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COVER: Contrails by Samantha R. Mandales.

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From the Editor

In this issue, historian Don Baucom concludes his two-part series, "Wakes of War: Contrails and the Rise of Air Power, 1918-1945," with "Part II: The Air War over Europe, 1939-1945." Here, he demonstrates the importance of the science of contrails and how airmen on opposing sides of the war exploited contrails to their advantage. By war's end the advent of radar had begun to eclipse the significance of the phenomenon.

Based on newly declassified sources, Major Bill Cahill's article sweeps away some of the decades-long mystery surrounding the EC-121 aircraft called Rivet Top that flew during the War in Southeast Asia. Readers will learn how Rivet Top's continual modification of equipment, tactics, and procedures met the war's needs for on the spot information and intelligence. Though short-lived, Rivet Top's developers and operators contributed mightily to advances in air power.

The image most people have of Howard Hughes is that of an intrepid aviator and gifted aircraft designer; he has a reputation as a brilliant but eccentric personality. In the first of a three-part series, biographer Tom Wildenberg reveals the "real" Howard Hughes. In "Part I: The Air Corps Design," Wildenberg debunks some of the myths surrounding his subject and introduces us to a different measure of the man.

The fourth article, by Air Force historian Daniel Haulman, details the timely and effective humanitarian relief that the U.S. Air Force provided to the victims of Hurricane Katrina in August 2005. While other Government agencies incurred a barrage of criticism for their neglect during the crisis, the military, especially the Air Force, came through in mitigating suffering and saving lives.

We are saddened over the deaths of several members of our community during the past three months: General Howell M. Estes, Jr., one of the makers of Air Force history, and in retirement for many years an energetic member of the Air Force Historical Foundation; Brig. Gen. Edwin H. Simmons, USMC (Ret.), who was both a wartime combat leader and later the director of Marine Corps history; Rear Adm. Eugene B. Fluckey, a Medal of Honor recipient, who sank a record number of enemy ships and later recorded his wartime service; and Dr. Dennis F. Casey, a thirty-year Air Force historian, who specialized in research and writing the history of Air Force intelligence and education. They will be sorely missed. See "News" and "In Memoriam" in the Departments Section.

Members of the Air Force Historical Foundation are urged to review the recommendations of the nominating Committee, concerning election of directors for next year. Please see page 60 and the stapled postcard ballot.

In this issue, too, you will find all the information necessary to sign up for and attend one of the year's major celebrations of the Air Force's Sixtieth Anniversary, the Symposium on *The Evolution of Air and Space Power: Know the Past—Shape the Future*. Whether you are an airman, soldier, sailor, or Marine; military historian or analyst; air power enthusiast; or simply interested in the subject, you must not miss this important event. Many active and retired Air Force leaders will participate, including the current Secretary of the Air Force and Chief of Staff, the noted aviation artist Keith Ferris, and leading spokesmen and women from throughout the Air Force. See the prospectus beginning on page 61, and the program starting on page 62 and sign up right away, as space will be limited.

A handwritten signature in black ink, appearing to read "J. Neufeld".

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Wakes of War: Contrails and the Part II—The Air War over [REDACTED]



The Rise of Air Power, 1918-1945

Europe, 1939-1945



© Donald R. Baucom

(Overleaf) The performance envelope of the Second World War's first-line combat aircraft transformed contrails from a little known phenomenon to a matter of life-and-death urgency in the opening days of the air war over Europe. In this photograph, American bombers are generating contrails as they fly toward their targets while Allied fighters flying cover for the bombers generate a pattern of curving vapor trails as they criss-cross above the bombers they are protecting.

Behind the engine-carrying body (fuselage or nacelle) a turbulent region or wake is formed as the airplane flies. The exhaust moisture and some of the engine heat are discharged into this wake and become diffused throughout the wake as a result of the mixing action of the turbulence. The moisture and heat do not, however, mix with the air outside the wake because there the air is "smooth." . . .

It is easy to see that, if the air is so cold that it cannot hold much water as vapor, the water in the exhaust may be sufficient, when added to the moisture already in the atmosphere, to raise the humidity in the turbulent wake to or beyond the saturation value. If this condition exists, some of the water vapor will condense and a visible trail will form.

Richard V. Rhode and H. A. Pearson,
Condensation Trails,

NACA Wartime Report, September 1942¹

IT WAS APPARENT THAT CONTRAILS WERE INTRINSIC TO MODERN AIR COMBAT AND HAD IMPORTANT OPERATIONAL IMPLICATIONS

Introduction



s we saw in the first part of this paper, contrails were observed as early as October 1918. Yet, they remained a rare phenomenon of relatively little interest across the 1920s and 1930s, despite developments that steadily raised the operational ceiling of military aircraft. By the time of the Spanish Civil War, state-of-the-art fighters could engage in combat in the upper regions of the troposphere where engine exhausts routinely turn into contrails. Francisco Tarazona's September 1938 report of contrails generated by dogfighting aircraft was a harbinger of things to come.

Within a year of Tarazona's report, Germany plunged Europe into a general war when she invaded Poland. In the months between the fall of Poland and the German invasion of France in May 1940, German pilots clashed in desultory combat with French and British airmen as both sides flew patrol and reconnaissance missions over Western Europe.² From these air operations and those that took place when Germany overran France in the spring of 1940, it was apparent that contrails were intrinsic to modern air combat and had important operational implications. These early months of the air war also spawned what may be the first published account of contrails in air combat.

The Battle for France and Saint-Exupéry's Train of Frozen Stars

At the time Germany invaded France, French aviation pioneer and famed author Antoine Saint-

Exupéry was just short of his fortieth birthday, well past the age when men were considered fit for air combat duties. Given his age, his literary achievements, and health problems caused by earlier aircraft accidents, Saint-Exupéry was not expected to volunteer for combat duty and could easily have honorably avoided it. However, he believed France was in grave danger and that all Frenchmen who could were obliged to come to her defense.³

True to his convictions, Saint-Exupéry managed to secure an assignment flying reconnaissance planes, specifically, the Potez 63. Such an assignment was a serious challenge for a man of his age and physical condition due to the difficulties and discomforts associated with flying in the cold cockpits of high altitude aircraft.⁴

Saint-Exupéry survived his combat missions against the Germans and escaped to the United States after France surrendered, settling into New York in January 1941. Here, he wrote about his wartime service and worked to build support for the war against Nazi Germany. After the United States captured North Africa, Saint-Exupéry was allowed to sail aboard an American transport to Oran, Algeria. He then secured permission from French authorities to rejoin his old French reconnaissance unit, Group 2 of the 33d Reconnaissance Wing, and began flying combat missions after being retrained to fly the unit's aircraft. Shortly after he rejoined the 2/33, it was transferred to Colonel Elliott Roosevelt's 3d Photo Group, which flew the reconnaissance version of the P-38. By this time, Saint-Exupéry was over forty-two years old, and regulations established thirty as the maximum age for pilots in Roosevelt's unit. Only through the intercession of a high-ranking French general with General Dwight Eisenhower's headquarters was this age requirement waived for Saint-Exupéry. After being trained in the American P-38, he flew this aircraft on reconnaissance missions out of North Africa beginning in July 1943 and continuing until he was killed during a mission on July 31, 1944.⁵

In February 1942, while still living in New York, Saint-Exupéry had published *Flight to Arras*, a memoir of his service against Nazi Germany in 1939 and 1940. Here, he described the challenges of his high altitude reconnaissance missions: the cold that could freeze the controls of his aircraft, finding and photographing enemy targets under fire, and the anxiety of knowing his plane was tailing a white streamer that pinpointed his position for

Donald R. Baucom is a 1962 USAF Academy graduate, who earned his Ph.D. in the History of Science from the University of Oklahoma in 1976. During twenty-eight years in the Air Force, he served tours as a communications-electronics officer in Spain and Thailand, taught history at the Air Force Academy, and established the official history program for President Reagan's Strategic Defense Initiative. Upon retirement from the Air Force in 1990, he returned to federal service as the civilian historian for DOD's missile defense program. His book, The Origins of SDI, was awarded the 1992 Leopold Prize by the Organization of American Historians. Dr. Baucom retired from DOD in 2003 and now lives in El Prado, New Mexico. Part I of this article was published in Air Power History, Vol. 54, No. 2, Fall 2007.

High flying P-47s and the B-17s they are escorting draw their "trains of frozen stars" through the skies over Germany.

A CONTRAIL AIDS ENEMY DEFENDERS BY BETRAYING THE POSITION OF AN AIRCRAFT THAT MIGHT OTHERWISE BE INVISIBLE



enemy fighters and gunners. Regarding this last challenge, Saint-Exupéry's wrote:

The German on the ground knows us by the pearly white scarf which every plane flying at high altitude trails behind like a bridal veil. The disturbance created by our meteoric flight crystallizes the watery vapor in the atmosphere. We unwind behind us a cirrus of icicles. If the atmospheric conditions are favorable to the formation of clouds, our wake will thicken bit by bit and become an evening cloud over the countryside.

The fighters are guided towards us by their radio, by the bursts on the ground, and by the ostentatious luxury of our white scarf....

The fact is, I have absolutely no idea whether or not we are being pursued, and whether from the ground they can or cannot see us trailed by the collection of gossamer threads we sport.

Gossamer threads set me daydreaming again. An image comes into my mind which for the moment seems to me enchanting. . . . As inaccessible as a woman of exceeding beauty, we follow our destiny, drawing slowly behind us our train of frozen stars.⁶

This passage in *Flight to Arras* may be the earliest first-hand account of combat-related contrails to be published. Although Tarazona recorded his observation of contrails in September 1938, as noted in part I of this paper, his diary was not published until the 1970s. *Flight to Arras* may also be the first published apprehension that contrails have major implications for air combat operations, although the significance of contrails was obvious

in the Royal Air Force long before the publication of Saint-Exupéry's memoir.

The Boffins Come to Grip with Contrails

Like Saint-Exupéry, Flight Lieutenant M. V. Longbottom was a pilot in an aerial reconnaissance unit, in this case, the RAF's No. 2 Camouflage Unit, a designation chosen to conceal the unit's mission.⁷ Furthermore, like Saint-Exupéry and his comrades, Longbottom and the members of his unit depended upon the speed of their planes and the stealthiness provided by high altitude flight to protect them against enemy defenses. Therefore, it should come as no surprise that Longbottom was keenly interested in condensation trails.

Thus, on Christmas day 1939, over two years before the publication of *Flight to Arras*, Longbottom issued a SECRET report titled "Condensation Trails at High Altitudes" which begins by explaining the major implication of contrails for air warfare: a contrail aids enemy defenders by betraying the position of an aircraft that might otherwise be invisible. In Longbottom's words:

It has been found that, at high altitudes over about 8000 meters (27,000 feet), under certain conditions, aircraft in flight leave behind them a dense white trail of condensation. In its most marked form this condensation, starting from the engine exhausts, forms a dense white trail behind the aircraft, which rapidly spreads to a band many times the width of the aircraft, stretching across the sky like a long wisp of well marked cirrus cloud. From the ground, this trail appears to come to a point, sharply

ONCE RADAR WAS MORE FULLY DEVELOPED AND APPLIED TO THE CONTROL OF ANTI- AIRCRAFT SYSTEMS, IT LARGELY NULLIFIED THE IMPOR- TANCE OF CONTRAILS

defined, at the exact position of the aircraft, so that although the machine itself may not be visible, every movement it makes—every turn and zig-zag—is easily visible to the naked eye of an observer on the ground, and may be very accurately plotted, enabling accurate A.A. fire to be opened.⁸

To bolster this point, Longbottom recounted the experience of a Spitfire pilot who was trailing a pronounced contrail at about 32,000 feet when he came under accurate antiaircraft fire near Trier, a town on the Moselle River near Germany's border with Luxembourg. He also noted that although anti-aircraft fire had been encountered at altitudes as high as 33,000 feet, this occurred only when the target aircraft was generating a contrail.⁹

Longbottom was clearly interested in finding some means by which RAF pilots could keep their planes from producing contrails. To this end, he examined the experiences of pilots who flew missions on December 20, 21, and 22, 1939. While one pilot flying on December 22 noticed only "slight wisps of condensation," the other four, including one who also flew on December 22, reported heavy contrails. All four of the pilots reporting contrails were able to eliminate them by throttling back their engines and descending one or two thousand feet.¹⁰

In an effort to correlate weather conditions with the experiences of these pilots, Longbottom consulted a French meteorologist regarding conditions in No. 2 Unit's mission area on the appropriate days. This consultation suggested a correlation of contrail formation with conditions of low temperature and high humidity aloft. When these conditions prevail at the altitude where a plane is flying, "the rapidly expanding gases from the exhausts" of the plane cause "sudden condensations to form in [the plane's] wake."¹¹

The information that Longbottom assembled also indicated the possible existence of layers in the atmosphere some of which would support contrail formation while others would not. The existence of such layers would account for contrail termination when a pilot reduced his altitude. It also suggested that a pilot might be able to stop contrail generation by climbing out of a layer conducive to contrail formation, provided such a climb was within the capabilities of his plane.¹²

In addition to the work carried out by Longbottom, several later contrail studies were completed under the auspices of England's Aeronautical Research Committee (ARC) that had been founded in January 1935. This was the same committee that spawned the British radar program.¹³ Once radar was more fully developed and applied to the control of anti-aircraft systems, it largely nullified the importance of contrails as a means of locating high-flying aircraft and directing anti-aircraft fire. However, as we shall soon see, radar did not eliminate the significance of contrails for air operations. A measure of the continuing importance of condensation trails is the series of contrail studies sponsored by the ARC.

On February 3, 1941, the ARC's High Altitude

Subcommittee issued a report that provides a glimpse of the state of knowledge of contrails in the British scientific community. "Until very recently," the report begins,

the data available on "vapour trails" was so meager that no positive conclusions could be drawn as to formation. War operations at high altitudes and high speeds have made the phenomenon more common, and data is [sic] now being accumulated in greater volume. The absence of essential information, however, makes it impossible, at present, to do more than put forward tentative ideas on the nature of the phenomenon.

As more information becomes available and knowledge of contrails increases, the subcommittee said, additional reports would be issued.¹⁴

At this stage, the subcommittee believed that there were three mechanisms that might account for the formation of contrails. One was the "precipitation, as ice, of water vapour previously present in the atmosphere in a supersaturated state." This precipitation would be caused by the cooling effect associated with the reduction in local pressure that is produced by the motion of propeller tips and airfoils. If the atmosphere were less than saturated, either no condensation would occur or the condensation process would be quickly reversed in the unsaturated air near the propeller and airfoil. In either case, no visible condensation trail would form. If, on the other hand, the air was supersaturated, the condensation produced by propellers and air foils would persist, and a vapor trail would form.¹⁵

A second possible mechanism was the "freezing of water vapour present in the products of combustion ejected from the engine exhaust." In this case, calculations had shown that there was sufficient water in aircraft engine exhaust to spawn "a visible trail." However, this water would not necessarily produce a contrail, since one must also consider the heating effects of high temperature engine exhaust. Where this mechanism was concerned, the subcommittee cautioned that the presence in engine exhaust of sufficient water to produce a condensation trail did not necessarily verify this mechanism as a cause of vapor trails.¹⁶

The third candidate mechanism was "the ejection from the engine exhaust of nuclei of condensation." While subcommittee members were certain that injecting nuclei into a supersaturated atmosphere could cause condensation, they noted here again that the effects of high temperature exhaust gases had to be taken into account in determining whether or not a visible contrail would be produced.¹⁷

Overall, the subcommittee wrote, it was apparent from a "number of excellent records" that aircraft engine "exhaust is often intimately connected with trail formation." In the words of the subcommittee report:

Clear evidence exists that adjustment of the throttle or mixture controls effects [sic] trail formation;

DOBSON CONCLUDED THAT THAT THE RATE OF CONTRAIL FORMATION WOULD PROBABLY INCREASE AS ALTITUDE INCREASED

opening throttle, or richening the mixture often increases the density of a trail. This effect may be due either to the water, or to the nuclei present in the exhaust, since opening throttle or richening mixture will increase both. Opening throttle will also increase the possibility of trail formation due to local reduction of pressure on the airscrew or wings.¹⁸

Moreover, there was sufficient information available to warrant suggestions as to how contrail formation might be curtailed.

It is difficult to advance any cure for a trail caused by the action of airscrew or wings in reducing the local pressure; on the other hand, an exhaust-formed trail can undoubtedly be affected in certain cases by an adjustment of throttle and mixture controls. Then, should it be vitally necessary to avoid forming a trail, the pilot should try these adjustments as soon as he is conscious that his aircraft is forming one. The very tentative suggestion may be advanced that a special fuel (producing few nuclei and less water) might be used with success on special high altitude flights. Such a fuel would be a "benzene rich" spirit (containing little lead) but before a definite statement can be made on this point, much experimental work would be necessary.¹⁹

One final point of interest from this report is its discussion of the altitudes where one might expect aircraft to spawn contrails. British anti-aircraft gunners had used range finding equipment to determine accurately the altitude of aircraft generating contrails. In no cases had they encountered an aircraft with a vapor trail below the altitude of 17,000 feet. As of the time of this report, there was no indication of the existence of an upper altitude limit on the formation of contrails.²⁰

Four days after the issuance of the report of the High-Altitude Subcommittee, G. M. B. Dobson, Fellow of the Royal Society, issued another report on contrails, this one sponsored by the ARC's Meteorology Subcommittee. Of central interest in this February 7 report were vapor trails spawned by engine exhaust and the atmospheric conditions that would permit their formation. Dobson began his report with the following observation regarding contrails.

While trails may possibly be formed from others causes, there is little doubt that a large proportion are due to water vapour from the exhaust of the engine. Since the effect of the engine is (1) to heat the air in the trail behind the aeroplane and (2) to add water vapour to this same air, we can calculate the conditions when condensation would be expected to occur behind the aeroplane. We shall assume that both the heat and the water vapour are distributed through the same air in the trail but this may not be strictly true: if it is not true then condensation will occur at temperatures above those given here.

The density of the trails observed is not unreasonable on the assumption that all the water comes

from the engine exhaust. If the trail consisted of water droplets 2 μ diameter [sic] and the trail contained 0.1 gm/m³ of liquid water, then light passing through it would be reduced to about one hundredth in 50 m.²¹

The Dobson report further states that the condensate that produces contrails could be either water droplets or ice particles. He based this conclusion on the observation that the tail-plane surfaces of an aircraft that had produced a dense contrail would sometimes be "varnished" with ice. However, for a contrail composed of droplets to be at all persistent, the droplets would have to freeze.²²

Since temperatures drop as altitude increases, Dobson concluded that the rate of contrail formation would probably increase as altitude increased. "However," he wrote, "once the stratosphere is entered trails would be expected to form much less frequently as the temperature no longer falls with height and the relative humidity probably decreases with height."²³

Additionally, concerning the variables involved in contrail formation, Dobson provided several charts showing the expected relationship between the cross-sectional area of contrails generated as related to free air temperature, relative humidity, throttle setting, and flight attitude. Three charts were specific to 20,000 feet, while a fourth dealt with the relation between the variables at 35,000 feet.²⁴

If the views he presented were valid, Dobson believed that there was little that could be done to preclude contrail formation when flying through a region of the atmosphere where meteorological conditions favored their formation. In his words:

It would probably be too difficult to condense the water vapour before it leaves the exhaust. A petrol rich in benzol [benzene] would produce less water vapour for a given power but the improvement would not be very great. Any construction by which the heat lost from the engine does not go to heat the same air that receives the water vapour is bad from this point of view: Thus radiators placed some distance out on the wings would be bad.

Nevertheless, Dobson offered some suggestions as to how pilots might minimize the contrails produced by their planes.

Partially closing the throttle considerably decreases the temperature which just gives condensation, while climbing slightly increases it. Hence throttling down would tend to decrease trail formation and would certainly decrease the density of any trail formed owing to the smaller amount of water per cubic metre in the trail. Climbing, on the other hand, would have the reverse effect, but the change would be less marked.

Additionally, leaning the engine's fuel-air mixture would also reduce the density of the contrail generated.²⁵

A SYSTEM MIGHT BE DEVELOPED THAT WOULD TRAP AND RETAIN THE WATER VAPOR BEFORE IT PASSES OVER THE TAIL PLANE

If, as Dobson suspected, contrails were an inevitable concomitant of high altitude operations, then the ability to forecast where contrails would be encountered could be advantageous. This was especially true for RAF photo reconnaissance pilots, who depended on speed and high altitude to protect them from enemy fighters. In support of developing the means of predicting contrail formation, Dobson called for increased flight testing to gather data on high altitude atmospheric conditions and observe how conditions affected the formation of vapor trails.²⁶

Some testing, at least, was already underway when Dobson issued his report. In fact, the same Flight Lieutenant Longbottom who had submitted the Christmas 1939 report was engaged in a limited test program. Flying a Spitfire at Boscombe Down, Longbottom had already completed four flights to 40,000 feet and gathered some data on contrail formation. Although flight operations above 35,000 feet were rare in February 1941, Dobson believed that regular test flights to 40,000 feet were essential, since operational ceilings were steadily increasing.²⁷

Finally, Dobson concluded that it was already possible "to issue forecasts of the danger of trail formation whenever cirrus was expected and the temperature was below, say, 220° a [absolute] at the height of the cirrus." However, such forecasts "would not be entirely reliable since the humidity might be high even when no cirrus was present."²⁸

Nine months after the submission of the Dobson report, Dr. A. H. R. Goldie of the Meteorological Subcommittee issued a report in which he summarized the status of the subcommittee's understanding of contrails. Here, Goldie noted that the British had determined that if one knows

*what portion of the total energy in the fuel becomes available as heat to the air into which the exhaust vapor is being discharged it is possible to calculate for any given height the critical air temperature at which the passage of the aircraft results in a positive rather than negative contribution to the relative humidity of the air in its wake. If the atmosphere before the passage of the aircraft was saturated with respect to ice then short trails ought to form at the critical temperature as determined in this way but not at a higher temperature.*²⁹

This knowledge allowed British scientists to establish a relationship between the percent of fuel energy that heated the exhaust trail and the critical atmospheric temperature for contrail formation. For example, if 100% of the energy went to warming the trail, the critical temperature at which contrails would form would be 235° absolute or Kelvin (K). If only 25% of fuel energy heated the exhaust trail, the critical temperature for contrail formation would be 254° K.³⁰

Reasonable corroboration for these relations had been found in a hundred test flights of a

Spitfire III at Boscombe Down. These flights had also provided information that pointed toward a relationship between the "consumption of petrol per meter of flight" and how soon contrails would form after the critical atmospheric temperature was encountered and how dense and persistent the resulting trails would be. Additionally, there seemed to be a correlation between the presence of cirrus and cirrus-stratus clouds and persistent contrails, while the absence of high clouds indicated that only light contrails would be formed.³¹

Regarding possible contrail suppression, Goldie took note of Dobson's theory that exhaust vapor first condenses as water and only later freezes. Should this prove to be the case, a system might be developed that would trap and retain the water vapor before it passes over the tail plane. Accomplishing this would require diverting the exhaust flow

*over some part of the rear end of the machine so that the water drops would ice up on that part of the machine. Nearly the whole water content of the exhaust would need to be deposited in this way to preen trail formation and it would amount to 50kg of ice per 100 km. traveled by the plane during the time the device was in operation.*³²

Goldie went on to note that "the information which is still chiefly wanted is precise measurement of the humidity of the high atmosphere." Goldie provided the following explanation of why these data were so critical.

