The Air University Pantheon of Air, Space, and Cyberspace Power Thinkers

Compiled by

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Foreword

This compendium offers a broad sweep of some of our service's most remarkable and memorable figures in the context of an evolving center for airpower education. An initiative of Gen Steven R. Lorenz, former Air University (AU) commander, now commander of Air Education and Training Command, the *Air University Pantheon of Air, Space, and Cyberspace Power Thinkers* is an effort to identify the intellectual roots of Air University. By giving us a glimpse of the synergism of the exchange of progressive, nontraditional ideas among AU faculty and students, this pantheon helps us to realize how the application of these ideas have influenced airpower. In part because Air University serves as a forum for innovative thought and discussion, the United States continues to be the preeminent air, space, and cyberspace power.

The dawn of today's Air University was with the Army Air Corps Tactical School's (ACTS) move to Maxwell Field in early 1931. There the school served as a think tank for new ideas, including the development of airpower doctrine. Gen George Kenney became a supporter of both close air support and interdiction while teaching at the ACTS. Former ACTS instructors Hal George, Laurence Kuter, Ken Walker, and Haywood Hansell created the famous Air War Plans Division-1 strategy that became known as the "air plan that defeated Hitler." The progenitor to AU has since fostered generations of Airmen who would sustain AU's role as the Air Force's intellectual center.

Gen Henry H. "Hap" Arnold envisioned that as early as 1940, a future independent Air Force would need its own education system and insisted not only on high-caliber schools but also on a first-rate library and research center. In 1946 the Air Force officially dedicated Air University, fulfilling Arnold's dream.

Gen Muir S. Fairchild, AU's first commander, advanced the idea of academic freedom to provide an environment to encourage views which might be divergent from the norm.

Together, these biographies provide a framework for understanding the evolution of Air University and its powerful legacy in providing a forum for academic discourse, contributing to dramatic changes in the employment of airpower. Air University has been graced with individuals possessing imagination and keen intellect and the fortitude to bring their vision to reality. May their examples inspire a future generation to add its fresh ideas and unconventional viewpoints so that the Air Force can continue to preserve America's peace and security.

Introduction

The *Air University Pantheon of Air, Space, and Cyberspace Power Thinkers* is designed to integrate and extend Jeffrey C. Benton's *They Served Here: Thirty-Three Maxwell Men* (Maxwell AFB, AL: Air University Press, 1999). In addition to his diligence, several authors contributed to this work by drafting biographies and creating the book's framework. From the project's outset, I have remained indebted to Dr. Richard Muller, Dr. Daniel Mortensen, Col Scott Gorman, Gen William Looney III, and Gen Stephen R. Lorenz.

Additional information contained within this manuscript originates with other authors, especially those who published their works within the "public domain," thereby delegating ownership to the US government. As such, throughout the text citations have been omitted unless deemed directly relevant for validating specific ideas (e.g., Ira Eaker's position regarding female pilots) or the verbiage emanates from copyrighted sources. For those sources, please refer to the endnotes at the end of this text. With this caveat in mind, principal sources include:

- Air Force Association (especially Air Force Magazine), Arlington, Virginia
- Air Force Historical Foundation, Andrews AFB, Maryland
- Air Force Historical Studies Office, Washington, DC
- Air Force Historical Research Agency, Maxwell AFB, Alabama
- Air University and Air University Press, Maxwell AFB, Alabama
- Aviation History Online Museum, http://www.aviation-history.com
- Defense Visual Information Center, Riverside, California
- International Space Hall of Fame, New Mexico Museum of Space History, Alamogordo, New Mexico
- National Aeronautics and Space Administration
- Robert Hutchings Goddard Collection, Clark University, Worchester, Massachusetts
- Smithsonian National Air and Space Museum, Washington, DC
- United States Air Force (especially *Air Force Link*)
- US Centennial of Flight Commission, http://www.centennialofflight.gov/index.cfm

The United States Air Force

Mission Statement

The mission
of the United States Air Force
is to Fly, Fight, and Win…
in Air, Space, and Cyberspace.

United States Air Force Vision

Global Vigilance, Global Reach, Global Power

Historical Lineage

The twenty-first century United States Air Force finds its roots steeped in a rich tradition of innovation, technical prowess, and youthful fascination with the impossible. This book profiles 16 individuals who collectively are responsible for the United States Air Force's air, space, and cyberspace expertise. These professionals led development within their respective fields and, through their imaginations, made tangible what had previously been theoretically and practically infeasible. Each of them lived his life believing that "if you can see it, you can do it." They did both! To appreciate their legacies within their respective chronological contexts, we must acknowledge the historical lineage that produced the world's most capable Air Force.

Before it became a separate service in 1947, Airmen developed ideas and applied their third-dimensional weapon under multiple organizational constructs. Each is listed here to preserve our legacy and contextualize the stories of the courageous Airmen you are about to engage.

Era	*Organizational Construct*
1 August 1907–18 July 1914	Aeronautical Division, US Signal Corps
18 July 1914–20 May 1918	Aviation Section, US Signal Corps
20 May 1918–24 May 1918	Division of Military Aeronautics
24 May 1918–2 July 1926	US Army Air Service (USAAS)
2 July 1926–20 June 1941*	US Army Air Corps (USAAC)
20 June 1941–18 September 1947*	US Army Air Forces (USAAF)
18 September 1947–Present	United States Air Force (USAF)

*The Air Corps became a subordinate element of the Army Air Forces on 20 June 1941, and it continued to exist as a combat arm of the Army (similar to Infantry) until disestablished by the US Congress with the creation of the US Air Force in 1947.

Born of the National Security Act of 1947, today's USAF remains linked directly to the legal authorities and purpose for which it emerged. While technologies have changed dramatically, the USAF's role in providing for our nation's defense continues to accomplish the core principles that spawned the service.

Legal Authorities

The National Security Act of 1947 (61 Stat. 502) provided for the creation of the US Air Force. In so doing, the US Congress framed the service's operational scope as follows:

> In general the United States Air Force shall include aviation forces both combat and service not otherwise assigned. It shall be organized, trained, and equipped primarily for prompt and sustained offensive and defensive air operations. The Air Force shall be responsible for the preparation of the air forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated joint mobilization plans, for the expansion of the peacetime components of the Air Force to meet the needs of war.[1]

Accordingly, the purpose of the USAF is established by 10 United States Code § 8062. The USAF is established to

- preserve the peace and security, and provide for the defense, of the United States, the Territories, Commonwealths, and possessions, and any areas occupied by the United States;
- support national policy;
- implement national objectives; and
- overcome any nations responsible for aggressive acts that imperil the peace and security of the United States.[2]

The Wright Brothers

Orville and Wilbur Wright pose for the camera, 1909

Courtesy US Air Force

The Wright Brothers

Wilbur (1867–1912) and Orville (1871–1948)

Legacy

- Fathers of flight
- Invented airplane (1903); first sustained flight (1905)
- Advocated airplane's military utility (US Army, 1909)
- Established first US civilian flying school

Wright Flyer. *Courtesy US Air Force*

"It all began with the Wright brothers." Many histories of aviation begin with a variation of this sentence, but the history of aviation teaching, learning, and development at what became Maxwell Air Force Base began with two bicycle mechanics from Dayton, Ohio—Wilbur and Orville Wright.

Seven years after the Wright brothers successfully completed their historic first powered heavier-than-air flight on the sand dunes of Kitty Hawk, North Carolina, on 17 December 1903, Wilbur Wright traveled through the South in search of a wide expanse of land on which to establish a flying school. Visionary members of the Montgomery Commercial Club, the predecessor of the chamber of commerce, quickly made available a good spot on the "flat land" next to the Alabama River. The Wrights arrived in late March 1910 with one of their latest aircraft designs, the Wright "Transitional Flyer." The *Montgomery Advertiser* reported that "a strange new bird soared over the cotton fields to the west of Montgomery, ascending in a long, graceful curve. Under perfect control it followed the hand of Orville Wright, turning, ascending, descending at his bidding."[3] The school was soon training its first students. Corporate sponsorship was much in evidence; the red barn-like hangar built for the Wrights bore a local merchant's slogan: "Our Prices Like Wilbur Are 'Wright.' " Curious townspeople flocked to see the spectacle—some traveling on a special train shuttle from Union Station downtown.

Thus was born the first civilian flying school in the nation. Another aviation "first" during the Wright brothers'

stay in the River Region was an airplane flight at night. Although it only operated for two months, the Wrights' flying school established a pattern that continues to this day—a vibrant center of air and space innovative learning in Montgomery. By the 1920s, Montgomery became an important link in the growing system of aerial mail service. It was in the early 1930s when the Army Air Corps Tactical School moved to Maxwell and Montgomery became the country's intellectual center for airpower education.[4]

Perhaps the most fitting tribute to the Wright brothers is captured by a label identifying the 1903 Wright airplane on display at the Smithsonian: "By original scientific research, the Wright brothers discovered the principles of human flight. As inventors, builders and flyers, they further developed the aeroplane, taught man to fly, and opened the era of aviation." One of their sales points to the Army was the potential utility of aircraft for reconnaissance.

Learn more . . .

- Billy J. Singleton, *Montgomery Aviation* (Charleston, SC: Arcadia Publishing, 2007).
- Smithsonian National Air and Space Museum, "America by Air," http://www.nasm.si.edu/exhibitions/gal102/americabyair/index.cfm.
- Smithsonian National Air and Space Museum, "The Wright Brothers: The Invention of the Aerial Age," http://www.nasm.si.edu/wrightbrothers/index_full.cfm.

Arthur Dargue and Edgar Gorrell photographed in Mexico in 1916

Reprinted by permission from Air Force Magazine, *published by the Air Force Association*

Col Edgar S. Gorrell

(1891–1945)

Legacy

- Pursued Gen Francisco "Pancho" Villa (Mexican Expedition)
- Designed first "strategical" bombing plan—framework for industrial interdiction employed during World War II
- First Air Transport Association (ATA) of America president
- Advocated aviation safety—led to creation of modern-day Federal Aviation Administration (FAA)

In 1917 the great armies of Europe remained locked in a struggle along the trenches of the western front. On the first day of the Battle of the Somme, nearly 80,000 British soldiers had been killed or wounded; similarly, the Battle of Verdun "consumed the young men of a medium-sized town" every morning and every afternoon for the 10 months it lasted.[5] Leaders on both sides sought an alternative to the carnage of "modern" war. Edgar S. Gorrell—a virtually unknown major assigned to the technical section of the newly arrived US Air Service—emerged as one such leader.

