System 118P, the Special Reconnaissance System. By September 1955, Bell’s support to WS-118P included further BOMI studies.¹⁰

Air Force studies of a more advanced reconnaissance-bomber began in March 1956. The Hypersonic Weapon And Research and Development System (HYWARDS) was to achieve Mach 12 flight, twice that of the X-15 then on the drawing boards.¹¹

Also, Bell got another contract for a highly advanced U-2 follow-on called BRASS BELL, Reconnaissance System 459L. Two months later, ARDC released System Requirement 126 for a rocket-bomber, ROBO. ROBO allegedly included a reconnaissance version combining radar, infrared and optical scanning sensors, with relay of the sensor information to the ground while the ROBO was still in flight.¹²

Working cooperatively with NACA Langley for the aerodynamics research, the HYWARDS team soon realized that Mach 12 was insufficient, and that Mach 15 "was about the lowest speed for which an attractive military boost-glide mission could be defined."¹³ From there, it seemed but a short step to Mach 18 (nearly orbital), which the group recommended in January 1957.

The plethora of spaceplanes formed a logical sequence, with HYWARDS to fly in 1965, BRASS BELL in 1968, followed by ROBO in 1974.¹⁴ The proliferating concepts begged for consolidation. Air Force Deputy Chief of Staff (Development) Lt. Gen. Donald Putt reviewed the programs in January 1957. He thought BRASS BELL and HYWARDS were complementary and could be combined into a single, two-phase program. Furthermore, the X-15A would clearly provide nearly everything that could be learned from HYWARDS. Thus, in April 1957, Putt directed ARDC to combine all hypersonic research programs into a single development plan.¹⁵

NACA was also struggling with spaceplane concept diversity. For instance, NACA Ames and NACA Langley were at odds over the relative advantages of high and low lift-to-drag ratios. With only that one variable in mind, the range of studies and technologies was very large, indicating the considerable work necessary to explore various parts of the high speed flight regime. The Ames-Langley disagreements were technical, political and organizational. They serve to highlight the complexity of the issues involved in advancing spaceplanes. The range of options was simply so extensive that no single correct solution would readily reveal itself.¹⁶

Within this swirl in both NACA and ARDC, WADC produced a reasonable response to Putt's direction for a unified development plan. HYWARDS, BRASS BELL and ROBO became three steps in an abbreviated program of development on December 21, 1957.¹⁷ The combined effort was designated System 464L, named DYNA-SOAR I, with a projected first flight in July 1962.¹⁸

Strategic Air Command was the operational home for a variety of space uses, not the least of which were those embodied by DYNA-SOAR. Strategic Air Command's General Curtis E. LeMay intended DYNA-SOAR I as an advanced bomber, reconnaissance, air defense and space defense vehi-

cle.¹⁹ The DYNA-SOAR project elements convey a feeling for the broad range of capabilities that spaceplanes might accomplish: Manned Capsule Test; Boost-Glide Tactical Weapon Delivery; Boost-Glide Interceptor; Satellite Interceptor; Global Reconnaissance; and Global Bomber.²⁰

Well aware of Putt's impending reorganization of spaceplanes, on the 54th anniversary of the first flight by the Wright Brothers, December 14, 1957, Air Force Chief of Staff General Thomas Dresser White announced "The missiles that are getting the headlines today are but one step in the evolution from aircraft to piloted spacecraft."²¹

Three days later, General White told the Senate Armed Services Committee that the X-15 "was a forerunner of the spacecraft...[and] requires all the characteristics that one would find in a manned satellite to take care of the man."²²

Human Orbital Spaceflight: Be First or Be Useful?

As rapidly as technology advanced, producing the first crucial operational space systems within two years of SPUTNIK (such as the CORONA, GRAB and POPPY reconnaissance satellites), the perception remained that these were really only interim capabilities awaiting routine human presence. The appropriate question, therefore, was not *whether* human spaceflight was needed, but rather, *when* it could be provided. Obviously, sooner was better than later.

By 1956, Air Force Project 7969, the Manned Ballistic Rocket Research System²³ was competing directly with the Army Ballistic Missile Agency's concept for a recoverable system on an Army missile (which became MERCURY). These bioastronautics research programs aimed at the minimum requirements to put humans in space and return them safely to Earth. These minimalist programs were not ends unto themselves, but simply necessary stepping-stones to operational missions.

The earliest design work on the X-15B dates from this period. Project 7969 was an important bridge between the minimalist and the robust, in that the proposals received from industry included both ballistic re-entry vehicles and winged vehicles. Perhaps the most interesting proposal was North American's proposal for an evolved X-15. Using staged boosters, the aircraft would orbit between 250,000 (perigee) and 400,000 feet (apogee). The first stage comprised three NAVAHO boosters;²⁴ another NAVAHO booster as a second stage; and the X-15B was the third. Its estimated gross liftoff weight was 720,000 pounds. Since the X-15B would have the same shape as the X-15A, nothing further was considered necessary for determining its flight characteristics. However, re-entry would only get the pilot to a safe ejection altitude, with the X-15 being lost in the Gulf of Mexico. North American's claimed cost and schedule were \$120 million and 30 months. This was not very satisfactory, as it was a very expensive, one-time shot with no residual operational utility.²⁵ Nevertheless, the

idea opened a door. After all, Putt's realization that most of HYWARDS' results could be gained from the X-15 meant that a version of the X-15 could be on a growth path to ROBO's operational mission, recently subsumed into DYNA-SOAR I. Nevertheless, making the X-15A withstand the expected re-entry heat and stress meant the X-15B would be a radically different vehicle in detail.²⁶

Things stood there when the Soviets launched SPUTNIK on October 4, 1957, and the emphasis on space programs changed.

The VANGUARD project to launch an artificial moon during the International Geophysical Year, seen as the US' competitor to SPUTNIK, was far from success. The military were the only source of response to SPUTNIK. The problem was not a lack of alternatives, but choosing the right one.

As a champion for spaceplanes and a military space visionary, General LeMay, by that time the Air Force Vice Chief of Staff, took a personal interest in satellite and human spaceflight. LeMay announced the Man-In-Space-Soonest (MISS) project, causing the re-orientation of a number of ongoing studies and projects. Project 7969 got folded into MISS as one of the alternatives.²⁷

Because of Project 7969's inclusion in MISS, MISS might sound like MERCURY. MERCURY began in the Army and eventually transferred to the new NASA after 1958. This was essentially the minimum system to put a human into space and safely return. Little weight or space remained for operational missions. This is not minimizing MERCURY's importance in demonstrating critical life support technologies and human spaceflight capabilities. However, MERCURY's limitations simply served to underscore the military objections to NASA's human spaceflight approach.

MISS' emphasis was on attaining *operational* capabilities from space at the earliest possible time. Interim steps might be needed to understand human physiology and life support systems, but the goal was operational uses. Competing ballistic re-entry and lifting re-entry (spaceplane) concepts abounded, though with scanty data available for design. By 1957, Boeing's DYNA-SOAR embodied the Air Force's goal, providing a means to put military humans into space to perform militarily useful operational missions. DYNA-SOAR's urgently needed capabilities were a long way off, with its expected first flight in 1962.²⁸

To grasp the range of alternatives, aside from the Air Force's own concepts, WADC held government-industry meetings January 29-31, 1958. In addition to discussing NACA projects, the Air Force invited 11 major contractors for an hour and a half apiece to brief concepts for achieving early human spaceflight.²⁹

NACA Langley discussed Max Faget's research on a ballistic vehicle (basically the MERCURY capsule) and John V. Becker described work being done on a triangular planform that would use lift during re-entry to provide great flexibility in landing sites. After these informal discussions, the serious work got underway with the contractors. The final per-

sentation was from North American Aviation, who described turning the X-15 aeronautical research aircraft into an operational (non-expendable) spaceplane.³⁰

The MISS project alternatives grouped into three basic categories: ballistic vehicles, boost-glide vehicles and satelloids. Ballistic vehicles were shapes like ballistic missile nose cones intended to survive re-entry. The boost-glide vehicles would achieve nearly the same velocity, but would skim the upper reaches of the atmosphere as gliders at lower altitudes. Satelloids were basically gliders that would achieve minimum orbital velocity well above the atmosphere and use their aerodynamic features for re-entry.³¹

In February 1958, LeMay reviewed the alternative paths from the WADC conference. For the most part, the ballistic re-entry idea was the most competitive if the goal were limited to getting into space for no other point than having gotten there. That remained operationally unsatisfying because it could not be tied to some useful purpose. The Army's MERCURY capsule was one ballistic approach having no residual operational utility, but the Air Force had an alternative with an operational tie-in.

The SAMOS E-6 photoreconnaissance satellite required a very large re-entry capsule because both the film and the camera were to be recovered for reuse.³² Unlike the blunt re-entry capsule of the familiar MERCURY design, the SAMOS capsule used a scaled-up General Electric RVX-2 missile re-entry nose cone.³³ Like CORONA, the SAMOS E-6 needed a plausible explanation for its launches. CORONA's cover story was the DISCOVERER research program. SAMOS used human spaceflight to explain the large size of its vehicles. Like MERCURY, the scaled-up RVX-2 was minimally large enough to fit a human inside, and was one alternative under Project 7969.³⁴ Also, the MISS version of the SAMOS capsule had little residual operational capability. In the case of SAMOS, however, the MISS version was secondary cover for an operational photoreconnaissance system. Since the human spaceflight story protected a classified mission, losing human spaceflight programs to NASA jeopardized the more important mission. Thus, in part, the Air Force objected, in support of the Army, to assigning human spaceflight responsibility to NASA.³⁵

Such wingless, ballistic shapes had the advantage of simplicity, but serious disadvantages if anything other than basic bioastronautics was the goal. Bell's MISS boost-glide alternative design team pointed out that "wingless would only be a stunt."³⁶

The second alternative path comprised boost-glide vehicles, including LeMay's favorite, DYNA-SOAR, undergoing initial source selection at that time.

Satelloid vehicles constituted the third alternative path, and included the X-15 that already had the first functional full pressure space suit and flew at the edge of space. The X-15A program per-

THE X-15A WAS AN IDEAL TEST-BED FOR X-20 TECHNOLOGY, BUT IT ALSO PROVIDED AN APPARENT PATH TO AN EARLIER, THOUGH MORE LIMITED, ORBITAL CAPABILITY

formed experiments inspired by the need for early DYNA-SOAR technology work. The X-15A was an ideal testbed for X-20 technology, but it also provided an apparent path to an earlier, though more limited, orbital capability. Making an orbital X-15 variant might be the fastest way to get real operational capability, while also resolving much of the flurry of proliferated spaceplane concepts. With an estimated much shorter (by half) development time than the boost-glide vehicles, the X-15B could also demonstrate critical technologies for DYNA-SOAR.³⁷

While all three alternatives continued to move forward, each having merit for different reasons, the heat shortly got turned up on the ballistic re-entry approach.

In April 1958, Maj. Gen. John B. Medaris, commander of the Army Ballistic Missile Agency, told Congress that he had recently asked for authority to launch a human on a JUPITER-C rocket and return him to Earth. He and Wernher von Braun claimed they could do this a year after direction to proceed. The Army and, after the concept's transfer to the new civilian space agency, NASA called it MERCURY.^{38, 39}

MERCURY was the fastest way to get humans into space and safely return them. Nearly as quickly, though, the X-15 might do far more in terms of residual capabilities. The MISS participants had all estimated between one and two and a half years to get a human into space and safely return (with two notable exceptions, whose estimates were more realistic at 5 years). Ballistic re-entry shapes had the shortest development times.⁴⁰

Nevertheless, the X-15 was designed to fly at the edge of the atmosphere at about one quarter of orbital speed. It already had to handle many of the physiological problems associated with orbital flight. The X-15 had shown it could handle sub-orbital flight, demonstrating its advanced capabilities on a regular basis. Orbital flight demanded long duration in space, so the X-15's life support system needed significant upgrading. Neither was its structure sufficiently durable to dissipate the heat of re-entry. Still, in theory, transforming the technologically mature X-15 into an operationally useful orbital spaceplane might be faster than any alternative.

Yet, by late 1957, interest in the orbital X-15B apparently evaporated, according to the sources that even discuss its existence. Hallion suggested that the MERCURY program overtook the orbital X-15B. However, MERCURY could not overcome its absence of residual operational utility. Jenkins claimed the X-15B drifted quietly away.⁴¹ He assumed DYNA-SOAR (which became the X-20 in 1958) required too much attention by the Air Force for serious attention to be paid to the X-15B. Neither answer is entirely satisfactory.

What was the reality?

Instead of drifting quietly away, the X-15B studies became classified in 1957, allowing only

spotty unclassified appearance of X-15B-related items.⁴² Reasons exist to believe interest in the X-15B shifted from WADC to the Western Development Division, home of the military space program.⁴³ Lacking external visibility due to classification, the X-15B might seem to have received sporadic interest.

Instead, it the X-15B as a viable proposal intended to achieve human spaceflight early while retaining some operational capability had not gone away. Instead of simply paving the technological way for the DYNA-SOAR, the serious possibility arose that the X-15B might achieve orbit earlier, as the DYNA-SOAR ran into significant technological problems. DYNA-SOAR's truly unique problems resulted in its clearly falling behind, so it was not on the path to the earliest human spaceflight.

As the Air Force cast about for a suitable operational response to SPUTNIK, the X-15B might provide not only an early capability, but one that also possessed some operational utility - not as a replacement for DYNA-SOAR, but as an interim. Thus, as DYNA-SOAR slipped to the right, the X-15B retained interest. In addition to its anticipated earlier orbital flight possibility, the X-15B objectives to demonstrate and prove technologies for the DYNA-SOAR and satellites seemed to come at a low cost per spaceflight while retaining residual operational utility.

Had the X-15B become a competitor to the DYNA-SOAR? By November 1959, the X-15B studies advanced far enough to answer the key questions about making the X-15 orbital, also answering whether the X-15B had become the DYNA-SOAR's competitor.

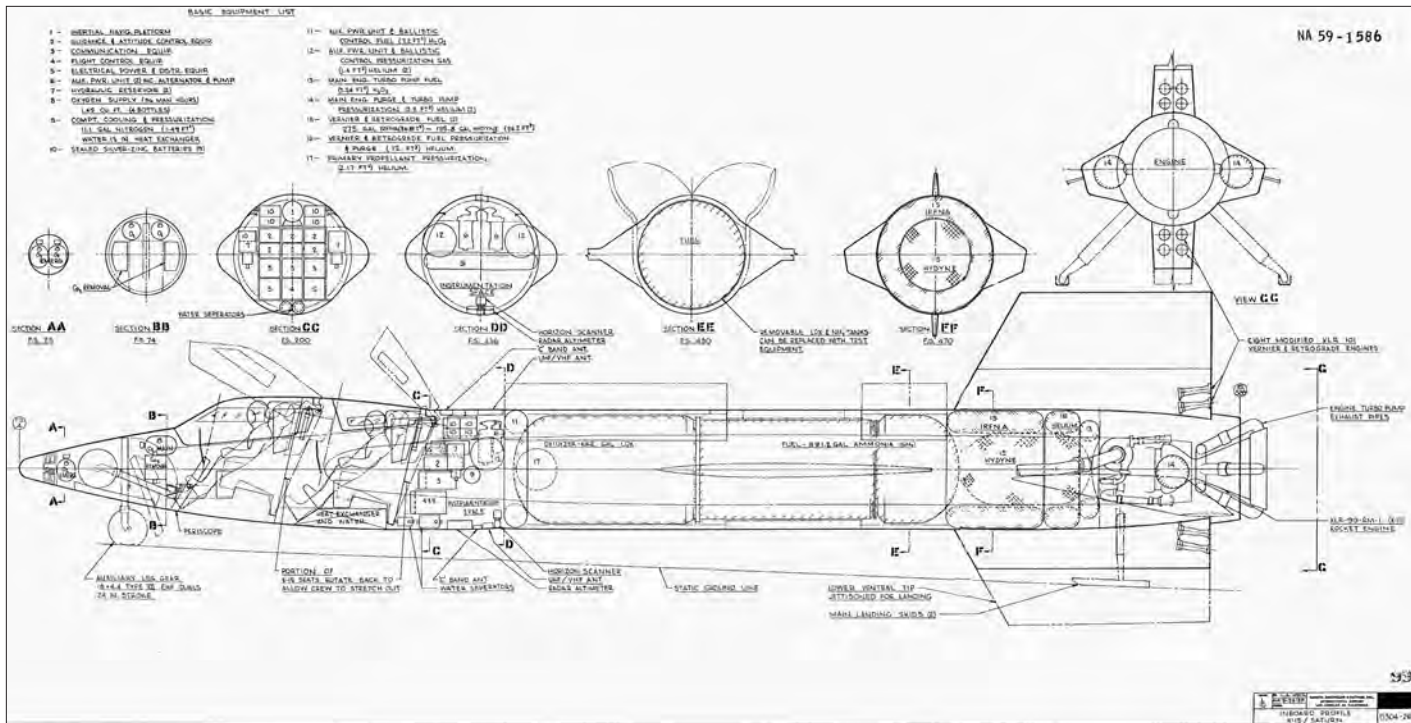
Harrison Storms, North American's Los Angeles Division vice president and chief engineer, conducted the work.⁴⁴ Recently declassified final reports, *SATURN/X-15 Flight Research Program Report*, and its companion, *Technical Summary Report, SATURN/X-15*, at last give insight into the fate of the X-15B.⁴⁵

X-15B Program Overview

The detailed studies of the X-15B's design and flight operations demonstrated the move from sub-orbital to orbital flight was larger than had been anticipated.

The X-15B program comprised four initial orbital flights. A "series of tests for attaining ...national objectives" would "make substantial contributions to the development of vast numbers of concepts and components envisioned for future space systems."⁴⁶ Building on the X-15 flight research program's capabilities, the X-15B added unique tests and experiments while slightly overlapping the MERCURY and CORONA/DISCOVERER programs. Four flight profiles exemplified the possible kinds of missions and planning. At the time, actual mission plans anticipated having to await the timing and progress from other programs such as MERCURY and CORONA/DISCOVERER.

The X-15B differed sufficiently from its flight



X-15B Cutaway Showing Second Cockpit, Payload Bay and Additional Thrusters. 47

Wind Tunnel Model of X-15B In Launch Configuration From B-70



research cousin that it needed qualification flight tests using the Boeing B-52 Stratofortress. Launch alternatives were air launch from a B-52 or the North American B-70 Valkyrie, contrasted with vertical launch aboard a Convair ATLAS or Martin TITAN rocket. Clusters of rockets were also a possibility, since the ATLAS and TITAN boosters alone were insufficiently powerful. These and other launch vehicle combinations reflected the emphasis on early human orbital spaceflight in the MISS program. By 1959, the studies had narrowed down

the most direct, simplest and preferred method, which was the NASA SATURN.

Unlike its flight research forbear, the X-15B would deliver up to 5,000 pounds of payload with its pilot and test director for 48-hour missions. Clearly, that was more than a simple evolution of the X-15A.

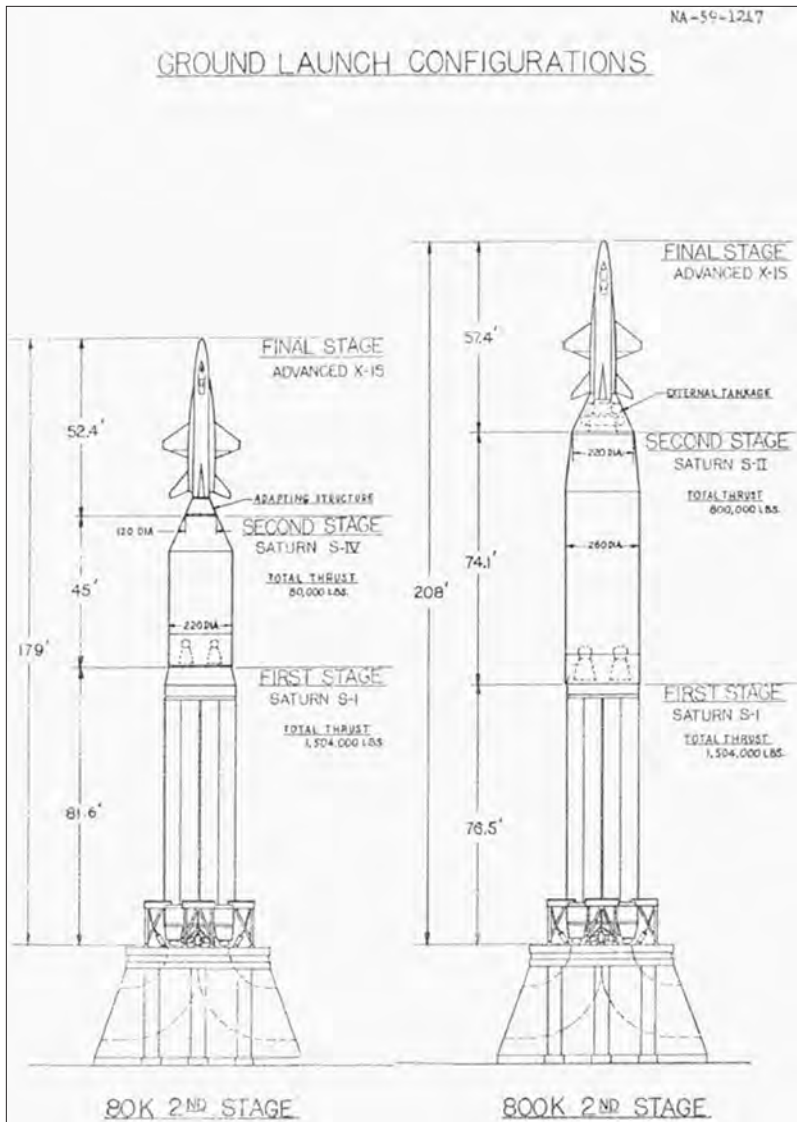
Advanced did not necessarily imply completely new, however. For instance, in the X-15's proposal phase, each bidder had to address a Navy requirement for a second crewmember.⁴⁸ Also, for the January 1958 initial source selection of the System 464L, DYNA-SOAR 1, North American proposed a 15,000 pound-class vehicle based on the X-15B operating as a satelloid.⁴⁹ This idea recurred when bioastronautics requirements firmed up in 1960.⁵⁰ The X-15B studies kept such concepts alive.