*From the variation in the height at which persistent trails begin and from the temperatures at which they cease in the stratosphere it seems probable that considerable variations in humidity can occur, but it is not possible to infer anything with precision because the cross sections of trails or extent of dilution at the point where they vanish are not known with any exactness and there are other unknown factors such as variability of nuclei for sublimation.*³³

One final point of interest surfaces in Goldie's report. It is that wingtip vortices were evidently being generated by the RAF's Sterling bombings. However, these did not seem to be a major problem, since they generally dissipated a few hundred yards behind the bombers. Furthermore, at the moment, no other aircraft in the RAF inventory was reporting this phenomenon.³⁴

About two months after Goldie's report on the state of British understanding of contrails, the Meteorology Subcommittee issued a collection of pilot reports on contrail formation. Apparently, the British had requested information from the Canadian government on the Canadian experience with contrails. As a result of this request, the Canadian Committee on Aeronautical Research asked the Air Transport Association of Canada to survey its members for input on four specific questions:

During a two-week visit to England in April 1941, General "Hap" Arnold observed "ribbons of condensation vapor twisting and intertwining" in the skies over London as the RAF and Luftwaffe fought for control of the air. Arnold is shown here is with RAF Air Marshal Sir Charles Portal.



1. Are the vapour trains associated with the wing tip trailing vortices or do they originate from the engine exhaust?
2. At what altitudes have they been observed?
3. What were the weather conditions at the time?
4. Any knowledge of the air temperature and humidity at the height at which the trails were formed.³⁵

The pilot reports out of Canada added little to what the British already understood about contrails. While a number of pilots reported seeing wing-tip vortices, the vast majority of respondents believed that contrails were caused by engine exhaust. One point that varied significantly from what was being observed in Europe was the low level at which contrails were encountered in the frigid climate of Canada. Here, contrails could be encountered from the surface on up. Additionally, a number of pilots noted that the contrails they observed tended to persist for lengthy periods, an observation that certainly would not have surprised the British.³⁶

By the time the British received the results of the Canadian survey, the Battle of Britain was long over. Lasting from July 20, 1940 to October 31 of the same year, this intense air campaign pitted the RAF against the Luftwaffe in a battle for control of the air over England and the English Channel. Without control of the air, Germany could not execute Operation Sealion, an invasion of the British Isles that was designed to take England out of World War II. British victory in this air campaign was signaled by the indefinite postponement of Sealion and a shift in Luftwaffe targeting from the destruction of the RAF to attacks against British cities.³⁷

The Battle of Britain and the continuing air

battles between the Luftwaffe and the RAF made contrails a dramatic feature of the British skyscape between 1940 and 1943. The intrusion of this man-made phenomenon into the natural setting of the heavens was documented by numerous photographs and captured on canvas by artists like Paul Nash, Richard Eurich, and Walter Monnington.³⁸ It is not surprising, then, that when America's top airman, General Henry H. "Hap" Arnold visited London in the spring of 1941, he would notice these telltale signs of aerial combat.

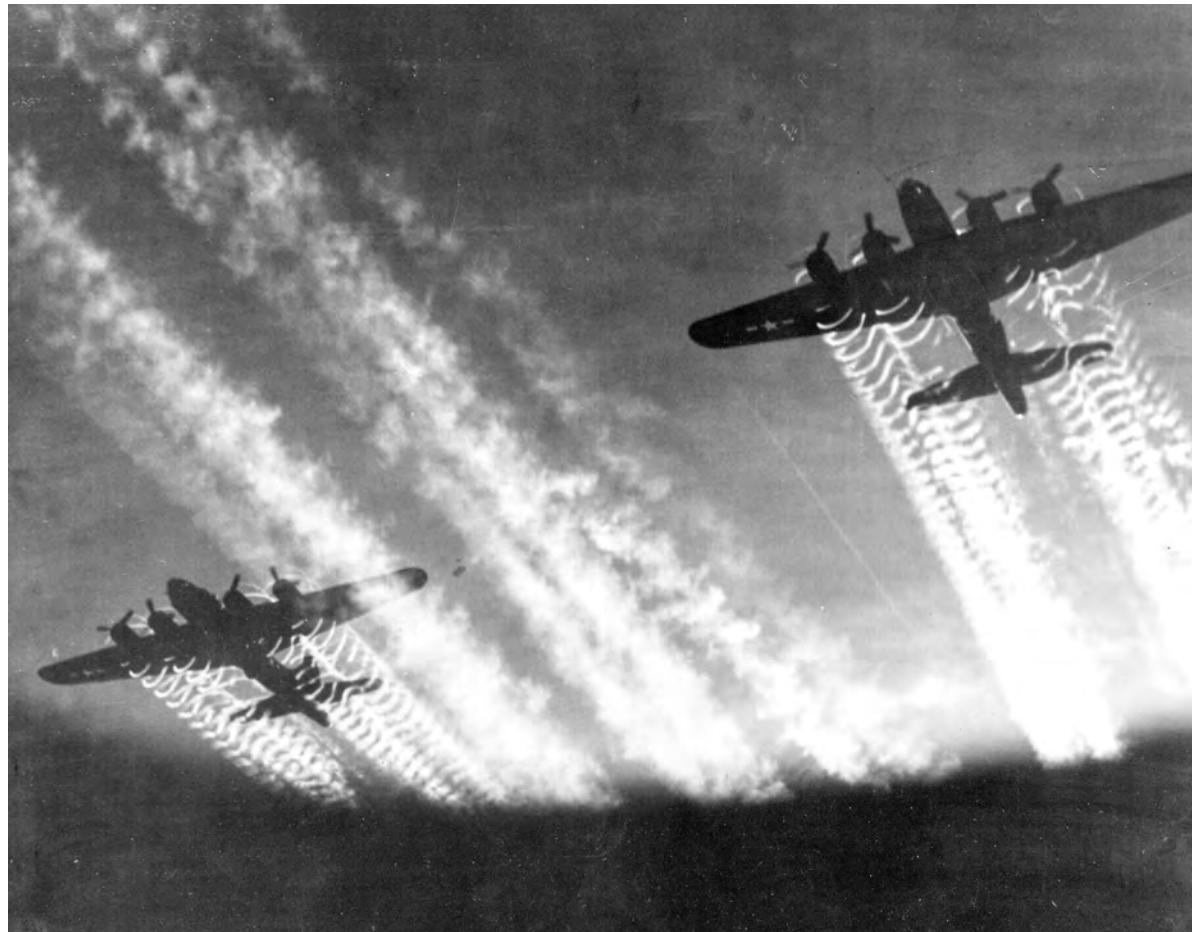
Arnold had come to the British capital on a mission for President Franklin Roosevelt. While there, he was to gain a firsthand appreciation of England's situation, to include an understanding of British requirements for American-made aircraft. Arnold was also to consult with British airmen as to how the Air Corps might in the future provide active support for the British war effort. The ultimate goal of Arnold's appraisal was to determine "the numbers and types of US aircraft to be produced" and how they were to be allocated between America's air service, the RAF, and other "claimants."³⁹

On April 18, 1941, near the mid point of his two-week stay in England, Arnold received a firsthand impression of what the air war looked like to Londoners. In his travel diary for that date, he described this experience as follows: "An air combat over London at 20,000 feet or more. Ribbons of condensed vapor twisting and intertwining over the city. Real sky writing but who wins?"⁴⁰

The sight of these contrails may have piqued Arnold's interest in contrails, an interest that apparently dated back as far as the period between 1928 and 1931 when he was serving in the Air Corps' materiel development and procurement organization. During this time, he reportedly directed a project that would have reduced aircraft

PILOT REPORTS OUT OF CANADA ADDED LITTLE TO WHAT THE BRITISH ALREADY UNDERSTOOD

This photograph of contrails being generated by B-17s illustrates the complex interaction that could take place between condensation vortices formed by propellers and the vapor trail produced by engine exhaust.



vulnerability to "enemy gunners" by dissipating their contrails.⁴¹

An interest on Arnold's part in mitigating the effects of contrails may have prompted a request to the National Advisory Committee for Aeronautics (NACA) for a study of contrails. For whatever reason, in September 1942, NACA's Langley Memorial Aeronomical Laboratory issued a report on condensation trails.

Described as a "brief, nontechnical discussion of condensation trails . . . for flying personnel," this report began by explaining that there were three basic types of contrails:

Exhaust trails—Formed by condensation of moisture from the engine exhaust.

Convection trails—Formed under certain atmospheric conditions as a result of rising of [sic] air warmed by passage of the airplane.

Aerodynamic trails—Formed by precipitation of atmospheric moisture as a result of adiabatic temperature drop associated with air flow past the airplane.⁴²

Of these three, the first was the most important from the standpoint of military operations, since this type of condensation trail was "consistently encountered" at high altitudes. These trails were produced by the condensation of water in the exhausts of aircraft engines, which produce about 1.25 pounds of water for each pound of aviation fuel

burned. The study provides the following detailed description of how this water vapor is transformed into a contrail.

Behind the engine-carrying body (fuselage or nacelle) a turbulent region or wake is formed as the airplane flies. The exhaust moisture and some of the engine heat are discharged into this wake and become diffused throughout the wake as a result of the mixing action of the turbulence. The moisture and heat do not, however, mix with the air outside the wake because there the air is "smooth."

The vortices in the wake grow and rotate more slowly as they pass downstream from the airplane. Thus the wake expands and decays. During this process the energy of the turbulence is dissipated as heat as a result of viscosity or friction, and finally so much energy has been dissipated that the wake can no longer continue to grow. This point is reached at a mile or more behind the airplane, the exact distance being somewhat indefinite and dependent upon the speed and power of the airplane. By this time, because of the action of wing-tip vortices, the wake has changed in form from its original compact cross section to a more or less flat ribbonlike form with curled-up edges, but this change in form does not involve any further mixing of the water vapor with the air.

It is easy to see that, if the air is so cold that it cannot hold much water as vapor, the water in the exhaust may be sufficient, when added to the mois-

IN
SEPTEMBER
1942, NACA'S
LANGLEY
MEMORIAL
AERONAU-
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A REPORT
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TRAILS

FACTORS THAT FAVORED THE FORMATION OF CONTRAILS INCLUDE LOW TEMPERATURE, HIGH ATMOSPHERIC HUMIDITY AT LOW TEMPERATURE, AND HIGH FUEL CONSUMPTION

ture already in the atmosphere, to raise the humidity in the turbulent wake to or beyond the saturation value. If this condition exists, some of the water vapor will condense and a visible trail will form.

Since the turbulent wake is narrow near the airplane, the density of moisture will be greatest at this location. Farther away, where the wake is larger and the exhaust moisture is more widely diffused, there will be less moisture density. Thus, under some conditions, a short trail may form that evaporates where the wake cross section becomes too large to maintain 100-percent humidity. If the amount of moisture is great enough to more than saturate the wake at its final and greatest cross section, however, the trail will be persistent and will not disappear until it is finally blown away by the wind or dissipated by atmospheric turbulence.⁴³

Based on this discussion, the report then listed the factors that favored the formation of contrails. These include low temperature, high atmospheric humidity at low temperature, and high fuel consumption such as that associated with high engine power settings. Additionally, low drag, which would result in lower turbulence and a narrower wake, would be conducive to contrail formation, since moisture from an engine would tend to remain concentrated in a smaller volume of the atmosphere. Similarly, low speed also favored contrail production, since it would produce less energy for turbulence.⁴⁴

The NACA report also provided several maps showing regions of the world where engine-exhaust contrails were likely to develop across different periods in the year. These were based on the atmospheric changes produced by a B-17E aircraft "in normal heavy cruising condition," which should provide a reasonable standard for judging how other types of aircraft might interact with the atmosphere when flying through the zones shown.⁴⁵

Additionally, a section of the report discussed the possibility of suppressing condensation trails. Where the exhaust trails were concerned, the report stated that the only reliable means of preventing their formation was to remove the water from engine exhausts by means of a water-recovery system. Unfortunately, such a device was not then practical. The study then recommended three courses of action for contrail abatement, recognizing that these might not be practical under combat conditions.

1. If reduction of altitude is permissible, throttle engines and glide at high speed to a lower level.

2. If net loss of altitude is not permissible, go into a shallow power dive at substantial increase in speed. Regain altitude by zooming. (Short lengths of persistent trail may be formed during latter part of zoom.) Alternative: Fly at reduced power.

3. If some reduction in speed is permissible with same power output and fuel consumption, as during

climb, open engine cowl flaps as wide as possible. (Airplanes without cowl flaps could be equipped with similar drag-producing devices.)⁴⁶

Finally, the authors of the NACA report disagreed with a British study's conclusion that "persistent exhaust trails would cease a short distance above the tropopause." In the view of the NACA researchers, the cessation of contrails suggested in the British report was a function of "reduced power and amount of moisture discharged per unit volume of trail." These "trails probably could have been made to cease at any elevation below the tropopause by throttling the engines in accordance with rule 1 or 2 governing the suppression of exhaust trails."⁴⁷

Contrails and World War II Combat Operations

By the time the NACA report was issued, the build-up of American air power in England was under way and Eighth Air Force had already completed its first bombing attacks against targets on the European continent. As the size of the American force grew and its operational tempo increased, the significance of contrails became increasingly apparent to American airmen.

One point was obvious: regardless of the growing importance of radar in air defense operations, a condensation trail could still pinpoint the location of an airplane that might otherwise go unnoticed. As a result, it could be unnerving to realize that one's plane was trailing a "pearly white scarf," especially if you were aboard an American bomber about to penetrate enemy air space. Thus, we note a tone of anxiety when Wally Hoffman tells us that the B-17s of the 351st Bomb Group formed up at 28,000 feet on October 14, 1943 and then crossed the English channel en route to Schweinfurt with "contrails following behind us for the Luftwaffe to see."⁴⁸

Air crews also felt that vapor trails increased the danger to bombers at their most vulnerable moment: the bomb run when planes flew straight and level to ensure bombing accuracy. Regardless of radar's role in controlling German flak batteries, during this time of heightened danger, crewmen believed that contrails pointed to them "like fingers" in the sky, making it easy for German anti-aircraft guns to locate their targets.⁴⁹

These fears were not unfounded. The Germans, like the British and Americans, had indeed developed gun-laying radar for their anti-aircraft artillery. The German gun-laying process can be broken down into three main steps. First, aircraft track data were acquired from either radar or optical rangefinders and then fed into a fire controller/director. Next, the fire controller, a primitive computer, used these data to produce a firing solution. And finally, the firing solution was transmitted to a battery where it was used to aim and fire the battery's guns. Throughout the war, tracking data obtained from German optical rangefinders

Dogfights often produced complex patterns of contrails that were clearly visible from the ground. Here, members of an American anti-aircraft crew watch the loops and knots of contrails formed as Allied fighters tangle with the Luftwaffe high above the Battle of the Bulge. Like General Arnold during his visit to London in 1941, these American soldiers could not tell from the contrails who was winning the air battle. However, at this late date in the war, it was a safe bet that Allied pilots were prevailing, since most of Germany's best pilots had already fallen in the war.



AMERICAN BOMBERS SUFFERED TWICE THE LOSSES WHEN BOMBING ON CLEAR DAYS AS COMPARED TO BOMBING FROM ABOVE A CLOUD LAYER

were more accurate than radar tracking data. Therefore, when optical data were available, German gunners used these to generate their firing solutions. This may explain why Eighth Air Force's report on flak losses for the month of December 1943 showed that American bombers suffered twice the losses when bombing on clear days as compared to bombing from above a cloud layer. According to Edward Westermann's excellent history of German anti-aircraft defenses, "throughout the war, optical targeting procedures using a fire director remained the most effective method for tracking aerial targets. One estimate found that engagements by visual means were five times more effective than engagements using radar control."⁵⁰

Contrails could even be a problem for the RAF during its nighttime attacks against Germany. During a raid in March 1944, the eight hundred RAF bombers carrying out a mission against Nuremberg were flying below 25,000 feet and ordinarily would not have generated contrails. For whatever meteorological reason, aircraft in the raiding formations left a heavy stream of contrails that could easily be seen in the evening's bright moonlight. These contrails guided German fighters to the bombers, allowing the fighters to down sixty-four Lancaster and thirty-one Halifax bombers.⁵¹

Vapor trails did not always work against bomber crews. In 1943, Andy Rooney, long-time resident curmudgeon on CBS's "Sixty Minutes," was a correspondent for the European edition of *Stars*

and Stripes. On February 26 of that year he flew on a bombing mission against Wilhelmshaven. His article about this mission included a description of how contrails could telegraph the presence of German fighters. "Fighter planes were always there while we were making our run," he wrote. "They come in so fast it's hard to tell where they're coming from, but frequently you could see a vapor trail start to form, like a cloud standing on end. You knew that was a fighter starting a run."⁵²

Rooney was not the only one to note the importance of contrails where spotting the presence of enemy fighters was concerned. After his first mission, a crewmember of the 91st Bomb Group noted: "The flak was still bursting everywhere, and in the distance I could see vapor trails of single engine fighters, and it began to look as [if] trouble was really falling down on us. . . . Fighters were in all directions by this time although many were out at a distance and probably we couldn't even have seen them had it not been for their vapor trails and we shot a flare to call in our fighter escorts."⁵³

In addition to helping bombers and fighters locate each other, contrails at times impeded bomber operations. An attacking force of a thousand heavy bombers included four thousand powerful engines that were pumping moisture into the upper atmosphere. As a result, large American bomber formations were literally capable of changing the cloud cover along the routes they traversed. At times, planes near the end of the bomber stream

PILOTS OF GERMANY'S JET FIGHTER, THE ME 262, SEEM TO HAVE REGULARLY USED CONTRAILS TO MASK THEIR APPROACH TO AMERICAN BOMBER FORMATIONS

had to complete their bomb runs by flying through condensation trails "so dense that it was no different than flying in clouds." Furthermore, these vapor trails could be so persistent that bomber formations sometimes took different routes on their return legs to avoid "the contrail clouds that we created." Apropos of this point, a pilot in the 457th Bomb Group later wrote: "We often said that we created weather over Europe."⁵⁴

What may be the quintessential example of contrails impeding bomber operations is found in a March 4, 1945 mission that was to attack German jet airdromes and a tank depot. Contrails affected this mission from the point of aircraft assembly over the continent of Europe right through the bomb runs made by B-24 Liberators of the 2d Air Division.⁵⁵

During this operation, the chief of staff, 96th Combat Wing, was responsible for the proper assembly of the division as it penetrated German airspace. Commenting on efforts to form up the attacking units, he noted that the vapor trails generated by the wing's aircraft made the assembly significantly more difficult. In his words:

*The weather as it appeared to the weather scouts was not insurmountable but . . . the contrails created by the First and Third Divisions plus the initial units of the Second Division created a cloud layer which units could not climb over nor descend below, for they created their own weather. It is unbelievable that so many units could fly so long in such conditions, turn around and withdraw without heavy losses from collision.*⁵⁶

Affected by "thick, twisting contrails," the assembly of the division's 14th Bomb Wing was also a confused affair. According to plans, the primary target for the 14th was the large Nazi tank depot at Aschaffenburg. After assembling as many of its planes as possible, the 14th struggled on looking for its target while continuing to be hampered by contrails and clouds. Poor visibility, along with failures of electronic bombing aids, created a confusing situation in which six B-24s involved in the mission dropped their bombs on Zurich in neutral Switzerland, causing extreme embarrassment for the United States and Eighth Air Force.⁵⁷

Similar remarks about large bomber formations creating their own weather appear in the wartime diary of Sergeant Harley Tuck of the 447th Bomb Group. Commenting on a mission to Schweinfurt on February 22, 1944, Tuck wrote:

*Bombing altitude was going to be 24000, . . . We fooled around over England until 10:45, when we climbed to 24000 ft. The planes up there had formed thousands of vapor trails; we couldn't see more than 100 yds,—couldn't form groups—wings. The group leader couldn't find the rest of the 3rd . . . [W]e lost each other going thru all the cloud banks—vapor trails on the way back home.*⁵⁸

Another account of contrails impeding bomber

missions appears in the mission diary of Staff Sergeant Earl G. Williamson, Jr. According to Williamson, clouds and "dense contrails" at mission altitude kept bombers from forming up properly for a March 3, 1944 mission against Berlin. Williamson reported similar problems during a mission the following day, this one against a ball bearing factory at Eckner in the outskirts of Berlin. Because the vapor trails and clouds were so bad, the mission was diverted to Cologne. Even then, Williamson wrote, "appalling weather, [along] with condensation trails that made formation flying virtually impossible, forced the recall of the bulk of the force."⁵⁹

The problem with vapor trails was especially bad for aircraft further back in the bomber stream. A pilot in the 381st Bomb Group reported that on a mission to Munich on July 16, 1944, the sky was so full of contrails in the target area that his formation had to climb to 30,200 feet for its bomb run.⁶⁰

Vapor trails could also be a problem even before aircraft took to the air. As already noted in Part I of this paper, condensation trails had been encountered at ground level in Canada as early as 1930. Army Air Forces units ferrying aircraft bound for the Soviet Union also experienced the phenomenon of ground-level contrails. The route flown by ferry crews took them from Great Falls, Montana, to Fairbanks, Alaska, where they handed their aircraft over to Soviet pilots who took the planes on across the Bering Strait and Siberia to Moscow, 6,000 miles away. Surface temperatures at Ladd Field near Fairbanks could be as low as -50° F, creating conditions in which taxiing aircraft at times left "ice-crystal contrails behind them, just as Fortresses do at 30,000 feet over Germany." In one case, a bomber taxiing out and taking off "fogged in Ladd Field . . . so that no one else could land or leave for hours."⁶¹

Contrails could also be used to turn air combat into a deadly cat-and-mouse game. During a 91st Bomb Group mission to Romilly, the pilot of a German FW 190 tried to use the group's contrails to cover his attack on the rear of its formation. The fighter entered the heavy contrails about a mile back from the formation and stayed in them until he was about a hundred feet back. However, an alert tail-gunner had spotted the German and shot him down as he popped out of the contrails.⁶²

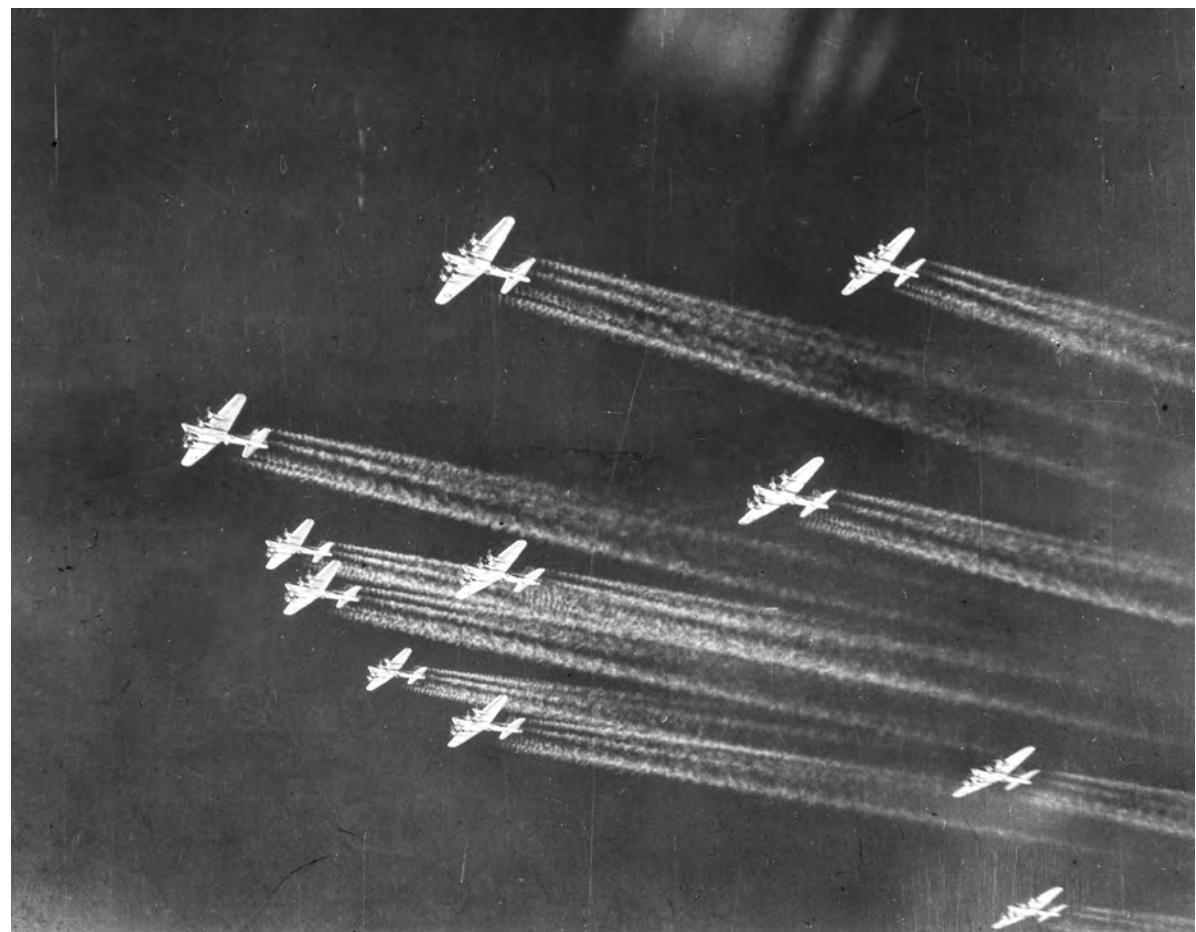
The pilots of Germany's jet fighter, the Me 262, seem to have regularly used contrails to mask their approach to American bomber formations. According to Roger A. Freeman, historian of "Mighty" Eighth Air Force, one such attack took place on March 18, 1945, when the Eighth sent 1,328 bombers against Berlin. "The jets took full advantage of the hazy day with contrails at altitude persisting and merged. Concentrating first on the rearmost groups of 1st Division as its bombers neared Berlin, between ten and twenty Me 262s approached unseen in the contrails before climbing to press their attacks in which two B-17s were shot down."⁶³

Similar tactics were again reported about a

During a raid on Cologne on October 14, 1944, B-17s generate contrails of modest density. At other times, when contrails were denser, Luftwaffe pilots used the thick, white vapor to mask their attacks on the rear of bomber formations.