Gorrell graduated from West Point in 1912 and then spent two years as an infantryman in Alaska before transferring to the Signal Corps, where he joined the 1st Aero Squadron, serving under Gen John J. Pershing in Mexico. On one of his flying missions in Mexico, Gorrell ran out of gas and was stranded in the desert for several days before being rescued. Upon returning to his unit, he began to criticize the poor equipment US pilots were forced to use, both in terms of actual aircraft components and the signals and communication equipment used on land. In 1917 he was promoted to captain, and in World War I he became the chief engineering officer for the Air Service and eventually the chief of staff for the Air Service, with the rank of colonel. After the war, Gorrell remained in Europe representing the United States at conferences and peace talks.[6]

Aware of the promise of emerging aircraft technology, he initiated a study of the military situation and the po-

tential for bombardment aviation to contribute decisively to the struggle. Using analytic techniques that would become forerunners of modern targeteering principles, Gorrell maintained that a heavy air attack on key industries supporting the German war effort could successfully impede the supply of munitions to the front.

Gorrell designed an aerial operations plan entitled "Strategical Bombardment." Drawing heavily on ideas borrowed from British and Italian theorists and aviators, Gorrell argued that modern armies could be compared to a steel drill. The hardened steel drill bit represented an army's formidable combat power: if the more vulnerable shank (the industrial and societal effort supporting that army) could be broken, the drill would prove useless. WWI ended before his plan could be executed. Lawrence Kuter would later capture the irony of Gorrell's work by characterizing it as "the earliest, clearest and least known statement of the American conception of air power."[7] After the war, Gorrell turned his energies to producing a lessons learned historical analysis of WWI air operations.

Under his direction, in 1919 the Air Service drafted two manuals: "Notes on the Employment of the Air Service from the General Staff Viewpoints" and "Tentative Manual for the Employment of Air Service." Despite Gorrell's explicit advocacy for strategic bombardment as an independent course of action, both manuals empha-

sized airpower's role in support of ground operations (i.e., the Army). Nonetheless, Gorrell's brief foray into independent airpower theory development would carry long-term implications: during the 1930s, the Air Corps Tactical School faculty rediscovered the "Gorrell Plan" and used it as the basis for a more sophisticated theory of targeting, an approach focused on incapacitating an adversary's "industrial web." An adaptation of Gorrell's "strategical bombardment" concept, WWII air operations interdicted German supply lines, thereby ensuring Allied victory in Europe.

Colonel Gorrell resigned his Army commission in March 1920 and joined the automobile business. He served as the vice president of Marmon Motor Car Company until 1925. He worked his way up the corporate ladder, becoming vice president, director and general manager, and then president of the Stutz Motor Car Company of America. Despite this brief venture into the automotive field, Gorrell never completely separated himself from airpower development or the policy process that guided its employment.

As a result of the Air Mail Scandal, in 1934 he sat on the Special Committee on the Army Air Corps, also known as the Baker Board.[8] While Gorrell and his colleagues did not advocate establishing an independent air service, they did establish the basis for eventual separation by recommending the Army establish General Headquarters Air Force, giving it responsibility for all aviation combat units within the United States.[9]

Members of the Baker Board in 1934

Reprinted by permission from Air Force Magazine, *published by the Air Force Association*

In January 1936, Gorrell returned to his roots, re-entering the aviation world when the ATA elected him as its first president. Through this organization, he promoted safety in civil aeronautics and became a vocal advocate for the Civil Aeronautics Act of 1938, the law that provided for government control and regulation of civil aeronautics. Gorrell continued to support civil aeronautics until his death in 1945.[10]

Learn more . . .

- William Edward Fischer, Jr., *The Development of Military Night Aviation to 1919* (Maxwell AFB, AL: Air University Press, 1998), http://www.au.af.mil/au/aul/aupress/Books/Fischer/fischer.pdf.
- Edgar S. Gorrell, "An American Proposal for Strategic Bombing in World War I," *Air Power Historian* 5 (April 1958): 102–17.
- Edgar S. Gorrell, *Gorrell's History of the American Expeditionary Forces Air Service, 1917–1919*, National Archives microfilm publications, no. 990, vol. B-9 (Washington, DC: National Archives and Records Administration, 1974).
- Col Edgar S. Gorrell, "The Measure of America's World War Aeronautical Effort" (lecture, delivered under the James Jackson Cabot professorship of air traffic regulation and air transportation, Norwich University, Northfield, CT, 1940).
- Maj Dennis Larm, "Expendable Remotely Piloted Vehicles for Strategic Offensive Airpower Roles" (thesis, School of Advanced Airpower Studies, Maxwell AFB, AL, 1996).
- "The Plan of Bombardment Aviation," appendix 2 to annex 3 (Field Orders No. 9), *Plan of Employment of Air Service Units 1st American Army*, Headquarters First Army, American Expeditionary Forces, 7 September 1918, RG 120, NA.

- Smithsonian Institution Research Information System (SIRIS), Edgar S. Gorrell Collection (1936–1940), National Air and Space Museum, Washington, DC, http://siris-archives.si.edu/ipac20/ipac.jsp?uri=full=3100001~!227754!0&term=#focus.

Billy Mitchell

Brig Gen William "Billy" Mitchell standing by a VE-7 at Bolling Field, Washington, DC, air tournament, May 1920. The Vought VE-7 Bluebird was an advanced World War I military trainer, observer, and fighter.

Courtesy US Air Force

Maj Gen William L. "Billy" Mitchell

(1879–1936)

Legacy

- Commander, US Army Air Service (USAAS) Forces, First Army, in France (World War I)
- Airpower crusader: advocated coastal defense via airpower
- Only person to have a US aircraft—the B-25 Mitchell—named in his honor

Court-martialed (and found guilty of insubordination) in 1925 and having resigned his commission in lieu of punishment in 1926, William Lendrum "Billy" Mitchell is recognized as *the* Airman who sacrificed his career in an attempt to guarantee the birth of an independent Air Force. While assigned to the Army General Staff as an Army Signal Corps officer, he became intrigued with aviation through the conduct of a collateral duty—assessing aviation's utility relative to military application. He became so enamored with the possibilities he personally envisaged for airpower employment that in 1916, at the age of 38, he began flying lessons at his own expense.

Assigned to France in 1917 shortly after the United States entered the Great War, he served as an aeronautical observer charged with recording and disseminating lessons learned. Earning flag officer rank, he "commanded all American combat air units within France. In September 1918, he planned and led nearly 1,500 allied aircraft in the air phase of the Saint Mihiel offensive. Recognized as the top American combat Airman of the war (he was awarded the Distinguished Service Cross, the Distinguished Service Medal, and several foreign decorations), Mitchell, nevertheless, managed to alienate most of his superiors—both flying and non-flying—during his 18 months in France."[11] Returning to the United States in early 1919, the Army appointed Mitchell assistant chief of the Army Air Service; for this post he retained his flag officer rank. As relations with superiors continued to deteriorate, he attacked both the War and Navy Depart-

ments for being "insufficiently farsighted regarding airpower."[12] Perhaps this Mitchell quotation encapsulates his viewpoint most effectively: "Those interested in the future of the country, not only from a national defense standpoint but from a civil, commercial and economic one as well, should study this matter carefully, because air power has not only come to stay but is, and will be, a dominating factor in the world's development."[13]

Mitchell's fight with the Navy climaxed with the dramatic bombing tests of 1921 and 1923 that sank several battleships. He used the tests to argue that aerial bombardment relegated surface fleets as obsolete instruments of national security and defense. Within the Army, he also challenged traditional thinking. In early 1925, the Army transferred him to a post in Texas; once assigned, he reverted to his permanent rank of colonel. He interpreted both actions as attempts to isolate him, thereby ensuring the Air Service remained subordinate theoretically, doctrinally, and organizationally to the existing armed services.

Shortly after Mitchell's posting in Texas, the Navy's dirigible, the *Shenandoah*, crashed during a storm killing 14 crewmembers; Mitchell publicly proclaimed his frustration. He accused senior Army and Navy leaders of incompetence and "almost treasonable administration of the national defense," and of military aviation specifically.[14] Pres. Calvin Coolidge responded to Mitchell's public insubordination by directing a court-martial.

Inside the courtroom during Mitchell's (*standing*) president-directed court-martial for insubordination (1925)

Courtesy US Air Force

Found guilty of insubordination and sentenced to five years without pay (later reduced to half of five-year's pay), Mitchell resigned his commission and turned to the private sector to attempt to influence public conceptions of aviation. Once out of uniform, Mitchell would never enjoy the same degree of influence.

In 1942 Pres. Franklin Roosevelt promoted Colonel Mitchell to two-star general officer rank in the US Army Air Corps (retired list). To reinforce the value of his contributions to airpower development and its application to military functions, in 1946 the US Congress awarded him the Congressional Gold Medal. Gen Carl "Tooey"

Spaatz, first chief of staff of the United States Air Force, presented the medal to Mitchell's son two years later.

"Billy Mitchell"—his name remains identified with the birth of a separate air service and acts deemed unbecoming an officer and a gentleman. Even those who cannot overlook his insubordinate acts recognize his contributions to air operations. Absent Mitchell's persistence, some argue that the autonomous Air Force would not have come as soon as it did.

Learn more . . .

- James J. Cooke, *Billy Mitchell* (Boulder, CO: L. Rienner, 2002).
- Alfred F. Hurley, *Billy Mitchell: Crusader for Air Power*, rev. ed. (Bloomington, IN: Indiana University Press, 1975).
- William (Billy) Mitchell, 1879–1936, Papers (1907–46), MS 59–154, Manuscript Division, Library of Congress, Washington, DC, http://www.nasm.si.edu/research/arch/arch_repos/GUIDE.PT4.html(repository listing).