Typical of the orbital research profiles was the first test carrying 4,068 pounds of equipment to 500,000 feet. During 32-orbits, the crew were to conduct tests such as:

- Optical and radio telescope
- Infrared, radar and visual terrestrial observations
- Human mobility in space
- Biological research
- Gravitational research.

The list illustrates the range of experiments and demonstrations, from theoretical scientific data gathering to practical applications with immediate utility.

The X-15B would fire retro-rockets during the 32d orbit, maneuvering for re-entry at 350,000 feet (as they thought) at 25,500 feet per second (fps). Twenty-five minutes of high-lift gliding flight would reduce these to 8,000 fps at 150,000 feet. The remainder of its flight to touchdown would mimic the X-15A, minimizing the number of unknowns in



Two SATURN Variants For X-15B Launch.

the X-15B flight profile. Thirty-two orbits drove some of the X-15B's sizing parameters. Bottled oxygen for two days in orbit imposed considerable weight penalties, making necessary a regenerative oxygen system for which no room existed in the X-15A.⁵¹

After understanding the first flight and making any changes, the second flight would push the altitude envelope. This flight profile evolution was a normal flight test approach. The second orbital flight would start from the same parameters as the initial flight, but then boost to 1,584,000 feet apogee (300 statute miles), with a 500,000 foot perigee. The third flight test would begin from these same elliptical orbital parameters and demonstrate aerodynamic braking and rendezvous techniques.⁵² The fourth and final test flight would push the maximum altitude to 3,168,000 feet (600 statute miles) to intensify the re-entry test. In addition to tests of magnetic and gravitational fields, meteorite and radiation measurement and mass spectrometry, the flight profile included re-entry characteristics and guidance tests.

Altitude increases came at the expense of payload weight, because total weight remained about

the same. Converting all the payload weight to fuel could have resulted in a 1,900 statute mile apogee.⁵³

Orbital construction might also justify the X-15B. Operational human presence required space stations. Space station size outstripped the largest launch vehicles, requiring orbital construction. Conserving robotic spacecraft weight by reducing redundancy could save money. Therefore, it was "important that the concept of manual maintenance in space be investigated early in the space research program."⁵⁴

Design Details⁵⁵

The final detailed design work assumed the SATURN S-1 launch vehicle. The S-1 had 1,500,000 pounds of thrust, and necessitated a modified TITAN second stage with a single XLR-87 engine. Alternative second stages were the SATURN S-II or S-IV (for additional thrust of 80,000 or 800,000 pounds, respectively).⁵⁶ The X-15B retained its XLR-99 rocket from the flight research program, but added eight Rocketdyne XLR-101 rockets in the aft fuselage for retrograde thrust at the end of the mission.






A large dorsal payload bay approximately amidships had two sets of power-driven doors, accommodating a wide range of sensors and equipment. The compartment could be segmented for additional fuel tanks. The X-15B would not deploy satellites but operate installed sensors and equipment for the mission and return these, providing a versatile and reconfigurable operational vehicle.⁵⁷

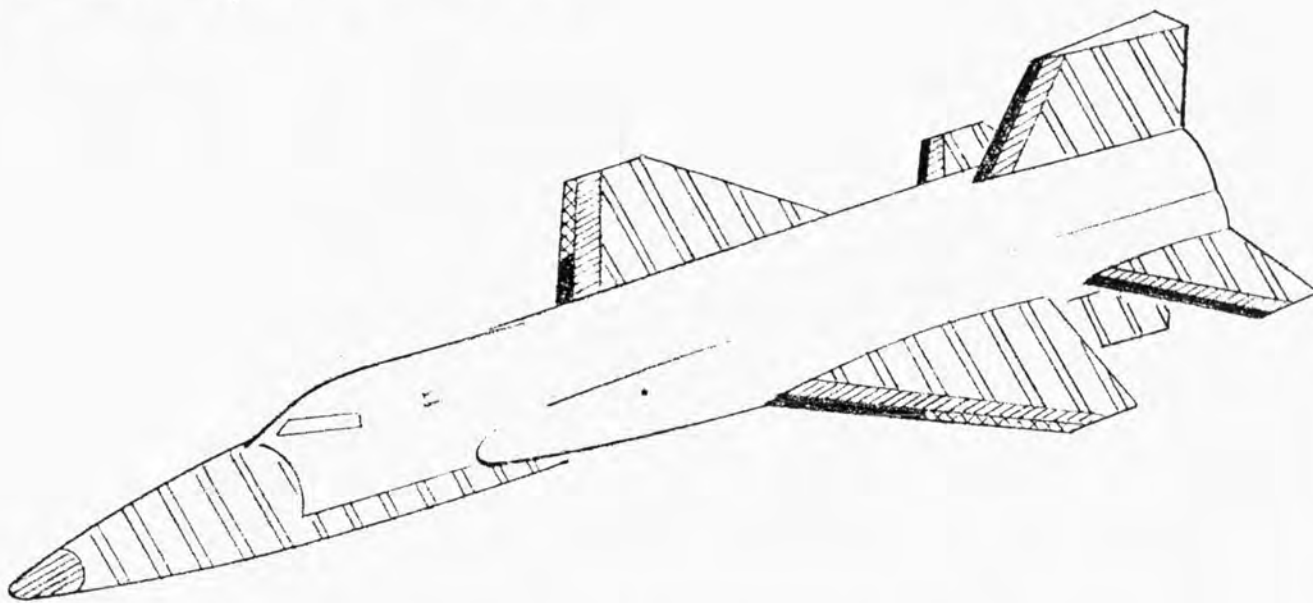
Surprisingly little information exists on the X-15B's anticipated size. Contradictory existing data at times indicates it was the same as the X-15A, or a much larger vehicle. An oxygen regeneration system, second crewmember and the long payload bay indicate that the X-15B would have been similar in planform, but necessarily scaled up from the X-15A.

The structures of the X-15A and X-15B are the most revealing part of the studies, indicating that the X-15B had to be radically different. Reentry heat loads were a major problem with significant unknowns. The best available data on the upper atmosphere, above the highest altitudes of balloon measurements, came from EXPLORER 1, which led to conservatism in estimating the potential heat loads – meaning the requirements encompassed the worst potential case. By the end of 1959, the worst-case heat loads were the ones that drove the skin and internal structure of the X-15B.

The X-15A's 1,200° F nose temperature and the wing leading edges 1,250° F allowed its skin to be Inconel X, a high strength nickel-chromium-iron alloy. In reality, the highest heat load on the X-15A was 1,250° F (although the X-15A-2 was later thought to be capable of 2,400° F at Mach 8+). However, the X-15B's heat loads were nearly triple that of the hypersonic research aircraft, reaching 3,400° F on the nose and 4,900° F on portions of the leading edges. The X-15B's leading edge structural

THIRTY-TWO ORBITS DROVE SOME OF THE X-15B'S SIZING PARAMETERS

-  GRAPHITE
-  MOLYBDENUM
-  NICKEL ALLOY
-  THORIUM OXIDE
-  BERYLLIUM OXIDE



STRUCTURAL ARRANGEMENT

Arrangement of High Temperature Materials

**BOTH
DYNA-SOAR 1
[AND] X-15B
SCHEDULES
WERE
UNACHIEVABLE**

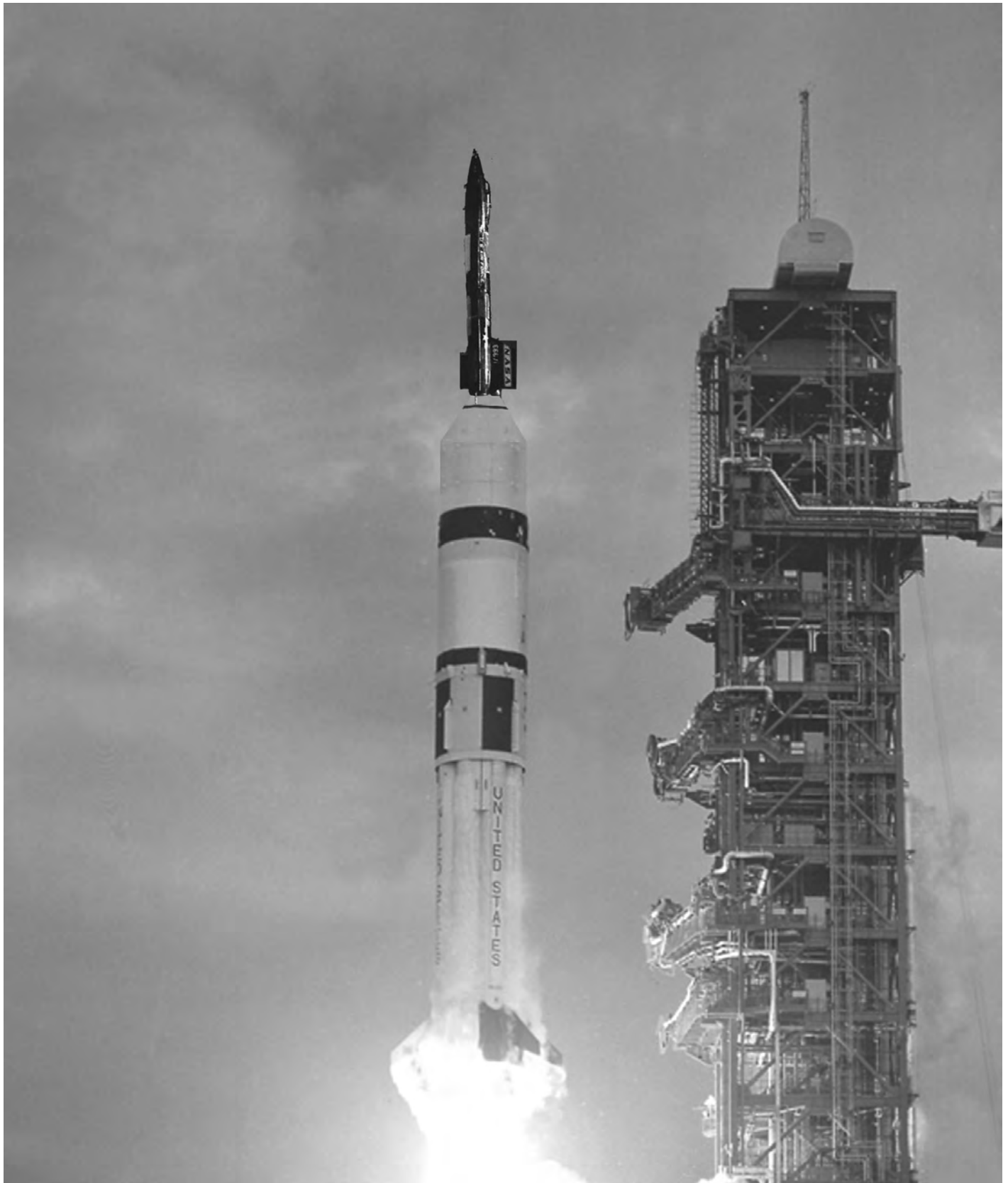
materials ranged from thorium oxide near the wing roots to beryllium oxide from mid-span to wingtip. Materials for the wing leading edge protective coatings ranged from columbium (good up to 2,800° F), molybdenum (3,000° F), graphite (3,800° F) and finally, tungsten (4,750° F). The trailing edges might have been Rene' 41.⁵⁸

The internal structure of the fuselage also had to deal with high heat loads, and the X-15A's tubular steel and titanium structures were not up to the re-entry challenge. The X-15B needed a coated molybdenum structural box.⁵⁹

Getting the X-15B to orbit proved harder than expected. After 26 months of design, from December 1959 to February 1962, fabrication would be paced by the availability of the first flight-rated engine in October 1962 (the 34th month of the development). With first vehicle delivery in January 1963, glide tests would have followed 4

months later. The second vehicle would extend speed and altitude by adding two droppable external fuel tanks. Finally, the first launch vehicle boosted flight using a dummy second stage would have been in March 1964, with orbital flights in June 1964 and every 2 months thereafter.

This schedule killed any expectation that the X-15A was a short step away from orbital flight. Also, as for its being a potential competitor to the DYNA-SOAR, the technology problems proved nearly identical, driving the long development schedule. Importantly, in 1959, DYNA-SOAR 1's scheduled first suborbital flight in July 1962 was nearly two years ahead of the X-15B's June 1964 schedule (both of which would in reality have been after John Glenn first American orbital flight in a MERCURY capsule). Hindsight shows both schedules were unachievable, although the X-15B had a smattering of greater realism because of the



X-15A's on-going and highly successful flight research program.

While the nation's civil space program, by that time, was focussing on going to the Moon, the military space program had demonstrated the extensive capabilities of robotic spacecraft. As the last

glimmer of interest in the X-15B waned in late 1959, the X-15B had not justified its continued support as a way to achieve early human spaceflight, or as a technology testbed for more advanced systems, or as a competitor for the first operational human spaceflight capability.

(Left) Artist's Concept of the Spaceplane That Might Have Been

NO SHORTCUTS TO HUMAN SPACE-FLIGHT EXISTED

Final Thoughts

Of course, the X-15B never went beyond design studies. At the same time, it was very much a part of the swirl of evolving spaceplane concepts in the 1950s, and very much a part of the rush to put the first human into space. It was an interesting excursion into the “what ifs” of aerospace history.

More than any other program, it demonstrated the difficulties of extrapolating a research aircraft into a spaceplane. The studies disproved that the technological maturity of the X-15 could easily bootstrap an operational orbital spaceplane program. The X-15B studies identified the same technology problems facing the much more advanced DYNA-SOAR X-20, eliminating its further consideration as a means to mature technologies for the latter program. Its demise can now be said to be understandable.

Yet, in the X-15B, we see things that were both logical and yet to come. The external fuel tanks eventually flew aboard an X-15A for the same purpose as proposed in the X-15B. The dorsal payload bay flexibly containing sensors, experiments or additional fuel later made eminent sense as part of the Space Shuttle.

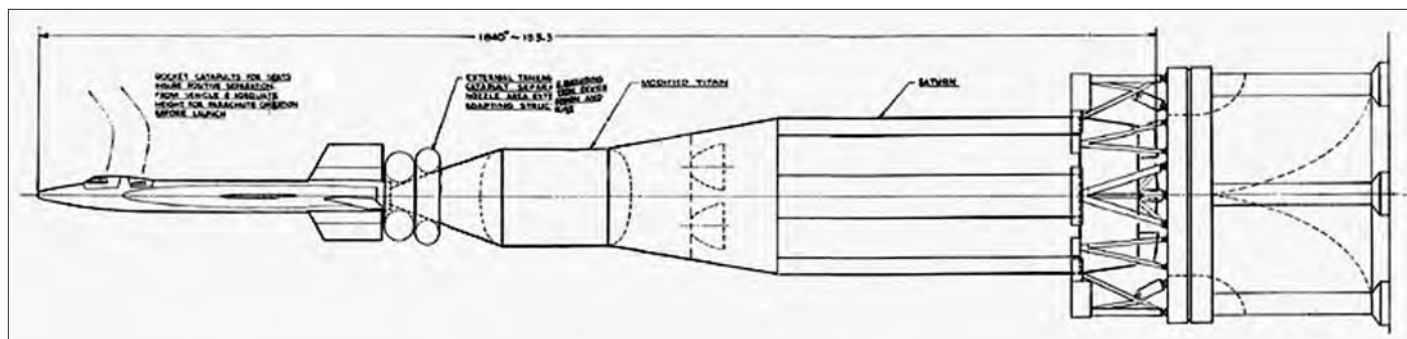
The studies straddled the transition of robotic spacecraft from crude demonstrations to the first operational capabilities without human presence. Robotic capabilities advanced faster than expected

by those whose experience consisted of robotic aircraft programs. The rush to put humans in space for national defense or security reasons died a slow and lingering death, as enthusiasm largely dampened out based on robotic spacecraft success, combined with the high cost technically challenging aspects of human spaceflight.

As an epilogue, a little over two years after the X-15B studies, having pushed DYNA-SOAR beyond achievability, Defense Secretary Robert S. McNamara said, given “the absence of a clearly defined military manned space mission, present military efforts should be directed to the establishment of the necessary technology base and experience upon which to expand, with the shortest possible time lag, in the event firm military manned space missions and requirements are established in the future.”⁶⁰ Against the earlier perception of the need for human presence to achieve true operational capabilities, robotic spacecraft progressed so rapidly that, by June 1, 1962, Director of Defense Research and Engineering Dr. Harold Brown told Congress he could not define a requirement for military manned space systems. “I think there may, in the end, turn out not to be any.”⁶¹

The military human spaceflight tide had changed. No shortcuts to operational human spaceflight existed, then or now. But, instead of the path not taken, what might the U.S. space programs have been like, had the X-15B and spaceplanes been pursued? ■

Illustration of X-15B on SATURN S-1/S-IV Emphasizing Additional Propellant For Higher Altitude Missions and Showing The Arrangement For The Ejection Seats



NOTES

1. The most authoritative source on the X-15 program devotes parts of two pages and occasional snippets to the project, by far the most extensive discussion before this paper (Jenkins, Dennis R., Tony R. Landis, *Hypersonic - The Story of the North American X-15* (North Branch, Minn: Specialty Press, 2003) pp. 209-210). The other authoritative source on hypersonic research programs was Richard P. Hallion's comprehensive two-volume work (Hallion, Richard P., *The Hypersonic Revolution* (Wright-Patterson Air Force Base, Ohio: Special Staff Office, 1987) Vol. I, p. I-x), whose scant references to the X-15B suggested that concept was successively shelved and revived for years, finally yielding to the MERCURY capsule. None of the sources, however, adequately explains the designation change of the X-15 to the X-15A. This is usually not mentioned, or discussed only as it applies to the heavily redesigned X-15A-2 (with external fuel tanks). It would appear that the redesignation may actually have been tied to the serious pursuit of the orbital X-15, neces-

sitating a “B” to differentiate its significant differences from the X-15 research aircraft, subsequently designated “A.” This supposition, however, seems equally unprovable. Readers interested in the X-15 program itself should also refer to sources such as Jay Miller, *X-Planes: X-1 to X-45*; Milton Thompson, *At the Edge of Space*; and Robert Godwin, *X-15: The NASA Mission Reports*.

2. Johnson, Clarence L., M. Smith, *Kelly: More Than My Share Of It All* (Washington, D.C: Smithsonian Institution Press, 1985); Rich, Ben R. and Leo Janos, *Skunk Works - A Personal Memoir of My Years at Lockheed* (New York: Little, Brown and Company, 1994), pp. 169-174. Johnson was seemingly aware of and more concerned with how to meet the Air Force's General Operating Requirement 12, the Special Reconnaissance System, discussed below, released within a few months of this meeting.