BUT, REALLY,
MY BIGGEST
TACTICAL
ADVANTAGE
WAS MY
EYES. I
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FROM GREAT
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KNOWING HE
COULDN'T
SEE ME
BECAUSE HE
WAS ONLY A
DIM SPECK

YEAGER, P. 85



month later. On this occasion, the attack came after the 91st Bomb Group's run against Dresden on April 17, 1945. A crewman described this attack as follows: "An element of three Me 262s had attacked our element of three B-17s coming in through and hidden by our contrails until the last moment." The Me 262s knocked two B-17s out of formation during this pass.⁶⁴

German pilots were not the only ones who used contrails to mask attacks on enemy planes. On November 11, 1944, Lt. Col. John C. Meyer, a leading American ace who would later become a four-star general, used a similar tactic to down a German FW 190. In this particular case, Meyer flew in the German fighter's contrail, firing the machine guns of his P-51 before he could actually see the FW 190. Then, as he continued his approach to the target, he could at last see the flashes made as his bullets began striking the enemy fighter. Finally, he broke off his attack just in time to avoid the burning German plane.⁶⁵

Contrails offered fighter pilots another important advantage against their opponents. In air combat, the pilot who sees his opponent first gains a decided edge. Spotting an enemy first offers a fighter pilot the opportunity to attack under the most advantageous conditions: from above and behind with the sun at the back of the attacker.

Several top pilots have commented on this advantage in their memoirs. For example, Charles E. "Chuck" Yeager claimed that he and his wing-

man, Clarence E. "Bud" Anderson, "had the best eyes in the group, and could pick up specks in the sky from fifty miles away."⁶⁶ A similar view was expressed by Adolf Galland, one of Germany's top fighter aces and a leader of the Luftwaffe's fighter forces.

*The first rule of all air combat is to see the opponent first. Like the hunter who stalks his prey and maneuvers himself unnoticed in the most favorable position for the kill, the fighter in the opening of a dogfight must detect the opponent as early as possible in order to attain a superior position for the attack.*⁶⁷

Obviously, a fighter dragging a "train of frozen stars" can be spotted much more easily than one who is not. Therefore, an important factor in air combat becomes finding a layer of the atmosphere where one's plane does not produce a vapor trail, yet one that is high enough not to seriously compromise the advantage of superior altitude. Johannes "Mackie" Steinhoff, another top German ace, made this point in his memoir of air combat in the Mediterranean Theater: "A delicate white condensation trail, plainly visible against the blue of the sky, began to form behind Bachmann's machine. Clearly I would have to lose height at once; otherwise we would give away our position to the Spitfires and Lightnings."⁶⁸

Knowing that contrails could be easily seen



During the last months of the air war over Europe, Eighth Air Force routinely sent forces of over a thousand bombers to attack targets inside Germany. With four thousand powerful engines pouring water vapor into the damp, cold skies, it is easy to understand how a bomber formation could create its own weather.

THE GERMAN PEOPLE WERE AWARE THAT THE DENSE CONTRAILS OVERHEAD HERALDED THE PASSAGE OF A MASSIVE BOMBER FORMATION

from a distance and would attract enemy aircraft was the idea behind a trap the Luftwaffe set for American escort fighters during an Eighth Air Force mission to Berlin on March 8, 1944. The bait was twenty to twenty-five German fighters making contrails at 30,000 feet. Unknown to the P-47 pilots of the 56th Fighter Group (Zemke's Wolf-pack) who went for the bait, lurking just below the contrail level were several squadrons of German fighters. The planes of these other squadrons "remained unseen until they commenced a vicious attack upon the 56th," inflicting on the crack American unit its heaviest losses in almost a year.⁶⁹

Avoiding layers of the sky where vapor trails formed was especially critical to the success of reconnaissance missions and to the very survival of reconnaissance pilots whose planes were usually unarmed. That Saint-Exupéry had learned this lesson in 1939 and 1940 should be apparent to anyone reading *Flight to Arras*. The point was driven home again when he returned to flying reconnaissance missions in 1943 and 1944.

Like the other reconnaissance pilots in Colonel Elliott Roosevelt's unit, Saint-Exupéry relied on the speed and stealthiness of his high-flying P-38 to protect him from enemy fighters. To avoid producing telltale contrails, these pilots would climb to where their P-38s first produced contrails and then descend a few hundred feet to a point where no contrail was generated. The logic behind this tactic has been aptly described by Curtis Cate, one of Saint-Exupéry's biographers:

By flying just below the vapour-trail ceiling the pilot stood a better chance of spotting the enemy if a German fighter climbed up to attack him. For so fast was the Lightning that only if the Messerschmitt or the even speedier Focke-Wulf climbed above it, could it hope to drive home its cobra-like strike; but this it could not do without unfurling its long white "bridal train", more easily detectable in the rear-view mirror than the fighter's bug-like blackness.⁷⁰

Finally, there is the intangible, psychological impact of masses of contrails on those undergoing a strategic bombing campaign. As noted earlier, air power theorists believed that a strategic air assault could break the popular will, prompting an early end to hostilities. While I have uncovered very little direct evidence of the effects of contrails on civilian morale, there is at least some tangential evidence that the German people were aware that the dense contrails overhead heralded the passage of a massive bomber formation and understood that these contrails were harbingers of an imminent attack, if not on their own neighborhood, on towns and cities in other parts of Germany.

As a boy, Roger Freeman experienced first hand the awe-inspiring passage overhead of a massive bomber formation. "Seeing hundreds of aircraft trailing formations [contrails?] was an extraordinary sight." He was especially impressed during a "freezing" morning early in 1945 when at the age of fifteen he saw the "contrails of a thousand bombers forming in the sky at one time." Although there were literally more planes than he could count, he knew that the number of bombers forming up had to be about a thousand because he could count twenty-eight groups and knew that each group consisted of thirty to forty bombers.⁷¹

A German description of a massive raid by more than 1,100 American bombers against Leipzig on July 7, 1944, noted that the German population was warned of the attack as the bomber force approached the Münster-Osnabrück area. According to this report, "it was a beautifully clear day. Dense condensation trails could be seen up in the stratosphere. There was a continuous deep roaring of the bomber formations."⁷²

A more direct suggestion of the psychological impact of massive bombing operations came from Lt. Col. John B. "Jack" Kidd, who served as operations officer for the 100th Bomb Group at Thorpe Abbott, England. Kidd wrote:

Groups bombed individually, separating at an "Initial Point" for the bombing run, then regaining the wing formation. Wings, as well as Divisions, followed each other in trail, all taking up an enormous amount of airspace, normally flying between 20,000 to 28,000 feet (over five miles high). To the enemy population on the ground it must have been a frightful sight, wondering if the bombs were meant for them, particularly when contrails were formed which became long tubes of cloud visible at great distances.⁷³

Perhaps the most powerful description of the psychological effects of contrails came from Elmer Bendiner who earned a distinguished flying cross and purple heart as a navigator on a B-17 in the European theater. Concerning the contrails generated by American bombers during a June 1943 raid against Bremen, Bendiner wrote:

Ahead and above us the armada on dress parade let

"Ahead and above us the armada on dress parade let fly vapor trails like royal plumes."

BY THE END OF WORLD WAR II CONTRAILS WERE A COMMON-PLACE IN THE SKY-SCAPE OF WARFARE AND HAD COME TO HAVE SERIOUS IMPLICATIONS FOR AIR COMBAT



*fly vapor trails like royal plumes. Mechanical things when they are grand as plumed fortresses flashing in the morning become endowed with divine invincibility.*⁷⁴

Finally, for Bendiner at least, contrails were symbolically intertwined with that terrible struggle that took place in the skies of Europe over six decades ago. His *Fall of Fortresses* is clearly one of the best memoirs of modern warfare. Its title comes from the fallen Fortresses that formed a line of funeral pyres marking the deadly paths to and from targets like the ball bearing works at Schweinfurt. Of contrails and death, Bendiner had seen his share, and he mingled the two in some of the most powerful descriptions of air warfare. The air war "was not, then, a game which we played with death in the sky. It was not all gallantry and white contrails against the blue." While "death creates the splendid illusion of brotherhood," it cannot forever mask the horrors of war. The grandeur, the horror, the brotherhood, the illusions of the European air war would seem to be summed up in the following passage.

At 1315 the entire formation was in place. Gleaming in silver with white contrails spinning behind them,

the Fortresses pulsed and throbbed. The sound of engines beat a rhythm for which my mind devised melodies. We strung out for perhaps ten miles or more across the sky as we left Orfordness.

*I exulted in that parade. I confess this as an act of treason against the intellect, because I have seen dead men washed out of their turrets with a hose. But if one wants an intellectual view of war one must ask someone who has not seen it.*⁷⁵

Epilogue: Symbol of the Aviation Age

By the end of World War II contrails were a commonplace in the skyscape of warfare and had come to have serious implications for air combat. While relatively rare in the United States, contrails were entering the wider public consciousness, as articles and photographs featuring contrails began appearing in popular magazines like *The Saturday Evening Post* and *National Geographic*.⁷⁶

Following the war, military aircraft engaged in operational and training flights would continue to mark their passage through the heavens with the long, white streamers of contrails. However, not until the advent of the jet age in commercial aviation would contrails become a

During World War II, vapor trails had heralded the advent of air power as a major element of modern warfare. After the war, operational and training missions by high-flying military aircraft would gradually spread awareness of contrails until the advent of commercial jetliners made them a routine feature of skies around the world.

WHAT HAD
BEEN A
NOVELTY...
HAS BECOME
A SYMBOL
OF OUR MAS-
TERY OF
FLIGHT



common feature in the skies over North America, Europe, and much of the remainder of the world. What had been a novelty in World War I, a curiosity across the twenties and much of the thirties, and a deadly serious matter in air combat during the Second World War, has become a symbol of our mastery of flight—the fulfillment of a dream that has haunted man since the legendary flight of Icarus.

Today, there is virtually no place in the United States where the skies are unmarked by contrails. Joggers at the Pentagon, monks in their isolated monasteries, hikers at the Ghost Ranch in northern New Mexico, tourists on the floor of Canyon de Chelly in Arizona—all may at some time during the day hear the dull rumble of jet engines and look skyward to see an aircraft writing its gossamer signature across the heavens. ■

NOTES

Dr. Baucom is interested in extending his contrails research. In addition to receiving information on additional sources related to the period covered in "Wakes of War," he would like to explore reactions to contrails in the post-World War II era in which the advent of the modern jetliner has made contrails a regular feature in the world's skies. If you know of any post-1945 written sources, fictional or non-fictional, please send bibliographical information and page references to baucomdr@msn.com or to the following U.S. Postal address:

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1942; A Harvest Book), pp. 15-18, 31. See also, Curtis Cate, *Antoine de Saint-Exupéry* (New York: Paragon House, 1990), pp. 379-80; Stacy Schiff, *Saint-Exupéry—A Biography* (New York: Henry Holt and Company, 1994; An Owl Book), pp. 327-29.

4. For a glimpse of what it was like to fly a 1930s vintage aircraft at 30,000 feet where the temperatures reached 55° F below zero, see *Saint-Exupéry, Flight to Arras*, pp. 19-20. High altitude flight, with its discomforts and outright pain where *Saint-Exupéry* was concerned, seems to have become a special form of sacrifice that he offered as part of his own special crusade to defend France against the German invasion and later free her from the yoke of Nazi oppression. According to Schiff, *Saint-Exupéry*, pp. 320-21, *Saint-Exupéry* was a physical wreck—his left shoulder was virtually immobile, other parts of his body were stiff because of old fractures, and he suffered from headaches. Schiff also stated that his old fractures pained him at high altitudes where human tissue could swell. In *Antoine de Saint-Exupéry, Wartime Writings: 1939-1944* (New York: Harcourt, Inc., 1986), pp. 70-71, the author tells us that in one severe crash he suffered a skull fracture, a fractured sternum, a broken wrist, and several wounds caused by splinters from the wooden structure of the plane. For *Saint-Exupéry*'s obsession with flight at 35,000 feet, see *Wartime Writings*, pp. 20, 23-24, 37, 141-142, 147, 199, 207.

5. Saint-Exupéry, *Wartime Writings*, pp. 120-21, 124-25, 128-29, 208-17. For a reconstruction of the circumstances surrounding Saint-Exupéry's last mission, see Cate, *Saint-Exupéry*, pp. 549-52.
6. Saint-Exupéry, *Flight to Arras*, pp. 44-46. According to Saint-Exupéry, *Wartime Writings*, pp. 88-89, 101-02, *Flight to Arras* first appeared in serialized form in *Atlantic Monthly* prior to the publication in Feb 1942 of the English translation by Lewis Galantière. The French edition of this book did not appear until near the end of Nov 1942, when it was published under the title *Pilote de Guerre*.
7. For information on No. 2 Camouflage Unit, see RAF Museum, "Milestones of Flight: British Military Aviation in 1939," Part 3, at www.rafmuseum.org.uk/milestones-of-flight/british_military/1939_3.html. The RAF's "first dedicated photographic reconnaissance unit" was known as the Heston Flight and was formed in No. 11 Group of RAF Fighter Command. The Heston Flight was renamed No. 2 Camouflage Unit on Nov 1, 1939.
8. M. V. Longbottom, "Condensation Trails at High Altitudes," Dec 25, 1939, United Kingdom Archives, Document AIR 20/321, p. 1. Later in his report, Longbottom describes the appearance of two aircraft over Nancy on December 21, 1939, noting that "the aircraft themselves were not visible to the naked eye, but the two trails left no doubt as to their exact position."
9. Longbottom, "Condensation Trails," pp. 1-2.
10. *Ibid.*
11. *Ibid.*, p. 3.
12. *Ibid.*
13. Hough and Richards, *Battle of Britain*, pp. 49-51.
14. High Altitude Sub-Committee of the Aeronautical Research Committee, "Interim Note on 'Vapour Trails' Started by the Passage of Aircraft," February 3, 1941, United Kingdom Archives, Document DSIR 23/10792, p.1.
15. High Altitude Subcommittee, "Interim Note," pp. 1-2.
16. *Ibid.*
17. *Ibid.*, pp. 1-3.
18. *Ibid.*, p. 3.
19. *Ibid.*
20. *Ibid.*
21. G. M. B. Dobson, Meteorology Subcommittee of the Aeronautical Research Committee, "Condensation Trails from Aeroplane Engine Exhaust and Meteorological Conditions," Feb 7, 1941, United Kingdom Archives, Document DSIR 23/10802, p. 1. Dobson noted that burning one pound of petrol produced one pound of water vapor.
22. *Ibid.*, p. 2.
23. *Ibid.*
24. For these curves, see figures 1 through 4 at the end of Dobson, "Condensation Trails."
25. *Ibid.*, pp. 2-3
26. *Ibid.*, p. 3.
27. *Ibid.*, pp. 2-3.
28. *Ibid.*, p. 3.
29. A. H. R. Goldie, Meteorology Subcommittee of the Aeronautical Research Committee, "Condensation Trails from Aircraft: Summary of Present Position," November 20, 1941, p. 1.
30. *Ibid.*, p. 2.
31. *Ibid.*
32. *Ibid.*, p. 3.
33. *Ibid.*
34. *Ibid.*
35. United Kingdom, Meteorology Subcommittee of the Aeronautical Research Committee, "Formation of Vapour Trails behind Aircraft: Copy of Pilots' Replies to Questionnaire Issued by the National Research Council of Canada," [nd (early 1942)], United Kingdom National Archives document DSIR 23/11406, pp. 1-2.
36. Meteorology Subcommittee of the ARC, "Copy of Pilots' Replies," pp. 2-15.
37. Hough and Richards, *The Battle of Britain*, *passim*.
- For specific dates of the battle, see pp. 121, 301
38. For reproductions of Nash and Eurich paintings, see the section of colored illustrations between pp. 142 and 143 in Hough and Richards, *The Battle of Britain*. Examples of Monnington's paintings may be viewed at the UK's Imperial War Museum website: <http://www.iwm.org.uk/server/show/conArtist.1795>. Of special interest here is Monnington's "Southern England, 1944, Spitfires Attacking Flying Bombs."
39. Henry H. Arnold, *American Airpower Comes of Age: General Henry H. "Hap" Arnold's World War II Diaries*, ed. John W. Huston, Vol. I (Maxwell Air Force Base [Montgomery], Ala: Air University Press, January 2002), pp. 129-65. Arnold arrived in England during the afternoon of April 12, 1941 and departed the morning of April 27. Editor John Huston makes the point that Roosevelt was on the verge of forcing Arnold to retire over the latter's resistance to allocations of newly produced American aircraft to the Royal Air Force. The reason for Arnold's resistance was his perception that the RAF allocation was hindering the buildup of America's own air arm that was underway at the same time.
40. Arnold, *American Airpower*, I, 148. In note 130, p. 194, Huston said that Arnold was here comparing the contrails with sky-writing in which pilots "released a vapor to spell out their commercial messages to those below." Huston also stated that Arnold's sighting of contrails over London "was his first experience with contrails." This conflicts with Dik Daso's account of Arnold's earlier involvement with a contrail suppression project (see next paragraph in text above and next footnote below).
41. Dik A. Daso, *Architects of American Air Supremacy: Gen Hap Arnold and Dr. Theodore von Kármán* (Maxwell Air Force Base [Montgomery], Ala: Air University Press, 1997), pp. 24, 32. See especially note 47, p. 32. I have included this information even though it is a minor point in Daso's book. The evidence offered on this matter is an oral history interview completed several decades after the event.
42. Rhode and Pearson, *Condensation Trails*, p. 1.
43. *Ibid.*, p. 2.
44. *Ibid.*, p. 3.
45. *Ibid.*, pp. 4-5. Four charts are provided at the end of the report, one each for January, April, July, and October.
46. *Ibid.*, p. 7.
47. *Ibid.* Although not specifically cited, the British report here referred to is probably G. M. B. Dobson's report of February 7, 1941.
48. Wally Hoffman, "From Fantasy to Reality to B-17 Mission to Schweinfurt: 1943," downloaded from (<http://www.magweb.com/sample/ww2/wl003sch.htm>).
49. Mike Banta, "A Story of Ruptured Duck," "Stories from the 91st," 91st Bomb Group Memorial Association Website (<http://www.91stbombgroup.com>), downloaded from (<http://www.91stbombgroup.com/rupturedduck.html>).
50. Edward B. Westermann, *Flak: German Anti-aircraft Defenses, 1914-1945*, Modern War Studies, Gen. Ed. Theodore A. Wilson (Lawrence, Kansas: University Press of Kansas, 2001), pp. 215, 230, 249.
51. *History Learning Site*, "World War II—Bomber Command 1944," at http://historylearningsite.co.uk/bomber_command_1944.htm.
52. Andy Rooney, "How it Feels to Bomb Germany...," *Stars and Stripes*, European Edition, Feb 27, 1943, reproduced at: <http://www.pbs.org/weta/reportingamericaat-war/reporters/rooney/wilhelmshaven.html>.
53. James W. Brady, "Our First Mission" at <http://www.91stbombgroup.com/firstmission.html>.
54. Willard Reese to Jay Reynolds, Undated Message, downloaded on July 28, 2006 from website <http://www.goodskyhomestead.com/files/deception5.html>.
55. Jonathan E. Helmreich, "The Bombing of Zurich," *Air Power Journal*, Summer 2000.
56. *Ibid.*, pp. 92, 94, 96-97 The quoted material is from

p. 97.

57. *Ibid.*, pp. 92, 97-102.

58. Harley Tuck, "Combat Diary," entry titled "Rattlesden," Feb 22, 1944. The three parts of Tuck's diary may be found at the home page for the 447th Bomb Group website (<http://www.447bg.com/index.html>). At the home page for the 447th site, click on "Combat Crews," and then select "Combat Diary—Sgt Harley Tuck." The quotation given here is contained in part 2 of the Tuck diary. Tuck was a radio operator/gunner on a B-17 of the 708th Bomb Squadron. His plane was shot down on Apr 22, 1944, and he was taken prisoner.

59. Earl G. Williamson, Jr., "My Lucky Thirty," Diary of Eighth Air Force Missions in 1944, ed. by Robert S. Morris, located at <http://www.91stbombgroup.com/williamson.html>.

60. Lloyd Sunderland, "A B-17 Mission to Munich," downloaded from the Official 381st Bomb Group (Heavy) Memorial Association and Triangle-L Society Web Site, http://www.381st.org/stories_lloyd-munich.html.

61. Wesley Price, "Ice in the Moscow Pipe Line," *Saturday Evening Post*, Jan 13, 1945, pp. 18-19.

62. Bill Goodman to Richard Goodman, et. al., Letter, Mar 31, 1995. This letter is one of ten that Goodman wrote to his sons and two grandchildren. These letters may be accessed through the section on World War II Aviation History of the All Aviation Flightline OnLine Site at <http://aafo.com/library/history/index.html>. The March 31, 1995, letter is part IX of the section on Goodman's letters.

63. Roger A. Freeman, *The Mighty Eighth: Units, Men and Machines—A History of the US 8th Army Air Force* (Garden City, N.Y.: Doubleday and Company, Inc., 1970), p. 214.

64. Banta, "A Story of Ruptured Duck."

65. John Frisbee, "Four-Star Ace," *Air Force Magazine*, May 1989. This article can be downloaded from http://www.afa.org/magazine/valor/0589valor_print.html.