Lt William C. Sherman in a Wright C Flyer at College Park, Maryland, in October 1912

Courtesy of National Museum of the US Air Force

Col William C. Sherman

(1888–1927)

Legacy

- Proposed that aviation's morale effect outweighed physical destruction
- Set two-man duration and distance record of four hours, 22 minutes for 220 miles (28 March 1913, with Lt T. D. Milling)
- Lobbied for an Air Service academy on par with West Point and Annapolis (1919)[15]
- Authored Air Service's first air tactics doctrinal manual (1921)

Applying clever analytic insight, Maj William C. Sherman and a group of officers working with him in France at the end of World War I produced an important document entitled "Tactical History" under Col Edgar Gorrell's supervision as part of the history of the Air Service (American Expeditionary Force [AEF]). Although published in part as an *Air Service Information Circular* in 1920, "Tactical History" has remained virtually unknown beyond the military aviation community. The analysis provides excellent information about the conduct of combat operations and should be of value to those interested in aerial warfare in the First World War.[16] During the interwar period, as the US Army Air Service processed lessons learned, Gen Mason M. Patrick recognized that the most daunting challenge he faced as chief of the Air Service would be to organize his Airmen into a cohesive fighting force. As a first step he turned to Sherman, charging him to synthesize Army aviation training materials into a cohesive body. Synthesizing ideas from multiple sources, Sherman produced the first text on air tactics for the Air Service Field Officers' School.

Initially the school's doctrinal texts followed concepts officially imposed by the military establishment—success in war depended strictly on the infantry, and all air operations were auxiliary to the ground battle. But by the mid-1920s, Tactical School instructors began to write the air doctrine that Army airmen really believed, and it was "a far different concept of the nature of war and the role of airpower."[17] In 1921 Sherman authored the school's

first major text, *Air Tactics*, "a classic Air Service text on air doctrine," followed by a 1922 school manual entitled *Fundamental Doctrine of the Air Service*.[18] While he accepted the traditional Army principle that the success or failure of ground forces remained contingent upon the infantry, he envisaged two potential roles for the Air Service. Agreeing with established doctrine, Sherman posited Army aviation in the form of the "air-service" sustained ground operations and, therefore, should be an auxiliary arm of the ground service. Departing from doctrinal principles, he suggested that "air-force aviation (pursuit, bombardment, and attack aircraft) constituted a true arm . . . the first duty [of which] was 'to gain and hold control of the air, by seeking out and destroying the hostile air force, wherever it may be found.' "[19] He went further, arguing that " 'the backbone of the air forces on which the whole plan of employment must be hung is pursuit.' Having established control of the air, the mission of the air force was to 'destroy the most important enemy forces on the surface of the land or sea.' "[20]

First published in 1926, designers, engineers, pilots, and students of aviation have had many opportunities to evaluate its merits. Still, in that historic year, with the public reeling from the outcome of the Scopes Monkey Trial, Charles Lindbergh's solo transcontinental flight, and the Billy Mitchell trial and verdict, Sherman advanced a need for aerial navigation and lauded the merits of aviation.

Coming at a time when flying was in its infancy, the book ushered in a new era in airpower historiography.[21]

Sherman relied on an assortment of illustrations to buttress his contention that aerial navigation would play a significant role in the future of air tactics. Readers may not be pleased with the paucity of citations and the absence of a bibliography, but Sherman makes it clear that he based *Air Warfare* on notes accumulated while he was an instructor at the Air Service Tactical School and at the Command and General Staff School. *Air Warfare* advances our understanding of aerial navigation so much so that Sherman can take credit for being the inspiration behind some of the technology currently used in military operations.[22] Air theory attained a more detailed form after the Air Corps Tactical School relocated to Maxwell Field in Montgomery, Alabama, in 1931.

The US Army acknowledged Sherman's contributions to airpower development, naming an airfield in his honor at Fort Leavenworth, Kansas.[23]

Learn more . . .

- "Airpower Doctrine—Airpower Theory," Air University (AU) bibliography, updated by Terry Kiss, AU Library bibliographer, Maxwell AFB, AL, October 2004, http://www.au.af.mil/au/aul/bibs/apty/apy2bib.htm.
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Robert H. Goddard

Dr. Robert H. Goddard

Courtesy US Air Force

Dr. Robert H. Goddard

(1882–1945)

Legacy

- A father of practical modern rocketry and space flight
- Goddard Space Flight Center namesake
- Obtained first US patent for the idea of a multistage rocket (1914)
- Pioneer in the development of liquid-fueled rockets

Dr. Robert H. Goddard is considered a father of practical modern rocketry and space flight. From the early part of the twentieth century, his experiments with both solid- and liquid-fueled rockets formed much of the basis of the development of ballistic missiles, earth-orbiting satellites, and interplanetary exploration. Along with Konstantin Eduordovich Tsiolkovsky of Russia and Hermann Oberth of Germany, Goddard envisioned the exploration of space. A physicist of unparalled insight, he continually demonstrated unique genius for invention.

Goddard first obtained notice in 1907 in a cloud of smoke from a powder rocket fired in the basement of the physics building in Worcester Polytechnic Institute. School officials took an immediate interest in young Goddard's work: to its credit, the school did not expel him. Thus began his lifetime of dedicated work.

In 1914 Goddard received two US patents. One was for a rocket using liquid fuel. The other was for a two- or three-stage rocket using solid fuel. At his own expense, he began to make systematic studies about propulsion provided by various types of gunpowder. His classic document was a study that he wrote in 1916 requesting funds from the Smithsonian Institution so that he could continue his research. This was later published, along with his subsequent research and Navy work, in Smithsonian Miscellaneous Publication No. 2540 (January 1920), "A Method of Reaching Extreme Altitudes." In this treatise, he detailed his search for methods of raising

weather recording instruments higher than sounding balloons. In this search, as he related, he developed the mathematical theories of rocket propulsion.

Toward the end of his 1920 report, Goddard outlined the possibility of a rocket reaching the moon and exploding a load of flash powder there to mark its arrival. The bulk of his scientific report to the Smithsonian was a dry explanation of how he used the $5,000 grant in his research. Yet, the press picked up Goddard's scientific proposal about a rocket flight to the moon and erected a journalistic controversy concerning the feasibility of such a thing. Much ridicule came Goddard's way, setting the stage for his reaching firm convictions about the virtues of the press corps—a perspective he held for the rest of his life. Nonetheless, several score of the 1,750 copies of the 1920 Smithsonian report reached Europe.

After constructing the first liquid-fueled rocket, he launched it on 16 March 1926 from a field near Worcester, Massachusetts. Although the rocket flew for just 2.5 seconds and rose to a height of only 41 feet, it proved that liquid-fuel rockets worked. Four years later, at Roswell, New Mexico, Goddard fired a rocket that reached an altitude of 2,000 feet and achieved a speed of 500 miles per hour. His experiments led him to develop many of the devices still used in modern rockets, including fuel-feeding devices, propellant pumps, and gyroscopic stabilizers, as well as instruments for monitoring rocket flights.[24]

The German Rocket Society formed in 1927, and the German army began its rocket program in 1931. Goddard's most significant engineering contributions materialized during the 1920s and 1930s. He received a total of $10,000 from the Smithsonian by 1927, and through the personal efforts of Charles A. Lindbergh, he subsequently received financial support from the Daniel and Florence Guggenheim Foun-

Goddard and his team work on a rocket without its casing in Roswell, New Mexico, in 1940. *Left to right*: Goddard, machinist Nils Ljungquist, machinist and Goddard's brother-in-law Albert Kisk, and welder Charles Mansur.

Courtesy US Air Force

dation. The Smithsonian published progress on all of his work in "Liquid Propellant Rocket Development" (1936).

Goddard's work largely anticipated in technical detail the later German V-2 missiles, including gyroscopic control, steering by means of vanes in the jet stream of the rocket motor, gimbal steering, power-driven fuel pumps, and other devices. His rocket flight in 1929 carried the first scientific payload—a barometer and a camera. Goddard developed and demonstrated the basic idea of the "bazooka" two days before the Armistice in 1918. His launching platform was a music rack. Dr. Clarence N. Hickman, a young PhD from Clark University (Worchester, MA), worked with Goddard in 1918, providing continuity to the research that produced the World War II bazooka. In World War II, Goddard again offered his services—the US Navy assigned him to the development of practical jet-assisted takeoff (JATO) and liquid-propellant rocket motors capable of variable thrust. In both areas, he was successful. He died on 10 August 1945, four days after the United States dropped the first atomic bomb on Japan.

Goddard was the first American scientist who not only realized the potentialities of missiles and space flight but also contributed directly in bringing them to practical realization. This rare talent in both creative science and practical engineering places Goddard well above European rocket pioneers. The dedicated labors of this humble

genius went largely unrecognized in the United States until the dawn of what is now referred to as the "space age."

On 16 September 1959, the 86th US Congress authorized the issuance of a gold medal in honor of Prof. Robert H. Goddard. In memory of the brilliant scientist, the National Aeronautics and Space Administration (NASA) established one of its primary space science laboratories—the Goddard Space Flight Center (Greenbelt, Maryland, 1 May 1959).

Goddard's contributions to missilery and space flight comprise a lengthy list, one befitting an eloquent testimonial to his lifetime of work in establishing and demonstrating the fundamental principles of rocket propulsion. Listed here are his noteworthy "firsts":[25]

- Explored mathematically the practicality of using rocket propulsion to reach high altitudes and even the moon (1912)
- Proved, by actual static test, that a rocket will work in a vacuum, that it needs no air to push against
- Developed and launched a liquid-fuel rocket, 16 March 1926
- Launched a scientific payload (barometer and camera) in a rocket flight (1929, Auburn, Massachusetts)
- Used vanes in the rocket motor blast for guidance (1932, New Mexico)
- Received US patent in idea of multistage rocket (1914)

- Developed gyro-control apparatus for rocket flight (1932, New Mexico)
- Developed pumps suitable for rocket fuels
- Successfully launched a rocket with a motor pivoted on gimbals under the influence of a gyro mechanism (1937)

Learn more . . .

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Haywood Hansell

Maj Gen Haywood Hansell, Jr.
Courtesy US Air Force

Maj Gen Haywood Hansell, Jr.