3. Jenkins and Landis 2003, p. 19.

4. *Ibid*; Crowley, Gus. “Minutes of the Meeting, NACA

- Committee on Aerodynamics,” October 4-5, 1954 (Washington, D.C: Files of the NASA History Office).
5. Murray, Arthur, *Man's Role in Dyna-Soar Flight* (Seattle, Wash: The Boeing Company, August 1962, declassified 1965), D2-80726; Temple, L. Parker III, *Shades of Gray, National Security and the Evolution of the National Reconnaissance Office* (Reston, Va: American Institute of Aeronautics and Astronautics, 2005), pp. 135-137. The latter contains a more complete list, explanation and critique of the list.
 6. *Aviation Week*, Mar 10, 1958, p. 39.
 7. Hansen, James R., *Engineer in Charge* (Washington, DC: National Aeronautics and Space Administration, 1986), NASA SP-4305, p. 356; Becker, John V., “The Development of Winged Re-entry Vehicles, 1952-1963,” unpublished, May 23, 1983, copy in NASA Langley Research Center Historical Archive. Dornberger even pushed to have Bell Aircraft hire Sänger, but this never worked out.
 8. York, Herbert F., *Arms and the Physicist: An Eyewitness Report on a Half Century of Nuclear-Age Drama* (New York: Springer-Verlag, 1994), Vol. 12, p. 129-130. Former Director, Defense Research and Engineering, Dr. Herbert York says Dornberger proudly recalled the number to show how indecisive the US government was. To York, however, it only proved how persistent Dornberger was.
 9. Hall, R. Cargill, C.D. Laurie, eds. *Early Cold War Overflights – 1950-1956, Symposium Proceedings* (Washington, D.C: National Reconnaissance Office, 2003), passim.
 10. U.S. Congress, House, Committee on Government Operations, *Organization and Management of Missile Programs*, 86th Congress, 1st Session, Sep 2, 1959, House Report 1121, p. 127.
 11. Becker 1983, 20; Hansen 1986, pp. 367-368.
 12. *Aviation Week* Feb 3, 1958, p. 26.
 13. Becker 1983, p. 15.
 14. Temple 2005, p. 134.
 15. Bowen, Lee, *The Threshold of Space: The Air Force in the National Space Program, 1949-1959* (Washington, D.C: USAF Historical Division Liaison Office, 1960), p. 23; Hallion 1987, Vol. 2, pp. 1989. This idea that technology needs could be met in another program not directly related would come back in the more advanced DYNA-SOAR. The designation X-15A is used in this paper to consistently refer to the hypersonic research aircraft, despite the fact that the designation was not used in the early part of the program.
 16. Becker 1983, pp. 18-19.
 17. Hallion 1987, Vol. 2, p. 209; Temple 2005, p. 134.
 18. Hallion 1987, *Ibid.* Note the advancement in the schedule from the early three-phased program. After combining the projects, first phase development time reduced by three years.
 19. Headquarters, Air Research and Development Command, “System Development Directive 464L,” December 21, 1957, pp. 2, 8, 11, 32; Headquarters, Air Research and Development Command, Detachment 1, “Preliminary Development Plan, System 464L,” November 1958; Butz, J.S. Jr., “Orbital Re-Entry Will Intensify Demands On Structures,” *Aviation Week & Space Technology*, April 21, 1958, pp. 50-51. I chose the December 21 date because it records the formalization of a decision reached in the Air Force on October 10 collapsing the efforts into one program. When General White spoke in mid-December, the decision to create DYNA-SOAR out of the other programs was already publicly released.
 20. Bowen, *Ibid.*
 21. White, General Thomas D., “Leadership — in the Conquest of Space,” address to the Air Force Academy, December 14, 1957.
 22. Gantz, Lt.Col. Kenneth F., ed., *The United States Air Force Report on the Ballistic Missile – Its Technology, Logistics and Strategy* (New York: Doubleday and Company, Inc., 1958), p. 277.
 23. Jenkins and Landis 2003, p. 209.
 24. NAVAHO was a supersonic, rocket boosted, ramjet powered cruise missile under development for the Air Force. Subscale models, designated X-10, flew in the mid-1950s, but the project was cancelled in favor of the ATLAS missile. At the time of the X-15B studies, the NAVAHO was in serious technical trouble, but represented an approach well understood by North American engineers.
 25. Jenkins and Landis, *Ibid.*
 26. Syvertson, Clarence A., “Visit to WADC, Wright-Patterson Air Force Base, Ohio, to attend conference on January 29-31, 1958, concerning research problems associated with a man in a satellite vehicle,” Memorandum for Director, February 13, 1958, pp. 8-9, in the Headquarters NASA History Office X-15 files.
 27. Hallion 1987, Vol. 1, p. 8.
 28. Hallion 1987, Vol. 2, pp. 204-207.
 29. Syvertson 1958, p. 1.
 30. Syvertson 1958, p. 9. Becker’s responsibilities had included getting the X-15 program going and later serving as NASA’s project manager on DYNA-SOAR. His “lessons learned” version of the WADC meeting is in Hallion 1987, Vol. 1, p. 411. The eleven MISS alternatives to early human spaceflight covered the gamut from spheres to missile re-entry nose cone adaptations, to the “stripped” X-15B and winged re-entry vehicles like DYNA-SOAR. Of note in his summary of the 11 alternatives was the absence of Boeing’s DYNA-SOAR boost-glide vehicle, which was already well underway, but whose schedule did not fall within the bounds of attaining early human spaceflight. In its place, the only boost-glide vehicles presented were the Northrop and Bell proposals for DYNA-SOAR.
 31. I owe the satelloid-boost-glide distinction to Hallion (Hallion 1987, Vol. 1, p. 210), which I expanded to differentiate the ballistic vehicles such as the blunt MERCURY capsule, spheres, and missile re-entry shapes. This distinction of Hallion’s is especially important to understand the difference between the final version and expectations of the X-20 and the original DYNA-SOAR 1. Originally designed for one purpose as a boost-glide vehicle, circumstances forced it into regimes it was not well suited to operate as a satelloid, which was a major part of the projects undoing.
 32. Temple 2005, p. 325; Perry, Robert L., *A History of Satellite Reconnaissance, Volume IIB – SAMOS E-5 and E-6* (Washington, D.C: The National Reconnaissance Office, October 1973, declassified September 2002), pp. 424-427; Day, Dwayne A., “A Sheep in Wolf’s Clothing,” *Spaceflight*, 44, October 2002, p. 10. SENTRY, the original designation of the Air Force photoreconnaissance program under WS-117L, changed to SAMOS in Aug 1959. For narrative simplicity, SAMOS is used consistently here. Several versions of the SENTRY capsules had removed much of the photoreconnaissance equipment replaced by human spaceflight equipment (and crew). These latter concepts were essentially packaging studies, to see whether a human and associated support could be fit into the space left by removing the camera. In some cases, the capsule itself was extended to include both camera and human, but that defeated the cover story by having an outwardly distinguishable capsule for reconnaissance and one for human spaceflight. The packaging was related to the launch vehicle-driven maximum capsule diameter. The SAMOS E-6 was to use a scaled-up TITAN II re-entry vehicle. To accommodate the large format camera, the E-6 was approximately 12 feet long and 8 foot across at the base, easily large enough for a seated astronaut. The CORONA program expended the camera, returning only the film, allowing (in early models) a much

smaller size. Day's article covers the rest of the attempts to mix human spaceflight with various SENTRY/SAMOS capsules, such as in the E-3 and E-5.

33. Hallion 1987, Vol. 1, p. lxxviii.

34. As explained in this article, the most common assertion about the X-15B is that it kept getting shelved and revived. This paper shows greater continuity behind the X-15B investigations, though some may find it interesting to note that the up-scaled human spaceflight version of the RVX-2 enjoyed its own shelving and reintroduction in the early 1980s. The concept was briefly alive again in the very early days after the establishment of Air Force Space Command. The author of this article was called upon to review this proposal while assigned to Air Force Systems Command at the time.

35. Temple 2005, p. 325; Day, Dwayne A., John M. Logsdon and Brian Latell, eds., *Eye in the Sky—The Story of the CORONA Spy Satellites* (Washington, D.C: Smithsonian Institution Press, 1998), p. 74.

36. Hallion 1987, Vol. 1, p. 411. Heroic human presence as fundamental to real capabilities was popularized in Tom Wolfe's best-selling book, *The Right Stuff*, minimizing the role of humans in the orbital MERCURY capsules.

37. Temple 2005, p. 144; Hallion 1987, Vol. 1, p. 411.

38. Swenson, Lloyd S., Jr., James M. Greenwood, and Charles C. Alexander, *This New Ocean: A History of Project Mercury*, (Washington, D.C: National Aeronautics and Space Administration, 1966), pp. 78-80.

39. Temple 2005, p. 144.

40. Syverston 1958, p. 11. Syverston sketched each of the basic shapes and then detailed important aspects of each of the 11 concepts, one being the estimated development time to manned spaceflight.

41. Jenkins and Landis 2003, *Ibid*.

42. Gantz 1958, pp. 296-297. In testimony before the Senate Committee on Armed Services' Preparedness Investigating Subcommittee, referring to the "manned satellite," General Schriever said he preferred "not to say anything more about the program that has been under discussion...because of its classification." When Congressman Weisl clarified the question referred to the X-15, Schriever explained that the X-15 was not a satellite, but a rocket-powered airplane. Senator Barrett responded, "Yes, I understand that, General, but I was thinking about an extension of the X-15, and it would be perfectly agreeable to wait for executive session." Schriever explained its relationship to the hardware then in existence supporting the ballistic missile program. Experimental recovery flights were possible with existing hardware, he claimed. The testimony was on December 17, 1957 and January 8-9, 1958.

43. This effort comprising only studies is very difficult to reconstruct. Western Development Division was indeed involved in the evaluation and possibly sponsorship of the X-15/SATURN in 1959, when Jenkins and Hallion indicate it had been shelved. The two Air Force development centers responsible for aircraft and satellites had a lengthy rivalry on the topic of spaceplanes. Each center had its own ways to extend aircraft technology higher and faster to become satellites or to make satellite technology capable of aerodynamic flight. I suspect that, as interest in the X-15B waned at Wright Air Development Center, it was either picked up briefly or worked collaterally at Western Development Division. This is not yet provable. I documented some of this rivalry relating to spaceplanes in *Shades of Gray*.

44. Jenkins and Landis 2003, *Ibid*.

45. North American Aviation Report, *SATURN/X-15 Flight Research Program Report*, November 19, 1959, NA 59-1586, SECRET original declassified by NASA Headquarters, 9 and passim; North American Aviation Report, *Technical Summary Report, SATURN/X-15*, November 19, 1959, NA 59-1247, SECRET original

declassified by NASA Headquarters, passim. These newly declassified reports were obtained through FOIA from NASA Headquarters.

46. North American Aviation Report, NA 59-1586, p. 5.

47. North American Aviation Report, NA 59-1586, restored from the original by Ms. Betty Temple, as with all drawings in this article.

48. Jenkins and Landis 2003, p. 28.

49. Hallion 1986, Vol., 1, pp. 209-210.

50. Jenkins and Landis 2003, p. 163.

51. The X-15 life support system used oxygen stored in canisters, sufficient for short duration atmospheric missions, but not for long duration orbital missions. Adding more oxygen bottles would be costly in terms of weight and performance, as well as operationally limiting. Orbital flight would have required some form of regenerative breathing system. At the time, the rule of thumb that one pound into 100 nautical mile orbit required 100 pounds of fuel and launch vehicle was unknown, but the expense of extra weight was appreciated. The X-15B studies showed a good anticipatory understanding of the kinds of trade-offs between fuel and payload each profile represented.

52. North American Aviation Report, NA 59-1586, p. 6.

53. North American Aviation Report, NA 59-1586, p. 29.

54. North American Aviation Report, NA 59-1586, p. 12.

55. For a more detailed description of the technical details of the X-15B, see Temple, L. Parker III, "X-15B: The Spaceplane That Almost Was," Paper presented at the 57th International Astronautical Congress, Valencia, Spain, October 2006, IAC-06-E4.3.01.

56. North American Aviation Report, NA 59-1247, 8.

57. The payload bay was narrow and long, apparently displacing one fuel tank from the original X-15 design. Interestingly, surviving cutaway drawings in the technical reports show a dorsal payload bay, but do not remove the internal fuel tank, which is contradictory.

58. North American Aviation Report, NA 59-1247, pp. 95, 102; North American Aviation Report, NA 59-1586, p. 96.

59. Interestingly, at the same time columbium was considered the material for the X-20 DYNA-SOAR, but the amount required exceeded the world's annual production of the element. Had both continued, there would have been competition for resources to complicate their acquisition.

60. Jenkins and Landis 2003, pp. 179, 181; Hallion 1986, Vol. 1, pp. 35-37; North American Aviation Report, NA 59-1247, pp. 95, 102.

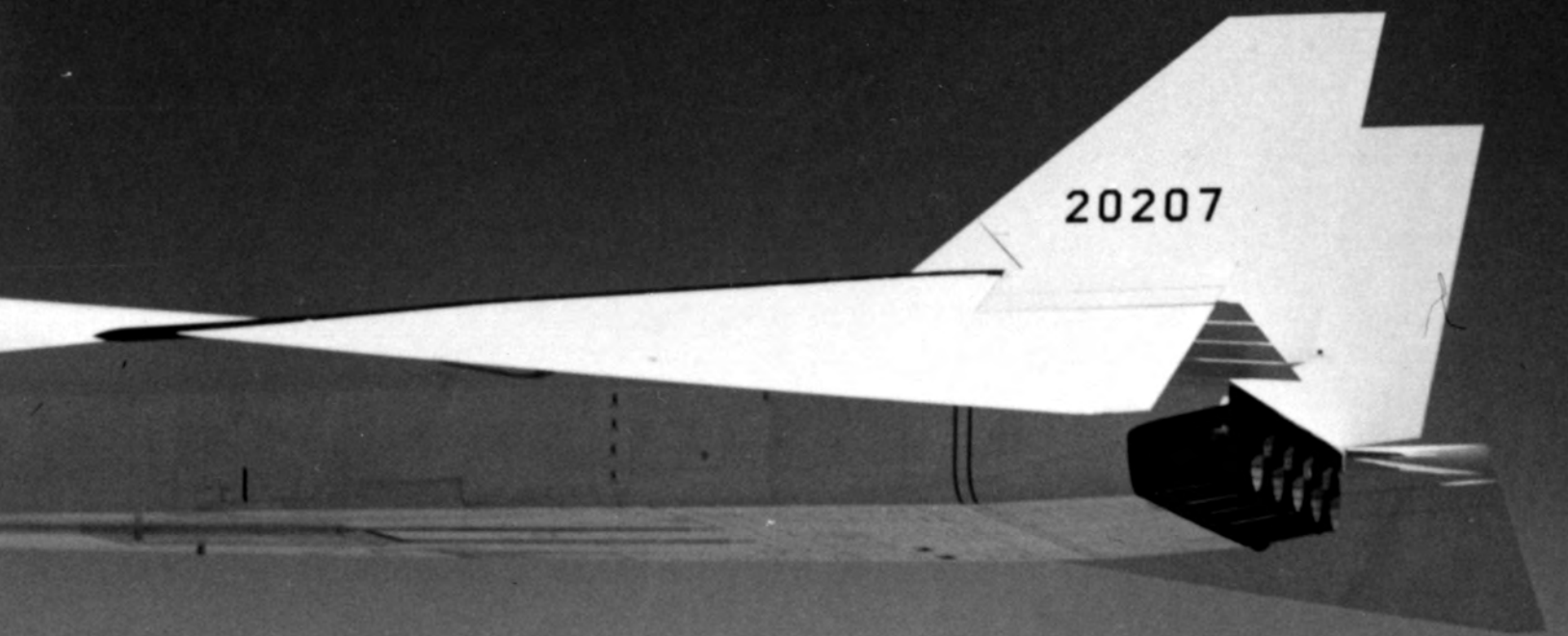
61. Carter, Launor F., *Interpretive Study of the Formulation of the Air Force Space Program* (Washington, D.C: US Air Force History Office, February 4, 1963), pp. 3, 16.

62. U.S. Congress, House, Committee on Government Operations, 85th Congress, 2nd Session, June 4, 1965, House Report 445, p. 82; U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, *NASA Authorization for fiscal year 1963*, 87th Congress, 2nd Session, June 1962, p. 348. This was hardly the end of the push for military human spaceflight, but the subsequent absence of such programs speaks volumes about the realities. Conceptual studies replaced the efforts aimed at actually developing flying systems, as both Air Force Systems Command's Aeronautical Systems Division and its Space and Missile Systems organization/Space Systems Division pursued concepts variously named Aerospaceplane, Trans-Atmospheric Vehicles, Reusable Aerodynamic Space Vehicles, and other names. These are covered in more detail in Temple, 2005, *passim* Improved rocket technology and other advances brought spaceplanes back into vogue in the late 1980s with the National Aerospace Plane (NASP). However, neither the NASP nor any of its predecessors were ever considered to be the key to operational uses of space - robotic spacecraft remain unchallenged for their operational utility to this day.

Chasing the XB



B-70 *A Valkyrie*



George J. Marrett

(Overleaf) North American Aviation XB-70A Valkyrie flying over Edwards AFB, 1965. (All photos courtesy of the author.)

“HOLD YOUR POSITION, WE ARE CHANGING YOUR MISSION, THE NUMBER TWO XB-70 VALKYRIE HAS CRASHED”

Hold your position,” crackled the Edwards Command Post over the UHF radio, “We are changing your mission, the number two XB-70 Valkyrie has crashed.”

The date was June 8, 1966, and I was acting as an instructor pilot in a T-38 Talon. My student, sitting in the front cockpit, was a Strategic Air Command (SAC) colonel obtaining some supersonic flight experience in the T-38 before checking out in the SR-71 Blackbird. We had preflighted our aircraft and were preparing to start engines when we received the chilling call. At the time I was a fighter test pilot assigned to Flight Test Operations and involved with testing the F-4C Phantom, F-5A Freedom Fighter and F-111A Aardvark. Colonel Chuck Yeager was the commandant of the Test Pilot School when I attended in 1964. Before my assignment to the school I had been an interceptor pilot in Air Defense Command for four years flying the F-101B Voodoo. So I was a very experienced pilot and prepared to complete any task assigned to me by the Command Post.

It did not surprise me when I heard that an XB-70 had crashed. In the year and a half I had been acting as a safety chase pilot flying a T-38, F-4 or F-104, the XB-70 had many close calls. While the official Air Force name for the XB-70 was Valkyrie, North American Aviation, builder of the aircraft, called it *The Great White One*. Because of all the mechanical problems the aircraft experienced, we safety chase pilots called it *Cecil, the Sea Sick Sea Serpent*. It did resemble a sea creature with its long thin neck and curved body and became sick on every test flight that I can recall.

Chase pilots routinely accompanied the XB-70 on every flight. We flew a loose formation position about 100 feet abeam the test aircraft, and looked for fuel or oil leaks, smoke trailing behind any part of the plane, missing side panels or any other unusual conditions and called them to the attention of the XB-70 test pilot. We had to be alert; aircraft problems occurred on every flight, some were very serious.

“One of these days *Cecil* will stub its toe and go down,” I had previously predicted to other pilots.

Little did I realize then the strange and ironic sequence of events, which had occurred to make June 8, 1966, one of the darkest days in Edwards flight test history.

Moments later the Command Post reported to me that the XB-70 had crashed about 35 miles from Edwards, just north of Barstow, California

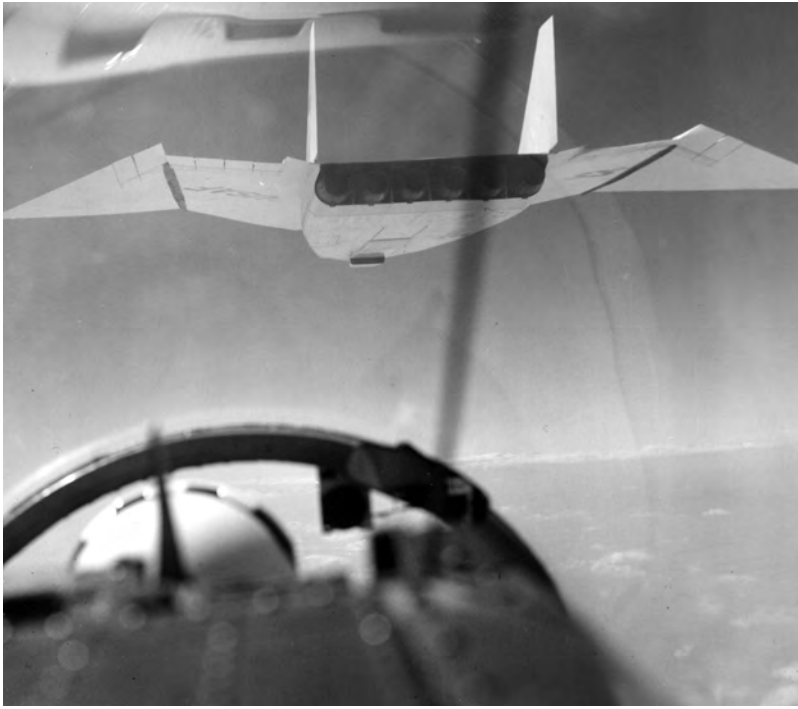
and directed us to take off and orbit over the crash site acting as a radio relay. We would relieve a T-33, which had been above the scene providing information on the unfolding events, but was running low on fuel and needed to return to Edwards. Additionally, a helicopter had been scrambled from Edwards to recover survivors, but would not arrive for another 10 or 15 minutes. We were directed to orbit overhead and relay information since the Command Post could not maintain line-of-sight radio contact with the helicopter while it was on the ground.