66. [Charles E.] Chuck Yeager with Leo Janos, *Yeager: An Autobiography* (New York: Bantam Books, 1985), pp. 68, 72, 85-86.

67. Adolf Galland, *The First and the Last: The Rise and Fall of the German Fighter Forces, 1938-1945* (New York: Bantam Books, 1954), p. 21. For other comments about the importance of keen eyesight and seeing the enemy first, see Gordon M. Graham, *Down for Double: Anecdotes of a Fighter Pilot* (White Stone, Virginia: Brandylane Publishers, 1996), p. 32; Richard Hillary, *The Last Enemy* (New York: St. Martin's Press, 1969), p. 98; Larry Forrester, *Fly for Your Life: The Story of R. R. Stanford Tuck, D.S.O., D.F.C., and Two Bars* (Garden City, N.Y.: Nelson Doubleday, 1973), pp. 23-24; and James Slater, *The Hunters* (New York: Random House, Inc., 1997; Vintage Books), pp. 8-9. Although *The Hunters* is a novel that focuses on air combat during the Korean War, its author is a West Point graduate who flew F-86s in the Korean War. In addition to keen eyesight, several autobiographical and biographical works stress the importance of the instincts (including the unhesitating willingness to kill) and skills developed through hunting as being important to the successful ace. See Forrester, *Fly for Your Life*, pp. 23-24, 28-29. Galland stressed the analogy between hunters and fighter pilots, see *First and Last*, pp. 21, 54. Chuck Yeager stressed his hunting background in his autobiography. See Yeager, *Yeager*, pp. 7, 9, 13, 19, 22, 28. At one point Yeager wrote: "Dad was an expert mechanic, and I just understood motors—a natural ability, like having exceptional eyes and the coordination to be a crack shot. Hand a rifle to a hill-billy and he'll hit a bull's eye every time. So, without knowing or even caring, I had the talents needed for flying in combat." (p. 22) Finally, Baron Manfred von Richthofen, the top German fighter ace of World War I, was also an avid hunter. See Peter Kilduff, *Richthofen: Beyond the Legend of the Red Baron* (New York: John Wiley & Sons, Inc., 1993), *passim*, but especially pp. 119-21, 157-58.

68. Johannes Steinhoff, *Messerschmitts over Sicily: Diary*

of a Luftwaffe Fighter Commander

(Mechanicsburg, Penn.: Stackpole Books, 2004), p. 138. James Salter made a similar point about air combat in the Korean War. In *The Hunters*, Cleve, the protagonist, is leading his flight north to the Yalu when, Salter tells us: "At thirty-four thousand feet they began to leave smooth, persistent trails in the air. Cleve stopped climbing and dropped down several thousand feet to remain below the contrail level where they would be less visible." (*The Hunters*, p. 81.) See also James Salter, *Burning the Days: Recollection* (New York: Random House, Inc., 1997; Vintage Books), p. 147, where one reads: "The sky that day was clear and deep. Heading north at forty thousand feet, there were smooth, straight contrails streaming out for miles behind us which could be seen from far off."

69. Freeman, *Mighty Eighth*, p. 126.

70. Cate, *Saint-Exupéry*, pp. 546-47.

71. Freeman is quoted in Pat McKenna, "The Mighty Eighth: U.S. Airmen's Sacrifices in Europe Helped Forge Today's Air Force," *Airman Magazine*, August 1996. This article may be downloaded from <http://www.af.mil/news/airman/0896/eighth.htm>. For the perspective of an American airman who was impressed by the massive formation of which he was a part and the contrails that formation generated, see James W. Brady, "Our First Mission" (<http://www.91stbombgroup.com/firstmission.html>).

Brady wrote: "We heard later that this had been the largest force ever sent out to date. The planes were leaving long vapor trails. It was a very interesting thing to see, and it gave one the feeling this was really a great show."

72. "Oschersleben: 7 July 1944," Part 1, located at <http://members.aol.com/falkeeins/Sturmgruppen/blitzluftschlacht.html>. This report is included in Neil Page, *Kaczmarek: a German View of the Air War—An English Language Reader* located at <http://members.aol.com/falkeeins/Sturmgruppen/contents.html>. Mr. Page's site states that it "aims to present selected short accounts for the Luftwaffe and air-combat enthusiasts from a variety of French and German sources including books, magazines, unpublished diaries and correspondence - most of the accounts you can read here have never appeared anywhere in English before."

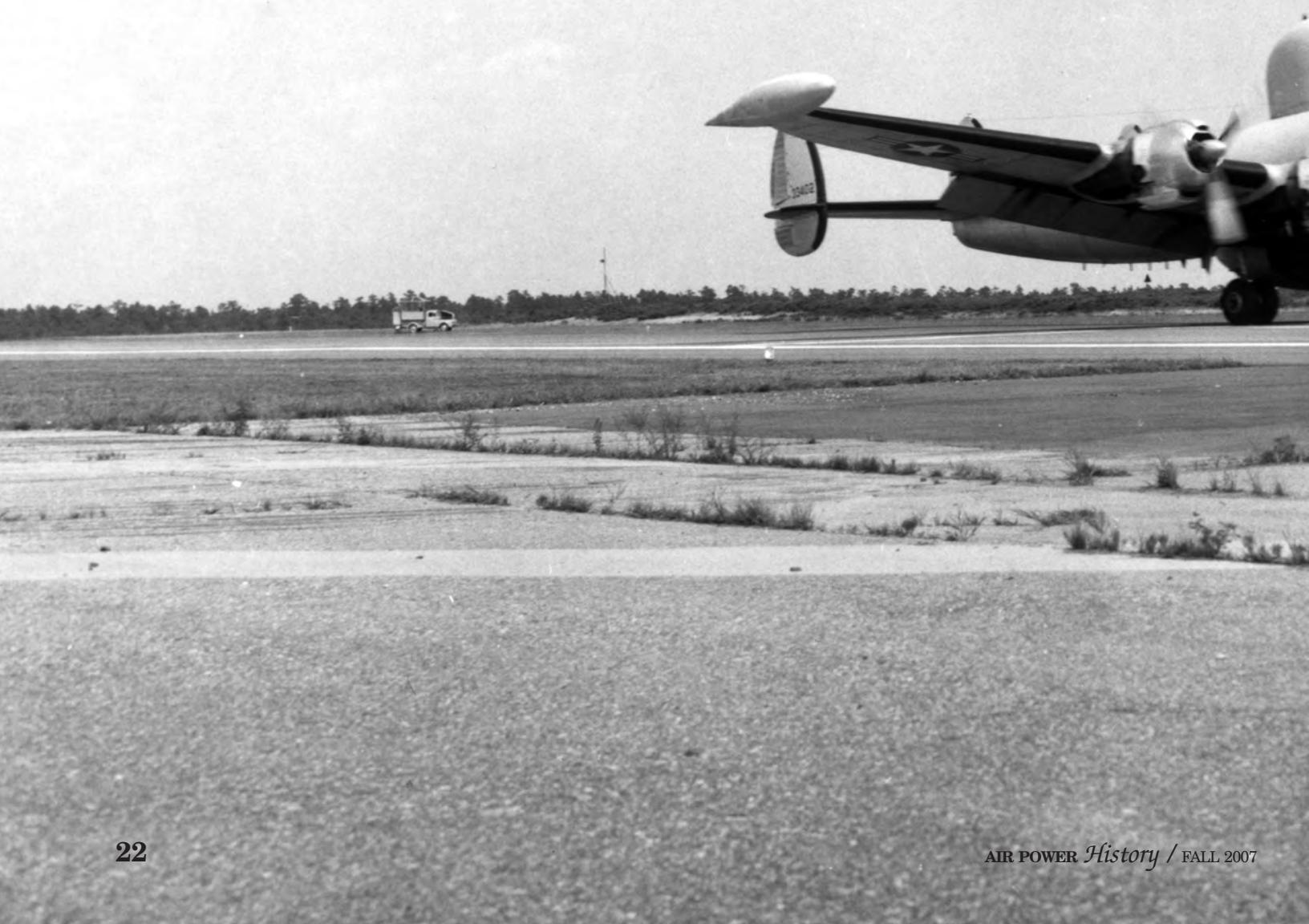
73. Jack Kidd, "World War II" at http://www.100thbg.com/mainpages/history/history2/kidd_ww2.htm. Kidd rose to the rank of major general after the war.

74. Elmer Bendiner, *The Fall of Fortresses: A Personal Account of the Most Daring—and Deadly—American Air Battles of World War II* (New York: G. P. Putnam's Sons, 1980), pp. 97-98.

75. Bendiner, *Fall of Fortresses*, pp. 168-69, 250-51. Victor Davis Hanson, one of today's leading military historians, rates *Fall of Fortresses* one of the top five books on 20th-century combat. See Hanson, "FIVE BEST: Fighting Words—The Definitive Books on the Battles of the 20th Century," *Wall Street Journal On-Line*, March 25, 2006.

76. An article in the *Saturday Evening Post* has already been cited. Additionally, contrails were discussed by F. Barrows Colton in "Weather Fights and Works for Man," *National Geographic*, December 1943, p. 655. Colton's article included a picture of contrails over England produced by German and British aircraft (p. 650). The caption under this photograph as well as Colton's article stressed the fact that contrails could give away the position of aircraft that might otherwise be too high to see. The source of these vapor trails was said to be condensation of water vapor in aircraft engine exhausts. Another photograph in *National Geographic* showed contrails forming elaborate curves. For this photograph, see F. Barrows Colton, "Aviation in Commerce and Defense," *National Geographic*, Dec 1940, p. 690. The caption under this photograph reads: "This grim 'skywriting' reveals breath-taking maneuvers of British and German planes during a 'dogfight' over the Kent coast, Aug 28, 1940. So high are the fighters that they are mere specks in the sky."

The Short But Interesting Life of a Plane Called Rivet Top





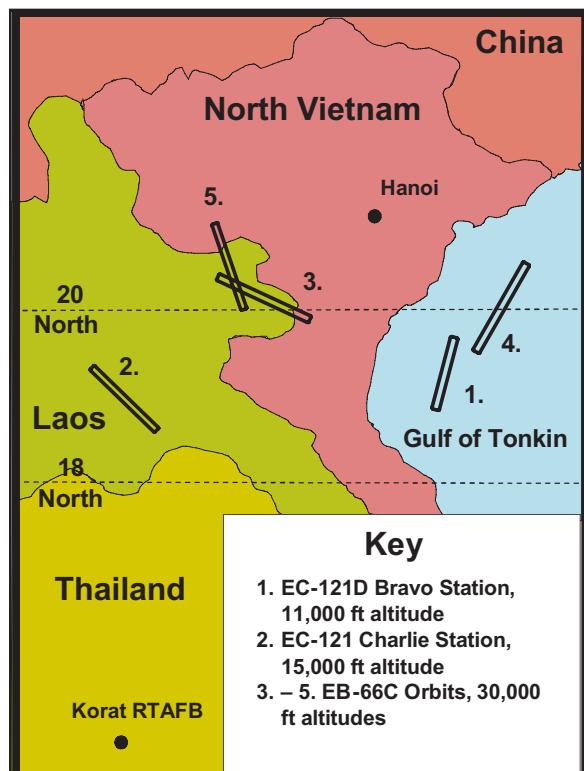
William Cahill

The ominous growl of the slow moving Lockheed Super Constellation disrupted the sultry autumn evening in 1967 at Korat Royal Thai Air Force Base (RTAFB). The United States Air Force (USAF) maintenance personnel and Thai cleaning staff paid scant attention to the EC-121 as she taxied onto the Constellation portion of the ramp and took her place among the parked EC-121Ds and EC-121Rs. From all outside appearances she was just another EC-121D assigned to Detachment 1 of the 552d Airborne Early Warning Wing. Yet the crew that climbed down the air stairs wore patches denoting assignment not to Air Defense Command, as one would expect, but to the fighter-owning Tactical Air Command. The aircraft was assigned to Detachment 2 of the Tactical Air Warfare Center and was a one-off modified EC-121K known as Rivet Top. Until recently her mission of direct support to fighters over North Vietnam has been shrouded in the mystery associated with classified signals intelligence (SIGINT) operations, but now her story can be told in full.

Genesis of a Program

Originally designated Sea Trap, Rivet Top evolved out of a series of studies in early 1966 designed to counter the SA-2 surface-to-air missile

HER MISSION OF DIRECT SUPPORT TO FIGHTERS OVER NORTH VIETNAM HAS BEEN SHROUDED IN THE MYSTERY, BUT NOW HER STORY CAN BE TOLD



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(SAM) system that was being used to great effect in North Vietnam. In May 1966, Headquarters USAF revised the mission of the program from merely locating SAM sites and directing strikes against them to also providing warning of SAMs and fighter aircraft hostile to USAF strike aircraft in the area. The updated plan was staffed through headquarters as a formal project re-named Rivet Top and approved in November 1966.¹ The final evolution of the Rivet Top plan centered on a concept called Airborne Tactical Air Coordination Center, where intelligence collection and command and control functions were fused on a single airframe.

Work on the design and development started immediately using a single EC-121K originally delivered to the U.S. Navy as Bureau Number (Bu No) 143184. Modifications designed by E-Systems and managed by the Big Safari Program Office proceeded briskly and the aircraft was delivered for operational test and evaluation in March 1967. The EC-121K gained a USAF serial based on her prior Navy Bu No, being carried on Air Force books as 57-143184.² The original plan called for the Tactical Air Warfare Center to test the Rivet Top aircraft for ninety days in the U.S. followed by a combat evaluation in Southeast Asia.³ Though her conversion work was completed in a relatively short amount of time, 57-143184 was far from a simple aircraft when she rolled off the modification line at the Greenville, Texas, plant of E-Systems.

Originally delivered to the U.S. Navy as a WV-2, 57-143184 was similar to the USAF airborne early warning EC-121D aircraft operated by Air Defense Command. However, 57-143184's airframe and interior received few major alterations, reducing the amount of flight test required for fielding the system. Previously in 1958, the Navy had modified eleven of 57-143184's WV-2 brethren for the SIGINT role and designated the new machines EC-121Ms.⁴ E-Systems took advantage of this work and many of the subsystems that flew on Rivet Top were developed for the EC-121M program. The WV-2's ventrally-mounted AN/APS-20 surveillance radar was disabled and the antenna turned into a large receiver for electronic intelligence (ELINT) purposes. This modification, similar to that used in the Navy's Big Look EC-121M aircraft, allowed the Rivet Top crew to develop precise location data against the SA-2's Fan Song radar via accurate direction-finding (DF) cuts. The new aircraft also benefited from the fitting of the EC-121M Brigand system which allowed the Rivet Top crew to accurately DF early warning radars.⁵ Unfortunately, both systems required up

The EC-121K Rivet Top parked on the ramp at Greenville, Texas..



AS THE AIR WAR DRAGGED ON, THE NUMBER OF STRIKE AIR-CRAFT OVER NORTH VIETNAM INCREASED AS DID THE AMOUNT OF THREAT REPORTING

to five minutes to develop an accurate location of the radar. While this timeline was effective against early warning radars that tended to stay active for tens of minutes at a time, it did not work well against the Fan Song radar, which would stay on the air for much shorter periods.⁶

To allow 57-143184 to track fighter aircraft, the QRC-248 and AN/APX-49 Identification Friend or Foe (IFF) systems, also fitted to USAF EC-121D aircraft, were carried.⁷ The AN/APX-49 IFF system allowed the weapons controllers in the back of the aircraft to identify U.S. aircraft by a distinct coded response to the AN/APX-49's electronic query, while the QRC-248 gave a similar capability against Soviet IFF systems used by the North Vietnamese.⁸ The final bit of kit on Rivet Top was arguably the most important. 57-143184 was fitted with eight positions for communications intelligence (COMINT), with specially-trained USAF airborne linguists operating Ultra High Frequency (UHF) and Very High Frequency receivers to intercept communications between ground controllers and pilots assigned to North Vietnam's Vietnamese People's Air Force (VPAF).⁹ The ELINT and COMINT capabilities—lumped together as “SIGINT”—were becoming critical to support the increasingly technical air war in Southeast Asia.

Initial SIGINT Efforts

USAF airborne SIGINT missions supporting the Vietnam War were about as old as the war itself. The 6091st Reconnaissance Squadron introduced SIGINT to Vietnam in July 1964 when it deployed two C-130B-II SIGINT aircraft to Thailand to fly COMINT missions off the coast of North Vietnam.¹⁰ Originally operating under the mission name Queen Bee, the C-130B-II aircraft would orbit over the Gulf of Tonkin to gather information

on VPAF air defenses as USAF strike aircraft bombed North Vietnam under Operation Rolling Thunder.¹¹ The tenuous relationship between the operations community and the intelligence community flared as the Second Air Division, the USAF organization controlling the air war at the time, fought with the SIGINT community over tasking of the SIGINT aircraft and the releasability of their intelligence information. The original method to “sanitize” and relay threat warnings derived from SIGINT was deemed cumbersome and a contributing factor in the loss of two F-105 aircraft on April 4, 1965.¹² The fallout of this incident was overwhelming and within one month the USAF approved the Queen Bee crews to provide enemy fighter (or “MiG”) threat warning direct to the strike aircraft over UHF radio on the “Guard” channel;¹³ by August the warnings were expanded to include information on active VPAF SA-2 batteries.¹⁴ In mid-September 1964 two additional C-130B-II aircraft arrived in theater, allowing the 6091st to fly a total of two missions per day under the new mission name of Silver Dawn.¹⁵

Silver Dawn SIGINT support continued unabated for the next two years with the C-130B-II mission crews refining threat warning format and procedures. At the same time USAF EC-121D aircrews were also brought into the threat reporting chain with the command and control crews relaying threat warning from ground-based SIGINT sites to strike aircraft.¹⁶ As the air war dragged on, the number of strike aircraft over North Vietnam increased as did the amount of threat reporting. Soon the warning information on the Guard channel was starting to lose its effectiveness as fighter crews repeated threats they saw, EC-121D crews relayed ground-based SIGINT and C-130B-II crews voiced their own intelligence. It was not uncommon for a single SAM inci-

An EC-121 with sensor bulges top and bottom.



**RIVET TOP
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FAN SONG
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F-100F
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AIR
CONTROLLER
AND F-105D
IRON HAND
AIRCRAFT TO
FIND AND
DESTROY
THE OFFEND-
ING SAM SITE**

dent to appear as multiple active missile batteries due to the duplicative nature of the Guard channel reporting net.

Off to War

The Rivet Top Task Force, designated Detachment 2 of the Tactical Air Warfare Center, arrived at Udorn RTAFB with their EC-121K on August 9, 1967. Their stay at Udorn was short with Detachment 2 joining the College Eye Task Force (CETF) EC-121Ds at Korat RTAFB later in the year. Once settled into their initial quarters at Udorn, the Rivet Top crews started flying combat missions in late August with their SIGINT sorties over the Gulf of Tonkin protected by Navy fighters operating a Combat Air Patrol (CAP).

Seventh Air Force, the follow-on organization to the Second Air Division, was authorized to task which missions were to be flown by the Rivet Top aircraft. Until this time, all SIGINT aircraft mission tasking was done by the National Security Agency (NSA). The switch from NSA tasking, as used by Silver Dawn, to the organization that managed the air war was a fundamental change in the way of doing business with SIGINT aircraft and allowed greater integration of intelligence with operations.

Rivet Top initially flew in support of a wide variety of missions to enable a broad data sample for her combat evaluation. Early Detachment 2 missions included support to Rolling Thunder operations near Hanoi, Iron Hand Suppression of Enemy Air Defense (SEAD) missions in southern North Vietnam and B-52 missions along the Demilitarized Zone (DMZ).¹⁷ A standard mission involved the aircraft launching to cover morning strikes into North Vietnam, landing to refuel at Da

Nang, South Vietnam, then taking off for afternoon strikes—a fourteen-hour mission to cover the two four-hour strike periods.¹⁸

During September, Rivet Top crews were assigned to support three Rolling Thunder raids against VPAF airfields.¹⁹ The plan called for the EC-121K crews to pass on threat information—both for SAMs and MiGs—to a ground-based command and control (C2) node or EC-130 Airborne Command and Control Center (ABCCC) aircraft that worked C2 of armed reconnaissance sorties near the DMZ and southern portions of North Vietnam. The airborne or ground-based C2 node would add the Rivet Top-derived data to other threat information and provide warnings to friendly aircraft operating under their control. Rivet Top could also pass ELINT-derived location data for SA-2s and early warning radars to the same agencies for prosecution of emerging targets.²⁰

The ABCCC-directed SEAD missions cued by Rivet Top worked well and soon procedures were refined to a science. As soon as Rivet Top derived an accurate Fan Song location it would be passed to ABCCC personnel who would immediately direct an F-100F “Misty” Fast Forward Air Controller and F-105D Iron Hand aircraft to find and destroy the offending SAM site while at the same time routing armed reconnaissance aircraft flying interdiction missions away from the threat area.²¹

A Change in Focus

By early October 1967 the Rivet Top mission had started to change. After gaining Seventh Air Force approval and coordinating with the Thailand-based 8th Tactical Fighter Wing (TFW),

**COLONEL
THOMAS
MORRIS.
BRIEFED
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THAILAND-
BASED
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CRAFT AND
REPEATED
THE BRIEF-
ING EVERY
THREE
MONTHS**

on October 9 Rivet Top crews started to provide MiG threat information directly to the strike force and protective anti-air “MiG CAP” aircraft via their respective “strike” and “CAP” discrete frequencies. These radio channels, used only by a limited number of aircraft, were less cluttered and easier to monitor for all players involved. Procedures continued to be polished throughout the month, with Rivet Top settling into a warning format that provided range and bearing of the threats—both SAMs and MiGs—to the alerted friendly aircraft.²² Rivet Top now relayed threat information to the C2 elements via an encrypted “secure” UHF radio and to the fighter aircraft via unencrypted UHF radio. The new warning procedures were a big hit with the fighter crews.

Rivet Top’s change in threat reporting procedures came just in time as these critical warnings were getting lost in the noise of the UHF Guard channel. Norm Nielsen, an F-4 pilot who flew with the 366th TFW out of Da Nang AB in 1967 and 1968, described the frenetic nature of Guard when he stated, “You’d hear SAM calls, you’d hear bull’s eye [MiG] calls, and of course you would hear a lot of calls from guys in trouble coming back.”²³ A raid on the VPAF airfield at Phuc Yen underscored the issue further—two F-105s were shot down by MiG-21s because three MiG warnings broadcast by College Eye were garbled by competing C2 communications.²⁴

The feedback from the fighter wings on the new warning system was immediate, with the Rivet Top command staff receiving verbal and written comments noting the exceptional support in combating MiGs.²⁵ Another factor that contributed to the success of the Rivet Top mission was the approach taken by the commander of Det. 2, Colonel Thomas Morris. He briefed each of the Thailand-based fighter wings about the capabilities of his aircraft and repeated the briefing every three months to cover pilot rotation. Even with the vagaries of schedules, Morris estimated 50 percent of the pilots in the three fighter wings had an understanding of the capabilities and procedures employed by Rivet Top.²⁶ The final factor was culture: Rivet Top was sponsored by Tactical Air Command, the host command of all CONUS-based tactical fighters, and was seen as a friend to help kill MiGs, while College Eye belonged to Air Defense Command and was perceived as an ill-tempered traffic cop with the job of keeping fighters away from the Chinese border.²⁷

The Rivet Top crews also worked to refine their internal crew coordination. Experience showed the best way to fuse tracking data with COMINT was for the lead airborne linguist, the Airborne Mission Supervisor (AMS), to stand behind the lead of the C2 crew. The AMS would point to targets on the radar tracking scope and convert data coming from his linguists over his headset to tactical information such as, “These are two MiG-21s out of Gia Lam and they are going to engage these F-4’s over here.”²⁸

By the end of 1967 Rivet Top had racked up an

impressive score, passing twenty-five MiG threat warnings to the strike force and providing range and bearing information on ninety-five separate MiG flights to the strike force and MiG CAP.²⁹ Leadership in all three fighter wings involved in Rolling Thunder operations praised the Rivet Top MiG warnings, the 388th TFW Deputy Commander for Operations noted the Rivet Top system of threat warning relative to the position of the strikers as, “... a tremendous step forward in the MiG warning system.”³⁰ More importantly, Rivet Top assisted in eight MiG engagements resulting in eight confirmed and four probable kills, the majority being MiG-17s downed by 8th TFW F-4s.³¹ In addition, ten Fan Song radars were DF’d and passed to C2 agencies as high threat areas and were subsequently nominated as lucrative targets.³²

1968

Rivet Top continued to fly at a high operations tempo to support Rolling Thunder and DMZ strike operations. January 1968 found the VPAF in one of its characteristic growth/renewal stages. New tactics started to appear, with experienced MiG-21 Fishbed pilots being vectored into the general area of a U.S. strike package and being allowed to engage as they saw fit. At times these single-ship formations would fly without their IFF on, lowering the probability of SIGINT forces to detect them because of reduced ground controller communications and no active IFF squawk for the QRC-248 to receive.