(1903–1988)

Legacy

- Coauthored Air War Plans Division-1 (AWPD-1): advocated daylight strategic bombardment without fighter escort
- Commander, 1st Bombardment Division (Europe) and XXI Bomber Command (Pacific)
- Credited with four feature film roles regarding World War II
- Authored *The Air Plan that Defeated Hitler*

Haywood Hansell devoted his professional life to strategic airpower development—the single most controversial military debate of the twentieth century. Hansell believed wars could (and should) be won through precision bombing of military and industrial-commercial targets. Much to his dismay, the United States Army Air Forces (USAAF) abandoned

this approach during World War II because the passions of war reduced moral concerns involving strategic bombing, technological limitations hampered precision bombardment, and the demands of combat constrained operational flexibility.[26]

Born into the Army in antebellum quarters at Fort Monroe, Virginia, Haywood Shepherd "Possum" Hansell, Jr., began to learn Chinese (his Army-surgeon father was on duty in China during the Boxer Rebellion) and then Spanish in the Philippines before his mother, a former Atlanta belle, taught him English. At Sewanee Military Academy, Hansell acquired the nickname Possum that he bore for the rest of his life. According to one story, he resembled the animal physically. Another explanation held that as a student he slept in class but claimed to be "playin' possum." The latter may be more accurate: as captain of the cadet corps, he was busted to private in his senior year because of declining grades.

The scion of four generations of Army officers refused a West Point appointment in favor of studying mechanical engineering at the Georgia School of Technology. Following graduation in 1924, he worked as an engineer in California. Yet family tradition prevailed in 1928, when he joined the Army and entered flight training. A year later, he received his pilot's wings and commission as a second lieutenant.

Lieutenant Hansell joined the staff of the Air Corps Tactical School (ACTS) as an armament officer in 1930 and moved with the school to Montgomery, Alabama,

the following year. In addition to his duties in the school's flying squadrons, Hansell flew as one of the "Men on the Flying Trapeze," the Air Corps' first aerial demonstration team. He also excelled at polo, tennis, squash, and dancing and was known as "the unofficial poet laureate of the Air Corps."[27]

Because of his understanding of how to use airpower, Lieutenant Hansell was selected to study tactics and strategy under Capt Hal George (1934–35). On promotion to first lieutenant in late 1934 (six years after commissioning but not unusual during the Depression), he joined the ACTS faculty. At 31 he was one of the youngest instructors in the school. During his three years on the faculty, he became a member of the school's bomber zealots, advocates of daylight strategic bombardment without fighter escort. During 1938 to 1939, Captain Hansell attended the Army Command and General Staff School at Fort Leavenworth, Kansas.

In June 1941, Lt Col Harold "Hal" George selected Major Hansell to join the four-man planning team made up of former ACTS instructors. They would be instrumental in forming the Army Air Forces' airpower strategy for World War II. Having no existing plans to work with and no research arm to use, AWPD officers had to be resourceful. Hansell got target information, including blueprints, about German power-generating plants from New York banks that had financed them.

As he rapidly rose in rank—lieutenant colonel (January 1942), colonel (March 1942), and brigadier general (August 1942)—Hansell continued to perfect the AWPD plan produced in the summer of 1941. After the Japanese attack on Pearl Harbor in December 1941, he led the revision of the plan. He also helped plan the Combined Bomber Offensive against Nazi Germany and served as Gen Dwight D. Eisenhower's air plans officer. General Hansell then got himself transferred to a combat command. He led the 1st Bombardment Division in Europe and then the XXI Bomber Command in the Pacific. His high-altitude precision daylight B-29 raids on Japan were deemed indecisive. Consequently, Gen Curtis LeMay, who was to begin devastating low-level incendiary bombing of the home islands, replaced him.

General Hansell was retired for medical reasons in 1946 but during the Korean War returned to active duty as an advisor to the Joint Chiefs of Staff. In 1955 Hansell retired for a second time.

Learn more . . .

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Lt Col Henry H. Arnold
Air Corps, 16 February 1935
Courtesy US Air Force

Gen Henry H. "Hap" Arnold

(1886–1950)

Legacy

- Only Airman to attain the five-star rank of General of the Armies
- Commanding general of the US Army Air Forces, 1938–46
- Career spanned both World War I and World War II
- Author of *Global Mission* (1950)
- Father of Air University: "We must think in terms of tomorrow."

Gen Henry H. "Hap" Arnold

Courtesy US Air Force

Gen Henry "Hap" Arnold's contributions to air and space power development earned him a central place in the pantheon of airpower thinkers. His career stretched from the pioneer era (Orville Wright signed Arnold's pilot's license) into the jet and missile age.

A top-notch pilot, Arnold established a world altitude record and in October 1912 became the first Mackay Trophy winner by successfully using aerial

reconnaissance to locate a cavalry troop. The next month, while participating in an artillery-fire-directing experiment, Arnold's plane suddenly dropped into a downward spin. Arnold survived, performing the first successful spin recovery. When he landed, he asked for a leave of absence from flying; the Army transferred him back into the infantry.

When Congress increased aviation appropriations at the beginning of war in Europe, the Army recalled Arnold into the Signal Corps. With a temporary wartime rank of colonel, Arnold spent the war in Washington overseeing aircraft production and mobilization. As one of the few officers with flying experience, Arnold brought a valuable, practical viewpoint to his job and, although not happy about being away from the battlefront, he gained valuable administrative experience.[28]

Under the leadership of Arnold, known best as the organizational genius who built the United States Army Air Forces (USAAF) into a war-winning weapon during World War II, the force grew from 2,000 airplanes and 21,000 personnel in 1939 to 79,000 aircraft and 2,300,000 personnel at war's end. A strategic visionary, he remained particularly interested in the development of sophisticated aerospace technology to give the United States an edge toward achieving air superiority. He fostered the development of such innovations as jet aircraft, rocketry, rocket-assisted takeoff, and supersonic flight.

After a lengthy career as an Army aviator and commander that spanned the two world wars, he retired from active service in 1946.

Arnold engaged both airpower theory and practice. A pioneer in strategic communications, he demonstrated media savvy by recognizing the public needed to be "sold" on the value of military airpower and commercial aviation. He authored (or cowrote) a number of influential books, including *This Flying Game* and *Winged Warfare*. Knowing he needed to reach young people to inculcate a sense of air-mindedness across America, he created the popular "Bill Bruce" series of aeronautical adventure tales.

As early as 1940, Arnold envisioned that a future independent Air Force would need its own educational system, a "University of the Air." He demanded not only a series of schools equal to those of the older services but also a first-rate library and research center. Arnold charted the course of airpower's future by creating the Scientific Advisory Board. Its influential studies, including *Where We Stand* and *Toward New Horizons*, addressed such visionary topics as unmanned aerial vehicles, space exploration, missile power, and cyberpower—all topics studied at Air University today.

Sadly, in 1946 when the Air Force officially dedicated Air University, Arnold, by then retired and in failing health, could not be present. Gen Carl Spaatz's words paid tribute to General Arnold: "The opening of Air University fulfills a dream for education in Air

Power . . . an academic center of our own." The dream was Arnold's.

Learn more . . .

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Air Corps Tactical School

Air Corps Tactical School, class of 1937

Courtesy US Air Force

Air Corps Tactical School (ACTS)

Legacy

- First airpower think tank—created airpower doctrine
- Incubator of airpower's "best and brightest"
- Faculty members produced Air War Plans Division-1 (AWPD-1)

Few noticed when in 1931 the Air Corps relocated its advanced officer school from Langley Field, Virginia, to Maxwell Field, Alabama. Intended as a specialized school for air officers, in practice the ACTS assumed the responsibility for developing airpower doctrine and serving as the young branch's think tank for innovative and unconventional ideas. In many respects, it served as the forerunner to the contemporary Air Force–directed "Skunk Works" directorate.[29]

Enjoying its heyday in the 1930s, a dedicated band of faculty members—among them Harold George, Haywood

Hansell, Laurence Kuter, Kenneth Walker, and Muir Fairchild—crafted the theory known as high-altitude precision daylight bombardment. They argued that modern states depended upon an "industrial web"—a linked network of manufacturing plants, raw material sources, electrical power generation and transmission, and transportation. Using the eastern United States as a model, they argued that modern bomber forces could quickly and efficiently cripple this network with a carefully planned attack on the key "choke points" within the industrial web. Powerful four-engine bombers could fight their way through to the targets with acceptable losses. Long and costly battles against the enemy's armies and navies would be unnecessary—airpower offered a better way. In heated debates, war games, and discussions in the classrooms in what is now the Air University (AU) headquarters building, this theory was refined. In August 1941, four ACTS faculty members got the chance to convert theory into practice. Hap Arnold charged them to write the Army Air Forces' requirements plan—AWPD-1, later known as "the air plan that defeated Hitler"—an air strategy to beat the Axis.

Their ideas proved far from perfect. Unescorted bombers over Europe suffered terrible losses, and the enemy war economy proved far more resilient than anticipated: a combined arms assault on Fortress Europe was still necessary. Yet these dedicated professionals blazed new trails. The German air force was defeated in the skies before D-Day. Their ideas became the foundation of modern strategic airpower doctrine and are reflected in

the very latest concepts of effects-based operations, network-centric warfare, and cyberspace warfare. All of these ideas—and many more—emerged from the hot, stifling classrooms of Maxwell Field.

Learn more . . .

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Lt Gen Harold L. "Hal" George
Courtesy US Air Force

Lt Gen Harold L. "Hal" George

(1893–1986)

Legacy

- Commanding general, Air Corps Ferrying Command (redesignated Air Transport Command, June 1942)
- Doctor of aeronautical science, Pennsylvania Military College (1943)
- Vice president and general manager, Hughes Aircraft Company (1948–53)
- City council, Beverly Hills, California (eight years); mayor, Beverly Hills (two terms)

Harold Lee "Hal" George began his Army career as a cavalryman in the Officers Reserve Corps (1917). Serving only a month, he resigned his commission to become a flying cadet in the Signal Corps. He studied aeronautics at Princeton University and learned to fly at Love Field, Dallas, Texas, earning his wings in March 1918. He went to France that September with initial assignment to the 7th Aviation

Instruction Center at Clermont. Two months later he joined the Argonne front, flying bomber sorties during the 47-day Meuse-Argonne campaign. In 1921 George participated in Brig Gen William "Billy" Mitchell's bombing tests on warships that sank six naval vessels. Mitchell set out to demonstrate that battleships were highly vulnerable to air attack. Although these tests did not alter Army or Navy airpower employment, they convinced George that Mitchell's theories proved sound.