As soon as we were airborne in the T-38, I spotted black smoke from the XB-70 crash site drifting up to around 10,000 feet into the clear blue Mojave sky. As the rescue helicopter approached the crash scene, we relayed a report from the Command Post to the chopper pilots to look for evidence of another downed aircraft, a NASA F-104. Parts of the XB-70 were still burning intensely, a picture that is still fresh in my memory even after forty-one years. I knew all the XB-70 pilots and many of the NASA pilots. Death was becoming a common visitor in the test community; I feared its presence again.

Orbiting over the smoking ruins, I recalled the first time I saw the XB-70 when I was a student in the test pilot school. Visiting the North American Aviation facility at Palmdale, California, I watched the incredible XB-70 roll out into the aviation spotlight of the world. The long-secret plane looked like a hooded cobra inside the shadows of the huge hangar where final assembly had been completed. The majestic plane, covered with a special white paint to resist the searing temperature of air friction, was designed to ride on its own shock wave. Its needle-like nose was shaped to push aside air beneath the triangular wing. The tips folded down 65 degrees to provide the same type of lift as the wave under a high-speed boat.

The aircraft was gigantic, 196 feet long with a 105-foot wingspan and twin 30-foot vertical tails. Even the air ducts, which supplied air for six General Electric J-93 engines were huge, measuring seven feet high and eighty feet long. The engines themselves were in the 30,000-pound class, gulping air through twin ducts controlled by a very complex and troublesome intake system. The eight landing gear tires appeared to be sprayed with an aluminum-colored paint, giving the Valkyrie a science-fiction image. Weighing in at 550,000 pounds, the XB-70 was in a class by itself.

George J. Marrett, from Grand Island, Nebraska, was a test pilot for the U.S. Air Force and Hughes Aircraft Company. In 1968-1969 he flew 188 combat missions in Vietnam as a Douglas A-1E Skyraider “Sandy” rescue pilot in the 602nd Fighter Squadron (C), C for Commando, flying from Udorn and Nakhon Phanom Royal Thai Air Force Bases in Thailand. After retirement from Hughes Aircraft in 1989, he became one of the founders of the Estrella Warbird Museum at the Paso Robles, California airport where he owns and flies a 1945 Stinson L-5E Sentinel. In the last four years he has published three books: Cheating Death: Combat Air Rescues in Vietnam and Laos by the Smithsonian Institute Press, Howard Hughes: Aviator by the Naval Institute Press, and Testing Death: Hughes Aircraft Test Pilots and Cold War Weaponry by Praeger Security International. The Naval Institute Press will publish his latest book, Contrails over the Mojave, in Spring 2008.



Capt. George J. Marrett flying chase on North American XB-70A Valkyrie, 1965.

THE ENGINEERS REQUESTED THAT I FLY A T-38 WITH A NORTH AMERICAN AVIATION PHOTOGRAPHER IN THE REAR COCKPIT AND ATTEMPT TO POSITION THE AIRCRAFT DIRECTLY BEHIND THE ENGINE EXHAUST NOZZLES

To complete flight tests at Mach 3, the XB-70 flew a huge circular flight path covering the five Western states of California, Nevada, Idaho, Utah and Arizona. Frequently a Convair B-58 Hustler with another XB-70 test pilot at the controls would fly a Mach 2 circle over the ground, staying inside the XB-70's flight path. That way another test pilot with intimate knowledge of the XB-70 could quickly join up and render assistance if needed. Also, an F-104 was pre-positioned at Mountain Home Air Force Base, Idaho, or Hill Air Force Base, Utah, ready to join up in formation if the XB-70 needed to land at either base or one of the dry lakebeds in that area. A massive armada of support aircraft was required for each XB-70 flight, similar to the X-15 rocketship missions.

My mind flashed back to the many flights I spent chasing the Valkyrie as it performed flight test maneuvers. Due to hydraulic, electrical or other mechanical failures occurring on practically every flight, several safety chase aircraft flew with the XB-70 during its test mission. A T-38 usually accompanied the XB-70 on both takeoff and landing, confirming that the landing gear worked properly. The takeoff chase pilot launched first, climbed over Rogers Dry Lake, and pulled up into a downwind pattern opposite the heading of the XB-70, which was awaiting start of takeoff roll on Runway 04. Due to the complexity of the XB-70 landing gear operation, the takeoff safety chase crew performed what we termed an "in-flight-pickup." When the XB-70 pilot called on the UHF radio, "Rolling in 30 seconds," the T-38 pilot timed the start of his 180-degree descending turn so as to be directly abeam the XB-70 as it lifted airborne. Standard practice called for the XB-70 test pilot to delay gear retraction until the T-38 pilot moved in under the aircraft and was in a position to watch the complex gear retraction motions. One of the other XB-70

test pilots frequently rode in the rear cockpit of my T-38 and confirmed correct gear retraction.

While flying safety chase, I had observed landing gear malfunctions many times. I saw the four tires on one gear arranged perpendicular to the ground—an eerie sight. Once I even saw the entire landing gear rotated 90 degrees away from the fuselage centerline, a condition that would require the test pilots to eject if it could not be corrected. There was always a sense of impending doom as one flew near this beautiful Mach 3 bird; disaster could be only moments away.

Another time, while I was flying in the back seat of an F-104D piloted by fellow fighter test pilot Capt. Joe Strofance, the XB-70 pilots asked us to fly directly under the XB-70 and visually check a landing gear linkage in the wheel well. The F-104 had a T-tail extending about 8 feet higher than the pilot's head, so vertical clearance of our tail and the underside of the XB-70's lower wing would be a very critical factor. Strofance deftly flew the F-104 not more than twelve to fifteen feet directly underneath the XB-70. Meanwhile, I was absolutely terrified without my own hands on the flight controls and throttle to assure myself that we would not collide. I pressed my body as low in the corner of the upward ejection seat as I could—knowing full well that this position could not possibly save me if we did collide. But taking any action at that moment made me feel better.

Early in the XB-70 flight test program, the J93 engines could not be restarted in-flight unless the aircraft was flown to at least 0.8 Mach, an excessive speed to have as a standard procedure. North American Aviation and General Electric engineers suspected that an irregular fuel pattern was to blame. The engineers requested that I fly a T-38 with a North American Aviation photographer in the rear cockpit and attempt to position the aircraft directly behind the engine exhaust nozzles so that photographs could be taken of the fuel pattern. I flew the nose of the T-38 to within fifteen feet of the engine exhaust nozzles, and slightly low so the photographer could aim his camera directly above my flight helmet and into the nozzles. Flight procedures had not been published nor briefed to safety chase pilots on any special precautions to be taken in flying very close to the XB-70. We simply relied on close verbal communications with the XB-70 test pilots and used whatever flight control movements were required to slide into position and stay there. We were considered part of the test pilot fraternity and expected to use good judgment. We got the photos.

The most demanding and dangerous personal experiences I encountered with the XB-70 before the accident of the second aircraft involved flying formation in supersonic flight. North American Aviation management wanted photographs of the XB-70 with the wing tips at their full down position of 65 degrees. The aircraft took off with the tips at zero degrees, or level. As the plane accelerated to 500 knots the tips were lowered to 30 degrees. Above Mach 1.2 the tips were placed full down.



Capt. George J. Marrett standing in front of Northrop T-38A Talon at Edwards AFB, 1964.

A SHOCK WAVE CAME OFF BOTH THE XB-70's NOSE AND TAIL, GRADUALLY BENDING BACK AT A GREATER ANGLE AS THE PLANE ACCELERATED FASTER AND FASTER

MANY CHASE FLIGHTS WERE FLOWN BEFORE WE GOT THAT PERFECT SUPERSONIC PHOTO

Aircraft flying at supersonic speeds create shock waves, which can be heard by an observer on the ground. The pilot in the supersonic aircraft does not hear this shock wave. He just feels slight changes in his flight controls and sees a momentary hesitation in his airspeed indicator around Mach .95 until it jumps to over Mach 1. The North American photo would have to be acquired near the shock wave.

The XB-70's shock wave had a great impact on a chase plane flying in formation both from a visual and aerodynamic perspective. Portions of the shock wave were visually observed as an optical distortion of the XB-70 airframe. In high school physics, we see the effect of placing a pencil in a glass of water. Due to the difference of index of refraction between air and water, the pencil appears to be bent or displaced as viewed by the eye. This same effect occurred with the Valkyrie, the plane was not exactly where I visually observed it.

A shock wave came off both the XB-70's nose and tail, gradually bending back at a greater angle as the plane accelerated faster and faster. It was important for the pilot in the photo chase plane to fly forward of the shock wave created by the XB-70's nose, thereby flying in undisturbed air. If he got behind the shock wave, the F-104D, with tip tanks installed in the tandem cockpit version, did not have enough engine power to punch back through the wave. Because this shock wave is actually a cone surrounding the supersonic XB-70, a chase aircraft will also experience a different effect on the wing nearest the XB-70 while flying in the shock wave. This disturbance caused the chase plane's nose to oscillate becoming very "squirrely." Many chase flights were flown before we got that perfect supersonic photo.

As we circled over the crash scene in the T-38, I watched the helicopter land and recover North American Aviation's chief XB-70 test pilot, Alvin S.

"Al" White. Al White, age 48 was born in Berkeley, California, and joined the Army Air Corps in 1941. He served first as an advanced flying instructor before going overseas. White spent two years in the European Theatre flying the P-51 Mustang in six major campaigns, including the Battle of the Bulge. He received an engineering degree from the University of California in 1947. White then joined North American Aviation as an engineering test pilot and participated in the flight testing of the F-86 SabreJet, F-100 SuperSabre, the F-107 and Sabreliner business jet. Al White was severely injured in the accident with back and arm injuries, but survived. However, he never flew the XB-70 again.

The helicopter crew reported they had found one fatality and we relayed that message to the Edwards Command Post. Later I would find out that the pilot killed was Maj. Carl C. Cross, age 41 from Chattanooga, Tennessee. Carl Cross was an Air Force bomber/cargo test pilot flying his first XB-70 flight as copilot. He earned his BS degree through the Air Force Institute of Technology program at Wright-Patterson Air Force Base, Ohio and attended the test pilot school in 1960. Cross was a quiet unassuming type, just back from a combat tour in Vietnam. Ironically, after a year dodging ground fire in the war, he was killed in the skies over the Mojave Desert. His death was a tremendous loss to those of us who knew him at the Flight Test Center.

Several months before the accident, I had flown as copilot on a Lockheed C-141 Starlifter; assisting Carl Cross perform "speed-power" performance tests. He had allowed me to make several touch-and-go landings in the Starlifter at the end of the mission. This was a tremendous thrill for me as a fighter pilot, a chance to fly what was then the most modern and advanced Air Force military transport. Follow-on versions of the C-141 flew for over 40 years but have now all been retired.

Only two XB-70s, serial numbers 62-0001 and 62-0207, were ever built. The second and most advanced model was the one involved in the accident. As a result of this mishap, the remaining XB-70 was grounded pending results of one of the most extensive accident investigations ever performed at the Flight Test Center.

The final accident report stated that the pilots of the XB-70 had completed their scheduled test flight. At the end of the flight, General Electric (maker of the Valkyrie jet engines) requested a photographer take publicity photos from a civilian Lear Jet. The photos would show four different fighter-type aircraft (F-5, F-4B, T-38 and F-104) all equipped with General Electric engines, joined with the XB-70 in formation flight.

It was during this formation flight that the accident occurred. The F-104N, serial number N813NA, flown by Joe Walker, NASA's chief test pilot at Edwards, who was on the XB-70's right wing, collided with the larger aircraft. The collision caused the F-104 to disintegrate and ripped off all the XB-70's left vertical tail and half of its right.



NASA test pilot Joseph A. "Joe" Walker preflighting Lockheed F-104 Starfighter at Edwards AFB, 1965. Killed in XB-70 / F-104 crash.

AS CHASE
PILOTS WE
ALWAYS
FLEW WITH A
GREAT
SENSE OF
CAUTION

Without the vertical tail to provide directional stability, the XB-70 fell into an uncontrollable spin. From the wreckage of both planes, it was quickly determined what caused the accident. Why the accident occurred was never determined precisely.

When two aircraft fly in close wing formation, they disrupt the airflow on the wing closest to one another. Their wing tip vortices are slightly modified, causing each wing to produce a small increase in lift. With two similar aircraft in formation, each pilot unconsciously holds a little "aileron into" the other aircraft. When the two aircraft are of greatly different wing size and sweep angle, as the case with the XB-70 and F-104, the relatively small F-104 experienced a much, much larger effect.

As automobile drivers, we sense the airflow off a large truck as we go around it on the highway at high speed. Our steering wheel must be slightly turned into the truck to maintain a straight course down the highway. As we pull in front of the truck we must remove this small steering angle to remain aligned with the road. We make these corrections automatically, sometimes without even being aware of it. Pilots don't look at their control stick any more than drivers look at their steering wheel. To maintain a safe position requires continuous visual contact of the other vehicle and smooth but quick adjustment of the steering wheel, or in the case of an aircraft, the control stick.

Joseph A. "Joe" Walker, age 45 from Washington, Pennsylvania was a very experienced pilot, a NASA test pilot for twenty-one years. Walker earned a

degree in physics from Washington and Jefferson before entering the Army Air Corps where he flew the P-38 Lightning in World War II. Walker had flown every experimental rocket aircraft from the early Bell X-1 to the North American X-15, flying the X-15 to a world speed record 4,104 mph and a record-breaking altitude of 354,200-feet. He had thousands of hours in the air and had flown practically every jet aircraft produced by the United States. In fact, Walker was scheduled to be the next pilot to qualify in the XB-70.

Evidently Joe Walker was distracted for a split second and drifted in too close to the XB-70's right wing or the strong wing tip vortices flowing off the XB-70 overpowered his ability to control the small-winged F-104, and his jet was pulled into physical contact. In either case, the destruction of his aircraft was total and his death immediate.

The black cloud, which flew with *Cecil*, continued to darken the Mojave Desert. A couple of days after the accident, my friend Captain Joe Basquez, an Air Force helicopter test pilot, was ferrying members of the accident board between the crash site and the Edwards flight line in a Bell UH-1 Huey. Basquez, age 31, was nicknamed "Jolly Joe" because of his magnetic personality and positive attitude. He had just graduated from the Navy Test Pilot School at Patuxent River, Maryland, and was assigned to Edwards to test Air Force helicopters. After landing on the ramp, Basquez shut down his jet engine and started walking away. Suddenly a gust of wind caused one blade to arc down striking him in the head. His severe injury required medical-evacuation to a Naval Hospital in San Diego. Basquez never flew again. Likewise, the General Electric engine photo flight was never attempted again.

After the accident board completed their investigation, the one remaining XB-70 resumed flying five months after the crash. Unfortunately it was the number one aircraft that did not have all the improvements made in the number two aircraft. By 1967 the XB-70 was transferred to NASA and thirty-two additional test flights were accomplished over the next two years. Fitzhugh "Fitz" Fulton, age 43 from Blakely, Georgia, and copilot Emil "Ted" Sturmthal, both test pilot friends of mine, ferried *Cecil*, the *Seasick Sea Serpent* to its final resting place at the National Museum of the United States Air Force on February 4, 1969. Sturmthal is credited with having said, "I'd do anything to keep the Valkyrie flying—except pay for it myself!"

Flying safety chase on the XB-70 Valkyrie was a thrilling experience, with never a dull moment. It was a challenge to fly far enough away to maintain a safe position and still be close enough to be of value to the XB-70 test pilots. As chase pilots we always flew with a great sense of caution and concern, never forgetting we were swimming through a great sea of air with a creature named *Cecil*, whose habits were not all known and whose very size could consume us in a flash—as it did my friends on that tragic day on the high Mojave Desert. ■

Aviator of Fortune: Lowell Yerex and the Anglo-American Commercial Rivalry, 1931-1946. By Erik Benson. College Station: Texas A&M University Press, 2006. Maps. Photographs. Notes. Bibliography. Index. Pp. xii, 264. \$45.00 ISBN: 1-58544-500-4

This is the story of an aviation pioneer—one who can rightly be labeled “forgotten.” Lowell Yerex built Central American aviation in the 1930s, at one point handling more cargo than any other airline in the hemisphere. But his work failed to last—a victim to forces greater than mere business innovation.

As a British citizen with an American upbringing, Yerex struggled throughout to establish his legitimacy with each government in order to gain government backing for his ventures. Officially or not, airlines of the period required government backing, particularly in areas where governments competed for influence. Central America and the Caribbean were such arenas of rivalry between the U.S. and Britain. Yerex consistently fell between the two stools: too American in his business style to garner British trust and support, and untrustworthy to the U.S. because of his Canadian birth. Besides, the U.S. preferred Pan American, already its carrier of choice in other areas and naturally enjoying powerful sponsors in the bureaucracy.

Despite the obstacles, Yerex built an airline that provided vital connectivity in Central America. He did so by innovating (critics called it cutting corners) and stripping down and modifying aircraft to fit local requirements (smaller runways in tighter areas, oversized cargoes, and overworked or bare-bones crews). While critics said he was violating safety standards, his accident record was good; and his airline delivered the goods. It became the national airline of several countries in the 1930s.

Yerex was ambitious, of course. He sought to tie his regional line to the U.S. through Miami. He also built a solid, if small, Caribbean line. But he eventually stretched himself too far, and the outbreak of World War II put him in a bind when funding and equipment became tight and getting either required a patron. Yerex's empire collapsed, and he faded from history.

The book is interesting in its portrayal of Yerex's building of an airline in a previously unserved area of the Americas. It shows a creative problem solver providing much needed support where the larger players opted not to go. Unfortunately, the book is weak in explaining exactly how Yerex got to be defined as a near outlaw. And presentation of the Anglo-American rivalry is a bit murky.

Benson performed a great deal of research into government documents on both sides of the Atlantic. Somewhat surprisingly, his documentation is short of material actually created by the central character. Perhaps the Yerex documents are unavailable, but their absence is a major deficiency. Government correspondence and reports are good sources for the decision-making process, but they show little of Yerex's motivation and the internal workings of his businesses. Benson has done a good job of working around the gaps, but the gaps remain nevertheless. That said, within the limitations of the evidence, this work is solid aviation industry history and worth the time it takes to read it.

John Barnhill, Ph.D., Independent Scholar, Houston, Texas



No End in Sight: The Continuing Menace of Nuclear Proliferation. By Nathan E. Busch. Lexington The University of Kentucky Press, 2004. Maps. Tables, Diagrams. Illustrations. Notes. Appendices. Glossary. Bibliography. Index. Pp. xiv, 490. \$40.00 ISBN: 0-8131-2323-2.

Nathan Busch is an assistant professor of political science at Christopher Newport University in Virginia. He invested several years into the research and preparation of this scholarly work, including a research fellowship at Los Alamos National Laboratory. In addition to this work, Busch has published several articles on the topic of nuclear weapons and appears to be an active participant in the ongoing dialogue of nuclear weapons proliferation.

The book opens with an assessment of the “optimist” and “pessimist” interpretations of nuclear proliferation. Essentially, the optimist perspective iterates that nuclear proliferation can be a positive force for international stability, predicated on the idea that states with nuclear arms will be more reluctant to engage in conventional conflicts for fear of escalation. The pessimist perspective asserts a contrary position predicated on a lack of credible evidence supporting the optimist standpoint. Busch offers examples—primarily that of India and Pakistan, two nuclear powers—who have engaged in several conventional engagements, undermining the optimist interpretation.

Busch asserts, through case studies of the overt nuclear powers (e.g. the U.S., Russia, China, India, and Pakistan; omit-

ting the UK and France for their assumed similarity to the U.S., and Israel, based on the ultra-secretive nature of their nuclear weapons program), that the optimistic interpretation of nuclear proliferation is fundamentally fallacious. One of the cornerstones of this argument is that the U.S., assumed to be the most stable of the nuclear powers, has faced a number of near-crises throughout its period of nuclear weapons possession. The author also examines nuclear proliferation in the “newly proliferating states” of Iraq, Iran, and North Korea. He also offers some theories on the assumed development of nuclear weapons programs in those states.

The author strings together his arguments cogently and effectively. Based on the idea that even the U.S. has had problems with command and control, he maintains that less stable polities would have even more troubles. This becomes most obvious in his case study of Russia's travails with the other former Soviet republics and their legacy of nuclear weapons. Additionally, Busch maintains that a newly proliferating state may be the most unstable for the purposes of nuclear command and control and materiel security.

Perhaps the only drawback in the work is that Busch failed to balance secondary and primary sources. He relied on a large number of American primary sources ranging from interviews with pertinent individuals to U.S. government documents, but there is a noted lack of sources from any of the other countries analyzed. He did review Indian, Pakistani, and Chinese newspapers and scholarly articles from many of the states included, but there are no “insider” documents. Whether this was impossible because of security or intentional on his part is impossible to say because he did not assess the sources he relied on.