These aberrations aside, early victories for the MiG-21 force in January turned into losses in February as the USAF continued MiG sweeps during the monsoon season. The northeast monsoon season was an annual occurrence, the USAF using the time to concentrate on air-to-air operations while its predominantly clear-weather strike force sat out the bad weather with a lighter tasking.³³ Taking advantage of their growing experience in working together, the Rivet Top crews aided the Thailand-based F-4 community in three of the five confirmed kills logged in February 1968.³⁴ MiG kills aside, February was light in activity as the EC-121K crews only observed twenty-five MiG flights and passed two MiG threat warnings to strike packages.³⁵ The VPAF had scaled back its flight activity for a couple months, preferring to not engage USAF assets because targets in North Vietnam were not at risk. The lack of MiG activity caused the Rivet Top crews to concentrate more on DF’ing the SA-2s that started to move into southern North Vietnam.³⁶ This activity increased the already effective Wild Weasel force operating in the SEAD role and also aided in threat reporting.

Coincident with the scale back in VPAF operations was a change in the U.S. strategy on the war. Battered by Congress, the American public and principal advisors including Secretary of State Dean Rusk, President Lyndon Johnson announced a bombing halt over North Vietnam on March 31,



The EC-121K takes off from Greenville, Texas runway.

1968. Johnson, reaching out to offers of peace talks from Ho Chi Minh, directed all Air Force and Navy strike missions north of the 19th parallel to stop immediately.³⁷ Once the Paris Peace Talks started, it was only a matter of time before this changed and on November 1st a bombing halt was ordered for all of North Vietnam with operations over the communist airspace restricted to reconnaissance missions.³⁸

The College Eye fleet entered 1968 flying two orbits—the Bravo track over the Gulf of Tonkin and the Charlie track over Laos. Due to the bombing restrictions in North Vietnam the CETF placed more emphasis on support to Barrel Roll interdiction efforts over Laos. After March 31st Detachment 2 split the duties of flying the Bravo track with CETF and the EC-121K started to fly missions over the Gulf of Tonkin on every other day. In May an EC-121D fitted with the Rivet Gym COMINT package performed in-theater flight tests, leading to deployment of the system in June with six aircraft being modified by June 30, 1968.³⁹

Rivet Gym was a direct result of the successful Rivet Top experience of late 1967 and early 1968. Seventh Air Force, enamored with the MiG-killing benefits of the EC-121K, conducted a study on providing a Rivet Top-like capability to cover all strike missions. A requirement calling for a minimum of seven new airframes was the recommended solution; time and money never being easy commodities in war-time, the USAF decided the best answer was to modify the eleven in-theater EC-121D aircraft with a stripped-down capability.⁴⁰ Air Defense Command, eager to recover from the black-eye College Eye was acquiring as an ill-tempered traffic cop, quickly agreed.⁴¹ Soon plans were made to fit Rivet Gym, essentially the same COMINT capability flown in the Rivet Top aircraft, to in-theater EC-121D aircraft.

The End

The end of Rolling Thunder did not mean the halt of air operations over North Vietnam as reconnaissance missions were flown to monitor North Vietnamese logistics activities and defensive capabilities. President Richard Nixon continued U.S.

bombing and interdiction efforts against North Vietnamese forces in Laos and South Vietnam, even approving B-52 missions into Cambodia in an effort to decrease the flow of communist supplies. The stepped-up bombing efforts were in part to aid the withdrawal of U.S. forces; in June 1969 President Nixon announced the first of many U.S. Army troop reductions in South Vietnam.⁴²

USAF forces also started to draw down in Southeast Asia in 1969, with Detachment 2 at the front of the charge. On January 9, 1969 Rivet Top Task Force closed up shop and sent its EC-121K back to the US. The long serving 57-143184 was considered excess by Seventh Air Force after the CETF EC-121Ds were fully fitted with the Rivet Gym modification.⁴³ The EC-121K was already long overdue for return, its original six month deployment stretching to seventeen months.⁴⁴

Thus, 57-143184 returned to the U.S. and, as the final test reports were written, was flown back to Texas for “de-modification.” Stripped of the secret black boxes that made her a lethal asset in Southeast Asia, the once-proud lady was flown to Davis Monthan Air Force Base in Arizona and unceremoniously relegated to “the Boneyard” to be sold for scrap—an unfitting end for such an accomplished bird.

Ripples to Today

The Rivet Top Task Force’s seventeen months of action with a single aircraft account for a small fraction of the total missions flown in the air war in Southeast Asia. Yet the sole EC-121K had a far reaching impact on the future conduct of air superiority operations. The Rivet Top crews aggressively worked to integrate their intelligence information real-time into actionable data, blazing a path soon followed by the RC-135M and subsequent RC-135 variants.

Before the arrival of the Rivet Top Task Force, intelligence flowed through a convoluted path enroute to the cockpit of friendly fighters, usually arriving too late to affect the outcome of engagements. Though the C-130B-II Queen Bee crews were the first to relay signals intelligence information direct to the cockpit, the Rivet Top crews were the first to work “blue force” integration. Through the technical integration of radar tracks with intelligence on board their EC-121K aircraft to the doctrinal integration of intelligence with the warfighter through “road show” briefings and tasking outside NSA channels, the Rivet Top Task Force broke down doors and created a paradigm shift in aerial warfare.

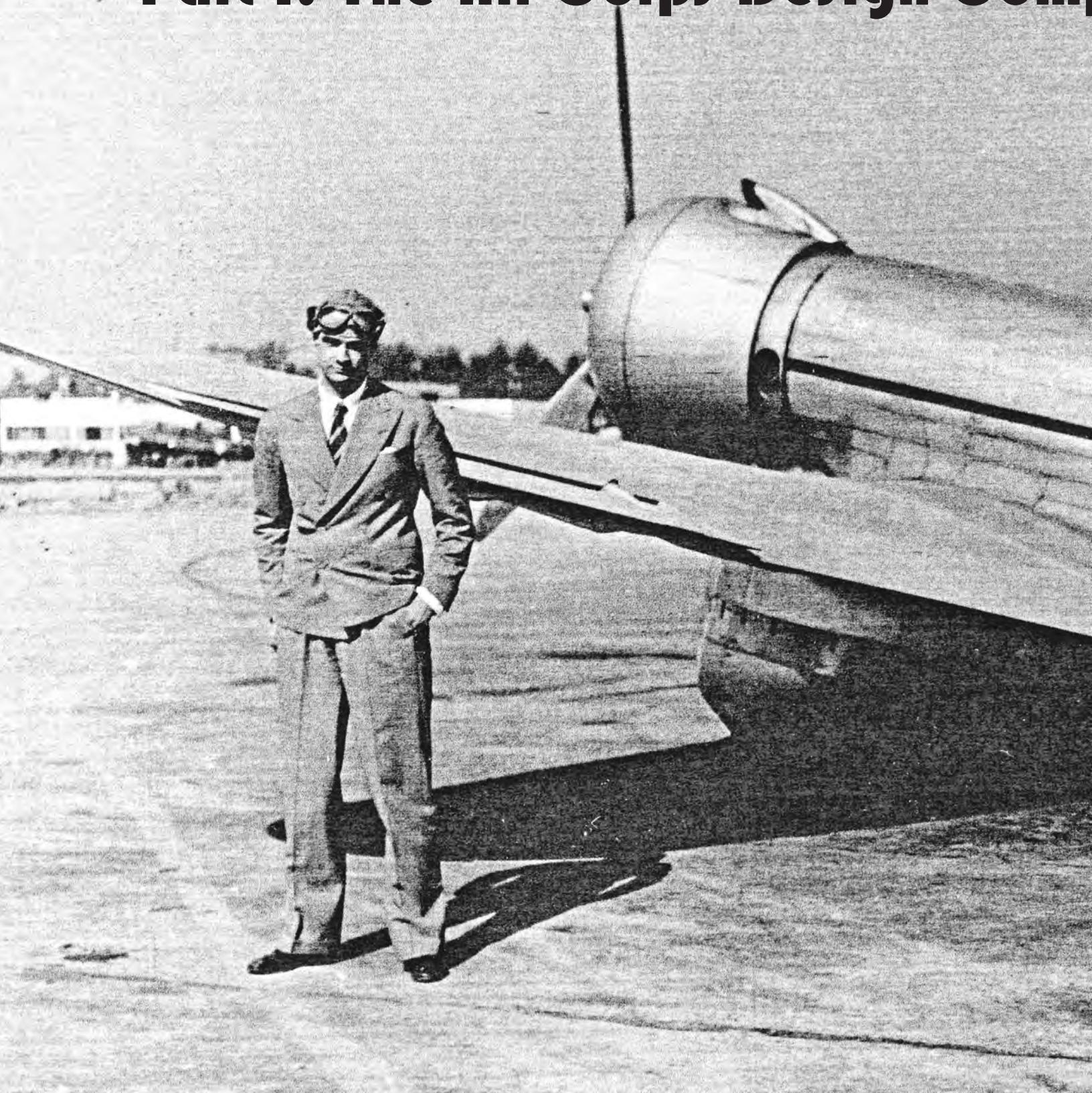
The fusion of E-3 AWACS track data with all-source intelligence data that today’s generation of aerial warriors takes for granted owes its origins to the innovative and hard charging men of the Rivet Top Task Force. Intelligence was no longer something to be analyzed post-mission—it had become a powerful weapon for the fighter pilot to use in day-to-day air combat. ■

THE FUSION OF E-3 AWACS TRACK DATA WITH ALL-SOURCE INTELLIGENCE DATA...OWES ITS ORIGINS TO RIVET TOP

NOTES

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14. Billy Thomas, *Classified Unit History, 1 July 1965 – 31 December 1965* (United States Air Force Security Service, 2 May 1966), 6, AIA Historians Office, Lackland AFB, Tex.; classified document, portions declassified by National Security Agency, 14 March 2007. Title "Classified Unit History" is not actual title but NSA determined actual unit designation is still classified.
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A Visionary Ahead of His Time: Howard A. "Hap" Arnold—Part I: The Air Corps Design Competition



Howard Hughes and the U.S. Air Force Competition



Thomas Wildenberg

(Overleaf) Jackie Cockran's Northrop Gamma, taken just before Howard Hughes "Lunch to Dinner" record setting flight between Chicago and Los Angeles on 14 May 1936. (Photo courtesy of the Library of Congress.)

Howard Hughes, was one of the greatest aviation personalities of the 20th Century. He was the only American to win the Harmon Trophy twice as the world's most outstanding aviator in an age when the public was captivated by airplanes and airmen. Hughes set a number of aviation records in planes that he built or modified, pioneered transcontinental air routes, was a major force behind one of the world's great airlines, and established an aircraft manufacturing concern that became one of the leading aerospace companies in the 20th Century. Though he won many awards and received numerous accolades from the aviation community, he is usually remembered as an eccentric, philandering billionaire who built the *Spruce Goose*.

In 2004, *The Aviator*, released by the Miramax Film Corporation, re-awakened the public's interest in Howard Hughes. Some of the most spectacular scenes of this popular movie involved the crash of the XF-11, an experimental photo-reconnaissance plane built for the United States Army Air Forces by Hughes Aircraft. Howard Hughes was at the controls of the XF-11 on its maiden flight and was severely injured when it smashed into a residential area in Beverly Hills, California, while Hughes was attempting to make an emergency landing on a nearby golf course.

While information on the development of the XF-11 and the events leading up the crash are readily available, very little has appeared in print on Hughes' earlier attempts to secure a production contract for a military version of the H-1 Racer or the privately funded D-2, which served as the prototype for the notorious XF-11. Even less has been written on how Hughes transformed Hughes Aircraft from an unsuccessful airframe manufacturer to a leading supplier of radar, electronic fire-control systems, and air-to-air guided missiles.

As the title suggests Howard Hughes was a visionary ahead of his time. Although he was a self-taught engineer with little if any formal training, Hughes embraced a broad range of cutting edge technologies that he applied in his various aviation projects. He was obsessed with streamlining and the need to fly ever faster, was enamoured with high altitude flight, and made use of the latest oxygen gear and meteorological expertise in his transcontinental record breaking flights. Hughes led the way in intercontinental air travel, pioneered the use of composite materials for aircraft construction, built the first "wide body" transport, and always made use of the latest in radio technology. In just twelve years — from 1935 to 1947 — Howard Hughes built and flew the fastest landplane in the world, set three transcontinental speed records, established a new record for

around-the-world flight, and built and flew the largest airplane in the world. Along the way Howard Hughes garnered enough accolades for a lifetime including: two Harmon International Trophies, a Collier Trophy, the Ghanute Award, a Congressional Medal, the keys to several cities, and a ticker-tape parade down New York's Broadway.

But this story is about Hughes involvement with the U. S. Air Force, a relationship that spanned seventeen years. It began in 1935 when he submitted the design for the XP-2 pursuit plane and ended in 1953 when he gave all the patents, trademarks, and goodwill of the Hughes Tool Company's Aircraft Division, along with all of the stock of the newly established Hughes Aircraft Company to the Howard Hughes Medical Institute. In the interim Hughes Aircraft proposed four different aircraft designs to the Air Force, obtained a contract to develop the Falcon air-to-air missile, supplied the radar for the first all-weather Air Force jet interceptors, and build the first totally integrated airborne fire control system.

The article that follows is divided into three parts: Part 1, which appears in this issue of *Air Power History*, will discuss Hughes attempts to enter the military airframe business by entering the design competitions sponsored by the Army Air Corps in the 1930s. Part 2, which will appear in a future issue, will discuss Hughes attempts to sell high performance military aircraft to the Army Air Forces. A venture that culminated in the development of the XF-11, which some claim to be one of the most beautiful piston powered airplane ever flown even though it was obsolete by the time it was finally accepted by the Air Force in 1947. Part 3, will discuss how Howard Hughes's life-long interest in radio electronics led to the establishment of the electronics laboratory that laid the ground work for transforming Hughes Aircraft into the Air Force's premier supplier of radar, guided missiles and fire-control systems.

VERY LITTLE HAS APPEARED IN PRINT ON HUGHES' ATTEMPTS TO SECURE A PRODUCTION CONTRACT FOR A MILITARY VERSION OF THE H-1 RACER

Part 1: The Air Corps Design Competitions

Howard Hughes involvement with the Air Force began in the spring of 1935 when he decided to enter the design competition for an experimental single-seat fighter. In January of that year, the Material Division of the Army Air Corps (predecessor to the U.S. Air Force), circulated proposals inviting the aviation industry to submit designs for one and two-place pursuit planes having an all-metal monocoque fuselage with cantilever monoplane wings.¹ The submittals were divided into two categories: a design competition to produce a concept aircraft that would form the basis for a

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Hughes H-1 Racer (short wing version). Note the extreme similarity to the XP-2 shown on page 37.
(Photo courtesy of the Florida Air Museum.)

HUGHES INVOLVEMENT WITH THE AIR FORCE BEGAN IN THE SPRING OF 1935 WHEN HE DECIDED TO ENTER THE DESIGN COM- PETITION FOR AN EXPERIMENTAL SINGLE- SEAT FIGHTER



long term development project, and a production contract competition to provide a sample aircraft that would become the prototype for the production of new Air Corps fighter. Entrants in the design competition did not have to build an aircraft. They only had to submit engineering data and preliminary drawings based on a comprehensive set of the specifications established by the Material Division for each type. Bids for the design portion of the competition were to be opened on May 6, 1935.

The design submitted by the Hughes team was a variation on the H-1 racer then under construction by another team of Hughes engineers working out of a leased warehouse building across the street from the Grand Central Airport in Glendale, California.² The idea for the H-1 was conceived while Hughes was attending the All-American Air Races in Miami, Florida, in mid January 1934. James R. Wedell, holder of the world's land plane speed record of 305 mph was there too. On January 12th, Wedell gave an exhibition flight in his record setting airplane, the Wedell-Williams 44, that involved three circuits of the event's 5-mile pylon racecourse.³ Hughes was scheduled to fly the course himself in a few days and it is inconceivable that he would not have wanted to be present for the exhibition. Howard Hughes had an insatiable interest in the latest advances in aviation and would not have passed up an opportunity to observe Wedell's demonstration flight and examine the Model 44 up close. As will shortly become evident, Hughes was not impressed.

Two days after Wedell's flying exhibition, Hughes flew his highly modified Boeing 100A in the Sportsman Pilot Free-For-All race. Hughes won handily, nearly lapping his nearest competitor averaging 187.5 miles per hour over the 20-mile triangular course.⁴

Glenn Odekirk, Hughes' mechanic, was on hand to congratulate him. It was the first aviation prize to be won by Hughes.

"Hell Glenn, there isn't a decent plane in the lot," Hughes was purported to have said after the meet.⁵

"Howard," Odekirk responded, "you won't be satisfied until you build your own plane ..."

In the months that followed, Hughes studied the technical data flowing out of the aviation industry on proposed inventions and designs for increased speed. As Paul Matt, the noted aviation historian explained in his classic article on Howard Hughes and his racer, these "were busy months, with visits to Hartford to see what Pratt & Whitney had in the latest engines and a similar assessment at the Wright Aeronautical plant in Patterson, New Jersey."⁶ While still in the East, Hughes sent a telegram to Dick Palmer in California asking the 30-year old engineer if he was willing to take on the task of designing the "fastest plane in the world."

Palmer, known for his advanced theories in aeronautical engineering, had further streamlined Hughes Boeing 100A after the Douglas Aircraft Company had finished modifying the plane to Hughes' specifications in 1931. Unhappy with Douglas's work, Hughes had taken it to the Lockheed Aircraft Company where Palmer was assigned the task of "cleaning it up." Palmer, who was now working for the Aircraft Development Corporation, agreed to take on the project on a part-time basis working in the evenings and during weekends. As the project progressed and the amount of work increased, Palmer chose to leave the Airplane Development Corporation in order to devote his full attention to the Hughes project.

In the early part of February, Palmer hired a small team of airplane designers and engineers to begin work on the wind tunnel models that he would use to validate the design for Hughes' Racer. Palmer had already discussed the choice of power plants with Hughes. Both men had agreed to use the new twin-row, 14-cylinder R-1535 Twin Wasp Junior engine developed by Pratt & Whitney. The engine, rated at 750-hp, had a relatively small frontal area that would significantly reduce the amount of drag produced by the engine.

In mid-April, Palmer and his six-man team were ready to begin testing the wind tunnel models that now included two different set of wings, two aft fuselage sections and tail surfaces, four

Table I
SPECIFICATIONS X603

		Desired	Minimum
(1)	High speed at 10,000 feet (Design useful load) m.p.h.	325	260
(2)	Operating speed, at 10,000 ft, m.p.h.	285	225
(3)	Endurance at operating speed at 10,000 ft (with design useful load and 1/3 of the full load required for the specified endurance, as an overload	3 hours	3 hours
(4)	Take off characteristics to clear a 50 ft obstacle with design useful load within, feet	500	1500
(5)	Service ceiling (design useful load) feet	30,000	25,000
(6)	Time to climb 10,000 ft (with design useful load)	3 min.	5 min.
(7)	Stalling speed Time to climb 10,000 ft	60	65
(8)	Path angle	10°	10°
(9)	Rate of climb (sea level)	2200	2200

Source: "Detailed Specification for Model XP-2 Airplane Type Single-Engine, Single Place Pursuit," p. 21A.

HUGHES AIRCRAFT HAD BEEN FORMED IN 1932 TO PROVIDE A CONVENIENT MEANS OF FUNDING THE EXPENSES ASSOCIATED WITH HOWARD'S PERSONAL AIRCRAFT AND HIS INTEREST IN FLYING

mid-ship fuselage sections and five engine cowls. Palmer loaded the models in his old Ford and drove over to his *alma mater*, the California Institute of Technology, for testing in the Institute's 10-foot wind tunnel. The tests, which began on April 20, 1934, were conducted under the title of Palmer Racing Plane, assigned to the Hughes Development Company of Glendale, California, and continued until July 31, 1934. The results were checked by Dr. Theodore Von Kármán, head of the Caltech Guggenheim's Aeronautical Laboratory and one the leading aerodynamicists in the world.⁷

By then Palmer's design team had moved into a warehouse building leased from aircraft dealer Charles Babb by the Hughes Aircraft Company. Hughes Aircraft had been formed in 1932 to provide a convenient means of funding the expenses associated with Hughes' personal aircraft and his interest in flying.⁸ The company was a division of Hughes Tool Company, the cash cow that permitted Hughes to indulge in his various aviation endeavors and owned all of his aircraft. Hughes assigned Glenn Odekirk as shop superintendent and, in keeping with his well known penchant for secrecy, had a temporary plywood wall constructed around the work area and saw to it that an armed guard protected the building at night.⁹

The H-1 racer was still under construction when the Material Division released its circular letter of January 15, 1935, announcing the pursuit plane design competition. Without notifying Dick Palmer or his team, Hughes quietly gathered another small group of aviation experts to draw up a proposal for a military version of the H-1. By the end of April, Hughes' second team had prepared the preliminary drawings and a detailed set of specifications. It was similar to the H-1, except it

was of all metal construction and had a higher aspect ratio, longer span, elliptical shaped wing.¹⁰ The new design was designated the Hughes XP-2 for experimental pursuit, model 2. It had provisions for two machine guns in each of the wing fillets, which were larger than those on the H-1, and conformed to the military equipment requirements listed in Army Specification No. X-603 (Table I).¹¹

When the bids were opened on May 16, 1934, the Hughes proposal (submitted under the Hughes Tool Company name) was one of sixteen designs offered to the Material Division by various firms. During the next five months several evaluating boards were convened at Wright Field to assess the merits of each design. The outcome remained in doubt until October 1, 1935, when the Wedell-Williams company was declared the winner of the design competition and awarded a study contract for a 4,350 pound fighter powered by a Pratt & Whitney R-1535 engine capable of 286 mph at 10,000 ft.¹²

The design submitted by the Wedell-Williams Air Service Corporation was based on the Model 45 racer, which had been enthusiastically endorsed by Capt. Claire L. Chennault, then an instructor at the Air Corps Tactical School. Chennault inspected the new plane in February. He was impressed by "its extraordinary speed" and by the fact that it appeared to be readily adaptable as an interceptor.¹³ No details of the Wedell-Williams design have survived and no records of the evaluations conducted by the Material Division been found, making it impossible to determine why the Wedell-Williams design—with a minimum speed contract requirement of 286 mph—was selected over the XP-2.