George served in two crucial Air Corps Tactical School (ACTS) faculty positions: first, as chief of the bombardment section (1932–34) and then as director of the Department of Air Tactics and Strategy (1934–36). Maxwell Field began to gain recognition as the center of innovative doctrinal thinking; George emerged as one of the leading proponents of precision daylight bombing for strategic operations. He helped develop the theories of strategic bombardment, convincing many in that generation of Air Corps officers that strategic bombardment could be decisive. Unlike most theoreticians, Colonel George's influence extended beyond the classroom. In the summer of 1941, he took charge of the Air War Plans Division (AWPD), a position on the newly formed Air Staff that would enable him to shape air operations throughout World War II's later stages.

Pres. Franklin D. Roosevelt secretly instructed the Army and Navy to determine what industrial capacity and manpower resources would be necessary to defeat the Axis powers. As the Army and Navy staffs rushed to

respond to the presidential tasking, George and a team of three former ACTS instructors—Haywood Hansell, Kenneth Walker, and Laurence Kuter—took the opportunity to advance their theories about the use of airpower. The AWPD outpaced the Army and Navy staffs because its planners had a military strategy (i.e., strategic bombardment) to leverage production and manpower requirements. ACTS had studied the industrial and economic vulnerabilities of both Germany and Japan. Fortuitous concerning timing, AWPD-1 enjoyed an advantage in that Gen George C. Marshall, the Army chief of staff, had recently become more aware of the potential decisiveness of strategic airpower.

Colonel George's small staff had one week in August to produce a plan. Immediately its members agreed on their main objective: destroy Nazi Germany's industrial capability. This task, they believed, could be done in no less than six months of sustained attacks against Germany's electrical power and transportation systems, petroleum industry, and ground- and air-based interceptor defenses. The team determined that the plan of strategic, long-range air attacks to destroy Germany would require more than 135,000 aircrew and 70,000 aircraft (almost 7,000 stationed in the European theater, with 2,000 required *each month* for replacements).

The plan did not neglect the need for ground forces or escort aircraft. However, it did state that ground forces might

not be required after six months of strategic bombardment and that high-altitude bombers *without fighter escorts* should be able to penetrate German air defenses during daytime hours. In revised form, the plan provided the basis for the Combined Bomber Offensive; consequently, it has been called the "air war plan that defeated Germany."

Confronted with the criticism that strategic bombardment alone did not defeat Nazi Germany, zealots countered strongly. While they recognized the employment of massive surface forces and the horrendous sacrifices of the Soviet Union, they argued that campaign operations never truly tested strategic bombardment theory because bombers frequently diverted to tactical targets.

Later in the war, General George directed the Air Corps Ferrying Command, which he transformed into the Air Transport Command (ATC), with more than 3,000 aircraft and 300,000 personnel. A predecessor of Air Mobility Command, by 1945 ATC possessed worldwide airlift capabilities.

After the war, he served briefly as director of information for the Air Force and as the senior Air Force representative of the military staff of the United Nations. He retired from active duty on 31 December 1946 with the rank of lieutenant general, dating back to March 1945. In 1955 the Air Force recalled Harold George to active duty for eight months as special consultant to the Air Force chief of staff; it relieved him from active duty a second time on 4 November 1955.

Learn more . . .

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Gen Muir S. Fairchild

Courtesy US Air Force

Gen Muir S. Fairchild

(1894–1950)

Legacy

- World War I combat veteran (bomber pilot on the western front)
- Participated in the Pan-American goodwill flight (1926–28)
- Air University's (AU) first commandant
- Vice-commander, USAF

Muir Stephen "Santy" Fairchild began his military career in 1916 as a sergeant in the Washington National Guard. The following year he became a flying cadet in California but finished his training in Europe, where the US Army commissioned him in 1918. During World War I, he flew bombers on the western front. After the war, he held several engineering assignments before participating in the Pan-American goodwill tour to South America in 1926–27. Pres. Calvin Coolidge awarded the eight pilots of this four-month tour the Distinguished Flying Cross. This honor was one of the few times in an illustrious career that Fairchild received public notice or acclaim.

A combat-tested World War I bomber pilot, Fairchild pushed the envelope in record-setting flights in the 1920s. In the 1930s, he graduated from the Air Corps Tactical School (ACTS), Army Industrial College, and Army War College before returning to Maxwell Field, Alabama, as an instructor and later as director of air tactics and strategy at ACTS. An influential faculty member at ACTS during 1937–40, he became an expert in strategic studies. A well-read individual, he relished including allusions to Lewis Carroll, Mark Twain, and William Shakespeare in his conversation and teaching.

The Maxwell assignment led naturally to the plans division in Washington and then to selection as secretary of the Air Staff (1941), followed by other highly influential Washington assignments. He promoted the

airpower theories he had studied and helped form at Maxwell and protected airpower from those, especially in the Navy, who were denigrating its potential role in warfare. In 1946 he became the first commandant of the newly formed Air University, an institution he planned to be both the mind and the heart of the Air Force.

From the first, this novel "university of the air" demanded exceptional leadership, someone with not only a broad grasp of the theoretical, technical, and practical issues undergirding modern airpower but also comfortable with the ambiguity inherent in advanced education. Fortunately for AU its first commander, Gen Muir S. Fairchild, was more than equal to the challenge.

General Fairchild served as the first in a long line of visionary AU commanders. Gen Carl Spaatz paid him tribute by proclaiming that the Air University bore the stamp of his "inspiration and wisdom." Clearly, Fairchild's imprint on AU is still with us. He believed passionately in academic freedom. His declaration that "faculty members who disagree with concepts and doctrines being presented . . . or who feel that orders and directives issued to them are in any way unduly hampering their conduct of instruction, not only have the *right* but the *obligation* to present their divergent views" ensured that AU remained a univer-

sity in the truest sense, a stronghold for free inquiry and discussion. To avoid the danger of groupthink within the faculty and administration, Fairchild created the AU Board of Visitors, a distinguished group of civilian academics and retired flag officers, to bring an outside perspective. After serving two years as the AU commandant, with his selection as vice-chief of staff of the Air Force, Fairchild achieved four-star rank. General Fairchild died while on active duty at Fort Myer, Virginia, in 1950.

In more than three decades of service, General Fairchild guarded his privacy while he helped mold the Air Force. Today, he is recognized appropriately: the Muir S. Fairchild Research Information Center at Maxwell AFB, Alabama; the main academic building at the United States Air Force Academy in Colorado Springs, Colorado; and Fairchild AFB in Spokane, Washington, are all named in honor of General Fairchild.

Learn more . . .

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Kenneth Walker

Brig Gen Kenneth N. Walker

Courtesy US Air Force

Brig Gen Kenneth N. Walker

(1898–1943)

Legacy

- Medal of Honor recipient for conspicuous leadership, personal valor, and intrepidity (World War II, 1943, posthumous)
- Cocreated Air War Plans Division-1 (AWPD-1)
- Commanding general, V Bomber Command, Fifth Air Force (1942)

Kenneth Newton "Ken" Walker began flying at the University of California's School of Military Aeronautics. After earning his pilot's wings and Army commission in 1918, he served as a flying instructor for three years. Staff, command, and flying assignments in the Philippines and Virginia followed.

In 1929 he graduated from the Air Corps Tactical School (ACTS) at Langley Field, Virginia, and then stayed on as a member of the school's faculty. He was with the school for its move to Montgomery, Alabama,

in 1931. Lieutenant Walker, a senior instructor at the ACTS, stood with the zealous instructors who propounded the theories that strategic daylight bombardment could achieve success without fighter escort, ideas in conflict with the Army's concepts of how airpower should be used. Lieutenant Walker's debates with Maj Claire Chennault (who argued that bombers were not invincible from fighter interception) became legend.

After graduating from the Army Command and General Staff School (1935) at Fort Leavenworth, Kansas, Walker was promoted to captain and, two months later, to major. He served in a variety of positions in intelligence, bomber, and pursuit operations until January 1941.

Lt Col Hal George selected Major Walker, his former ACTS instructor, to join three other officers to form the Air War Plans Division. In August 1941 this team, which also included two other ACTS graduates—Maj Larry Kuter and Maj Haywood Hansell—produced the AWPD-1 plan. During this time, Walker also organized the secret American Volunteer Group (AVG) in China, the American flying unit that became Chennault's Flying Tigers. Three rapid promotions followed: lieutenant colonel in July 1941, colonel in March 1942, and brigadier general in June 1942. Extraordinary staff work on the newly formed Air Staff in Washington merited these promotions.

Capt Freddie Donnenberg, Maj Harrison Overturf, and Gen Kenneth Walker in the Southwest Pacific. It is believed that Harrison is Walker's cousin; Donnenberg and Overturf were Walker's aides.

Reprinted from Martha Byrd, Kenneth N. Walker: Airpower's Untempered Crusader *(Maxwell AFB, AL: Air University Press, 1997)*

In July 1942, Brig Gen Ken Walker transferred to the Asiatic-Pacific theater. In the Southwest Pacific, he routinely flew B-24 and B-25 bombing missions. Such missions allowed him, as commanding general of the V Bomber Command, to learn firsthand about combat conditions and to develop tactics to thwart Japanese fighters and antiaircraft fire.