Another criticism could be built around Busch's failure to address two very unique case studies in the history of nuclear weapons: Libya and South Africa. While he mentions Libya's claims to have given up the pursuit of nuclear weapons in 2003, he doesn't seem convinced that their abandonment of nuclear material production was genuine. He never mentions South Africa, even though it developed nuclear weapons and then voluntarily abandoned them. It would have been interesting to have incorporated these two states into his analysis.

On the whole, this work has a great deal of utility. While there are many works available on nuclear proliferation, Busch's work is timely with ongoing international events. Now, more than ever, nuclear prolifer-

eration stands as a hot-button issue, especially if one buys the argument that the Cold War was much less stable than usually interpreted. The book's conclusion also provides a way ahead, with the recommendation that the pessimist approach to nuclear proliferation is preferable.

David J. Schepp, 332d Air Expeditionary Wing Historian, Balad Air Base, Iraq



Spy Satellites and Other Intelligence Technologies That Changed History. By Thomas Graham, Jr., and Keith A. Hansen. Seattle: University of Washington Press, 2007. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. xvi, 171. \$14.95 Paperback ISBN: 978-0-295-98686-7

The adage that “good things come in small packages” certainly holds true for this book. At first glance, some readers might question whether so slender a volume has substantial value. Within the first dozen pages, however, most will recognize they are holding a real nugget. The authors, both veterans of strategic arms control and disarmament negotiations over several decades, deliver a straightforward analysis of the importance of intelligence-collection technologies to making arms control possible at the height of the Cold War. Had it been otherwise, the proliferation of nuclear weapons might have undermined international peace and security.

While numerous books over the past dozen years have explored the development of reconnaissance satellites and a few, like David Lindgren's *Trust But Verify* (2000), have provided some explication of the relationship between that technology and Cold War strategies or policies, *Spy Satellites* has a distinctive focus. It emphasizes the centrality of satellites and other intelligence-collection systems in promoting arms control and disarmament. Graham and Hansen carefully define and explain how “national technical means” (NTM), a purposeful euphemism for a host of space, air, sea, and ground sensor systems, enabled the United States and the Soviet Union to verify each other's compliance with arms-control agreements. Space-based systems, more than anything else, ensured “verification”—the essential ability to unilaterally and reliably determine that other signatories remained faithful to treaty obligations and did not jeopardize national security.

The authors explain how secrecy, historically, has had deleterious effects on verification. In the 1950s, the inability of

Western intelligence organizations to collect sufficient critical information about Soviet nuclear-delivery capabilities increased the risk of the United States overestimating Soviet strength and misdirecting resources to unnecessarily expand its own nuclear forces. Conversely, as happened during the mid-1970s, poor data and analytical inattention risked underestimating Soviet capabilities and, ultimately, leaving the United States vulnerable to a Soviet first strike. Employment of sophisticated NTM reduced the risk of miscalculation by American and Soviet leaders. Furthermore, by ensuring credible, effective verification of compliance, NTM paved the way for arms-control and disarmament agreements from SALT I to the Comprehensive Test Ban Treaty.

This little book contributes in a big way to helping us understand how NTM, especially reconnaissance satellites, were every bit as important as nuclear weapon systems in deterring major war between the Soviet Union and the United States. The ability to peer into each other's homeland and accurately measure the other side's strategic forces, thereby avoiding potentially catastrophic miscalculations, allowed the superpowers to change the course of history. Punctuating this history lesson, however, is the disquieting acknowledgment of limited NTM capability to monitor the presence and proliferation of “weapons of mass destruction” (WMD), particularly the chemical and biological variety, among rogue nations and terrorist groups.

The three-page postscript to *Spy Satellites* warns, furthermore, that the relentless progression of weapons technology is making space a more dangerous place. An arms race in space would undermine that domain as a sanctuary for “important national monitoring capabilities,” which it has been since the 1960s. The authors insist that preservation of international peace and security in the twenty-first century depends on long-term preservation of space-based monitoring and verification capabilities. Albeit a complicated undertaking with many interests to protect, they suggest crafting a “non-armament” agreement for space akin to the Antarctic Treaty of 1961 and, perhaps, built upon the Outer Space Treaty of 1967. This might be the only way to prevent a costly, destabilizing “weaponized space free-for-all” that would destroy the foundations previously laid for a comprehensive, treaty-based arms control and disarmament regime.

Dr. Rick W. Sturdevant, Deputy Director of History, HQ Air Force Space Command



The AEF Way of War: The American Army and Combat in World War I. By Mark Ethan Grotelueschen. New York: Cambridge University Press, 2007. Maps. Photographs. Notes. Bibliography. Index. Pp. x, 387. \$75.00. ISBN: 0-521-86434-8

This book is a detailed examination of the combat experience of the American Expeditionary Force (AEF) during World War I. Unlike most World War I histories of American involvement in the “Great War,” Grotelueschen's book goes beyond the well known stories of Belleau Wood and the Argonne Forest to describe how the AEF adapted to combat in France. Focusing on four AEF divisions, the 1st, 2nd, 26th, and 77th, the author analyzes their organization, training, and combat operations from the time they are established following the American entry into World War I in April 1917 until the end of the war in November 1918. In the process, he demonstrates how pre-war US Army doctrine clashed with the realities of trench warfare on the Western Front.

The first chapter examines the pre-war U.S. Army. Despite the opportunity to learn from the lessons of combat since the beginning of World War I in 1914, the US Army remained totally unprepared for the fighting raging on the Western Front. The senior leadership of the AEF, exemplified by AEF commander-in-chief General John J. Pershing, retains a belief in “open warfare,” a doctrine placing central emphasis on the individual infantryman with rifle and bayonet. With this doctrine, General Pershing hoped to break the stalemate on the Western Front. As the reader quickly learns, this “open warfare” doctrine proved unworkable in the static trench warfare prevailing between the Allies and Germany since late 1914.

In the following chapters, Grotelueschen follows each of the four AEF divisions as it reached France and prepared for combat. He examines how the officers and soldiers adjusted their tactics in response to initial combat experience. The official U.S. Army doctrine evolved in most cases to one of limited-objective, firepower-based, set-piece attacks requiring detailed planning and preparation. Artillery, not the rifle, was the “king of the battlefield” in World War I. The most successful at adapting to this new reality, the 1st and 2nd Divisions, are considered the premier AEF fighting units during the final months of World War I.

Through the combat experiences of these four AEF divisions, the reader gains a new appreciation for the tremendous achievement of the United States armed forces. In only eighteen months, a small, inexperienced U.S. Army with few modern

weapons expanded to a force of over two million men in Europe. Despite the ill suited pre-war doctrine of "open warfare," the AEF adapted to meet the demands of the modern warfare of the Western Front. In so doing, it played a crucial role in winning World War I. The success of the AEF lays the foundation for the firepower-focused doctrine that prevails through World War II and Korea. With the final veterans of the "Great War" passing away, Grotelueschen provides a distinguished critique of their battlefield success. His book is a must for anyone interested in World War I and the development of US Army doctrine.

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



Shadow and Stinger: Developing the AC-119G/K Gunships in the Vietnam War. By William P. Head. College Station: Texas A&M University Press, 2007. Tables. Illustrations. Photographs. Notes. Glossary. Bibliography. Index. Pp. xii, 340. \$49.95 ISBN: 1-58544-577-6

William P. Head, chief of the Air Logistics Center Office of History at Robins AFB, has contextualized development of the AC-119G and K gunships during the Vietnam War. He desired to unveil the important role of the Warner Robins Air Materiel Area (WRAMA) to remind readers of the significance of air logistics centers in national defense. In addition, he used the AC-119 story to narrate the challenges of wartime innovation in the evolving strategic context of the war and its ramifications for the air war. He also sought to provide a face to his history, ensuring that readers remember the human element of war. Designed for a general audience, *Shadow and Stinger* blends broad explanations of the Vietnam War with detailed program history.

Head structured the eleven-chapter book into three overlapping parts, the first of which explained the conceptual history of gunships. The story is well told and follows the themes of earlier works, including Jack Ballard's *Development and Employment of Fixed-Wing Gunships, 1962-1972*, and Richard Kott's *The Role of United States Air Force Gunships in Southeast Asia*. Head judiciously explained the perceived wartime need for gunships, the intellectual inspiration for these weapons, and the efforts of junior officers to convince their superiors of the need for them. For students of wartime military innovation, the AC-119 story

becomes a classic case of innovation from the ground up and of the tension of clashing service cultures. Examples included proponents of high flying and fast jets not desiring the addition of low-and-slow-flying converted cargo planes to the force; the desire of the Air Force not to lose the close air support mission to the Army; and the battles between Department of Defense analysts and Air Force program managers.

In the second major section, by far the largest, Head utilized previously unused archival material from the WRAMA archives and other sources to analyze the project's evolution, which focuses on WRAMA and contractor Fairchild-Hiller's actions. Here he resumed the trail first explored in the 1970s by Air Force historian Richard Maltais but added the perspective of an additional thirty years. These chapters, comprising over a third of the book, provide a highly detailed examination of contract changes, program requirements, theater headroom concerns, and technical problems. Minutely traced through archival 1960's minutes, messages, briefings, letters, and contracts, Head's account revealed the headaches that project personnel experienced in re-equipping a 1950s cargo plane to perform a 1970s mission. Moreover, the gaining command never specified the speed, weight, maneuverability, or operational capacity that it required. WRAMA had to develop two models of the same aircraft without clear guidance regarding mission profile, performance specifications, or concept of operations. This alone guaranteed frustration, delays, and cost increases.

Originally, Air Force leaders wanted to replace the AC-47 Spooky gunship with a C-130-based platform, but concerns over a shortage of theater airlift and the cost of developing a C-130 gunship forced consideration of other platforms. The service selected the fifties vintage C-119, agreeing upon two versions. The "G," known as *Shadow* and powered solely by twin propeller engines, flew mainly in South Vietnam and performed close air support. The more powerful "K" model (*Stinger*) added two jet pods to improve performance and flew interdiction missions in more heavily defended areas. Senior Air Force leaders ranging from the Chief of Staff's office to Seventh Air Force disagreed on the program's value, arguing that scarce resources were best applied to converting AC-130s. Secretary of the Air Force (and later Secretary of Defense) Harold K. Brown continuously asked for studies regarding cost and force mixture, as did the Air Staff, before demanding a mixed

fleet of gunships to satisfy cost concerns. Conceived as an interim solution until the arrival of AC-130s, the tale of the AC-119 became a microcosm of Defense Department-wide planning, programming, and budgeting issues.

Similar to the first section, the book's final section consists of a broad explanation of American grand and air power strategy in the war's closing years. Here Head went beyond his focus on the AC-119 to discuss major campaigns including Commando Hunt and the twin Linebackers. He showed the AC-119's contribution and effectiveness as a truck destroyer while explaining its weaknesses and limitations, concluding that the *Shadows* and *Stingers* were created prior to the Tet Offensive, a time when victory seemed possible, but that their ultimate contribution was covering a strategic retreat. To illuminate the human side of the story, Head allowed a few voices from the AC-119 community to tell their tales near the book's end.

Head wanted to create a history accessible to the general reader, and in the first and last sections of the book, he succeeded. The middle chapters describing programmatic details are likely to challenge many readers and may be more useful to specialists than many members of his target audience. Plentiful use of military terms and abbreviations ensures that readers unfamiliar with program development will flip often to the glossary which lists 179 acronyms. Relating the particular elements of program development necessitated some re-explanation of earlier points. Nonetheless, the scholarship is excellent, and the contextual notes (all included at the book's end and organized by chapter) will aid readers unfamiliar with the Vietnam War. A few minor editing errors appear, including a reference to the late Senator William Proxmire as representing Connecticut rather than Wisconsin. Such errors are few, and those seeking an explanation and analysis of AC-119 development will find Head's book useful.

Lt. Col. Steven A. Pomeroy, USAF, Deputy Head, Department of Military Strategic Studies, United States Air Force Academy



Farmans and SIAs: U.S. Army Aviation Training and Combat in Italy with Fiorello La Guardia, 1917-1918. By Jack B. Hilliard. Trento, Italy: LoGisma in collaboration with Museo Aeronautico. Illustrations. Photographs. Notes. Appendices. Glossary. Biblio-

graphy. Pp. 615. € 27,00 Paperback ISBN: 88-87621-60-8

When the United States declared war on Germany on April 16, 1917, the United States Army Air Service was grossly unprepared for the requirements that were immediately placed on it. There were only twenty-six pilots in the entire Air Service and only a few military airfields. If U.S. pilots were to be available to crew the large number of U.S. aircraft that were expected to reach Europe in the spring of 1918, they would have to be taught to fly by America's allies, including the Italians who offered to train 500 American flying cadets within twelve months.

The first detachment of aviation cadets to be trained in Europe sailed from New York on August 13, 1917. All forty-six had received their initial training at one of the aviation ground schools established at a number of American universities three years earlier. They were initially assigned to the French aviation flight school at Avord but were soon detached and assigned to the Italian aviation school at Foggia. They were the first of an eventual total of 457 American aviators to be trained there.

The bulk of the material in this book consists of extracts from several diaries kept by some of the members of this detachment as well as a number of Americans who entered the Italian training program later. The diary entries are all arranged chronologically and divided into a number of chapters describing: the voyage across the Atlantic, the transition from England and France to Foggia, life in the camp, flight training, and the very limited combat experienced by a few of the graduates. Of the 615 pages in this book, 576 are devoted to this material. The remaining pages contain brief commentary of the history of the American involvement at Foggia and four appendices. Included in the later is an extensive list of all the combat missions flown by the American graduates of the Italian aviation training program. Unfortunately, the book lacks an index, which severely hampers its use for reference.

Another weakness is problematic inclusion of multiple entries for a single date. This does not make for easy reading nor does it add significantly to the picture presented by this material. It would have been better if the author had selected the most representative entry for each date and discarded the others. The diary entries do provide a wealth of material on the journey to Foggia, however, which was quite an adventure for those involved. Travel was aboard troopships, which usu-

ally were converted passenger liners; and the cadets traveled in varying status depending on whatever the senior officer aboard decided. The diaries also provide a great deal of information on the nature of the training at Foggia as well as the living conditions, recreation, and morale of the American cadets.

One final comment: those readers who are interested in Fiorello LaGuardia should look elsewhere, as he is mentioned only briefly in passing.

Thomas Wildenberg, Burtonsville, Maryland



Unconquerable Nation: Knowing Our Enemy, Strengthening Ourselves. By Brian Michael Jenkins. Santa Monica, Calif.: RAND, 2006. Illustrations. Notes. Appendices. Bibliography. Index. Pp. vii, 222. \$19.95 Paperback ISBN: 0-8330-3891-5

Brian Jenkins initiated RAND's research on terrorism in 1972. He starts this book with an assessment of the current terrorism situation and what constitutes the enemy camp, goes on to offer a set of strategic principles to follow in countering terror, and ends with suggestions on how to win this war. All the while he proposes that the concept of a global conflict may conflate too many unconnected threats.

The faceless, amorphous nature of this threat makes it difficult for structured organizations to deal with by conventional methods. It's like punching a pillow when you try to fight a war without a front. Different types of terrorism require different responses. There is no "one size fits all," and there is also no quick fix. The worst period of terror within our own borders (except perhaps the genocide against the Native American population) lasted from Appomattox until the Civil Rights legislation of the 1960s. Such movements are often hydra-headed: cut one off and others may spring up to renew the attack. Their mindset is alien to us. Suicide is not a valued part of our culture. We don't have a religious devotion that encourages us to die for eternal salvation. We don't share the feral, fanatic appeal of martyrdom.

Though it may appear a matter of semantics, it is important to realize that there is not a Civil War in Iraq. There is no opponent government; not even a shadow government or government-in-exile. There is domestic violence (with some help from outside). It is a form of protest

and opposition accompanied by criminality and lawlessness.

Jenkins probably provides more detail than the general reader needs to understand the recommendations that he makes. He is not a Pollyanna, but he believes that "controlling" (even if not eradicating) terrorism is possible and offers concrete ideas. One intriguing thought is that much of the Islamic World is also threatened and that we should use the dynamic of a shared enemy to better advantage.

There are two useful appendices: one on selected Jihadist attacks since 9/11 and the other on failed plots. The reading list is divided into seventeen categories, which may be useful to some. The text is relatively short and worth reading by those concerned with "strengthening ourselves."

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



Chronological Encyclopedia of Soviet Single-Engine Fighters 1939-1951. By Herbert Léonard. Translated by Alan McKay. Paris: Histoire & Collections, 2005. Tables. Illustrations. Photographs. Appendices. Pp 208. 82,00 ISBN: 2-915239-60-6

Herbert Léonard, a well known singer and entertainment figure in France, has produced both a rare and wonderful book on Soviet fighter aircraft which were developed, designed and deployed during the Great Patriotic War (known here in the west as World War II). Léonard is obviously passionate about the subject, something which becomes readily apparent not only from the breadth of research that went into this work but also from the layout and contents within. He has assembled in one volume what seems to be every single-engine fighter design conceived in the USSR during this period.

Previous English language texts by authors such as Vaclav Nemecek and Heinz Nowarra have focused on a broad range of aircraft types as well as the period covered. Even the seminal Russian language work by V.B. Shavrov, *Istoriya Konstruktsii Samoletov v SSSR, 1938-1950*, deals as much with bombers and transport aircraft as it does with fighter designs.

Léonard has painstakingly amassed three-view drawings of each aircraft as well as a number of superbly colored side-view illustrations. However, he also tapped into the photo-archives of Russian

aviation historians for some really unique and excellent-quality images of the aircraft presented. This, again, is a major difference in comparison to some previous publications that relied heavily on photographs from the USSR that were edited with the peculiar airbrushed look all too familiar to centerfolds as well as Soviet era photographs—nice but not the real thing.

By and large, the book follows the chronological order of design not only by year but also by the time of year. Using this approach makes perfect sense, since an aircraft design can be followed and compared with those of other design OKBs (*Opytnoe Konstruktorskoe Byuro*, or Development Design Bureau).

The preface is important, as it prepares the reader with some of the specifics about this publication: abbreviations used; notes on the translation; and an explanation on the use of color-coded stars appearing next to the aircraft to let the reader know at a glance whether the fighter was a front-line craft, prototype, or simply a design study.

The book's foreword places into historical perspective the economic and political origins in Germany that led up to the Second World War. It also touches on the particular relationship established at the Treaty of Rapallo prior to the war between Russia and Germany. The essay continues with the status of the aircraft industry and air forces in the Soviet Union at this pivotal time in its history. It poignantly looks at how Stalin recognized Germany's ascendancy in this area and how he realized Russia's need for parity—if not technologically, then at least by numbers. For the reader who wants more on the topic, Von Hardesty's *Red Phoenix* is still an excellent source.

Of particular interest in this volume are the preliminary design studies and prototypes—both unfinished and flying. Concept aircraft are always curiosities as they anticipate future designs or possibilities. Some are obvious dead ends due to lack of speed, payloads, projected armament, or simply poor aerodynamics; while others are a window to the future but just a little ahead of their time.

Carl J. Bobrow, Collections Staff, National Air and Space Museum



On "Other War": Lessons from Five Decades of RAND Counterinsurgency Research. By Austin Long. Santa Monica, Calif.: RAND National Defense Research Institute, 2006. Photographs.

Appendix. Pp. xvii, 101 pages. \$20.00
Paperback ISBN: 0-8330-3926-1

On "Other War" is a deceptively slender monograph generated by RAND for the Office of the Secretary of Defense. Operations Enduring Freedom (Afghanistan) and Iraqi Freedom were specifically in mind when the author tackled five decades worth of counterinsurgency (COIN) research conducted by RAND in order to extrapolate lessons of value. This monograph succinctly summarizes lessons learned again and again in Malaya, Vietnam, Algeria, El Salvador, Nicaragua, and other conflicts in the post-World War Two era. In six short chapters, Long constructs what is essentially a paradigm for the conduct of COIN. One must understand the insurgent's motivations while undermining his pyramid of needs (weapons, financing, and a supportive population). He also identifies tools for isolating the insurgent from his requirements while at the same time developing the confidence of the population. Underlying successful COIN is a population that accepts the legitimacy of its government and is made secure from exploitation and retaliation. The population in COIN is the center of gravity. Long concludes that the metric for success in this arena is not the population's attitude but its actions.

This monograph addresses other key areas that must be embraced by an effective counterinsurgency. Areas of focus are:

Unity of effort and command: the various agencies involved in COIN cannot operate as autonomous entities; they must be synergistic and ultimately answer to one "master." Long sees the US ambassador as the most logical person in charge (in a sense like the "country teams" that serve under all ambassadors), and not the combatant commander. Consequently, there should be a structural hierarchy of effort that integrates all agencies (Long suggests structuring an integrated team effort from the village/city neighborhood level up to a "National Reconstruction Team" at the ambassadorial level).