In all likelihood, the Material Division felt that the Wedell-Williams company was a more qualified airframe manufacturer. It had already built several successful racers and had been exchanging technical data with the engineers at Wright Field, whereas the Hughes Tool Company (at the time the evaluation was conducted) had never constructed a single airplane. In short, the Air Corps' engineers may have concluded that the Wedell-Williams design was more attainable. Ironically, the XP-34 never came to fruition, whereas the H-1, upon which the XP-2 was based, set new speed records under Hughes airmanship.¹⁴

While the Material Division was deciding against the XP-2, Hughes' team of engineers was secretly putting the finishing touches on the H-1 racer. On Friday, September the thirteenth—Hughes wasn't superstitious—Hughes piloted the H-1 to a new landplane speed record of 352 miles per hour. He made seven passes through the timing gates of the three-kilometer timing course that had been set up alongside the Eddie Martin Flying Field near Santa Ana, California, before his engine cut out for lack of gas. Hughes make a wheels up, dead stick landing in a nearby beet field that the official observers deemed sufficiently controlled for the record to stand.

Table II
Hughes Tool Co. Ltd.
Model XP-2

PERFORMANCE

Full speed at 10,000 feet	347 mph
Stalling speed at sea level	70 mph
Climb in 10 minutes from sea level	22,000 ft.
Service ceiling	31,000 ft.
Endurance at full speed	1.61 hrs.
Endurance at (economical) cruising speed	2.57 hrs
Range at full speed	560 miles
Range at economical cruising speed	1,553 miles
High speed at 10,000 ft.	347 mph
Endurance at operating speed at 10,000 ft. with design useful load and 1/3 of the full load required for the specified endurance, as an overload, in hours	Max. 5.67 Min. 2.57
Take off characteristics to clear and land over a 50 ft. obstacle with design useful load within	541 ft. (no wind)
Service ceiling (design useful load)	31,700 ft.
Time to climb to 10,000 ft.	4 min.
Stalling speed	70.5 mph
Path angle	17 degrees
Rate of climb at sea level	2500 ft. per minute.

Source: "Detailed Specification for Model XP-2 Airplane Type Single-Engine, Single Place Pursuit," p. 21.

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The similarity between the XP-2 and the H-1 has never been fully understood, nor the reasons why the Army rejected the Hughes' design. Some writers have suggested that the H-1, like other racers of the era, were not designed for the high stress maneuvers required of Army fighters and "couldn't carry the weight of a combat type."¹⁵ But the H-1 was "stressed for pursuit work," and was reported to be able to take 9 Gs in a dive.¹⁶ It is true that R-1535 Twin Wasp Junior had been specially tuned to burn 100 octane gasoline boosting the engine's horsepower to between 900-1,000 horsepower, but engine technology was advancing rapidly and there is no reason why a military version of the H-1 built to the XP-2 design could not have been powered by the same R-1830 that was subsequently selected for the XP-34.¹⁷

One can only speculate as to the possible outcome had Hughes been selected in the design competition and then given the go ahead to develop a military version of the H-1 using the more powerful R-1830 engine. The design would have been finished well before the end of fiscal year 1936, giving the Material Division sufficient time to award Hughes a construction contract for an experimental model (XP) or service test model (YP) based on the XP-2 design. Had this aircraft proved successful, which is highly likely given quality of Hughes design team and the proven performance of the H-1, the Air Corps would have had its first 300 mph fighter a year earlier (**Table II**).

Having accomplished his goal of building the fastest airplane in the world, Hughes now set out to break Roscoe Turner's transcontinental speed record using a redesigned version of the H-1 modified with larger wings and a greater fuel capacity.¹⁸ It would take several months, however, before the H-1 could be fitted out with the new wing. In the interim Hughes decided to attempt the record using Jackie Cochran's Northrop Gamma, leased at a price that Cochran could not refuse.

The Gamma was taken over by Hughes in November and trundled into the "secret" hangar that housed the H-1. There, Palmer's crew went to work installing new gas tanks and a new 850-hp Wright R-1820-G5 Cyclone engine with a three-bladed constant speed propeller. The R-1820-G5 engine, which had a special high altitude supercharger under development for the Army, had not been released to the public and Hughes had to get special permission to use it.¹⁹

Hughes began the record-breaking transcontinental flight at 12:15 p.m. on January 13, 1936, when he took off from Burbank airport. Nine hours and 15 minutes later, he landed the Gamma at Newark Airport breaking Roscoe Tanner's transcontinental mark by 47 minutes. When interviewed by the press, Hughes, who was very modest about his flying achievements, refused to talk about himself referring only to the equipment he used and the results obtained.

He continuously gave credit to the United States Army Air Corps for permitting him to use the 1,000 hp Wright Cyclone engine, which was then on the restricted list, and insisted that the credit for the successful flight was due to his chief engineer, Richard Palmer, his factory superintendent, G. E. Odekirk, his meteorologist, W. C. Rockefeller, and his other employees.²⁰

Hughes sought the Air Corps' help again in July when Albert Lodwick, Hughes' flight manager, requested the services of Lt. Thomas Thurlow to serve as the navigator on a flight that Hughes planned to make from Shanghai to New York in the DC-1 that he had recently purchased from Transcontinental and Western Air.²¹ Thurlow, an expert in celestial navigation had just reported to Wright Field for assignment to the Instrument and Navigation Unit and could not be spared.²²

On August 9 Hughes sent a wire to Brig. Gen. Austin W. Robbins, chief of the Material Division asking permission to land the next day at Wright Field so that he could stop and see him.²³ Hughes landed the DC-1, dubbed the "flying laboratory," at Wright Field at 5:44 p.m. on August 10 accompanied by a five man team that included Harry Conner, navigator; Richard Stoddard, radio operator; Harry Lund, flight engineer; W. C. Rockefeller, meteorologist; Al Lodwick, flight manager.²⁴ Hughes met with General Robbins the next day to talk about the equipment that Hughes wanted for the long distance flight.²⁵ We don't know the details of their discussions, but it seems likely that



Lt. Thomas L. Thurlow.
(Photo courtesy of the
Lodwick Collection,
Lakeland Public Library.)

HUGHES HAD NOT GIVEN UP ON GET- TING THE ARMY TO ACCEPT A MILITARIZED VERSION OF THE H-1

Hughes requested Thurlow's assistance along with the use of the latest radio and navigation aids being developed by the Air Corps. The flight from Shanghai never took place, but Thurlow, with the Air Corps' permission, was part of the crew that participated in Hughes' record-breaking around-the-world flight of 1938. Hughes must have had very good relations with the folks at Wright Field, because they let him take along the Fairchild Maxon Line of Position Computer; the first time this confidential device had been permitted for civilian use.²⁶

The August meeting with General Robbins is significant because it illustrates the close relationships that existed between Army aviators and their civilian brethren. There were relatively few people in aviation at this time and "direct communications and mutual trust were normal and instinctive."²⁷ As Brig. Gen. Benjamin S. Kelsey pointed out in his book *The Dragon's Teeth*, patriotism and integrity were the guiding principles behind the cooperation between the military and the civilian sectors.²⁸

Although Hughes was busy preparing for both another transcontinental record and a future flight of long duration, he had not given up on getting the Army to accept a militarized version of the H-1. He justly claimed that it was the most aerodynamically efficient airplane ever built. "It has the lowest 'drag' any ship in the air," he explained

to the press, adding that they were making changes to the H-1 that would make it more suitable for military use.²⁹

Hughes had not given up on the aircraft business. He had assigned the task of managing Hughes Aircraft to J. B. Alexander. Alexander had given Hughes some of his first flight lessons before managing the air force that Hughes assembled to make *Hells Angels*. At the end of March 1936, Alexander wrote to Wright Field requesting "recent design studies of pursuit types ... in connection with investigations which we are making, particularly any multi-engined studies that might be available."³⁰ Lt. Col. Oliver P. Echols, chief of the Engineering Section responded on April 22, 1936, forwarding Alexander a series of Army design studies "selected because they indicate the trend in present day thought."³¹

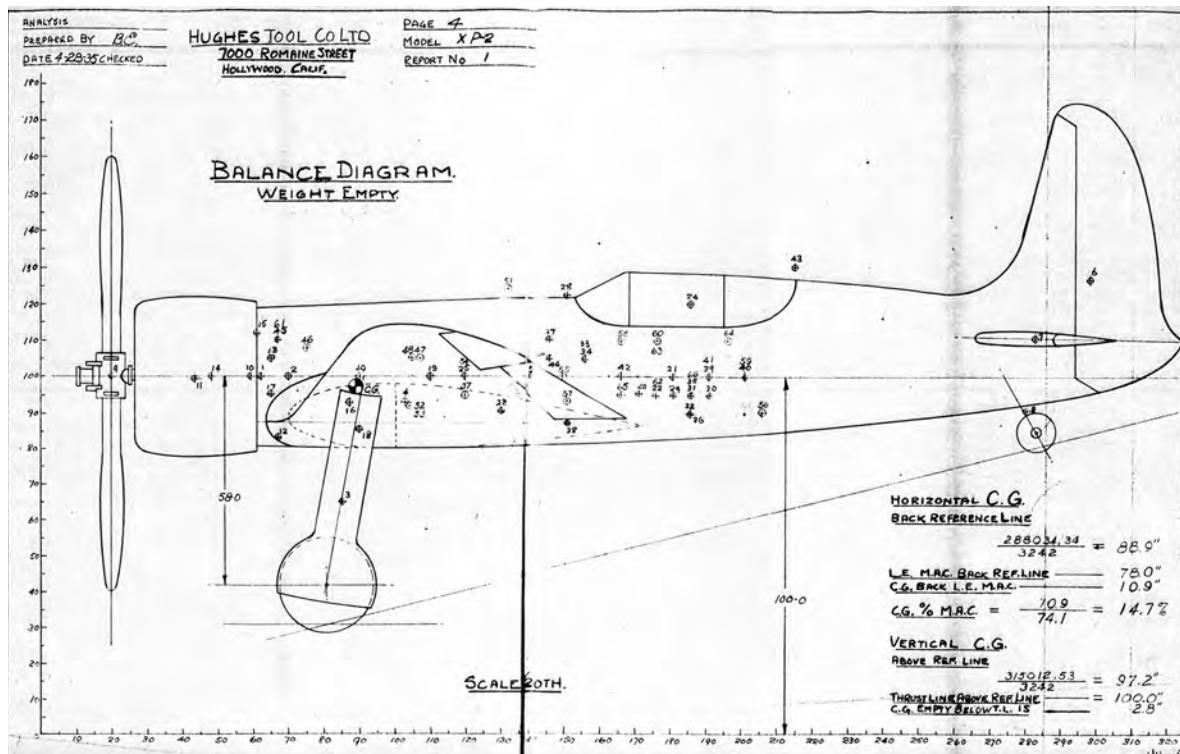
Within a month, Hughes' team of engineers came up with the design for a two-engine pursuit that was good enough to be of interest to the Army. On May 26, Alexander went to Wright Field to brief Maj. J. G. Taylor on the Hughes Aircraft Company's proposal to build a twin-engine pursuit plane. Hughes Aircraft, Alexander stated, was ready to proceed with the final wind tunnel model testing and to undertake construction of a development prototype if the Army would give the go ahead.³²

Major Taylor believed the design was good enough to warrant a development contract. "It would be to the advantage of the Government to enter into a limited competition development with this Company and one other," he wrote in a memorandum addressed to Echols.³³ Taylor felt that it was a waste of time and money for the Air Corps to issue a circular design proposal as planned. Design competitions in the past had "amounted to absolutely nothing," and would only result in the "Hughes's design ...being thrown into competition with many sketchy designs with unwarranted performance claims."³⁴

Unfortunately for Hughes, the Air Corps had no money. In a long distance telephone call made on July 31, 1936, General Robbins informed Alexander that the President had impounded \$250,000 of the Air Corps' development program. It was unlikely, he informed Alexander, that the Air Corps would be able to act on any development proposal until 1938 [fiscal year of].³⁵

If Hughes Aircraft wanted to produce a twin-engine pursuit for the Air Corps it would have to wait for the next year's design competition. In the interim the engineering staff continued to work on the design the Air Corps was now calling an "interceptor" airplane. The initial design developed by Hughes Aircraft incorporated two Curtiss V-1570 inline engines rated at 700 hp each.³⁶ It had an estimated top speed of 375 mph at 20,000 feet (310 mph at sea level) and would climb to 20,000 feet in 5 minutes. Although the design team had made "several reductions in the performance estimates based upon conferences with the Material Division," the Air Corps believed that the theoret-

Balance Diagram taken from Model XP-2 specifications. (Photo courtesy of the Florida Air Museum.)





Howard Hughes leaning against the H-1 racer having just made an emergency wheels up landing at the conclusion of his record setting speed flight of 13 September 1936.
(Photo courtesy of the Florida Air Museum.)

HUGHES AIRCRAFT HAD YET TO PRODUCE A COMMERCIALLY VIABLE AIRCRAFT DESIGN

Preparations for the world flight shifted to the Lockheed after the Bureau of Air Commerce declined to approve the Sikorsky for safety reasons.⁴⁴ With the scheduled time of the flight fast approaching, Hughes began to devote a great deal of time to the project. He usually arrived around noon, spent the entire afternoon working on the airplane, and continued long into the night, taking care of the many details that were associated with the forthcoming flight.⁴⁵

The details of Howard Hughes' record setting round-the-world flight would fill many pages (see *Howard Hughes: An Airman, His Aircraft, and His Great Flights* by Thomas Wildenberg and R. E. G. Davies) and are beyond the scope of this article. It suffices to say that the flight, which took place between July 10-14, 1938, generated worldwide attention and acclaim for Hughes and his four-man crew that included Lt. Thomas L. Thurlow, co-navigator.

Thurlow, a recognized authority on aerial navigation, was a 33-year old Army flyer on leave from the Material Division at Wright Field where he was in charge of the Instrument and Navigation Unit.⁴⁶ A graduate of the Air Corps Technical School at Chanute Field, Illinois, he had taught navigation at Rockwell Field, California,

and was the inventor of a number of navigation aids including a periscope drift indicator.

The Fairchild-Maxson Line of Position Computer used during the flight was developed and manufactured for the Army Air Corps by the Fairchild Aerial Camera Corporation and was used to simplify the calculations needed "for the reduction of celestial observations."⁴⁷ Thurlow described its use in a two page article that appeared in the *Air Corps News Letter* published on November 1, 1938.

As a result of the flight, Howard Hughes and the members of his crew were honored recipients of Collier Trophy for 1938. The highly prestigious award was bestowed for having made the most significant achievement in the advancement of aviation in that year. The citation accompanying the award stated that:

Their around-the-world flight involved notable advances in aerial navigation, communication and engineering; demonstrated the value of organization; and planning in long range aircraft operation and a world wide demonstration of the superiority of American aviation products and techniques.⁴⁸

Although Howard Hughes had won worldwide acclaim as an aviator who had made notable contributions to aeronautical progress, Hughes Aircraft had yet to produce a commercially viable aircraft design. Howard Hughes was still searching for the proper mix of technology and market readiness needed for economic success.

As Charles Barton noted in *Howard Hughes and His Flying Boat*, "aviation success was an economic matter; an aircraft had to be marketable, which meant that it had to be useful to a significant number of aircraft buyers."⁴⁹ By 1939 it was apparent that such success in the near future would depend almost exclusively on building aircraft useful in war.

Still riled by the Army's selection of the Lockheed twin-engined interceptor, Hughes "decided to build from the ground up with my own money an entirely new airplane, which would be so sensational in its performance that the Army would have to accept it." This was to be the D-2. ■

NOTES

Note on Sources: Much of the information in published sources on Howard Hughes is contradictory, misleading, incorrectly dated, or taken out of context. I have tried to use primary source material whenever possible. There are many gaps in the official record however, and much of the most interesting and informative material on Howard Hughes' aviation career is anecdotal. I have selectively included such information only when it is in agreement with the historical record and Hughes persona.

1. Irving B. Holley Jr., *Buying Aircraft: Material Procurement for the Army Air Forces* (Washington, D.C.:

Department of the Army, 1964), p. 139; Ray Wagner, *American Combat Planes of the 20th Century* (Reno, Nevada: Jack Bacon & Co., 2004), pp. 274-75. In 1941 the U. S. Army Air Corps (USAAC) became the U. S. Army Air Forces, which in turn became the U. S. Air Force in 1947.

2. Paul R. Matt, "Howard Hughes and the Hughes Racer," *Historical Aviation Album*, Vol. XVI, (Temple City, California: Historical Aviation Album, 1980), pp. 9-10.

3. Reginald M. Cleveland, "Plane Hits Ground," *The New York Times*, December 13, 1934. [6th Annual All-American Air Races File, National Air and Space Archives, Washington, D.C.]

4. Charles Barton, *Howard Hughes and His Flying Boat* (Blue Ridge Summit, Pa.: Tab Aero, 1982), p. 34.
5. Matt, "Howard Hughes and the Hughes Racer," p. 9.
6. *Ibid.*
7. Telegram from Howard Hughes to Dr. Theodore Von Karman, dated September 18, 1935, thanking Von Karman for his cooperation and the wind tunnel predictions that agreed with the speed attained by the H1, Von Karman Papers, Institute Archives, California Institute of Technology; Charles Hoppe, "Breaking the Record," *Aero & Airways*, November, 1935, P.30-31 (copy in Howard Hughes File, American Institute of Aeronautics Collection, Library of Congress, Washington, D.C.).
8. Peter Mitcel, "Hughes Aircraft and Electronics," An exhibition from UNLV Special Collections, UNLV Libraries, Las Vegas, Nevada, <http://www.library.unlv.edu/hughes/pages/aircraft.html>.
9. No outsiders were allowed in the hangar, neither was any information given out. Hughes was extremely security-minded since Clarence Reed, an engineer employed by Hughes Tool Company, had walked out one day with some company blueprints and set up a rival drill bit manufacturing company (See Barton, Note 12, page 252).
10. Matt, "Howard Hughes and the Hughes Racer," p. 10.
11. "Detailed Specification for Model XP-2 Airplane Type Single-Engine, Single Place Pursuit," dated April 28, 1935, Hughes Collection, Florida Air Museum (hereafter XP-2 specification).
12. Ray Wagner, *American Combat Planes* (New York: Hanover House, 1960), p. 275; Birch Matthews, *Race with the Wind: How Air Racing Advanced Aviation* (Oscela, Wis.: MBI Publishing, 2001), p. 105. The alleged visit by J. B. Alexander to Wright Field in August 1935 has numerous errors and is unlikely to have occurred as described. Instead, it's likely that those relating the event, as described in Matt's article, had in mind the visit made the following year. There is no evidence that the so-called misunderstanding caused a rift between Howard Hughes and Lt. Col. Oliver P. Echols, then chief of the Engineering Section at Wright Field. On the contrary, the evidence suggests that Howard had very good relations with Echols, otherwise he would not have gotten the Army's cooperation in his future flights, nor would Echols have later recommended the procurement of the D-2 (see Echols to Arnold memo of May 27, 1942 in official project history).
13. Claire L. Chennault to Chief of the Air Corps, February 14, 1934, Wedell-Williams Folder, RD-3284, U.S. Army Air Forces Research and Development Files, National Archives, College Park, Md. (hereafter Sara Clarke Collection).
14. Jimmy Wedell was a seat-of-the-pants designer, engineer and builder who had long term financial backing from Louisiana millionaire Harry Williams. Jimmy, his brother Walter and Harry Williams were all killed in airplane crashes before the XP-34 design could be brought to fruition.
15. Ray Wagner, *American Combat Planes of the 20th Century*, (Reno, Nevada: Jack Bacon & Co., 2004), p. 275.
16. Hoppe, "Breaking the Record," p. 31.
17. After awarding the contract to the Wedell Williams company, the Army realized that the performance of the Wedell plane would be inferior to either the Seversky Sev-1 or the Curtiss Model 75 that had been submitted in the production competition. This led to a negotiated contract calling for the use of the 850-hp Pratt & Whitney Twin Wasp R-1830 twin-row radial engine and a speed of 308 mph. The death of Harry Williams, the sole survivor of the Wedell-Williams team, on May 19, 1936, forestalled further work on the XP-34 and the company was unable to complete the contract.
18. According to *The New York Times* article "World Speed Mark Set by Coast Flier," of September 14, 1935.
19. *The New York Times*, January 15, 1936; *New York American*, January 15, 1936.
20. *U. S. Air Services*, April 1937, p. 26.
21. Al Lodwick to Brigadier General A. W. Robins, telegram dated July 7, RD-3277, Sara Clarke Collection.
22. Transcript of long distance call to Washington dated July 8, 1936, Hughes Aircraft Folder, RD-3277, Sara Clarke Collection; "Hughes' Flight Navigators and Navigation Procedure," *Aero Digest*, August 1938, p. 63.
23. Howard Hughes to General A. W. Robbins, telegram dated August 9, Hughes Aircraft Folder, RD-3277, Sara Clarke Collection.
24. "Hughes Lands in Ohio Non-Stop From Coast," *The New York Times*, August 11, 1936.
25. *Flight Tribune*, August 11, 1932.
26. "Hughes' Flight Navigators and Navigation Procedure," *Aero Digest*, August 1938, p. 63; "Hughes Tested Army Robot Navigator; First Use of Device on a Civilian Plane," *Army Times*, July 15, 1938.
27. Benjamin S. Kelsey, *The Dragon's Teeth* (Washington, D.C.: Smithsonian Press, 1982), p. 94.
28. *Ibid.*, p. 107.
29. *The New York Times*, April 26, 1936.
30. J.B. Alexander, Manager, Hughes Aircraft Company, to Wright Field, March 31, 1936, Hughes Aircraft Folder, RD-3406, Sara Clark Collection.
31. Oliver P. Echols to J. B. Alexander, April 12, 1936, Hughes Aircraft Folder, RD-3406, Sara Clark Collection.
32. J. G. Taylor to O. P. Echols, Conference on Two-Engined Pursuit Airplane Design, May 27, 1936, Hughes Aircraft Folder, RD-3406, Sara Clark Collection.
33. *Ibid.*
34. *Ibid.*
35. Transcript of long distance telephone call between General Robbins and Mr. Alexander, July 31, 1936, Hughes Aircraft Folder, RD-3406, Sara Clark Collection.
36. A. W. Robins to Chief of the Air Corps, Two-Engine Interceptor Designs, November 11, 1936, Twin Engine Interceptor Folder, RD-3305, Sara Clark Collection.
37. *Ibid.*
38. Barton, *Howard Hughes and His Flying Boat*, p. 49.
39. In the four-month period between the Alexander's telephone conversation with General Robbins and the circular proposal, Hughes was forced to lay off some of his engineers who then went to work for Lockheed. In 1947 while testifying before Congress, Hughes insinuated that Lockheed had gotten the idea for two-engine flight from his former employers.
40. Untitled manuscript, Project III Binder [hereafter D2 Project Book], no page numbers, Howard Hughes Collection, Florida Air Museum, Lakeland, Florida
41. U.S. Congress. Senate. Special Committee to Investigate the National Defense Program Hearings. 80th Congress, 1st Session, Part 40: Aircraft Contracts (Hughes Aircraft Co. and Kaiser-Hughes Corp.), p. 24370.
42. Donald L. Bartlett and James B. Steele, *Empire: The Life, Legend, and Madness of Howard Hughes* (W.W. Norton, 1979), p. 89.
43. Robert E. Gross, President to Hughes Aircraft Company, confirmation letter signed by Noah Dietrich, November 3, 1937, Hughes Collection, Florida Air Museum.
44. Bartlette and Steele, *Empire*, p. 90.
45. "Round-the-World Flight," p.3, Project II Notebook, Howard Hughes Collection, Florida Air Museum, Lakeland, Florida.
46. "Hughes' Flight Navigators and Navigation Procedure," *Aero Digest*, August 1938, p. 63.
47. "Hughes Tested Army Robot Navigator; First Use of Device on a Civilian Plane," *Army Times*, July 15, 1938, p.2; John D. Peace, Jr., "The Fairchild-Maxon Line of Position Computer," *Aero Digest*, August 1938, p. 67.
48. *New York Times*, November 17, 1939.
49. Barton, *Howard Hughes and His Flying Boat*, p. 45.