Ignoring orders to stop flying combat missions, Walker was leading a daylight raid on Japanese shipping in the harbor at Rabaul, New Britain, when enemy fighters shot him down on 5 January 1943; he was last seen leaving the target area with one engine on fire and several fighters on his tail. For his leadership in combat and his personal valor, the US Congress recognized him with the award of the Medal of Honor. Walker became one of 38 Army Air Forces flying personnel so honored during World War II. The citation for his medal reads:

> For conspicuous leadership above and beyond the call of duty involving personal valor and intrepidity at an extreme hazard to life. As commander of the 5th Bomber Command during the period from 5 September 1942, to 5 January 1943, Brigadier General Walker repeatedly accompanied his units on bombing missions deep into enemy-held territory. From the lessons personally gained under combat conditions, he developed a highly efficient technique for bombing when opposed by enemy fighter airplanes and by antiaircraft fire. On 5 January 1943, in the face of extremely heavy antiaircraft fire and determined opposition by enemy fighters, he led an effective daylight bombing attack against shipping in the harbor at Rabaul, New Britain, which resulted in direct hits on 9 enemy vessels. During this action his airplane was disabled and forced down by the attack of an overwhelming number of enemy fighters.[30]

In January 1948, the US Army designated Roswell Army Air Field at Roswell, New Mexico, as Walker Air Force Base. Likewise named in his honor, Walker Hall on Maxwell's Chennault Circle is the home of the Curtis E. LeMay Center for Doctrine Development and Education.

Learn more . . .

- Martha Byrd, *Kenneth N. Walker: Airpower's Untempered Crusader* (Maxwell AFB, AL: Air University Press, 1997), http://www.au.af.mil/au/aul/aupress/Indexes/author_ndx_bks.htm.
- Douglas P. Walker, "A Short Biography of Kenneth N. Walker," Hawaii Aviation Preservation Society, http://hiavps.com/Walker.htm.
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Gen George C. Kenney
Courtesy US Air Force

Gen George C. Kenney

(1889–1977)

Legacy

- World Wars I and II combat veteran
- Commander of 91st Aero Squadron (1919) and Fifth Air Force, Allied Forces, Southwest Pacific Area (1942–45)
- Progenitor of "attack aviation" and the joint force air component commander (JFACC) construct
- First commander of Strategic Air Command
- Commander, Air University

From the early days, the Air Force has striven to produce broadly educated officers, schooled in air and joint war fighting, who can tackle the most complex and challenging assignments. Few epitomize that type of "warrior-scholar" more than General Kenney.

Canadian-born George Churchill "Little George" Kenney studied civil engineering at the Massachusetts Institute of Technology for three years before leaving to take a job with a Canadian railroad; within four years he was president of an engineering company. Kenney joined the nascent US Army Air Service in 1917, becoming a flying cadet within the Signal Corps. Earning his wings, he soon found himself over the trenches in France, where he shot down two German aircraft. Captain Kenney ended the war as the commander of his squadron.

During the interwar era, Kenney made the most of the educational opportunities available to him. In 1921 he graduated from the Army Air Service Engineering School. In the mid-1920s, he completed the Air Corps Tactical School (ACTS) and the Army Command and General Staff School. From 1927 to 1929, while teaching at the ACTS he became an advocate of attack aviation (namely, close air support and interdiction). Two years after completing the Army War College in 1933, Captain Kenney translated a French version of the essential points of the airpower ideas of Italian air theoretician Guilio Douhet. These ideas influenced Air Corps thinking and congressional understanding of attack aviation's potential for decades. Beyond what he learned in the classroom, through

these experiences Kenney began several lifelong friendships and associations with officers from other Army branches. He understood land maneuver warfare and injected an aviator's perspective into their discussions.

Captain Kenney jumped the grade of major, becoming a lieutenant colonel. In 1939, while the chief of production at Wright Field, Ohio, the Army promoted him to colonel. As assistant attaché for air in Paris in 1940, he became convinced that the United States lagged the major European powers in aeronautical technology and production. Returning to the United States, he continued his meteoric rise: brigadier general in January 1941, major general the following month, and lieutenant general in October 1942.

George Kenney's promotions rested on his performance as an aggressive, hard-working, and innovative officer. Moreover, he combined technical expertise with leadership to make things happen. His innovations included low-level air strikes, machine guns mounted on the wings rather than the aircraft's cowling, bulletproof cockpit glass, power turrets on bombers, improved oxygen systems, parachute bombs, and antiship skip bombing.

From 1942 to the end of World War II, Kenney held several major command positions in the Southwest Pacific theater. As Gen Douglas MacArthur's air commander, General Kenney made MacArthur's island-hopping strategy possible. MacArthur said of Little George, "Of

all the brilliant air commanders of the war, none surpassed him in those three essentials of combat leadership: aggressive vision, mastery of air tactics and strategy, and the ability to exact the maximum in fighting qualities from both men and equipment."[31]

Kenney's contributions while on the faculty of the ACTS proved especially important. He was the chief of the Attack Aviation Branch of the curriculum, educating Airmen in tactics to support the surface fight. "I was the papa of attack aviation," he remembered. "I wrote the textbooks on it, taught it, and developed the tactics." He also invented new weapons—including parachute fragmentation bombs—that would resurface in a time of national emergency. The "Bomber Mafia" may have dominated the ACTS, but the school also produced the WWII senior leaders who excelled across the spectrum of air operations.

In 1942 the Army sent Kenney to the Southwest Pacific to take over MacArthur's air forces. A formidable boss, MacArthur had proven too much for several of his predecessors. Kenney assured MacArthur that the Air Force would deliver. In short order, Kenney revitalized Fifth Air Force, transforming it into a powerful air component.

Sometimes referred to as the first modern JFACC, by 1944 Kenney's bombers and fighters dominated the airspace and the sea-lanes in the Southwest Pacific.[32] The ideas Kenney formulated in the 1920s paid handsome dividends.

Left to right: Mr. F. M. Forde (Minister for the Army), Gen Douglas MacArthur, Gen Sir Thomas Blamey, Gen George C. Kenney, Maj-Gen C. A. Clowes, and Brig Gen Kenneth Walker

Reprinted from Martha Byrd, Kenneth N. Walker: Airpower's Untempered Crusader (Maxwell AFB, AL: Air University Press, 1997)

After World War II, the most distinguished air commander in the war against Japan led the Pacific Air Command, 1945–46, and the Strategic Air Command (SAC), 1946–48. Because of additional responsibilities, such as a nine-month assignment as senior US representative to the United Nations Military Staff Committee and placing too much trust in his vice-commander, General Kenney neglected SAC combat crew training. Consequently, Gen Curtis LeMay replaced him as SAC's commander.[33]

General Kenney ended his 34-year career commanding Air University (1948–51). During this period, he wrote two books: *A Personal History of the Pacific War* (1949) and *The MacArthur I Know* (1951). His oft-quoted maxim remains valid in the twenty-first century: "Airpower is like poker. A second-best hand is like none at all—it will cost you dough and win you nothing."[34] In addition to two manuscripts and words recalled by modern-day Air Force leaders to substantiate escalating budgets, he left behind a legacy of innovation, leadership, and true joint war fighting.

Learn more . . .

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Gen Laurence S. Kuter
Courtesy US Air Force

Gen Laurence S. Kuter

(1905–1979)

Legacy

- Cocreator of Air War Plans Division-1 (AWPD-1) plan
- Commanding general, 1st Bomb Wing (England, 1942)
- Commander, Military Air Transport Service (1948–50)
- Commander, Air University (AU) (1953–55)
- Commander, Pacific Air Forces (1957–59)
- Commander, North American Air Defense Command (NORAD) (1959–62)

Laurence Sherman "Larry" Kuter graduated from West Point in 1927. He served in the field artillery at the Presidio of San Francisco until he entered flying training in May 1929. In 1930 he was assigned to a bomb squadron at Langley Field, Virginia, where he helped develop bombing techniques; he also headed the operational development of the B-9 bomber and related high-altitude bombing tactics. When Pres. Franklin D. Roosevelt gave the responsibility for airmail service to the Army in 1934, Lieutenant Kuter served in the Eastern Zone airmail operations.

He graduated at the top of his Air Corps Tactical School (ACTS) class in 1935 and remained at Maxwell Field, Alabama, on the school's faculty. Captain Kuter's lectures on bombardment aviation and employment of airpower predicted a 10,000-plane air force, a force structure achieved during World War II. He challenged his students to understand military doctrine to the extent that they could disagree and successfully argue their points.

In 1939 Gen George C. Marshall, Army chief of staff, had junior officers assigned to the General Staff. Capt Larry Kuter, one of the junior officers selected, planned for the basic employment of airpower. In August 1941, Major Kuter joined the team of former ACTS faculty that was preparing the Air Staff's response to a presidential tasking for wartime industrial and manpower requirements. The famous AWPD-1 plan set forth not only

the numbers of aircraft and personnel but also presented a strategic bombardment plan that the team claimed could defeat Nazi Germany.

In November 1941, Major Kuter assumed duties as the assistant secretary of the War Department General Staff. Within months, the Army promoted him to lieutenant colonel, and then, skipping colonel, he became the deputy chief of the Air Staff as a brigadier general. In late 1942, as commanding general of the 1st Bomb Wing in England, he directed the B-17 bombing of Germany. He then served in North Africa until Field Marshal Erwin Rommel surrendered in May 1943. In North Africa, he came to appreciate the necessity for air superiority and the use of airpower to support surface operations.

Returning to Washington, Major General Kuter participated in strategic-level, politico-military conferences in Quebec, Cairo, London, Yalta, and Malta. His book, *Airman at Yalta* (1955), provides a detailed account of the Yalta conference discussions. At the end of World War II, Kuter served in the Pacific. Just after the war, he represented the United States at major civil aviation conferences in Montreal, London, Cairo, Lima, and Rio de Janeiro.

From 1953 to 1955, Lieutenant General Kuter commanded Air University. He raised the Air Command and Staff School to the collegiate level. By expanding the

doctrinal emphasis of AU, he hoped to make it the brains of the Air Force (just as the ACTS had been during the 1930s). He believed that Air War College students, particularly, had the potential for long-range planning and doctrinal research. To disseminate their work, he founded Air University Press in 1953. In 1955, with a promotion to general, he commanded the Far East Air Forces (Tokyo) and its successor, Pacific Air Forces (Honolulu).

From 1959 until his retirement in 1962, General Kuter commanded NORAD. While there, he fought to prevent downgrading of interceptor defenses, forces being neglected because of the increasing Soviet nuclear-armed missile threat. His dedication and advocacy enabled the USAF to remain dominant throughout the Cold War.