Intelligence: all intelligence must be integrated and made available to the effort and not "stove piped" for sole use by the respective intelligence agencies.

Border control: the experiences in both Iraq and Afghanistan have demonstrated the need for effective control of movement across international borders.

COIN metrics to measure mission success: "body counting" in the Vietnam War was a useless metric. In COIN the measurements may come from subtle indicators such as voluntary flow of intelligence

from a cooperative population.
Identification of the need to provide insurgents with an alternative to continued struggle: One important tool is an amnesty and reward program to wean insurgents away.
Pacification: the COIN effort must integrate security with development.

Lt. Gen. Petraeus, the recently appointed commander of forces in Iraq, is a serious student of COIN. As the commanding general of the 101st Airborne Division, he employed, with some success, COIN techniques in northern Iraq in 2003-4. He now intends to turn the war in Iraq around by employing nation-wide the lessons of COIN. It is of great importance that the lessons summarized in this monograph be incorporated in pre-deployment training so that the actions of US combatants do not become counter-productive to the overall effort (witness the lasting impact of the 2003-4 Abu Ghraib Prison abuses).

In closing, Long makes an interesting observation: "The United States, by virtue of its massive nuclear and conventional capability, has driven almost all potential opponents to embrace terrorism and insurgency as their only potentially viable theory of victory." Consequently, conventional forces, if they are to be effective in current and future conflict, need to better understand and employ the lessons encapsulated in this book.

John L. Cirafici, Col. USAF (Ret.), Milford Delaware



Phantom Reflections: The Education of an American Fighter Pilot in Vietnam. By Mike McCarthy. Westport, Ct. and London: Praeger Security International, 2007. Photographs. Index. Pp. xiv, 176. \$44.95 ISBN: 0-275-99327-2

At first glance, this volume may appear to be just one more Vietnam War retrospective among many other similar tomes already in existence. However, there are a few unique facets to Colonel (retired) Mike McCarthy's action-filled account that make this a welcome addition to any aviation buff's bookshelf.

McCarthy, a veteran of 124 combat missions over Vietnam and Laos (now an Arizona State University professor), has done an excellent job at fulfilling the goal stated early in his introduction: "...to show what it felt like" to fly an F-4 Phantom II jet in combat. He traces his journey from flight school to Vietnam and beyond, highlighting key aspects of air-to-

air and air-to-ground operations, as well as providing a glimpse into the mindset of a young American fighter pilot. The majority of the text revolves around his one-year assignment as a member of the famous 8th Tactical Fighter Wing, Ubon Royal Thai Air Base, Thailand, from 1967 to 1968, and his personal journey from peacetime airman to combat veteran. The memoir includes many humorous and serious accounts of what life was like during this turbulent yet transformational period in Air Force history. Mission tactics, procedures, and hazards are accurately described in detail. What makes this account stand out from other Vietnam “there I was...”-type memoirs, is its jargon-free, easy-to-understand explanations of air combat techniques, strategies, and formations. For example, the author uses a three-dimensional model to describe wingman and flight lead maneuvers that enable the reader to grasp these concepts without the need for a sketch pad. Likewise, when the author describes his fear at being assigned “number four” in a bombing run over Hanoi, he then takes the time to explain that the phrase refers to the trailing aircraft in a flight of four aircraft—statistically, the aircraft that usually receives the most battle damage. One gets the impression that this book was not primarily written for fellow air warriors, but rather for readers without a military or flying background.

There is a welcome absence of combat glamorization that gives the book an aura of integrity. Pre-mission feelings of fear and anxiety are accurately portrayed, and the gripping narrative includes the retelling of a close call with an enemy surface-to-air missile that exploded mere meters away from McCarthy’s aircraft. There is also an interesting description of the combat rescue of F-100 driver and future Voyager pilot Dick Rutan, and McCarthy’s own admissions of relationship troubles between loved ones and family members that often occur during long deployments.

Despite the smooth text, there are some distractions that take away from the book’s potential: the rather hefty price tag for such a small volume is one. While the author does include 19 original photographs from his personal collection, he did not provide maps or references of any kind. The noticeable map void proves troublesome when trying to visualize locations of mentioned airbases and enemy targets. Likewise, I would have expected a book written by a university professor to have included footnotes and a simple list of references and sources, if not a bibliography. Nevertheless, while the book may not meet the scholarly level useful for his-

torians, it is addictively engrossing and a must read for anyone interested in a close-up view of the Vietnam air war. Mike McCarthy is completely successful in attaining his goal of showing us all “what it was like.”

Lt. Col. Stephen T. Ziadie, USAF, 341st Space Wing, Malmstrom AFB, Montana



A Carrier at War. By Richard F. Miller. Dulles, Va.: Potomac Books, 2007. Map. Photographs. Index. Pp. xii, 243. \$17.95 paperback. ISBN: 1-59797-047-6

Inasmuch as I’d seen very little about the Navy’s role in Iraqi Freedom, I was anxious to see what this book had to offer to fill the void. It wasn’t exactly what I hoped for. The author didn’t get aboard the ship (USS *Kittyhawk*, CV 63) until page 59, and the first combat flight wasn’t launched from the carrier until page 219. Nonetheless, the work is enlightening in some respects and even entertaining. However, I’ve learned more about the missions and capabilities of carriers from my favorite television show, “JAG.”

I’ve read a considerable number of stories by other embedded reporters, but this one varies both in the locale of the reporting and the background of the reporter. Miller is a 51-year-old with a law degree and a 25-year career in investment banking who started a second vocation as an historian specializing in the social aspects of our Civil War. Family connections expedited getting credentials as a correspondent for Talk Radio News Service.

During the two weeks he spent on the “Shitty Kitty,” he describes how the suspense builds up to the moment of truth when the F/A-18 Hornets and F-14 Tomcats are catapulted with live munitions toward living targets. The approach he used is to cover, in turn, each function and activity aboard ship and show how each contributed to the total effort. He spent time in the brig, sick bay, chaplains’ office, wardroom, enlisted mess, and smoking sponsors. From these contacts, he drew conclusions about the feelings on a number of issues such as going to war and racial integration. He touched on “Don’t Ask, Don’t Tell,” but not in any depth. I’m not sure he is aware of what the Universal Code of Military Justice (UCMJ) says about sodomy. He may know less about with it takes to change a law that is strongly supported by many Americans.

Miller was not alone among the

embedded reporters in not having had military service (their ranks are thinning); but, in his case, this lack was a factor leading him to accept a potentially hazardous assignment. He had evaded the draft during Vietnam and, rather than taking pride in the acumen and affluence that allowed him to beat the system, felt some shame in having others suffer in his stead. His strong religious convictions may have contributed to this feeling of guilt.

The one map included doesn’t serve any particular purpose. The numerous photographs are helpful, but I would have appreciated more photos of the facilities about which he wrote. I was hoping to update what I learned about carrier operations from the Naval War College 40 years ago, but that will have to wait for another book. This one does, however, give a good picture of life on a carrier today.

Brig. Gen. Curtis Hooper O’Sullivan, ANG (Ret.), Salida, California



Flight from Fear [A Novel]. By Sarah Byrn Rickman. Santa Fe, N.M.: Disc-Us Books, 1996. Pp. 241. \$16.50 Paperback ISBN: 1-58444-273-5 and

The Originals: The Women’s Auxiliary Ferrying Squadron in World War II. By Sarah Byrn Rickman. Santa Fe, N.M.: Disc-Us Books, 2001. Glossary. Bibliography. Index. Pp. 413. \$24.95 Paperback ISBN: 1-58444-264-6

It isn’t everyday that an author who writes a fictionalized account of an actual event so piques the interest of her readers that they can turn to another book written by the same author to learn more about the trials and tribulations of the first book’s heroines. Sarah Byrn Rickman has managed to pull off this feat with a World War II novel, *Flight from Fear*. The central character is Lacy Stearns whose pilot-husband is killed while flying his B-24 in England. Lacy, in a selfless act of love for her husband and her country, makes the courageous decision to earn her pilot’s wings so that she “can fly in her husband’s place.”

Once Lacy earns those wings she is accepted into Jackie Cochran’s Women Airforce Service Pilots (WASP) program. From there Rickman successfully weaves the fictionalized story of Lacy and her flying cohorts with true accounts of what happened to many of the WASPs who served during World War II. Much of this book relates the determination that it took for these young women to earn pilots’

licenses at a time when teaching a woman to fly was considered a waste of a man's time. Thankfully, many of these pioneering women crossed paths with men who were not only open-minded enough to teach a woman to fly but also realized that our country would need more pilots—even if some of them happened to be wearing dresses.

While *Flight from Fear* starts out with a predictable storyline, readers are soon surprised at the turn of several heartbreaking events and will find themselves stealing a few minutes here and there during their busy day to see just what will happen with Lacy and her new friends. Rickman even goes so far as to match some of her fictional characters' storylines with the family backgrounds of actual WASPs. Many of the women flyers cross paths in the storyline with Jackie Cochran, Nancy Love, and Betty Gillies.

While the emphasis in *Flight* is on the WASPs, Rickman's follow-up book, *The Originals*, tells the story of Nancy Love and the Women's Auxiliary Ferrying Squadron (WAFS). Love started this program with the encouragement of the accomplished Brig. Gen. William Tunner who liked to say while referring to his early flying days, "We didn't fly planes in those days; we rode them." Since it was easier to get fuel for an airplane than for a car, Nancy, while working at a civilian post with the Army Transport Command (ATC) in Baltimore, flew the sixty miles from Washington to Baltimore daily in her own plane. A chance meeting at the proverbial water cooler between Nancy's husband, Bob Love, and Tunner, who was scouring the country for skilled pilots, would set in motion the creation of Nancy's WAFS.

Though many books have been written about the WASPs, this is a book that finally focuses on the 29 qualifying women that Nancy Love had recruited for her WAF program. They were forever to be known as "the Originals," because they were flying before Cochran's Women's Flying Training Detachment (WFTD) program was airborne. This book delves deeply into each separate program as no other has. While previous books scratched just below the surface of the relationship between Love and Cochran, this one doesn't make the reader read between the lines. Rickman writes of the competition and machinations of the battles that went on behind the scenes on the emerging and merging of both Nancy's and Jackie's programs. It didn't hurt Cochran's position that, through the influence of her millionaire husband, she was able to gain the ears of Franklin and Eleanor Roosevelt.

Excerpts taken from the interviews,

letters, and diaries of several "Originals" give the reader a sense of the intensity of these events as though they happened yesterday instead of decades ago. Rickman takes the reader along on some wild rides with the WAFS women who gradually worked their way up flying fifty different types of airplanes, from trainers to P-47s, P-51s, and P-38s. She covers the gut-wrenching last minute abort of Love's and Gillies' potential history-making flight as the first women to fly a B-17 "across the pond." These stories along with the merging of the two programs into the WASP program to their inevitable disbanding while the war was still on are covered in this volume.

Also of note are accounts over the years of WASPs trying to gain military recognition for their war efforts, only to be foiled. It was not until the mid 1970s when the ten women who began flight training for the U.S. Air Force were heralded in a Pentagon press release as "the first women military pilots" that things really started flying. WASP legislation was introduced thanks to the help of Barry Goldwater, who also happened to be one WASP's instrument instructor during the war; Tunner, who came out of retirement; and Hap Arnold's son, Bruce. In a last ditch effort, Arnold inserted a copy of a WASP's service discharge. When one congressman compared it to his own World War II discharge and realized they were identical, he and several others changed their votes in favor of the act.

Nancy Love didn't live long enough to see her "girls" get their recognition. When she died at age sixty-two, she left behind a box she had kept for more than thirty years. Inside was a handwritten list of the women pilots along with clippings and photographs of those who had died while under her command. Just as the veterans of World War II ranks are thinning, so too are theirs; and it's about time these WAFS get the recognition they deserve. Just as so many women pilots delivered desperately needed planes to their destinations, Sarah Rickman delivers this one for them.

Janet Baltas, Docent, Udvar-Hazy Center,
National Air and Space Museum



Marauder: Memoir of a B-26 Pilot in Europe in World War II. By Louis S. Rehr with Carleton R. Rehr. Jefferson, N.C.: McFarland, 2004. Photographs. Maps. Appendices. Index. Pp. 224. \$39.95 ISBN: 978-0-7864-1664-6

Louis Rehr's autobiography of his

World War II service as a B-26 pilot is a well written book from a knowledgeable veteran. It focuses on the period from his arrival in England with his B-26 in July 1944 until his return to the U.S. in June 1945.

Rehr's flying experience makes him an expert in the B-26 and its use to attack targets in France and Germany after D-Day, June 6, 1944. Rehr was a B-26 instructor pilot from February 1943 until he was sent to England in 1944. Because of his experience in the bomber, he often trained newer pilots and crewmen at his bases in England and France.

In addition to training others, Rehr flew 60 combat missions, leading other aircraft in 23 of them. He and his bombardier became very proficient at blowing up bridges to hinder German forces, even though his longer bombing runs for bridges placed him, his crew, and those following him in greater danger of attack from air and ground defenses.

Rehr does not hide the perils or his emotions. He discusses the deaths and injuries that resulted from training accidents, equipment malfunctions, and combat. He explains the perspective of a veteran pilot who has watched his peers die or return home, while green replacements fill the ranks. He expresses his dislike of the German pilots who continued to resist and fight long after Germany had clearly lost the war. Rehr's insightful personal comments about combat are punctuated by terrific photographs.

This book has great black and white pictures, from the cover shot of a B-26 on a bomb run with explosions in the background, to the last photo of the book with Rehr and his crew in front of a B-26. Included are shots of B-26s in formation, terrific pictures of bridges being hit by bombs, and other photos of bomb damage. There are many photos of the crews and air bases, which illustrate their living conditions during the war. Some of the most moving combat photos show a B-26 being hit by flak and a group of six B-26s under attack by a German Me 262 jet.

In contrast to the tales and photos of war, Rehr adds information about his personal experiences in Europe during peacetime. He visited Europe in 1938 and was able to contrast his vacation memories with the ruined cities he visited during and after the war. Before and during the war he visited London and Paris. After the war was over, Rehr spent May-June 1945 stationed in Germany as part of the forces disarming the defeated enemy. While stationed in southern Germany, he was able to visit that area and some of Italy.

After the war, Rehr went to college and became a farmer in Florida. An

appendix to the book by Lou Rehr's wife, Carleton, tells about Lou and seven of his fellow Marauder veterans and what they did after the war.

The information about the survivors helps put their lives in perspective, but it also highlights a weakness in the book. This biography is too short. The great photographs and well-written stories left me wanting to know even more about B-26 bombers and their crews. I recommend this book to anyone interested in World War II or in air campaigns. But, be warned that you may find yourself seeking to learn more about this aircraft.

Major Herman Reinhold, USAF, Administrative Law Attorney



Red Flag: Air Combat for the 21st Century. By Tyson V. Rininger. St. Paul, Minn.: Zenith Press, 2006. Maps. Photographs. Appendix. Index. Pp. 128. \$19.95 ISBN: 0-7603-2530-8.

Tyson Rininger promises to take readers "behind the scenes of the biggest, most complex, high-tech military exercise conducted anywhere in the world." The book largely delivers on that promise. Its well-organized chapters logically step through the history of Nellis AFB, the origins of Red Flag, the Red and Blue Teams, and the future of the exercise.

It is obvious that Red Flag cadre and exercise veterans provided considerable support to the author. The book is filled with quotes and stories from aircrew who provide an insider's view of Red Flag.

The best part of the book is the spectacular collection of photographs. Rininger is a top photographer for the International Council of Airshows whose photographs have graced the covers of *Airshows* magazine and *World Airshow News*. His collection of glossy photographs will make all readers, including those with just a casual interest in aviation, want to "strap in tight, light it up, and take to the skies."

At times, however, the author's overzealous quest to excite readers borders on exaggeration. For example, the book begins, "Red Flag. Two words that can make or break an air force fighter pilot." Really? Certainly, Red Flag provides some fabulous training, but the two-week exercise hardly makes or breaks an individual's aviation career. Moreover, Red Flag's training mandate goes beyond simply preparing fighter pilots for aerial combat. The real value of Red Flag lies in the integration of various platforms—bombers,

unmanned aerial vehicles, tankers, etc.

Because the book was published in 2006, it does not contain the most up-to-date Red Flag developments and includes some out-of-date information. In February 2007, the F-22 Raptor made a record-setting exercise debut, and the F-117A Nighthawk flew its last scheduled Red Flag. The book also discusses only briefly Red Flag Alaska. One photograph identifies General John Jumper as the USAF Chief of Staff, while a later quote is from General T. Michael Mosely, the current Chief.

Sidebars that describe military aircraft are also a slight disappointment. These provide only a cursory description of each aircraft's history, mission, and capabilities. Moreover, the appendix is slightly repetitive as it repeats information contained in the sidebars.

Additionally, the book uncritically parrot's industry claims regarding the future effectiveness of the F-22 and F-35. For example, "The F-22A will have better reliability and maintainability than any fighter aircraft in history. ... Increased F-22A reliability and maintainability pays off in less manpower to repair and maintain." The Raptor is a superb aircraft, but reliability and maintenance advantages over legacy aircraft have yet to materialize. In fact, the Raptor has underperformed in this area.

Lastly, the book devotes too much text describing mundane organizational activities at Nellis. In a book focused on Red Flag, does the reader really need to know that the 99th Air Base Wing is separated into three groups which provide a "wide array of services including transportation, supply, morale, welfare, recreation and services, contracting, civil engineering, security police, mission support, and communication? Or that the wing is responsible for the operation of a new 114-bed hospital? The space would be put to better use if it were devoted to including more of Rininger's amazing photography.

The author correctly notes, "Without a doubt, it is the Red Team that makes the Red Flag experience so successful." With that in mind, Rininger could have spent more time detailing how the new Aggressor squadron realistically replicates current threats. Armed with the latest intelligence, Aggressors go way beyond simple replication of old Soviet tactics.

On a side note, readers interested in learning more about the celebrated Red Baron report, a driving factor in the creation of Red Flag, should obtain a copy of the Fall 2005 (vol. 52, no. 3) edition of *Air Power History*. In "The Red Baron Re-

ports: What They Really Said," William Sayers attacks some of the myths surrounding the report.

Lt. Col. Lawrence Spinetta, USAF, 1st Fighter Wing Chief of Safety



The Last of a Breed. By Errol D. Severe. Eureka Springs, Ark.: Lighthouse Productions, 1997. Illustrations. Photographs. Bibliography. Pp. 366. \$39.95 ISBN: 0-9656957-0-0

Many books have been written about our military in various wars. Countless personal accounts and unit histories exist of the air war over Europe and the Pacific, Korea, and Vietnam. However, *The Last of a Breed* is a unique book. Although it targets a specific group of men, it encompasses not one war nor one unit or squadron. Rather, it covers an era when the Aviation Cadet program was responsible for the training of almost all of the rated aircrew officers in the Signal Corps, Air Service, Army Air Corps, United States Army Air Forces, and the United States Air Force. For well over forty years, the program provided the Service with its new rated officers. But these are the men who went to war throughout most of the conflicts that took place in the Twentieth Century, so the impact of the Aviation Cadet program was truly far reaching.

Severe describes the training of the men who would defend our nation in the skies from the program's inception in 1917 through the period of the most vigorous air combat in our history. He well describes the rigorous program that was so unique and positive that it not only trained great flyers but also produced some of the greatest men of our country. During this time, the backbone of our Air Force was formed by these young men who were, in a very short time, turned into what were some of the finest pilots who have ever lived. However, one also needs to understand that Cadet program trained not only pilots, but the navigators, observers, and bombardiers who made up the crews of the thousands of bombers and transports who served in World War II and much of the Cold War.

Severe's book is an excellent historical account of the program. But, perhaps even more importantly, he tells numerous personal stories reflecting on the character and greatness of the Aviation Cadet. The book provides a panorama of experiences, events, and history. There is hardly a Cadet alive who will not agree that this program

is what made him who he is today. I realize that there are as many different stories as there are Cadets to tell them, so this book only scratches the surface. But what it does is allow the old Aviation Cadet to go back to a time in his life when he was in his early twenties and going through Hell to wear those wings of silver over his left pocket. To all of my fellow Cadets out there, put on your parachute, climb into the cockpit of that Air Force trainer, fasten your seatbelt, start the engine(s), and get ready to go into the "Wild Blue Yonder" again. For other readers who just want to know what this huge program was like and what it took to get through it, this is definitely the book to read.

*Lt. Col. Al Hopkins, USAF (Ret.),
Class 55-J, NASM Docent*



LeMay: A Biography. By Barrett Tillman. New York: Palgrave Macmillan Press, 2007. Photographs. Notes. Index. Pp. 192. \$21.95. ISBN-13: 978-4039-7135-7

This compact biography of LeMay covers his professional life with almost no references to his personal background or family. There are mentions of his wife, daughter, brothers, sisters, mother, and father; but that is not a part of LeMay's life Tillman sets out to record. Rather he uses these few pages to define LeMay as the military man and leader that he was.