THE U.S. AIR FORCE RESPONSE



RESCUE TO HURRICANE KATRINA



Daniel L. Haulman

A U.S. Air Force Reserve C-130 Hercules from the 910th Airlift Wing at Youngstown Air Reserve Station, Ohio, sprays Dibrom, a pesticide approved by the U.S. Environmental Protection Agency, over the city Sept. 13, 2005.

Media images of destitute flood victims in New Orleans in the wake of Hurricane Katrina generated the impression of an unresponsive federal government. Critics understandably took aim at the mayor, the Louisiana governor, the Federal Emergency Management Agency, and the President. Some also criticized the Department of Defense as if it had failed to furnish the quick and massive humanitarian relief which the American people had come to expect after a natural disaster. Some suspected that Pentagon resources were stretched thin for an adequate response because of ongoing combat operations in Iraq and Afghanistan on the other side of the world. This paper will explore the validity of that impression by focusing on the response of the U.S. Air Force, as part of the larger Department of Defense, to the crisis posed by Hurricane Katrina.¹

The Air Force was involved even before the storm hit. During late August 2005, the Hurricane Hunters of the 53d Weather Reconnaissance Squadron (403d Wing) in their WC-130 airplanes tracked and measured Katrina's intensity and location as it crossed the tip of Florida and grew into a category 5 monster in the Gulf of Mexico. Between August 23 and 29, squadron aircrews flew more than 109 hours tracking the storm. As Katrina approached the central Gulf coast, the squadron dispersed its aircraft, which were stationed at Keesler Air Force Base, Mississippi, to bases beyond the projected storm path.²

Early on Monday morning August 29, Hurricane Katrina hit southeast Louisiana with winds up to 140 miles per hour. After making landfall near Buras, it followed a northward track to the Louisiana-Mississippi border. East of there, the counterclockwise winds pushed a 28-foot storm surge from the Gulf of Mexico northward into the towns of coastal Mississippi and southwestern Alabama. A combination of wind, rain, and storm surge destroyed countless buildings, leaving a scoured landscape, but the floodwaters there receded almost as rapidly as they had come. West of the storm center, the winds blew from north to south, pushing a swollen Lake Pontchartrain into the canals of New Orleans. Failures of floodwalls along those canals and overtopping of levees in the east left 80 percent of the city flooded for weeks. Of some 485,000 residents, approximately 100,000 who had not evacuated awaited rescue as they struggled to survive without adequate food, water, shelter, plumbing, electricity, and communications. All the parishes east and south of New Orleans were also flooded. Hurricane Katrina eventually

caused 1,304 deaths and some \$50 billion in destruction and damage.³

President George W. Bush waited for Louisiana governor Kathleen Blanco's request for federal assistance before committing the defense forces already prepared. That request was delayed, in part because initial news reports prematurely declared that New Orleans had "dodged the bullet" and escaped another big hurricane. The broken levees and resultant flooding did not become apparent until after the storm had passed. On August 31, Governor Blanco asked for federal intervention. That same day, the President cut short his Texas vacation and returned to Washington. Aboard Air Force One, the President flew low over the coastal disaster area so that he could see the destruction for himself.⁴

Once the governors of the affected states requested federal assistance, the Federal Emergency Management Agency (FEMA), tapped the Department of Defense for military assistance. The same day, the U.S. Northern Command set up Joint Task Force Katrina under Lt. Gen. Russell L. Honore, the commander of the First U.S. Army, at Camp Shelby, Mississippi. Maj. Gen. M. Scott Mayes, commander of the First Air Force, served as the task force's joint forces air component commander (JFACC). General Mayes established the 1st Aerospace Expeditionary Task Force-Katrina at Tyndall Air Force Base, Florida. The task force set up various air expeditionary groups for a massive disaster relief operation. For example, the 97th Air Expeditionary Group was activated at Keesler. By September 7, the Air Force, Air Force Reserve, and the Air National Guard had deployed some 8,000 personnel for the emergency.⁵

USAF helicopters took part early in the disaster relief effort. Their role was most important in the New Orleans area, where only helicopters were allowed to fly below 20,000 feet. Late on August 30, the Air Force Reserve Command's 920th Rescue Wing from Patrick AFB, Florida flew large HH-60 Pave Hawk helicopters to Jackson, Mississippi in order to deliver FEMA damage assessment teams to the disaster zone. On August 31, they and other HH-60s from wing's 943d Rescue Group from Davis-Monthan AFB, Arizona, began flying search and rescue missions. HC-130 tankers, staging at Patrick AFB, Florida, refueled the helicopters.⁶

At the same time, other HH-60s and HC-130s from the Air Force Special Operations Command's 347th Rescue Wing from Moody AFB, Georgia and 563d Rescue Group from Davis-Monthan AFB,

THE 1ST AEROSPACE EXPEDI- TIONARY TASK FORCE- KATRINA... SET UP VARIOUS AIR EXPEDI- TIONARY GROUPS FOR A MASSIVE DISASTER RELIEF OPERATION

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The pararescueman is from 38th Rescue Squadron at Moody Air Force Base, Ga., and was deployed to New Orleans for Hurricane Katrina search-and-rescue operations.

**USAF
HELICOPTER
CREWS
RESCUED
4,322 PEO-
PLE, 2,836 OF
THEM BY
HH-60s, 1,461
BY MH-53s,
AND 25 BY
UH-1s**



Arizona, performed similar search and rescue missions in the disaster area. The Pavehawk helicopters flew their missions from Jackson, Mississippi, refueled by HC-130s. MH-53 helicopters refueled by MC-130 tankers from the 16th Special Operations Wing, home based at Hurlburt Field in Florida, also took part in the search and rescue operations in the disaster zone. Like the Air Force Reserve helicopter assets, they served under the 347th Expeditionary Rescue Group under Task Force Katrina. The Air National Guard's 106th Rescue Wing also took part in the helicopter search and rescue operations.⁷

Air Force Space Command deployed eight UH-1 helicopters, two each from Minot AFB, North Dakota; F.E. Warren AFB, Wyoming; Malmstrom AFB, Montana; and Vandenberg AFB, California, for Hurricane Katrina search and rescue missions. Smaller than the MH-53s or the HH-60s, the UH-1s were in some ways more versatile. They came from the Air Force Space Command's 37th, 40th, 54th, and 76th Helicopter Flights. From Columbus AFB, Mississippi, they carried food, water, medicine, and other supplies to hurricane victims along the Mississippi Gulf Coast. The UH-1s served in the 620th Air Expeditionary Squadron of the 347th Expeditionary Rescue Group. Two other UH-1s took part in relief efforts, one from the Air Force Materiel Command and one from Air Force Special Operations Command.⁸

Between August 31 and September 10, USAF helicopter crews rescued 4,322 people, 2,836 of them by HH-60s, 1,461 by MH-53s, and 25 by UH-1s. On September 4, the 347th Expeditionary Rescue Group rescued a record 791 persons in one day. Some missions lasted up to 11 hours at a time. The helicopters at first concentrated on search and rescue missions, hoisting victims stranded on roofs in flooded areas of New Orleans to dry ground, but later they carried refugees from shelters within

New Orleans, such as the Superdome and Convention Center, to the New Orleans (Louis Armstrong) International Airport, where there were medical treatment personnel, equipment and supplies, and where air and surface transportation resources were being concentrated for evacuation to designated shelter areas beyond the disaster region.⁹

Besides helicopters, USAF fixed wing aircraft, including C-130s, C-17s, and C-5s, flew crucial airlift missions to transport both people and equipment and supplies. The Eighteenth Air Force's Tanker Airlift Control Center (Air Mobility Command) coordinated airlift flights. Col. Jeff Franklin served as lead controller for Katrina mission taskings. Many of the same aircraft that flew equipment, supplies, and emergency personnel into the disaster area also flew medical patients and displaced persons out.¹⁰

By mid-September, the Air Force had air-evacuated a total of 2,602 medical patients from the Hurricane Katrina disaster area to medical facilities across the United States. The busiest day was September 4, when Air Force transports evacuated some 1,500 patients from the New Orleans International Airport in 24 hours. Many of the medical evacuees flew to San Antonio or Houston, Texas. For example, a C-5 of the 433 Airlift wing shuttled more than 1,200 patients from New Orleans to San Antonio. Two C-130s of the 139th Airlift Wing flew 31 children and their families from the New Orleans Children's Hospital to Mercy Children's Hospital in Kansas City. As early as August 30, a C-17 and a C-130 landed at Keesler to evacuate hospital patients and pregnant women to Lackland Air Force Base's Wilford Hall Medical Center in Texas.¹¹

Not only patients, but those made homeless by Hurricane Katrina, needed airlift from the disaster area. The Air Force airlifted 26,943 displaced persons from New Orleans to temporary or new

Several Air Force Space Command UH-1N Huey helicopters and crews deployed in support of Joint Task Force-Katrina. Crews, as part of the 620th Air Expeditionary Squadron, provided search, recovery and relief for displaced persons.



USAF AIR-CRAFT MOVED 30,412 AIR NATIONAL GUARD PASSENGERS AND 5,414 AIR FORCE RESERVISTS, AND A TOTAL OF 43,713 JOINT TASK FORCE SUPPORT PERSONNEL

homes in more than 35 states across the country. In 55 hours, 89 aircraft moved almost 10,000 refugees from New Orleans to Kelly Field, San Antonio, Texas, where Lackland Air Force Base personnel had set up temporary shelters. C-17s that had delivered emergency personnel and equipment to New Orleans, instead of returning to their home bases empty, carried refugees from New Orleans to Dobbins AFB, Georgia, as well as San Antonio, Texas. Other C-17s of the 97th Air Mobility Wing, after having delivered generators to Keesler, airlifted 437 USAF technical students from Biloxi, Mississippi, to Sheppard AFB, Texas. A total of 1,100 USAF technical students were moved from Keesler to other Air Education and Training Command facilities.¹²

Besides airlifting displaced persons and patients from the disaster area to other parts of the country for housing and medical treatment, the Air Force also transported large numbers of emergency personnel to the New Orleans and surrounding areas, including medical and communications personnel, engineers, and armed troops. USAF aircraft moved 30,412 Air National Guard passengers and 5,414 Air Force Reservists, and a total of 43,713 Joint Task Force support personnel.¹³

Many of the airlifted emergency personnel came to restore infrastructure. As early as August 30, two C-5s from the 60th Air Mobility Wing at Travis AFB, California, delivered tanker airlift control elements and search and rescue teams to the disaster area. A C-17 from the 305 Air Mobility Wing from McGuire AFB, New Jersey, airlifted contingency support groups to New Orleans International Airport. Between August 31 and September 3, other C-17s airlifted emergency

response personnel and equipment from New Jersey and Michigan to New Orleans. C-5 transported the 615th Contingency Response Wing from Travis AFB, California, to Lafayette, Louisiana, as advance team to receive aircraft and cargo. On August 31, the 621st Contingency Response Wing's 818th Contingency Response Group deployed from McGuire AFB to New Orleans International Airport with combat controllers and medical teams to establish bare base operations there. An AFSOC MC-130 took a team of combat controllers and a medical team to New Orleans International Airport on the same day. The 822d Contingency Response Group also deployed there. Meanwhile, the 615th Contingency Response Wing's 571st Contingency Response Group deployed from Travis AFB to Keesler for bare base operations in the Biloxi area of Mississippi. A C-5 moved equipment for fire and rescue personnel to New Orleans International Airport.¹⁴

The 49th Materiel Maintenance Group, the only USAF Base Expeditionary Airfield Resources (BEAR) group, deployed personnel and equipment to New Orleans and Biloxi. On September 4, four C-5s each carried a BEAR Base set and more than 550 personnel from Holloman AFB, New Mexico, to New Orleans International Airport. On September 5, the 4th Air Expeditionary Group under Col. Leonard Coleman bedded down at a tent city there.¹⁵

On September 2, a 60-member contingency aeromedical staging facility team from Lackland AFB deployed to New Orleans, where it set up a 25-bed tent facility manned by 182 medical personnel to care for patients. The 932d Airlift Wing moved medical teams by C-9 to the medical staging area in New Orleans, where 80 doctors, nurses,

An Air Force Reserve Command WC-130 Hercules sits on the runway at Dobbins Air Reserve Base. The Hurricane Hunters from the 53d Weather Reconnaissance Squadron evacuated their home at Keesler Air Force Base, Miss., before Hurricane Katrina slammed the Gulf Coast.



THE AIR FORCE AIR-LIFTED... SOME 11,450 TONS OF EQUIPMENT, SUPPLIES, AND VEHICLES

and medical technicians of the 375th Medical Group served. A mobile aeromedical staging facility from Lackland AFB operated in an airport concourse at New Orleans to treat patients awaiting evacuation.¹⁶

Absence of adequate communications in the wake of Hurricane Katrina required the importation of equipment and expert personnel to operate it. The 139th Airlift Wing flew military communications personnel from Colorado to Gulfport, Mississippi, while the 5th Combat Communications Group deployed resources from Robins AFB to nearby Keesler AFB. At the request of U.S. Senator "Kit" Bond, the 139th Airlift Wing (Missouri ANG) flew members of National Guard Communications Element from Buckley ANG Station in Colorado to Gulfport.¹⁷

On September 2, President Bush, flying aboard a VC-25 from the 89th Airlift Wing, returned to the disaster area he had flown over two days earlier in Air Force One. He landed at Louis Armstrong International Airport in New Orleans, where he met with the Louisiana governor and the mayor of New Orleans about control of the Louisiana National Guard and federal troops already active in the area. The same day he also landed at Keesler to meet with state and local officials in coastal Mississippi.¹⁸

The first week in September exposed a growing breakdown of law and order in New Orleans. Thousands of refugees, lacking adequate food, drink, plumbing, air conditioning, and space, crowded at the Superdome and the convention center, where violence threatened to erupt. Desperate people broke into grocery and drug stores in search of necessities, while others looted clothing and elec-

tronics stores for items to sell or barter. During the first nine days of September, hosts of USAF C-130s and Air National Guard KC-135s airlifted U.S. Army and Army National Guard troops from various parts of the country to New Orleans. Between September 3 and 8, thirty-three C-17 missions airlifted troops of the 82d Airborne Division from Fort Bragg, North Carolina, to New Orleans. C-5s, the largest airplanes in the Air Force, also airlifted division troops to the city.¹⁹

The Air Force airlifted not only emergency personnel into the disaster area, but also some 11,450 tons of equipment, supplies, and vehicles. For example, between September 8 and 11, four C-17s and two C-5s carried large water pumps from Ramstein Air Base in Germany to New Orleans to expel flood waters from the city. Other C-5s imported vehicles and relief cargo from New York and New Jersey to New Orleans and Gulfport between September 5 and 8. On August 31, C-17s from the 97th Air Mobility Wing of Altus AFB, Oklahoma, transported 200-watt generators to Keesler. On September 7, a C-17 delivered more FEMA generators to New Orleans. C-17s delivered engineering equipment and supplies from other USAF bases to Keesler. Food was one of the most important of airlifted emergency supplies. Between September 1 and 9, the 155th and 185th Air Refueling Wings of the Air National Guard delivered 66,000 Meals, Ready to Eat (MREs) from Nebraska to New Orleans, using KC-135 tankers as transports. On September 4, C-5s transported huge quantities of MREs from Norfolk, Virginia, to Gulfport. To Keesler Air Force Base in coastal Mississippi went 182,640 meals ready-to-eat, 243,507 gallons of water, and 92 tons of supplies. On Sept 6, a C-5 airlifted 27,300 British

An R-11 jet fuel truck drives through the flooded streets of New Orleans to its operating location. A fuels team from Barksdale Air Force Base, La., deployed to New Orleans to assist with refueling operations in the city, to include refueling generators and stranded vehicles.



SPECIALIZED AIR FORCE AIRCRAFT PERFORMED OTHER CRUCIAL MISSIONS

MREs from RAF Mildenhall, UK, to Little Rock AFB, Arkansas, the base designated for delivery of foreign relief supplies.²⁰

Insects, breeding profusely in the floodwaters, posed a disease threat to New Orleans and its vicinity. Between September 12 and 20, two C-130s of the 910th Airlift Wing, Ohio, sprayed insecticide over disaster area, staging out of Duke Field, Florida. Flying 44 aerial spray sorties, they treated more than 2.8 million acres, using 13,775 gallons of insecticide. They served under the 153d Air Expeditionary Group.²¹

Specialized Air Force aircraft performed other crucial missions. E-3 AWACS aircraft and crews from 552d Air Control Wing (960 Air Control Squadron) provided air traffic control for more than 1,000 helicopters between September 3 and 19, flying eleven sorties. The 99th Reconnaissance Squadron from Beale AFB, California, flew U-2s over the disaster area for aerial photography and imagery, while the 45th Reconnaissance Squadron from Offutt AFB, Nebraska, flew OC-135s for the same purpose. The Air Force flew 361 intelligence, surveillance, and reconnaissance sorties during the Hurricane Katrina operation. Two 145th Airlift Wing C-130s equipped with the Modular Airborne Fire Fighting System deployed from North Carolina to Pensacola for possible use against fires that had broken out in New Orleans.²²

The Civil Air Patrol (CAP) also responded to the crisis, in league with Defense Department elements. CAP Personnel from seventeen states flew 68 aircraft on hundreds of sorties over southeastern Louisiana and southern Mississippi to survey the damage and help determine the need for rescues and relief. They also used 71 ground vehicles. By September 19, they had surveyed 4,266 houses.²³

Statistics support the quantitative significance of the Air Force (including the Air Force Reserve

and Air National Guard) role in Hurricane Katrina relief operations. USAF helicopters flew 648 sorties, 599 of these on search and rescue missions that rescued 4,322 people. Air Force fixed-wing aircraft flew 4,095 sorties, 3,398 of these on air mobility missions. USAF aircraft evacuated 26,943 displaced persons from New Orleans and surrounding areas to airports and bases outside of the disaster area. The Air Force air-evacuated more than 2,600 medical patients to medical facilities across the country. USAF medical teams at the New Orleans International Airport treated 16,714 patients, including more than 5,500 in two days. The Air Force airlifted 11,450 tons of relief cargo from various parts of the country to the disaster zone. Transports carried thousands of emergency personnel, including engineers, electricians, doctors, nurses, cooks, and troops from all over the country to New Orleans and southern Mississippi. Among the Air Force aircraft involved were 49 C-130s, 31 KC-135s, 25 HH-60s, 16 C-5s, 15 C-17s, 31 KC-135s, 9 UH-1s, and 5 MH-53s, as well as HC-130s, MC-130s, WC-130s, U-2s, and OC-135s.²⁴

The immense contribution of the Air Force in Hurricane Katrina disaster relief represents only a fraction of the total Defense Department effort, which involved elements of the National Guard, the Army, Navy, and the Marine Corps. Although not part of the Defense Department, the Coast Guard also played a major role. The Defense Department flew 12,786 helicopter sorties, rescuing 15,000 and transporting 80,000 in one of the largest mass evacuations in history. From nine regional military bases, the Defense Department distributed huge quantities of equipment and supplies, including more than 30 million meals. The Pentagon's response to Hurricane Katrina was the largest deployment of military forces for a civil support mission in U.S. history. ■

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Book Reviews

A Mighty Fortress: Lead Bomber over Europe. By Charles Alling. Philadelphia: Casemate, 2002 and 2006. Illustrations. Maps. Photographs. Notes. Index. Pp. xiii, 186. \$19.95 Paperback ISBN: 1-932033-59-9

This book is the author's personal account of his service as pilot of an Eighth Air Force B-17 lead bomber based in the European Theater of Operations (ETO) during World War II. The Eighth flew strategic bombing missions deep into enemy territory. To survive enemy fighter attacks the B-17s had to fly in tight formations and use the overlapping coverage of their .50-caliber machineguns to defend the formation. Lead bombers headed these formations and held a command pilot—usually a major or lieutenant colonel—and had radar installed that allowed the B-17 to drop its bombs by radar should the target be obscured by weather or smoke. Only lead bombers had radar installed. The other bombardiers in the formation simply dropped their bombs when the bombardier in the lead bomber dropped his. The Germans knew this and understandably focused their attacks on lead bombers. Despite the added responsibility and danger lead-bomber crews faced, they had to fly more missions before rotating home because of the critical need for their skills. Author Charles Alling commanded the lead bomber *Miss Prudy* while flying with the 34th Bomb Group.

Captain Alling flew 27 combat missions in *Miss Prudy* before the war ended in Europe in May 1945. He earned the Distinguished Flying Cross and the Air Medal with four oak leaf clusters along the way. After the war, Alling went to Yale and excelled in civilian life as he had in the skies over Europe. In 1989, he founded the Alling Institute of Ethics. Today he continues to support air power by serving on the Board of Visitors of the Air University at Maxwell AFB.

Alling has organized the book like a diary with historical recollections written in chronological order beginning with the attack on Pearl Harbor on December 7, 1941, and progressing to the end of World War II. The narrative flows well and is an entertaining and easy read. Each chapter begins with a poem that reflects the emotion of the coming narrative. While of little research value, the book is an excellent book for persons interested in World War II air combat from the individual airman's point of view.

The author provides about 50 photographs of people discussed in the text and of B-17s in action over Europe—most from the 34th Bomb Group. He also appends copies of operations orders for

missions flown by *Miss Prudy*. A map is included to orient the reader to the Eighth Air Force's battleground. Diagrams are used to show the stations of the air crew.

A Mighty Fortress offers the reader an index, which always aids in locating incidents and items quickly. While the book provides no footnoted documentation, it does have an endnotes section that the reader can use for further reading. Unfortunately, the endnotes also reveal that *A Mighty Fortress* offers no new historical information.

This book is meant for readers of military history looking for entertainment and a better understanding of the heart and psychology of the young men who flew B-17s into harm's way during World War II.

David F. Crosby, former USAF history writer and a doctrine developer for the Army Air Defense Artillery School



Almanac of World War I. By David F. Burg and L. Edward Purcell. Lexington: University Press of Kentucky, 1998. Pp. vi 320. Maps. Illustrations. Photographs. Appendices. Bibliography. Index. Pp. xiv, 320. \$22.00 Paperback ISBN 0-8131-9087-8

With all of the books about World War I, one would think that nothing more could be written about this war. Yet, although the war ended almost a century ago in 1918, it still fascinates historians—perhaps more so among Europeans than Americans. For Europeans, World War I is still the "Great War" in which about 8 million soldiers died, 18 million were wounded, and almost 2 million were missing in action. An additional 6.5 million civilians died and much of Europe was devastated for years after the war. Europe still bears the scars of this tremendous war even today after another more devastating war. Given this continuing interest in the Great War, historians, teachers, and fans of the war would appreciate an almanac—a publication that provides useful information and data, often in charts and tables—that encompasses all major facets of this conflict.

Burg and Purcell's almanac is one of many works that have appeared since the late 1990s on this fascinating topic. Burg is a freelance writer and editor with a B.A. and M.A. in English and an M.A. and Ph.D. in American civilization. He has authored or coauthored six other books, including Facts on File's *The American Revolution*. Purcell has written *Who Was Who in the American Revolution* and *The Vice Presidents: A Bibliographical Dictionary*; and the two coauthored the *World*

Almanac of the American Revolution. As a result, both are well acquainted with this type of historical work.