Learn more . . .

- David G. Estep, "Air Mobility: The Strategic Use of Nonlethal Airpower" (thesis, School of Advanced Airpower Studies, Maxwell AFB, AL, 1994).
- Gen Laurence Sherman Kuter, *Airman at Yalta* (New York: Duell, Sloan and Pearce, 1955).
- Gen Laurence S. Kuter, United States Air Force oral history interview, 1974, no. K239.0512–810, Air Force Historical Research Agency collection, Air University, Maxwell AFB, AL.

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Claire L. Chennault

Maj Gen Claire L. Chennault

Courtesy US Air Force

Maj Gen Claire L. Chennault

(1890–1958)

Legacy

- Joined the service in World War I
- Combat veteran of Sino-Japanese War and World War II
- Chief, China Air Task Force (World War II, 1942)
- Commander, American Volunteer Group (AVG) "Flying Tigers"
- One of the fathers of pursuit aviation

The "Bomber Mafia" may have ruled the Air Corps Tactical School (ACTS) during the 1930s, but other voices were also heard. Among the most strident of these was that of Capt Claire Chennault, the former chief of pursuit training in the Air Corps. A fighter pilot to the core, the crusty Chennault (known as "Old Leatherface" to his comrades) was having none of the "bomber invincibility" theory. He argued, in his course and in a concise article entitled "The Role of Defensive Pursuit," that with proper early warning from ground observers and telephone communications, fighter aircraft could intercept unescorted bomber formations and disrupt their attacks.

In 1917 Claire Lee Chennault left his job in an Akron, Ohio, tire factory to enter the Officers Training School at Fort Benjamin Harrison, Indiana. Ninety days later he emerged as a lieutenant in the infantry reserves. Lieutenant Chennault, however, wanted to fly, so he quickly transferred to the Aviation Section of the Signal Corps.

In 1919 he overcame Army opposition to his entering flying training because of his age and because he was married with three children. In 1920 Chennault earned his pilot's wings. Later that year, he obtained a regular commission in the newly organized Air Service and commanded a pursuit, or fighter, squadron in Hawaii.

As the leader of Maxwell's daring aerial exhibition team, the "Three Men on the Flying Trapeze," Chennault gave practical demonstrations of fighter tactics while dazzling local crowds. Chennault's abrasive character

"Three Men on a Flying Trapeze." Pictured here are sergeant pilots William McDonald, John Williamson, and Ray Clifton. With Chennault, these men flew Boeing P-12 biplanes, a peppy little aircraft equipped with 450-horsepower engines that could achieve a top speed of 194 miles per hour.

Courtesy Air Force Historical Research Agency

and eccentric behavior (he was removed from base housing, reportedly for having too many junker cars in his driveway, and subsequently flew to his off-base house for lunch in his P-12 fighter) led to his departure from the service in 1937. Though no one at Maxwell understood that radar was in the offing, Chennault was one of the few who argued that an air defense was practical. He, like most others there, did not think that long-range escort would be feasible.

Chennault went on to tremendous fame as the commander of the AVG, a cadre of ex-US military pilots who signed up to fight the Japanese alongside Chiang Kai-shek's Nationalist Chinese forces. During the first grim months of the war in the Pacific, Chennault's "Flying Tigers" were a ray of light against an almost unbroken dark backdrop of military disaster. Chennault would later return to active duty to command Fourteenth Air Force.

Chennault reminds us that there must always be a place to voice and debate unpopular, innovative airpower ideas. His views ran against the Air Force thinking of his day. However, the unexpected coming of radar and the British development of an integrated air defense system made them practical (though neither the Japanese nor the Germans succeeded in defending their homelands.)

While his fellow ACTS instructors promoted strategic bombardment theories, he advocated fighters, air superiority, and an air-defense warning net (before the development of radar). Needless to say, his colleagues did not receive his theories with open arms (or minds). Chennault medically retired at his permanent rank of captain in 1937.

However, Chennault did not remain on the sideline for long as he became involved in the Sino-Japanese War. By 1940 he had secured American assistance and in August 1941 formed the AVG, the "Flying Tigers." In the seven months following the Japanese attack on Pearl Harbor, the AVG proved the most effective Allied fighter

American Volunteer Group "Flying Tigers"

Courtesy "Flying Tigers," Moody AFB, Georgia, Web site, http://www.moody.af.mil

group in the Far East, shooting down hundreds of Japanese planes—with 297 confirmed victories—while sustaining almost insignificant losses.[35]

Chennault returned to US service in 1942 as commander of the China Air Task Force, which had to be supplied over the Himalayas from India. His acerbic personality and almost insubordinate advocacy of his airpower tactics and politico-military strategy led to estrangement with Gen Joseph W. "Vinegar Joe" Stilwell, commander of the China-Burma-India theater, and with Gen George C. Marshall, chief of staff of the Army. Major General Chennault retired just before

Japan surrendered. Subsequently, Chennault formed a contract cargo carrier, Civil Air Transport (CAT), in the Far East. The CAT provided Chennault, an outspoken anti-Communist and friend of Generalissimo Chiang Kai-shek, with the means to support the Nationalist Chinese in 1948–49 during China's civil war. The Central Intelligence Agency took over the CAT in 1950.

Appropriately, the street that is home to the ACTS's descendants and the Air Force's professional military education schools is named "Chennault Circle" in his honor.

Learn more . . .

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Ira C. Eaker

Gen Ira C. Eaker
Courtesy US Air Force

Gen Ira C. Eaker

(1896–1987)

Legacy

- Aviation pioneer and Air Force leader
- Led the Eighth Air Force in its daylight precision bombing over Germany during World War II (1943)
- Air commander in chief, Mediterranean Allied Air Forces (1944)
- Deputy commander, US Army Air Forces (1945–47)
- Promoted to lieutenant general and general on the retired list

Commissioned a second lieutenant of infantry in 1917, within six months Ira C. Eaker decided he wanted to fly. Lieutenant Eaker earned his pilot's wings in 1918. During the interwar years, Captain Eaker helped defend Brig Gen William "Billy" Mitchell in his court-martial for insubordination in 1925; piloted one of the planes on the 22,065-mile Pan-American goodwill trip of 1926–27; flew with others, such as Elwood Quesada and Carl A. "Tooey" Spaatz, in 1929 on the trimotored Fokker, setting an in-flight refueling endurance record of 150 hours (11,000 miles and 43 aerial refuelings, all over Los Angeles); and flew the first documented transcontinental instrument flight in 1936.

His flying included somewhat more routine work: commanding two pursuit squadrons, flying on Western Zone routes when the Air Corps carried the airmail in 1934, and participating in the Pacific naval maneuvers in 1935. During the interwar years, Eaker also furthered his education. He studied at the University of the Philippines (1920–21), Columbia Law School (1922–23), and the University of Southern California (1932–33), where he received a journalism degree.

From 1935 to 1937, Major Eaker attended the Air Corps Tactical School (ACTS) at Maxwell Field and the Army Command and General Staff School at Fort Leavenworth, Kansas. Together Eaker and Hap Arnold wrote *This Flying Game* (1936), the first of three books they would coauthor. The others were *Winged Warfare* (1941), which stressed the

Eaker in an informal shot

Courtesy US Air Force

need for a separate air force, and *Army Flyer* (1942), which explained the duties and rewards of being a pilot.

Rapid wartime promotions followed: colonel in December 1941, brigadier general in February 1942, major general in September 1942, and lieutenant general in September 1943. His fourth star did not come until 1985, almost 38 years after he retired. These promotions—and

Ira Eaker's place in history—rest on his two World War II combat commands.

From 1942 until the end of 1943, he commanded US bombing efforts from Great Britain. An advocate of high-altitude daylight precision bombing as taught at ACTS, Eaker insisted the B-17 Flying Fortresses conduct combat missions over Europe. In August 1942, Eaker himself flew one of the aircraft in the first American bombing raid over Nazi-occupied France; subsequently, he flew bombing raids over Germany. The absence of adequate fighter escorts resulted in crippling bomber losses, especially in the large raids against Schweinfurt and Regensburg. As commander of the Eighth Air Force, Eaker bore much of the responsibility.

Eaker successfully lobbied Col Oveta Culp Hobby (director of the Women's Army Corps (WAC) and his superiors to assign a WAC company to his command (first in England; later near the front in Italy). Of the WACs in Italy, Eaker wrote of their "superb" work habits, suggesting that "one girl is worth three men," and raved that despite "extremely unpleasant conditions . . . this little group of American girls is exhibiting the best and most cheerful type of morale of any soldiers I have ever seen."[36] As another tangible demonstration of his egalitarian beliefs, despite reservations he honored the request of Dixie Tighe, a woman war correspondent who wanted to go on a bomber mission as her male counterparts had.[37]

Former aide and biographer James Parton reports Eaker as saying the Casablanca Conference "turned out

to be one of the war's most decisive, especially in regard to the use of airpower."[38] Among the many issues decided upon at Casablanca in January 1943, two stand out as critically important. First, after much debate, US air leaders convinced British prime minister Winston Churchill that daylight precision bombing should be given a chance. Second, the major participants agreed to invade Sicily in an operation code-named Husky. Moreover, the Casablanca Conference provided an opportunity to discuss these issues within the context of grand strategy as a whole.[39]

As the world's most powerful decision makers met at Casablanca, the US Army Air Forces (USAAF) deployed major combat air forces in the European and North African theaters. In the United Kingdom, General Eaker commanded the Eighth Air Force—the USAAF's primary strike force for its strategic daylight precision bombing offensive against Germany. At this time, the strategic bombing offensive constituted the undisputed, preeminent USAAF campaign of the war. Eaker's "Mighty Eighth" was created to demonstrate the ability of airpower to defeat an enemy nation by bombing alone. The commanding general of the AAF, Gen Henry H. "Hap" Arnold, hoped that the Eighth and Fifteenth Air Forces would defeat Germany by strategic precision bombing before the Allies invaded the continent. The B-17 and B-24 four-engine long-range heavy bombers

served as their main weapons.[40] By early 1943, Eaker's strike force included 337 B-17s and B-24s.[41]

From 1944 to April 1945, he commanded the Allied Air Forces in the Mediterranean theater. Flying first from North Africa and then from Italy, his air assets were involved in many missions. They helped keep the sea-lanes open, air dropped supplies to anti-Nazi partisans in the Balkans, bombed southern Germany and the Romanian oil field at Ploesti, and provided air support for landings in southern Italy and southern France. In August 1944, he personally flew a fighter supporting the invasion in southern France.