In telling LeMay's story, Tillman draws heavily—almost too heavily—on a small number of references. There are 36 references to LeMay's autobiography which he wrote with MacKinlay Kantor and at least nine references to Coffey's *Iron Eagle*. Nothing is used from Judge Nutter's *The Possum and the Eagle*.

Tillman's book is deserving of wide circulation if only to show people what an outstanding leader LeMay grew to be. Tillman works to erase the dour curmudgeon image left by critics. In the "Debrief" chapter at the end of the book, a few quotes are given from LeMay's contemporaries. General Norstad called him an "operator": he was all about results. That is exactly the word we who served under him used in referring to him. In the only B-29 combat mission Washington allowed him to fly, he flew with Colonel Ira Cornett's crew to Anshan, Manchuria. The plane took some flak hits and some crew members were slightly injured. LeMay crawled through the tunnel to the back of the ship and provided first aid. LeMay was not a planner or a philosopher or a strategist. He was an "operator." More-

over, he was skilled at every position needed to fly a bomber: pilot, navigator, bombardier, engineer, and possibly even radio operator.

In a book *Air Leadership* which records the proceedings of an Air Force conference on the subject, Allan R. Millett noted: "The people, particularly in peacetime, who have had the greatest impact upon their services are those who have had time, a great deal of power and a substantial amount of vision. I don't think it is accidental that in the history of the USAF, for example, people like Hap Arnold and Curtis LeMay stand out as strong leaders, because each had all three of those ingredients."

Tillman takes us through LeMay's career in combat with the Eighth Air Force in Europe, the XXth Bomber Command in the CBI, and the XXIst Bomber Command in the Marianas. His period as head of Strategic Air Command—when he took a force that was almost a negative factor and transformed it into the most formidable war weapon in the world at the time—is covered, though not in the depth I would have liked. There is a somewhat sour taste to the part on LeMay's tour in Washington. For example, Tillman did not mention how LeMay must have felt about reporting to McNamara as Secretary of Defense, when in India, McNamara served under LeMay as an undistinguished lieutenant colonel Statistical Control Officer.

Everyone whose life was touched—or commanded—by LeMay, has an anecdote by which to remember him. Mine took place in Hsinching, China, when preparations were being made for the Anshan mission. The afternoon before the mission, I came bursting out of a door to the briefing room and there, sitting in a jeep, was LeMay firing up his pipe. I was a puny captain, intelligence officer, scared spittleless at the sight of the general. What to do? Salute before you make another move. This was done. Puttering with his pipe, LeMay returned the salute—with his left hand.

William A. Rooney, Group Intelligence Officer, Twentieth Air Force, World War II



Reflections of a Technocrat: Managing Defense, Air, and Space Programs during the Cold War. By Dr. John McLucas, with Kenneth Alnwick and Lawrence Benson. Maxwell AFB, Ala.: Air University Press, 2006. Photographs. Notes. Appendices. Glossary.

Bibliography. Pp. xxvi, 367. Paperback ISBN: 1-58566-156-2

This book combines autobiography, biography, personal memoir, and history of aerospace programs in an important period of history. John McLucas, well known manager and leader of military and industrial enterprises in aerospace, provided the essential framework for the autobiographical and historical elements of the book. The collaboration of retired Colonel Ken Alnwick and Larry Benson, both card-carrying historians, produced a solid work. Though packed with dates, events, people, battles, companies, decisions, and programs, it is quite readable for anyone interested in the developments and issues in which McLucas was involved. It should also interest students of management and political science for the insights it gives into the personalities and practices of the movers and shakers in this business.

The exposition seems, to one who knew him, typically McLucasian. It is matter-of-fact, but many gems of information and flashes of a dry, often puckish, wit enliven it. No doubt many readers, though they knew him well, will still have some "I didn't know that!" moments. The final chapter was written after McLucas's death, based on his draft material and further research by his co-authors.

Five major subject areas are covered: personal history, industry work, Air Force service, directorship of the National Reconnaissance Office (NRO), and other government service.

McLucas's brief personal family history emphasizes the modesty of his circumstances as a child and the difficulties caused by the early death of his father and separation from his mother. Children of the Great Depression will recognize a familiar pattern of a family rallying around its more needy members and providing the support and succor needed for them to get on with life in tough times. Young John got that support, worked hard, went to good schools and colleges, and got on with a fulfilling life. On his way to his career as a technocrat, he served as a Navy radar officer at Okinawa. This surely qualifies McLucas for Tom Brokaw's Greatest Generation. He did not dwell on his combat experience, but its memory must have been with him when he was making decisions about combat systems other people would take to war.

Work in industry provided bookends for McLucas's long tenure in government. His post-war graduate education led to a job with a Pennsylvania startup company. While still in his thirties, he became president of HRB Singer. Here he showed the

combination of technical understanding, business acumen, management skills, and entrepreneurial spirit that characterized his professional life. In 1977, after long service in government, he returned to industry and consulting for the rest of his career. Rising to the presidency of Comsat World Systems, he became a leader in world telecommunications and a leading advocate of international cooperation in space and technical information interchange. After formal retirement at age sixty-five, he was an active consultant with government and industry and pursued his entrepreneurial bent with several startup companies.

Air Force service was high on McLucas's list of accomplishments. This material, together with that on the NRO, is the heart of the book. He provides a compact history of Air Force management during the critical period 1969-1975. Of particular interest is his description of the synergistic relationship between the Secretary, Dr. Robert Seamans, and himself while he was Under Secretary and Director of the NRO. The two were quite different in style and background, but their compatibility and unity of purpose made them a great management team. As a staff assistant, I sat in on many of the meetings and deliberations of this team and regard that two-year course in executive management as superior to anything one could have obtained at Harvard or Wharton!

In describing his Air Force service, McLucas names many superb technocrats who served in the Pentagon during his tenure: Dave Packard, John Foster, Bill Perry, Al Flax, and Jim Schlesinger are a few examples of the eye-watering collection of technical and managerial talent in DoD during this period.

McLucas characterized his management style as "just a bit more easygoing." He favored "management by walking around" – gathering a strong professional staff and using them skillfully. He solicited a wide range of inputs; listened carefully; and, through discussions, debate,

compromise, and elimination, winnowed out the best ideas and reached a decision. This approach left no bruised egos and assured the team would be available for the next problem.

When describing interactions of DoD and other government people, McLucas pulls no punches. Readers get insider insights into high-level conflicts, many of which arose out of the conduct of the Vietnam War and the drawdown of U.S. forces. He, himself, wrestled with the war commitment, wanting it to end while at the same time feeling that the Air Force, differently equipped and trained, could have been more decisive. He believed in air power's role in defeating large-scale ground offensives but also believed that Vietnamization was doomed. The arcane rules of engagement (ROE) for operations in southern Laos was another area that substantially bothered him.

McLucas took great interest in Air Force personnel matters, particularly race relations and women's career opportunities. He didn't just talk the talk. A picture in the book shows him participating in a race relations class. After he became Secretary of the Air Force, McLucas played a leading role in the admission of women to pilot training and to the Air Force Academy.

As Director of the NRO, McLucas found a perfect fit with his management background and DoD experience. At that time, the NRO directorship went with the territory of the Under Secretary of the Air Force. Thus, he was dual-hatted in 1969-1973 and had three bosses: the Air Force Secretary, Secretary of Defense, and the Director of Central Intelligence. This could have been a managerial mess, but McLucas handled it with great skill. He felt his NRO tenure was a kind of golden age due to the combination of a smooth running operation, technical success, exceptional people, minimal bureaucratic interference, adequate funding, minimal congressional interference, and the satisfaction of making a great contribution to national security. His description of the working relations among Defense, Air

Force, CIA, and NRO is insightful and complementary, although he possibly understates some of the sharp elbowing that went on in the trenches. This competition was probably beneficial, and ultimately everyone involved in the NRO had the overall success of the program uppermost in mind.

As he was leaving the Air Force, he was persuaded by President Ford to run the troubled Federal Aviation Administration. During his two years there he managed problems with airport safety, terrorism, jet noise, air traffic controller labor issues, and cockpit manning disputes with his customary equanimity before leaving the government sector.

I was surprised by a few omissions in the text. Given McLucas's interest in women's career development, the book fails to note Professor Sheila Widnall's service as Secretary of the Air Force. I also would have expected more than a passing reference to the establishment of the Air Force Space Command. Further, while the bibliography is good, some references may be difficult to access for all but the most dedicated researchers. This difficulty is, in part, an artifact of the secretive origin of the NRO. Finally, the book might be too full of technical, managerial and political details to appeal to the general reader and is probably not the book to take on vacation for reading on the beach.

Minor criticisms aside, the book is well written and edited. It reads easily, at least for a reader who generally knows the territory. Many readers will keep it at hand as a reference on Air Force history. In my case, it is also a reminder of a valued colleague, boss, and friend—a man who personified the sentiment of that old Army recruiting slogan: Be all that you can be.

*Brig. Gen. William Shields, USAF (Ret.),
Tucson, Arizona*



Books Received

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

Atkinson, Rick. *The Day of Battle: The War in Sicily and Italy, 1943-1944*. [Volume 2: The Liberation Trilogy] New York: Henry Holt and Co., 2007. Map. Notes. Glossary. Bibliography. Index. Pp. \$35.00 Paperback ISBN: 0-8050-6289-2

Bourque, Stephen A. and John W. Burdan III. *The Road to Safwan: The 1st Squadron, 4th Cavalry in the 1991 Persian Gulf War*. Denton: University of North Texas Press, 2007. Maps. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. 312. \$27.95 ISBN: 1-57441-232-1

Call, Steve. *Danger Close: Tactical Air Controllers in Afghanistan and Iraq*. College Station: Texas A&M University Press, 2007. Maps. Photographs. Appendix. Glossary. Index. Pp. xvii, 250. \$29.95 ISBN: 1-58544-624-7

Cotter, Jarrod. *The Battle of Britain Memorial Flight, 50 Years of Flying*. Pen & Sword, 2007. Appendices. Bibliography. Index. Pp. 240. \$60.00 ISBN: 1-84415-566-8

Franks, Norman, Hal Giblin and Nigel McCrery. *Under the Guns of the Red Baron: The Complete Record of Von Richthofen's Victories and Victims Fully Illustrated*. London: Grubb Street, 2007. Diagrams. Illustrations. Photographs. Glossary. Index. Pp. 222. \$12.99 Paperback ISBN: 1-904943-97-7

Gargus, John. *The Son Tay Raid: American POWs in Vietnam Were Not Forgotten*. College Station: Texas A&M University Press, 2007. Maps. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. xv, 332. \$29.95 ISBN: 1-58544-622-X

Graff, Cory. *P-47 Thunderbolt at War*. [The At War Series] St. Paul, Minn.: MBI Publishing, 2007 [Zenith Press]. Photographs. Appendix Bibliography. Index. Pp. 128. \$19.95 Paperback ISBN: 0-7603-2948-1

Gray, Stephen R. *Rampant Raider: An A-4 Skyhawk Pilot in Vietnam*. Annapolis, Md.: Naval Institute Press, 2007. Maps. Photographs. Index. Pp. ix, 284. \$32.50 ISBN: 1-59114-342-0

Malloney, Sean M. *Learning to Love the Bomb: Canada's Nuclear Weapons during the Cold War*. Washington, D.C.: Potomac Books, 2007. Maps. Tables. Diagrams. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. xxv, 471. \$29.95 ISBN: 1-57488-616-0

Michaelson, Ky. *Rocketman: My Rocket-Propelled Life and High-Octane Creations*. St. Paul, Minn.: MBI Publishing, 2007 [Motorbooks]. Photographs. Appendices. Pp. 240. \$27.95 ISBN: 0-7603-3143-9

Miller, Roger G. *Billy Mitchell: Evangelist of Air Power*. [Shapers of America.] Stockton, N.J. OTTN Publishing, 2007. Maps. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. 152. \$25.95 Paperback ISBN: 1-59556-025-4

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: scottwille@aol.com

* Already under review.

Coming Up



2008

April 17-20

The Society for Military History (SMH) will hold its annual conference in Ogden, Utah. The theme is, "The Military and Frontiers," with papers exploring the military's relationship to geographic, technological, social, and political boundaries. Contact: www.weber.edu/History/WhatsHappening/SMH2008.html

May 14-18

The Council on America's Military Past (CAMP) will hold its annual conference in Salt Lake City, Utah. The conference will focus on the American West. Contact: Dale Floyd at: caponier@aol.com

The Military Classics Seminar meets on the third Tuesday of each month at Ft. Myer, Virginia, for dinner and a book review and discussion. For details, contact Dr. Ed Raines: rainedandbecky@starpower.net

The MCS schedule for 2008 is:

March 18, 2008 Dual: MacDonald, Charles. *The Battle of the Huertgen Forest*. Boston: Lippincott, 1963 (South Mountain Press 1986); Rush, Robert S. *Hell in the Huertgen Forest: The Ordeal and Triumph of an American Infantry Regiment (Modern War Studies)*.

Lawrence, Kan.: University Press of Kansas, 2001. Speaker: Dianne L. Smith, Defense Intelligence Agency

April 15, 2008 Janowitz, Morris. *The Professional Soldier: A Social and Political Portrait*. Free Press, 1960 (Updated 1971). Speaker: David Segal, University of Maryland

May 20, 2008 Millett, Allan R. *The War for Korea, 1945-1950: A House Burning (Modern War Studies)*. Lawrence, Kan.: University Press of Kansas, 2005. Speaker: Janet Valentine, Historian, Air National Guard

June 17, 2008 Reynolds, Clark. *The Fast Carriers: The Forging of an Air Navy*. New York: McGraw Hill, 1968 (Naval Institute Press 1992). Speaker: Curtis Utz, Naval Historical Center

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

Air Power History
11908 Gainsborough Rd.
Potomac, MD 20854
E-mail: JNeufeld@comcast.net

Miller, Roger G. *"Like a Thunderbolt": The Lafayette Escadrille and the Advent of American Pursuit in World War I*. Washington, D.C.: Air Force History and Museums Program, 2007. Maps. Photographs. Notes. Appendices. Pp. v, 68.

Ottaway, Susan. *Dambusters: The Life of Guy Gibson, VC, DSO*, DFC**. UK: Pen & Sword, 1994. Appendices. Index. Pp. xii, 196. \$24.95 Paperback ISBN: 1-84415-605-4

Tomaselli, Phil. *Tracing Your Air Force Ancestors*. UK: Pen & Sword. [Family History]. Maps. Tables. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. 211. \$19.95 Paperback ISBN:

Winter, Frank H., Ed. *History of Rockets and Astronautics: Proceedings of the Thirty-Third History Symposium of the International Academy*

of Astronautics, Amsterdam, The Netherlands, 1999. [AAS History Series, Vol. 28; IAA History Symposia, Vol. 19]. San Diego, Calif.: AAS Publications Office, 2007. Illustrations. Photographs. Notes. Index. Pp. xvi, 544. \$70.00 Paperback ISBN: 0-87703-540-4

Wise, James E. Jr. and Scott Baron. *The Navy Cross: Extraordinary Heroism in Iraq, Afghanistan, and Other Conflicts*. Annapolis, Md.: Naval Institute Press, 2007. Maps. Photographs. Notes. Bibliography. Index. Pp. xiv, 250. \$34.95 ISBN: 1-59114-845-3

Wright, Robert K., Jr. and John T. Greenwood. *Airborne Forces at War: From Parachute Test Platoon to the 21st Century*. Annapolis, Md.: Naval Institute Press, 2007 [in association with AUSA] Maps. Illustrations. Photographs. Bibliography. Index. Pp. ix, 214. \$39.95 ISBN: 1-59114-028-3

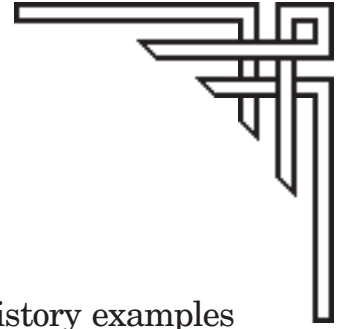
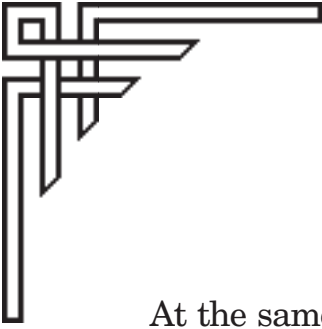


The President's Message

The value of recording and studying history is subject to nearly as many differing viewpoints as is religion, although I'm not aware of any wars or deaths resulting from its disputing parties. Of course, few would deny that history is at least interesting, lest why so many rows devoted to history at book stores, a special television network, and Ken Burns?

But answers to the following questions are tougher: Can knowledge of history have any impact—or ought it to have an impact—on decisions of the current day? Or the counterpart: through ignorance does *lack* of knowledge of history have its own impact? And implied in both questions, the grand slam: Does knowledge of history deliver better outcomes than ignorance?

It shouldn't surprise you to know, since you are reading a magazine committed to the importance of United States Air Force history, that I believe it useful, maybe even mandatory, to know about the past—and the more you know the better. I believe such knowledge leads to understanding the culture we inhabit, why some things are important, why others are not, why things happen the way they do, and why challenging a cultural norm might be difficult (though worth it) or maybe just stupid.



At the same time, I also believe it is possible to pull out of history examples that are completely irrelevant to modern decision-making, just as it is possible to thwart healthy change from the effects of history too strictly applied. How well one sorts the relevant from the irrelevant is a crucial skill, forming the basis for countless PhD dissertations, tons of historical treatises, thousands of history professors, and more symposia than anyone could attend. But that doesn't diminish the importance of the attempt. On the contrary, it argues for maximum attention and rigor.

Unfortunately, it is my impression, supported by observations from more credible sources that the study of history—and the accompanying respect for history—in this society is declining. Seemingly, it is taught in public and private schools from middle school through post-graduate studies less often and with less enthusiasm and less competence each year. I will leave my opinion of the reasons for this trend for another day, but will enthusiastically assert that, if it is a fact, it potentially contributes to a dangerously rootless and shallow society.

We are trying in our small domain to do our part in the cause of history. I hope you will join us, if you haven't already done so, in this campaign. You'll find our website helpful in this regard, plus you can join the Air Force Historical Foundation there.

How about sharing your ideas with us about the value of recording and studying history, particularly U.S. Air Force history? Send them to us at:

Air Power History
c/o Jacob Neufeld
11908 Gainsborough Rd.
Potomac, MD 20854
jneufeld@comcast.net

We'll consider posting the best of them on our website and in this magazine. I'll look forward to hearing from you. Hope you have a pleasant spring reading history.



Lt. Gen. Michael A. Nelson, USAF (Ret.)
President
Air Force Historical Foundation



AWARD WINNERS, 2007

NOMINATIONS OPEN FOR SPAATZ AND HOLLEY AWARDS

Last year the Air Force Historical Foundation created two new awards: the General Carl “Tooe” Spaatz Award and the Major General I. B. Holley Award.

The Spaatz Award recognizes a living person(s) who has made a significant and sustained, contribution to the making of Air Force history during a lifetime of service. This award is named for General Carl A. “Tooe” Spaatz, the first Chief of Staff of the Air Force and the first President of the Air Force Historical Foundation. Secretary of the Air Force, the Honorable Michael W. Wynne, presented the award to General David C. Jones, retired, (below left) the Chairman of the Joint Chief of Staff (June 1978-June 1982) and Chief of Staff of the Air Force (July 1974-June 1978), at a banquet on October 16, 2007. General Jones’s wife, Lois, and other family members and friends attended the banquet and presentation, as did General Spaatz’s daughter, Carla Spaatz Thomas, and four Spaatz grandchildren. General Jones spoke with candor and humor of his forty-year military career and of the aspects in which he takes justifiable pride.



The Honorable Michael W. Wynne, the Secretary of the Air Force, and Foundation 1st Vice Chairman General John A. Shaud present the General Carl “Tooe” Spaatz Award for 2008 to General David C. Jones.



Air Force Chief of Staff General T. Michael Moseley presents the Major General I. B. Holley Award for 2007 to Mr Dick Anderegg, who accepted on behalf of General (Professor) Holley, who was unable to travel to the award ceremony.