After assignments as deputy commander of the Army Air Forces and chief of the Air Staff, Lieutenant General Eaker retired in 1947. On 10 October 1978, the president of the United States, authorized by act of Congress, awarded in the name of the Congress a special Congressional Gold Medal to General Eaker for contributing immeasurably to the development of aviation and to the security of his country. Almost 40 years after his retirement, at the behest of Senator Barry Goldwater and endorsed by Pres. Ronald Reagan, the US Congress passed special legislation awarding four-star status to General Eaker. On 26 April 1985, Gen Charles Gabriel, chief of staff, and Mrs. Ruth Eaker, the general's wife, pinned on his fourth star.

General Eaker's influence continued well after he exited uniformed service. For 18 years he wrote a syndicated column for more than 180 newspapers, concentrating

on defense posture, national security, and airpower. An exhibit in Air University's Ira C. Eaker College for Professional Development on Chennault Circle houses some of General Eaker's memorabilia.

Learn more . . .

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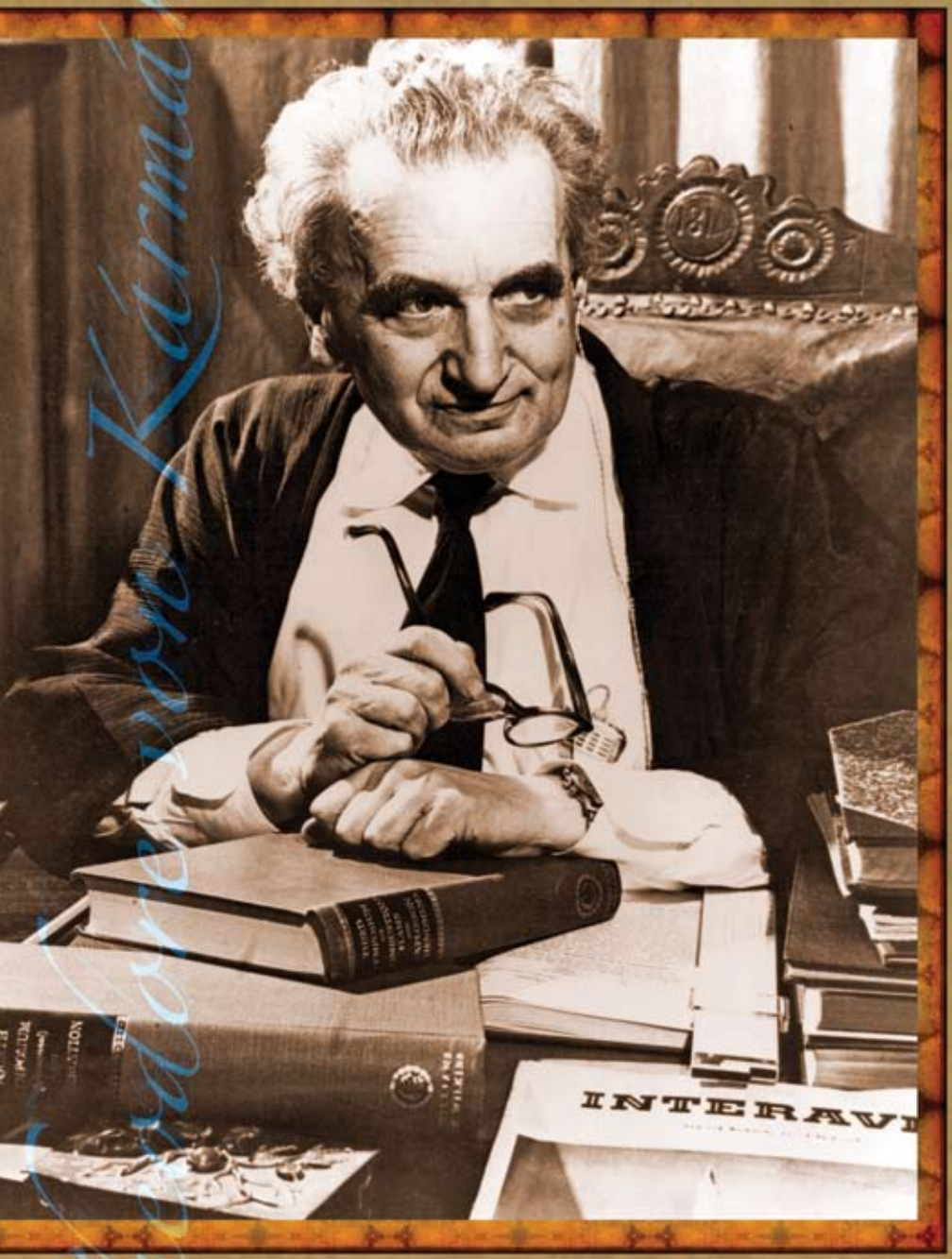

Dr. Theodore von Kármán

Courtesy of NASA

Dr. Theodore von Kármán

(1881–1963)

Legacy

- Father of supersonic flight
- Guggenheim Aeronautics Laboratory professor at the California Institute of Technology (1930–49)
- Founder, US Institute of Aeronautical Sciences (1933)
- Head of US Army Air Forces' Scientific Advisory Group (1944)
- National Medal of Science recipient (1963)

Born in Budapest, Hungary, the geopolitical climate shaped by Germany caused Dr. Theodore von Kármán's emigration to the United States in 1930; in 1936 he became a US citizen through naturalization. Best known for his work to develop the fields of aeronautics and astronautics, modern technologies incorporate von Kármán's ideas relative to supersonic and hyper-supersonic airflow dynamics.

In 1906 von Kármán received a scholarship to the University of Göttingen, Germany, earning a PhD in engineering in 1908. In March of that year he made a trip to Paris, where he watched an airplane flight by French aviation pioneer Henri Farman. Thus began von Kármán's lifelong interest in the application of mathematics to aeronautics. In 1911, after conducting wind tunnel experiments, he made an important analysis of the alternating double row of vortices behind a flat body in a fluid flow, a dynamic known today as the von Kármán vortex street.

In 1913 von Kármán became director of the Aachen Aerodynamics Institute and a professor at the Technical University in Aachen, Germany. With the outbreak of World War I in 1914, he returned to Austria-Hungary and became head of Research for the Austro-Hungarian Army Aviation Corporation. Although he built a prototype helicopter during the war, the Austro-Hungarian army did not pursue his ideas.

Due to the political upheaval in Hungary at the end of World War I, the scientist returned to Aachen (1919) to

resume his post as head of the Aeronautical Institute, a position he retained until 1930. While there, he designed and built the first wind tunnels at Aachen; in 1926 he did likewise in California. The California Institute of Technology (Caltech) offered him the post of director of the Aeronautical Laboratory. Troubled by the rise of the Nazis within Germany, he accepted the position; in 1936 he became a naturalized US citizen.

Dr. von Kármán was head of the Caltech Guggenheim Aeronautical Labs at Pasadena from 1930 to 1957. In 1935 he began a long association with Frank J. Malina, one of his graduate students. Their collaboration resulted in America's first high-altitude sounding rocket, the WAC Corporal (1945). In 1938 Theodore von Kármán chaired the National Academy of Sciences committee and in 1941 cofounded Aerojet General to develop rocket engines for the US military. In 1944 von Kármán and Malina played a key role in the creation of Caltech's Jet Propulsion Laboratory. The same year, Dr. von Kármán chaired the Army Air Corps Scientific Advisory Group.

As chair, he oversaw production of *Where We Stand*, an influential report that framed the foundation of the US Air Force's technical needs during the Cold War. For the rest of his career von Kármán continued to work closely with the US military, as he had earlier with the Austro-Hungarian army. The group further investigated technologies in the field of rockets, guided missiles, and jet

propulsion. Later, it recommended independence vis-à-vis the Office of the Secretary of Defense strategic research program and provided for setting up the RAND project.[42] In 1946 von Kármán helped create the Scientific Advisory Board to the chiefs of staff. In 1951 he proved instrumental in establishing the Advisory Group on Aeronautical Research and Development—the North Atlantic Treaty Organization's aeronautical research arm; he also served as its first chair.

In 1956 he helped establish the International Council of the Aeronautical Sciences and the von Kármán Institute for Fluid Dynamics. In 1960 he cofounded the International Academy of Astronautics. Theodore von Kármán received many honors for his pioneering work in aerodynamics, including the Medal for Merit in 1946 and the Franklin Gold Medal in 1948. In 1963 he received the first National Medal of Science, presented by Pres. John F. Kennedy.

Dr. von Kármán's scientific reputation rested on a series of profound insights on the nature of aerodynamics, which he demonstrated through a highly intuitive style of applied mathematics. He published more than 200 papers, which identified much of the technical basis of flight. He forged scientific cooperation, developed many theories of aeronautical and space science, and played an important role in the creation of supersonic aircraft and ballistic missiles.

Theodore von Kármán died at the age of 81 in Aachen, Germany, on 7 May 1963. His family buried him in

Pasadena, California, near the Jet Propulsion Lab he helped found. Craters on the Moon and on Mars are named in his honor. He is also commemorated through the Theodore von Kármán Prize, established by the Society for Industrial and Applied Mathematics (1968): the society recognizes the notable application of mathematics to mechanics and/or the engineering sciences made during the five to 10 years preceding the award. Von Kármán's most interesting and best-known quotations include:

- "Scientists discover the world that exists; engineers create the world that never was."
- "I came to realize that exaggerated concern about what others are doing can be foolish. It can paralyze effort, and stifle a good idea. One finds that in the history of science, almost every problem has been worked out by someone else. This should not discourage anyone from pursuing his own path."
- "Mr. President, one does not need help going down, only going up." (While receiving the first National Medal of Science from President Kennedy at age 81, politely refusing the president's helping hand.)

Learn more . . .

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