The Holley Award recognizes a living person(s) who has made a sustained, significant contribution to the research, interpretation, and documentation of Air Force history during a lifetime of service. The first annual Holley Award, named for a retired USAF Reserve officer who has taught military history at Duke University for 60 years, was presented to General Holley himself. General Holley, better known at Duke as Professor Holley, was informed in late summer that he would be unable to travel to receive the award due to health concerns. In the absence of Dr. Holley, the Air Force Chief of Staff, General T. Michael Moseley, presented the award to Mr. Dick Anderegg, Director of Air Force History and Museums Policies and Programs, (above right) in the absence of Dr. Holley, at a luncheon on October 17, 2007. On January 22, 2008, a group of four from the Foundation, led by the President Lt. Gen. Michael A. Nelson, accompanied by Mr. Anderegg, drove to Durham, North Carolina to present the award to Dr. Holley in a public ceremony. After lunch at the home of Professor and Mrs. Alex Roland, Dr. Holley treated his guests to a guided tour of the Duke University campus. The day’s events were capped by the award presentation in the university’s ornate Old Trinity Room. (facing page) Among those present were Dr. Holley’s wife Janet, other family members, a Duke vice president, and several colleagues and friends from the community. General Nelson spoke for the Foundation, and Mr. Anderegg presented the award trophy. Professor Holley spoke briefly, saying that the most thrilling aspect of the award for him in this tough year was the approval of his peers and professional colleagues for the Foundation having named the award for him.



Lt Gen Michael A. Nelson speaks before the award presentation to General Holley.

NOMINATIONS FOR 2008

The Air Force Historical Foundation will present its second annual Spaatz and Holley Awards during a banquet in the Fall of 2008; the exact date and venue are in coordination. The following process has been approved by the President, pending Board of Directors action on April 3, 2008.

PURPOSE OF AWARDS: As outlined above, the Air Force Historical Foundation's General Carl A. "Tooy" Spaatz Award recognizes a living person(s) who has made a sustained, significant contribution to the making of Air Force history during a lifetime of service. The Air Force Historical Foundation Major General I. B. Holley Award recognizes a living person(s) who has made a sustained, significant contribution to the research, interpretation, and documentation of Air Force history during a lifetime of service. The processes for both awards are the same this year.

WHO MAY NOMINATE: Any current member of the Air Force Historical Foundation member may nominate a person(s) for these awards. Nominations will be accepted by the Foundation's Executive Director any time during the six month period following the previous award presentation (in this case, until April 30, 2008). The nomination should be brief – not longer than one page – and highlight significant contributions. After the selection process is completed, the nominating member will be asked to provide the winner's biography which will be incorporated into the citation to accompany the award.

SELECTION PROCESS: The Foundation President, with the advice of the Board of Directors, will select the ultimate winner of each award.

Letters

My compliments on a superb issue of *Air Power History* [Vol. 54, No. 4. Winter 2007]. Wonderful insights and anecdotes, and fascinating history.

Jacques Paul Klein, Under Secretary-General of the United Nations (Ret.), McLean, Virginia.

Regarding "Session I, Emerging Air Power: The World War II Era," [Winter 2007, *Air Power History*, Vol. 54, No. 4], page 21. Colonel Taylor was mistaken in his assertion that Ted Timberlake got a Medal of Honor (MOH) for the August 1, 1943 Ploesti attacks. Two group commanders and one acting commander received the MOH—Col. Leon Johnson, leader of the 44th Bomb Group; Col. John Kane, leader of the 98th Bomb Group; and Lt. Col. Addison Baker, who commanded the 93d Bomb Group instead of Timberlake. (Timberlake was denied participation on the orders of either General Arnold or Brereton, or both.) Baker's co-pilot, Maj. John Jerstad received his medal posthumously, along with Lt. Lloyd Hughes of the 389th, who bombed with Col. Jack Wood's Group on Campina Red target to the north of Ploesti. Lt. Brian Favelle flew the route lead aircraft of the 376th Bomb Group. Favelle and his crew spun in over the Mediterranean approaching Corfu; they did not crash in Turkey, as alleged. His wingman, Lt. Gus Iovine, circled to locate survivors; finding none he aborted the mission and returned to base. Col. K. K. Compton commanded the 376th and from every post-mission account was the "leader" of his group over the mountains and on to the target area. Compton, ahead of all groups after airborne difficulties split up the five-group bomber stream after Corfu, led his group and the 93d (in trail) over the pre-IP at Targoviste. He mistook this village for the briefed IP of Floresti, and subsequently directed the wrong turn there—driving the 376th and the 93d toward Bucharest instead of Ploesti. The 93d, led by Lt. Col. Baker, realizing the error almost immediately, split off and began driving due southwest to northeast, toward the target area. This added to the ensuing aircraft track dilemmas over the targets that were briefed for Colonel Kane (White IV) and Colonel Johnson (White V) whose forces drove into their targets (already mostly aflame) on course, as prescribed, on a briefed southeasterly course some thirty minutes later. Colonel Compton's 376th Group (with the mission commander, General Ent, aboard) never hit their briefed target except for Maj. Norm Appold and his element, who peeled off to strike a 376th target. After discovering their error, the entire group

circled to the southeast and east and left Bucharest. Colonel Wood's 389th hit their assigned target of Campina Red. Additionally, another target that was obliterated was not mentioned. Col. Jim Posey and pilot John Diehl (44th Bomb Group) hit the Blue Target, the Creditul Minier at Brazi, concurrent with Colonel Johnson's White V strike. The film sponsored by the Mormon Church that Colonel Taylor mentioned concerned Walter Stewart, a pilot in the 93d Group, who flew the ship *Utah Man*. One final note, Roger Freeman's book, *The Ploesti Raid*, [London: Battle of Britain International Ltd. ISBN: 1-870067-55-X] is a treasure trove of information for anyone interested in the Ploesti mission.

Colonel Robert E. Vickers, USAF (Ret.), Taos, New Mexico.

Reunions

USAF Pilot Training Class 58J will hold its 50th Anniversary Reunion April 8-11 in Dayton, Ohio. Contact:

PTC 58J
3349 Arnold Lane
Falls Church, VA 22042
e-mail: ptc58j@aol.com

Strategic Air Command will hold a reunion and dedication of the SAC Memorial April 30-May 4, 2008, in Dayton, Ohio.

UPT Class 68-08, Laredo, Texas will hold a reunion in June 2008, location to be determined. Anyone interested contact:

Putt Richards
(808) 638-0268
e-mail: grzlyputt@aol.com

B-47 Stratojet Association will hold a reunion September 25-27 in Marietta, Georgia. Anyone associated with or interested in the B-47 is cordially invited. Contact:

Bob Bowman
(703) 826-5562
e-mail: bbowman@northhighland.com
www.B-47.com

Strategic Air Command Airborne Command and Control Association (SAC ACCA) will hold a reunion October 15-19, 2008, in Dayton, Ohio. Contact:

Wilton Curtis
(804) 740-2290
e-mail: Wcurtis123@aol.com

The Association of Air Force Missileers will hold a reunion, October 9-13, 2008, at the Hyatt Dulles, Herndon, Virginia. Contact:

AAFMM
PO Box 5693
Breckenridge, CO 80424
www.afmissileers.org

USAF Pilot Class 53A will hold a reunion October 23-26, 2008, at the Doubletree Hotel, San Antonio, Texas. Contact:

Maj. Gen Wayne Whitlatch
jwwhitl@satx.rr.com
or
daedalus@daedalians.org
or
reunion53A@aol.com

News

"Father of U.S. Army Aviation" Honored

Brig. Gen. William Wallace Ford, USA (Ret.) was inducted into the Kentucky Aviation Hall of Fame in Lexington on November 3, 2007. A West Point graduate (class of 1920), he served on the ROTC staff at Eastern Kentucky University from 1937-1940. An air enthusiast, Ford earned a private pilot's license. He recognized the military benefit of light aircraft for artillery batteries, observing from the air and providing firing instructions. Writing in the *Field Artillery Journal*, Ford outlined his theories on "air observation posts." An experimental program grew from this article, and Ford later became Director of Air Training at Fort Sill, Oklahoma. General Ford's innovations and service earned him the title "Father of U.S. Army Aviation." He died in 1986.

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

Air Power History
11908 Gainsborough Rd.
Potomac, MD 20854
E-mail: JNeufeld@comcast.net

Brig. Gen. Paul Warfield Tibbetts, Jr., USAF (Ret.) 1915-2007



Paul W. Tibbetts Jr., died at his home in Columbus, Ohio, on November 1, 2007, at the age of ninety-two. He was best known as commander of the Boeing B-29 *Enola Gay*, which dropped the atomic bomb on Hiroshima, Japan, on August 6, 1945.

Born on February 23, 1915 in Quincy, Illinois, Paul was nine when the Tibbetts family moved to Miami, Florida. In 1928, his father enrolled him in the Western Military Academy in North Alton, Illinois. He attended the University of Florida at Gainesville in 1933, but transferred to the University of Cincinnati for pre-med studies. His love of flying, dating back to a 1927 ride aboard barnstormer Doug Davis's plane, won out over a career in medicine. Tibbetts joined the Army Air Corps in 1937 and after flying the Consolidated PT-3 biplane trainer and the North American BT-9 low-wing monoplane at Randolph Field, Texas, was awarded his wings in February 1938. Although he graduated with the highest cumulative scores in his class, he selected an observation assignment rather than a tour in fighters. He flew the Douglas O-46 high-wing monoplane at Fort

Benning, Georgia. He was meticulous about following flight rules and was also dedicated to perfection in the air. He remained at Fort Benning until 1940. During those happy years he was married, had children and was able to fly the North American O-47 and the Martin B-10. Tibbetts also hunted and shot skeet with Lt. Col. George Patton during his years at Benning.

In June 1941, Tibbetts was transferred to the A-20 Attack aircraft as a member of the 90th Squadron, Third Attack Group located in Savannah, Georgia. Shortly after the Japanese attack upon Pearl Harbor, Hawaii, Captain Tibbetts was reassigned to fly the new B-18 twin-engine bomber. His unit began patrolling the east coast on the lookout for German U-boats. He next moved to MacDill Air Base, near Tampa, where he began to check out young pilots in the brand new, four-engine B-17 Flying Fortress. Tibbetts, rapidly promoted to major, was part of the first deployment of B-17s to England—Operation Bolero. It was from this initial deployment experience that the book, *Twelve O'clock High*, was written. Tibbetts was the young major who was assigned as the unit executive officer in an effort to improve base security and elevate morale.

On August 17, 1942, Tibbetts led the first American heavy bomber raid against German-occupied targets in Rouen, France. Tibbetts dropped the first strategic bombs of the war. While in Europe, on every raid, Tibbetts always flew in the lead plane. He was wounded on August 24th on another raid and received the Purple Heart.

In October, Tibbetts was selected as one of two pilots to fly a secret liaison mission from England to Gibraltar. Then, in November 1942, Tibbetts flew Gen. Dwight D. Eisenhower to Gibraltar in anticipation of the invasion of North Africa—Operation Torch—in which Tibbetts also participated as a bomber pilot leading the first heavy bomber raid in the North African Theater of Operations.

Soon Tibbetts joined the Twelfth Air Force acting as bombardment chief for the commander, Maj. Gen. Jimmy Doolittle. During this time at Algiers, Doolittle and Tibbetts flew together on a memorable Martin B-26 Marauder flight. Several B-26 crews had crashed during operations due either to poor

control during engine-out situations, or failure by the crew to set the aircraft batteries to the “charge” position prior to takeoff. Tibbets recalled that Doolittle took off, killed one of the engines and feathered the prop while executing high performance maneuvers, including a loop-the-loop, before restarting the dead engine prior to a successful landing. This flight set a tone for the B-26 crews that the Marauder could be flown properly with some practice and patience.

Because of his combat experience and excellent airmanship—and partially to avoid a personality conflict with his commander—Tibbets was ordered back to the U.S. to participate in the testing of the new high-altitude bomber, the Boeing B-29 Superfortress. In September 1944, he was selected to organize and command the secret 509th Composite Group, which was assigned to deliver the newly developed atomic bombs. After several months of preparation and practice flying from the Pacific island of Tinian, Tibbets took off with his crew and six other B-29s on August 6, 1945, in the *Enola Gay*, a B-29 named after his mother and specially modified to carry “Little Boy,” the first atomic bomb. Six and a half hours later, at 8:15 a.m. local time, the *Enola Gay* dropped the weapon that destroyed Hiroshima and hastened the end of World War II. The 509th then relocated to Walker Air Force Base in New Mexico and participated in the nuclear tests at Bikini Atoll during that period—Operation Crossroads.

After attending the Air Command and Staff College at Maxwell Air Force Base, Alabama, Colonel Tibbets was assigned to the Pentagon and served as the director of the Strategic Air Division. As the bomber branch chief he worked closely with Boeing during the development of the six jet engine, swept-wing B-47 Stratofortress until February 1952. There, he flew with the legendary Boeing test pilot, “Tex” Johnson, who taught Tibbets what the B-47 could really do in the air. During these years, Tibbets was also the subject of a Hollywood movie about the Hiroshima mission—*Above and Beyond*, released in 1952. The film, although exaggerated in places, communicated many of the personal and emotional issues related to the crewmen in the 509th Group.

Following a stint at the Air War College in 1955, Tibbets’ next assignment was director of war plans, Allied Air Forces in Central Europe at Fontainebleau, France. In 1956, he returned to the United States to command the 308th Bomb Wing located at Hunter AFB, Georgia. In just one year, under Tibbets’ strict discipline and leadership, the 308th went from a lowly unit to the top of the ratings. In January 1958, Tibbets was reassigned to MacDill AFB, Florida, where he assumed command of the ailing 6th Air Division. With this command came the star of a brigadier general. Again, the new general whipped the base into shape with strict discipline and ruthless personnel changes. Soon, the 6th AD was on its way to recovery as the largest SAC base in the country.

From February 1961 until mid-1964, General Tibbets was assigned to Headquarters Air Force as director of management analysis. During his last two years of Air Force service, Tibbets traveled to New Delhi, India, as part of the American military mission there. After his retirement in 1966, he began work for a commuter aviation company initially in Geneva, Switzerland, called Executive Jet Aviation, later becoming its president. For the past two decades, Tibbets had been an active participant on the international air show circuit and also was a frequent public speaker at military and civil events.

During his thirty-year-long military career, General Tibbets was a command pilot. His military decorations included the Distinguished Service Cross, Distinguished Flying Cross, Legion of Merit, Purple Heart, Commendation Medal and Air Medal. General Tibbets is survived by his wife, Andrea; sons Paul Tibbets III, Gene, and James; six grandchildren; and several great-grandchildren. Tibbets and his first wife, Lucy, divorced in 1955.

Brig. Gen. Paul W. Tibbets visited the *Enola Gay* for the final time in 2005. While in the cockpit he recounted stories of how he loved his crewmen and how well they had executed their mission—a mission that heralded the end of World War II. His personal views of the 509th Bomb Group mission accomplishment never changed during his lifetime. “I am content that we did what reason compelled and duty dictated.”

Col. Arval James “Robie” Roberson, USAF (Ret.) 1923-2007

Col. Arval James Roberson, 84, died unexpectedly on December 7, 2007 in Kilmarnock, Virginia. Born in Indiana in November 1923, he grew up in Inglewood, California. He entered the Army Air Corps in June 1942 as an aviation cadet and was commissioned as a pilot in May 1943.

He flew 76 missions in the ETO in the P-51 Mustang with the 362d FS, 357th FG, destroying 6-1/2 enemy aircraft and one probable in the air, as well as one on the ground. He returned to the U.S. as a captain in time for his 20th birthday in November 1943.

After his return from England, he had assignments in Nevada, Florida, and Illinois. In Chicago, he first flew the C-47, known as the “Gooney Bird” and over the next 20 years flew that aircraft intermittently for a total of almost 950 hours. In 1949 and 1950, he flew out of bases in Kansas, Indiana, and Michigan.

During the Korean War, he flew 100 combat missions in the F-51 with the 12th FS, 18th FBW. He next had assignments in Kentucky and then England where he flew the F-84 and finally in Belgium with Military Assistance Advisory Group. On return to the U.S., he became adjutant for the group headquarters at Luke AFB. From there in 1955 he went to his favorite assignment, Support Squadron Commander at the Auxiliary Field at Gila Bend, Arizona.

He next returned to Brussels, where he flew the VC-47. He then went to Headquarters, Air Training Command at Randolph AFB, Texas, and to Florida with the Tactical Air Warfare Center. In 1965 he entered his third war as Liaison Officer to the VN JCS in Vietnam. He managed to also fly 26 combat support missions in the C-47.

From Vietnam he went to France as the Chief, Logistics Branch, and was promoted to colonel in August 1966. He then went to Sembach Air Base, Germany, as Vice Wing Commander, 603d ABW and then as Commander, 60151 Combat Support Group. There, in 1970, he went to Otis AFB, Massachusetts, from which he retired as the last USAF base commander on March 1, 1973.

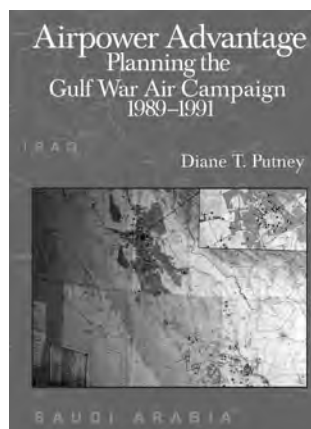
In total, he had flown twenty different aircraft for almost 4,000 hours, but his favorite was always the P-51 Mustang. During his thirty-one years of military service Colonel Roberson received the following decorations and awards: the DFC with 3 Oak Leaf Clusters (OLCs), Bronze Star, Air Medal with 15 OLCs, Meritorious Service Medal with one OLC, Army Commendation Medal, American Campaign Medal, Europe-Africa-Middle East Campaign Medal, World War II Victory Medal, Korean Service Medal, Vietnamese Service Medal, United Nations Medal, Republic of Vietnam Campaign Medal, Presidential Unit Citation, Republic of Korea Presidential Citation, Croix de Guerre with Palm, Vietnamese Medal of Honor, Russian Freedom Medal, and the Occupation Award Army Air Corps.

Roberson is survived by his wife of 31 years, Dr. Mildred Roberson, a daughter, a son, and several grandchildren from a previous marriage.



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Our winter mystery aircraft was the one-of-a-kind Convair XC-99 cargo aircraft, based on the B-36 bomber.

Designed in 1942, the XC-99 was powered by six 28-cylinder Pratt & Whitney R-4360-35 radial “pusher” engines rated at 3000 horsepower each.

The XC-99’s cavernous double-deck interior was designed to carry 400 combat troops or 101,000 pounds of cargo. Only slightly smaller in some dimensions than today’s C-5 Galaxy, the XC-99 was the largest aircraft in the world in the 1950s and is the largest piston-engine aircraft ever built.

Our fall issue’s photo showed the XC-99 making its maiden flight at the Convair San Diego plant on November 23, 1947. The aircraft was stationed throughout its operational life from 1949 to 1957 at Kelly Air Force Base, Texas. Some crewmembers were Air Force civilians. In 1951 and 1952, the XC-99 hauled seven million pounds of supplies in support of the Korean War effort.

The XC-99 never failed to amaze when it appeared at air shows. At one open house event while the plane was still very much an operational part of the Air Force, a woman asked pilot Capt. Jim C. Douglas, “How will you move this thing from here?”

Douglas replied, “We fly it, lady.”

The woman quickly retorted, “Young man,

what kind of a fool do you take me for?”

In 1957, examining the plane’s condition, experts concluded that \$1,000,000 in immediate maintenance would be necessary to keep it airworthy. The Air Force retired the XC-99. It was derelict for decades.

Retired Maj. Gen. Charles Metcalf, director of the National Museum of the U.S. Air Force, said he believes the plane can be preserved for future generations, but not quickly or easily.

Today, some of the XC-99 is in the museum’s restoration hangar, but most of it still at the former Kelly Field awaiting movement to Dayton. According to the museum’s Robert J. Bardua, restorers now have the leading and trailing edges of the wings, wing tips, horizontal and vertical stabilizers, flight controls, tail section, engines and propellers. The rest will come later, Bardua said.

Our follow-up image is a rarely-seen official Air Force photo showing the XC-99 near the end of its service career.

Our XC-99 “name the plane” winner is David Bragg of Albuquerque, N. M., who submitted his entry while on duty in Iraq. Mr. Bragg will receive a copy of the new book *Hell Hawks: The Untold Story of the American Pilots Who Savaged Hitler’s Wehrmacht*, by Robert F. Dorr and Thomas D. Jones when the book is published on April 4.

Can you identify our latest “mystery” aircraft, shown here? For a clue as to where it was taken: this is a photo by Robert F. Dorr. But remember the rules, please:

1. Submit your entry on a postcard to Robert F. Dorr, 3411 Valewood Drive, Oakton VA 22124, or by e-mail to robert.f.dorr@cox.net.

2. Name the aircraft shown here. Include your postal mailing address and telephone number. Last time around, several entries had to be disqualified for not including a phone number.

3. A winner, picked from among correct entries, will receive a copy of the *Hell Hawks* history book.

This feature needs your help. Do you have a

photo of a rare or little-known aircraft? We’ll return any photos provided for use here.



This Issue’s Mystery Plane