This book provides a chronological chronicle of this great conflict on all fronts. It begins with the pre-war European alliances and then presents a virtually daily account of the major and lesser events of the war to the end of 1918. Although the authors emphasize military and political events, they do give some attention to the effect of the war on civilians. They arrange the chronology by year, theater, campaign, operation, and battle. As a result, the reader gets a basic sketch of the war's events and its milestones. The book also has many photographs and drawings, six maps, and eighteen sidebars on various topics from "Naval Strength" to "The Literature of the War." At the end, there are short biographies of many of the war's important military and civilian leaders and a select bibliography.

Although, this book fulfills its purpose as an almanac, it has some problems. From the daily entries, one gets a sense of the military and political progression (or lack of it) but with a sterility that prevents the reader from truly sensing the overall large-scale death and destruction of the war—a basic problem of most "almanacs" of any conflict. The sidebars are helpful in introducing their topics but are too brief to offer in-depth insights to the issues they address. Additionally, while the book covers the war in the Middle East and Africa, the majority of the entries are about the Western Front. One finds similar emphasis in the biography section—Lawrence of Arabia is there but not Sharif Hussein, Faisal, Sir Henry MacMahon, or other key players in the Arab Revolt, individuals of equal if not greater stature than some who rate a biography. The six maps are insufficient to convey the global nature of this war.

In other words, Burg and Purcell may have intended this to be a fairly comprehensive almanac of the "Great War," but it falls short of that goal. It is essentially only a basic overview of the war's military aspects with some entries of its political aspect. As a result, this book is mainly for the general reader.

Dr. Robert B. Kane, Assistant Historian, Air Armament Center, Eglin AFB, Florida



Boys' Books, Boys' Dreams and the Mystique of Flight. By Fred Erisman. Fort Worth: TCU Press, 2006. Photographs. Notes. Bibliography. Index. Pp. xx, 346. \$29.95 ISBN: 0-87565-330-8

I've been an aviation historian for

twenty years and, while there are a number of books I have truly enjoyed, there have been only a handful that I wish I had written—Joseph Corn's *Winged Gospel* and Robert Wohl's *A Passion for Wings*, are examples. I just added *Boys' Books, Boys' Dreams* to the list. Authors often specialize in the technical details of aviation and/or aerial warfare. And that's fine. But my interests are in how aviation changed our perception of the world around us, the way we think, the way we live, the things to which we most aspire. Fred Erisman's book details the influence of books on three generations of boys, from the earliest days of flight to the rocket age.

I have books from more than a dozen of the series discussed by the author, and I love the pseudonyms and heroes invented by some of the series writers (Roy Rockwood's (pseudonym) Dave Dashaway is my favorite). Sure, many of the early stories were formulaic, but you knew who the good guys were and that, somehow, despite all odds, they would triumph. Aviation was new when the first books appeared, and the authors often discussed recent advances in the technology or newly set speed and distance records. Series were often described as "thrilling and scientifically correct" or "absolutely modern."

World War I, with larger-than-life-size heroes, helped establish the cult of the aviator and celebrity. The "ace," a pilot who shot down five or more enemy aircraft, became the modern gunslinger in the tradition of America's Old West. Even the "Red Baron," Manfred von Richthofen, who shot down 80 Allied aircraft, became an iconic figure, remaining so even today as he lives on in the *Peanuts* comic strip and as brand name for a pizza.

When Charles Lindbergh, an All-American boy, became the first to fly the Atlantic solo (in 1927), he inspired the interwar generation to become "air-minded." Commercial airlines found a place in the Boys' Books as the first airlines took hold; and aviators, in general, established an intimate culture, a "world of spruce, fabric, lighted cabins, and friendly men." During the interwar years, speed and endurance records fell regularly. This was the era of the great speed races and great adventure, all celebrated in books for young readers.

World War II brought significant change: the rise of aircraft carriers, development of long-range bomber and fighter aircraft, the atomic bomb, and rockets. Tried-and-true formulas, especially the staple good guys versus bad guys; the importance of friends and teamwork; and the virtues of perseverance, loyalty, and doing right carried through from the ear-

liest days. And as before, the Boys' Books discussed new technologies and aviation advances. While many authors are content to discuss aviation through the end of World War II, I was especially gratified to see how Erisman takes the story farther. First he introduces two of my favorite authors, Isaac Asimov and Robert Heinlein, as Boys' Book authors, and then describes how some Boys' Books series became some of the first television series of the early 1950s.

Though there is much material Erisman necessarily had to leave out, I found this a most enjoyable read. I felt as if I was having a conversation with a friend. Erisman shows how aviation moved from novelty to part of everyday life and draws a larger lesson—that the advances of the atomic and space age will likely create "a world of staggering complexity, far removed from that of 'The Airship Boys' and 'The Boy Aviators'."

Bruce Ashcroft, Ph. D., Air Education and Training Command History Office



Lost Black Cats: Story of Two Captured Chinese U-2 Pilots. By H. Mike Hua. Bloomington, Ind.: Author House, 2005. Photographs. Pp. x, 208. \$14.95 Paperback ISBN: 1-4184-9917-X

H. Mike Hua is a retired Republic of China (ROC or Taiwan) Air Force general and pilot. In *Lost Black Cats* he tells the story of two ROC Air Force U-2 pilots shot down over mainland China during the Cold War who did not return home until 1990. Hua was one of the Taiwanese U-2 pilots and had been a roommate of one of the downed airmen.

In the early 1960s, a joint United States and ROC squadron of high-altitude Lockheed U-2 reconnaissance aircraft, called the "Black Cat Squadron," was established on Taiwan. Overflights of the People's Republic of China (PRC) by Taiwanese pilots began in 1962 and continued until 1974. These flights targeted nuclear, missile, and other military facilities. During this period the ROC Air Force conducted over 100 overflights, losing five U-2s in the operation. Three U-2 pilots were killed and two captured: Yeh Changti in 1963 and Chang Liyi in 1965. This compares with the CIA-sponsored U-2 flights over the Soviet Union starting in 1956 that culminated with Gary Powers' shoot-down and capture in May 1960.

The book focuses on Yeh Changti, the author's former roommate, who survived 19 years in the PRC until released with Chang Liyi in 1982. During his incarceration in

mainland China, Yeh endured solitary confinement, interrogation, "re-education" at a communal farm, and work as a teacher. *Lost Black Cats* describes life in the PRC during the turbulent period of the Cultural Revolution, the opening of the PRC to the West following President Nixon's visit in 1972, and the death of Chairman Mao in 1976. The reader learns about the lives of ordinary Chinese Yeh encounters, from illiterate peasants to Communist functionaries. While incarcerated in mainland China, Yeh's wife in Taiwan remarried and his family remained uncertain of his fate. In 1982 he and Chang were allowed to relocate to Hong Kong, eventually immigrating to the United States. It was not until 1990, with support from former ROC Air Force pilots and the CIA, that both returned to Taiwan to be reunited with their families and received belated recognition from the ROC Air Force.

Occasional grammatical problems, a few minor errors, and the lack of an index and bibliography detract from an otherwise engaging story. *Lost Black Cats* is a simple but moving account of courage and perseverance. Besides describing an intriguing aspect of U-2 operations during the Cold War, the book provides the reader with valuable insight into Chinese culture and the rivalry between mainland China and Taiwan.

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



The Joint Chiefs of Staff and the First Indochina War, 1947-1959. By the Office of Joint History, JCS. Washington, D.C.: Office of Joint History, 2004. Maps. Photographs. Notes. Appendices. Glossary. Index. Pp. xi, 285. ISBN: 0-16-072430-9

That the JCS has its own history office and publication program (as do the four service components of that staff) is an indication that, after 63 years, it is here to stay! This may not have seemed certain when it was established on January 23, 1942. It was an expedient at that time to match the British Chiefs of Staff Committee and to form the Combined Chiefs of Staff. Up to that time, the Joint Board (JB, aka Joint Army and Navy Board) had seemed to serve our purposes, though it hadn't been called on to do much in the First World War, despite the fact we were an associate power with inter-service and international concerns. The JB had been formed in 1903 as one of the reforms after the Spanish-American War (with the Navy's General Board and the Army's General Staff and War College).

That war had shown a need for improved coordination among the three services of that time.

Joint operations started early in U.S. history, though the War of 1812 was the first significant conflict of that type. Operations on the Great Lakes showed that better results might have been achieved there with improved cooperation between the Army and Navy. Narrow parochial service interests were a big part of this, but there were also personality clashes. The Mexican War was the opposite. Maj. Gen. Winfield Scott and Commodore Connor at Vera Cruz shared interests and had a friendly rapport. The Civil War had a variety of inter-service campaigns with an equal assortment of success and failure; personalities again played a role. Even though those in command during the Spanish-American War had served in that earlier conflict and should have learned something, the Cuban Expeditionary Force represented the nadir of our joint operations. One good thing that came out of that war was a degree of cross-fertilization by attending and teaching at each other's war college (actually, this had started in 1885 when future Chief of Staff Tasker Bliss started a three-year tour as Instructor at the Naval War College).

By 1947, when this book begins, the JCS had proven itself in World War II. Along with the National Security Council (NSC, which was to play a dominant role in the events that were to unfold in Vietnam and elsewhere), it had been authorized by Congress as part of the post-war establishment. This national defense structure was about to be tested in a very different environment. It is amazing that so little attention has been given to Indochina when one considers the reams of paper spent on our later involvement there from 1964 to 1973. It is true that there was competition for attention during the period covered—the hot war in Korea and the build-up for the Cold War with NATO. We started in Indochina with mixed feelings and policies. FDR had been strongly opposed to restoring French colonial rule there. There was a fatigue and distaste for dealing with Asiatic matters. Our mantra had long been to avoid ground operations on the mainland there—not changed by our participation in the Boxer Rebellion, Siberian Expeditionary Force, or Merrill's Marauders/Mars Task Force. Our initial preference for non-involvement gradually eroded, however, as we began to see events there as part of the global struggle against communism. The book gives a lucid account of the step-by-step movement to where we essentially replaced

France as the major power in the area. We provided an immense amount of military aid before that but could not buy our way out of assuming responsibility.

The book starts with an excellent summary of events in Indochina before 1947. The appendices summarize the Aid Program, several important NSC Directives, and the Geneva Declaration. An innovation is the list of principal officers, but this is connected to one disappointment. This is an official history, yet there is virtually nothing about the interplay among the Joint Chiefs. Many aren't even mentioned in the text. Though familiar names disappeared with the passage of time after World War II, these were all powerful men with strong convictions (their own and/or their service's). Their debates must have been exciting, but we're presented with only the conclusions. The one map (repeated front and back covers) is adequate for this level of explanation. The notes indicate a thorough search of American sources but are largely limited to those.

This is an important contribution to the neglected subject and is highly recommended.

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



Fire From the Sky: Seawolf Gunships in the Mekong Delta. By Richard Knott. Annapolis, Md.: Naval Institute Press, 2005. Maps. Photographs. Notes. Glossary. Bibliography. Index. Pp. xx, 260. \$29.95 ISBN 1-59114-447-7

Richard Knott is eminently qualified to write the history of the "Seawolves," Helicopter Attack Squadron (Light) 3 (HAL-3), the U.S. Navy's first and only helicopter gunship squadron of the Vietnam War. A thirty-year Navy veteran, he flew several thousand hours in a variety of aircraft and is the author of other aviation books. He compiled the story of the Navy's most decorated squadron from historical documents and recollections of more than sixty Seawolf veterans.

Following an exciting introduction, Knott skips to a detailed description of the Mekong Delta and "Charlie," the Viet Cong enemy. In the first two chapters the reader learns about the intense sea-air patrols along the South Vietnamese coastline using destroyers, destroyer escorts, minesweepers, gunboats, Coast Guard cutters, SEAL teams, and new fast patrol boats (swift boats). Aircraft included the carrier-based A-1 Skyraiders and P-3 Orions.

In December 1965, the Navy estab-

lished Task Force 116. Although the river boats were heavily armed, Charlie also boasted heavy weaponry. This eventually brought helicopter gunships (Bell UH-1Bs) into play. They were flown by Navy and Army pilots from landing ship docks (LSD's) based on the waterways. As action heated up in the spring of 1966, the Navy took over full control of the operation. Gen. William Westmoreland provided his battle-scarred Hueys and the Navy supplied the crews. While those personnel in Vietnam received on-the-job training from the Army, the Navy formed a helicopter combat support squadron (HC-1) at Ream Field in Imperial Beach, California. Training was quick and furious and by August 1966 Navy crews arrived in country to begin their operations with Army crews.

The various detachments were kept busy not only patrolling the rivers and surrounding river banks but also flying troop insertions. In 1965 and 1966 the patrols had done a great job of interrupting the enemy's seaborne supply lines. Charlie was forced to change his supply routes, eventually moving to areas in which our forces were not allowed. Knott offers outstanding descriptions of both air and boat attacks that wreaked havoc on the enemy.

As operations expanded, the Navy's new volunteers (which they had no problem obtaining) first went to the Bell Helicopter factory in Texas. Basic pilot training was finally taken over by the Army at Ft. Benning. That was followed by survival school in California and small arms and self-defense training with the Marines at Camp Pendleton. While the attack detachments were in heavy fighting, action was going on in Washington to establish a full-fledged gunship squadron. HAL-3 officially stood up on April 1, 1967.

As the years went by, helicopters, armament, and other systems were upgraded. Air crews of HAL-3 were getting into some extremely dangerous situations along with the swift boat crews and SEAL teams. But U.S. participation in the war, including in the Delta, started to wind down; and HAL-3 was officially deactivated on March 16, 1972.

Knott's book recounts the story of the Seawolves from the dawn of an era until the last commander turned off the lights. His research was extensive, and the result is a comprehensive history that gives names, detachment numbers by action involved, crew members, types of weapons, and much, much more. This is exciting history and an excellent read!

Stu Tobias, Indianapolis, Indiana



The Smell of Kerosene: A Test Pilot's Odyssey. By Donald Mallick with Peter Merlin. Washington D. C.: NASA History Office, 2004 [NASA SP 4108]. Photographs. Notes. Glossary. Appendices. Index. Pp xi, 252. \$22. 00 ISBN-030-000-01270-5

What does one have to show for a 30-year career as a NASA test pilot during the "golden age" of NASA's Dryden Flight Research Center? Answer: an aviation biography that reads like a fantasy list of incredibly varied aircraft test flown from the late 1950s through the late 1980s. This book chronicles the career of Donald Mallick, a military aviator turned civilian test pilot, who was there in the waning days of NACA and the early years of its successor, NASA. Trained in the early 1950's reciprocating-engine Naval aviation, Mallick then flew some of the Navy's earliest carrier-based jet attack/fighter aircraft. All of that would be a sufficient story upon which to predicate a fine book, yet it was just the beginning of this pilot's storied career.

A key value of this well written work is its acknowledgment of the human element of test flying: the emotions, loss of friends, test victories, and moments of high adrenaline to name only a few. From humble western Pennsylvania roots, Mallick went flew some of this nation's most advanced platforms such as the Apollo program's lunar-lander simulator, YF-12A, and XB-70. However, his NACA career began at the Langley Research Center flying a venerable stable of fixed wing aircraft such as the C-47 and F2H-1 and quickly moving to extensive rotary wing time in several Sikorsky models such as the HO3S-1 and HRS-1.

With his transfer to the Dryden Research Flight Center in 1963, Mallick ended his rotary wing test days and moved on to test a diverse number of fixed wing aircraft from the B-52/57/58 bombers, to the F-100/104/106/15 fighters to name yet a few more of the 125 aircraft in his logbook. However, it was his participation in the nation's high speed/altitude test programs in the YF-12A and XB-70 which provided the book's most compelling chapters.

As a career fighter pilot interested in the mechanics of high altitude flight, I was not disappointed by the engaging writing style. Not overpopulated with technical test pilot jargon nor loaded with excessive aviation factoids, Mallick and his NASA archivist partner, Peter Merlin, successfully bring to life the thrill of flight at the edges of both human and aircraft performance envelopes. They deftly transport those sagas from the cockpit to the

written page. What aviation aficionado has not wondered what it was like to fire up the YF-12A/SR-71 for the first time and feel the raw power of the two Pratt & Whitney J58s as they ripped the sky apart? Mallick vividly recalls the sensations, feelings, and perceptions as he rode one of, if not the, hottest aircraft in aviation history.

Equally interesting to anyone who appreciates the Edwards and Dryden test environments during the 1960s and 1970s will be Mallick's accounts of flying the beautiful and complex XB-70. His mission narratives combined with his insight into the 1966 aerial collision between an XB-70 and an F-104 (an accident that ultimately doomed the XB-70 program), was the most gripping portion of the book. His first-hand behind-the-scenes description of the mishap, aircrews involved, and his take on likely causes is the sort of detail that professional pilots crave but seldom find.

Those interested in that golden time in test aviation when everything was about bigger, faster, higher, and more challenging should read this wonderfully written book. The smell of kerosene—an unforgettable flightline smell that spells home.

Lt. Col. Vincent Alcazar, Commander 479 Operations Support Squadron, Moody AFB, Georgia



Reflections of a Technocrat: Managing Defense, Air, and Space Programs during the Cold War. By John L. McLucas, with Kenneth J. Alnwick and Lawrence R. Benson. Maxwell AFB, Ala.: Air University Press, 2006. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. xxvi. 367. Paperback

In his autobiography, *Reflections of a Technocrat*, John McLucas effectively carries the reader through a network of interlocking events and institutions that framed his multifaceted career in academia, industry, and government during the height of the Cold War. Born in rural South Carolina in 1920, McLucas demonstrated an early interest in science and technology, studying physics and engineering at Davidson College and Tulane University before serving in the Navy during World War II. His wartime experience working on radar technologies set the stage for a productive career in industry, first at a small start-up firm—HRB (Haller, Raymond, and Brown)—in central Pennsylvania and later at the MITRE Corporation near Boston and COMSAT

General Corporation in Washington, D.C. It was also through his industrial experience that McLucas gained entrance into the Department of Defense (DoD), serving in several high-level positions, most prominently Undersecretary and Secretary of the Air Force in the 1960s and 1970s.

Among the myriad subjects and events that McLucas examines in the book, perhaps the most interesting is his discussion of the founding and growth of HRB. The firm had been established by two physics professors (George Haller and Dick Raymond) and one of their graduate students (Walter Brown) at nearby Pennsylvania State College in 1946. All three men had acquired extensive electronics expertise in the Army during World War II. McLucas joined HRB in 1948, less than a year after he arrived at Penn State to pursue a Ph.D. in physics. At that time, HRB designed and built electronic countermeasures equipment for the Air Force and later moved into the development of aerial reconnaissance technologies. In absorbing detail, McLucas shows how HRB grew into a successful business while also recruiting top-notch researchers, including William Perry, another Penn State Ph.D. who later founded his own successful electronics company in California and later served as Secretary of Defense in the mid-1990s.

Historians of science and technology will find McLucas's discussion of HRB refreshing, especially given that much of the post-World War II history of the electronics industry in the United States has focused overwhelmingly on either the big East Coast electronics firms (e.g., Westinghouse, RCA, and IBM) or California's Silicon Valley and the entrepreneurial culture that thrived there. McLucas's discussion of firms—HRB (and also COMSAT General, where he served as president in the 1980s)—outside this explanatory framework highlights the extent to which more historical research is needed to flesh out even further the interrelated historical patterns of institutional growth, regional economic development, and technological diversification that defined the commercial and military electronics industries during the Cold War.

Through the contacts he developed at HRB, McLucas left industry for a career in government in 1962, first as head of Tactical Warfare Programs in the Office of the Director of Defense Research and Engineering and finally as Secretary of the Air Force a decade later. McLucas covers this period through a detailed discussion of his involvement in the management and development of key weapons

programs, such as the F-111 fighter-bomber, C-5A transport aircraft, and the F-15 tactical fighter. He also reflects at some length on the key personalities present when he worked in the Pentagon and the strategies they used to run the Defense Department. Robert McNamara's predilection for centralized administrative control of DoD activities in the Office of the Secretary of the Defense contrasted sharply with the decentralized management structure implemented later in the decade by Melvin Laird and his deputy, David Packard. McLucas himself favored decentralization and applauds Laird and Packard for their efforts to streamline the weapons acquisition process.

In 1969, while serving as Undersecretary of the Air Force, McLucas also directed the National Reconnaissance Office, thereby maintaining his long-standing interest in aerial reconnaissance that had begun at HRB two decades earlier. Significantly, as NRO director, McLucas presided over the shift from film-based satellite reconnaissance—embodied in such pioneering programs as CORONA—to its real-time equivalent. Although he does not discuss specific programs and the technologies behind them because of their classified status, McLucas does provide an interesting look at the inner workings of the NRO organization during what he calls its "golden age." He left the NRO to become Secretary of the Air Force in 1973.

Other themes discussed in the book's later chapters include McLucas's service as head of the Federal Aviation Administration after leaving the Pentagon and his abiding interest in space exploration and international cooperation in the field. Although many of his space-related efforts largely proved abortive, McLucas nevertheless remained committed to the scientific and commercial exploitation of space through his involvement and membership in various business ventures, conferences, foundations, and educational institutions. Representative examples discussed at length include the Arthur C. Clarke Foundation, the International Space University, and the Mission to Planet Earth program sponsored by the National Aeronautics and Space Administration.

McLucas began writing his autobiography in the late 1990s, just a few years before he died. In addition to recalling personal memories of key events, individuals, and organizations, McLucas also relied on documentary sources. To help him sort through and organize the papers, books, and other materials he had collected over the years, McLucas collaborated with Kenneth J. Alnwick, a retired Air Force pilot and defense analyst, and

Lawrence R. Benson, a retired Air Force historian. Together, Alnwick and Benson helped McLucas draft and edit the chapters, and they also completed the remaining sections of the book left unfinished at the time of his death in December 2002. The book also includes a foreword by former Secretary of Defense Melvin Laird.

Thomas C. Lassman, U.S. Army Center of Military History, Fort Lesley J. McNair, Washington, D.C.



The Iraq War: A Military History. By Williamson Murray and Robert H. Scales, Jr. Cambridge, Mass.: The Belknap Press of Harvard University Press, 2003. Maps. Tables. Photographs. Notes. Appendices. Bibliography. Index. Pp. 312. \$24.95 ISBN: 0-674-01280-1

Written by two military historians, *The Iraq War: A Military History*, is one of several books published since 2003 focusing on the military aspects of Operation Iraqi Freedom, the American-led invasion of Iraq. After an overview of Iraq's history and the rise of Saddam Hussein, Murray and Scales examine the Gulf War (Operation Desert Storm in 1991) and the events leading up to the invasion of Iraq in March 2003.

To set the stage for the military campaign, the authors examine how America's armed forces evolved during the 30 years after the end of the Vietnam War, describing the proliferation of precision guided weapons and the growing importance of special forces. Of particular interest is how General Franks and his staff planned the 2003 Iraqi campaign taking into account lessons learned from Desert Storm and the operations in Afghanistan in 2001. One noticeable difference was the decision to begin the air and ground campaigns simultaneously, unlike in 1991 when the air campaign began a month earlier. The authors are particularly good at describing the organization and capabilities of the coalition ground forces (both American and British) as compared to the Iraqi forces.

Both the ground and air campaigns during March and April 2003 are presented in some detail, with the role of the British in southern Iraq and special forces in the north and west included with the US Army and Marine drive north from Kuwait. Ending with the capture of Baghdad and fall of Saddam Hussein, the authors then consider some of the military lessons learned from the invasion. An appendix with details on air, ground, and sea weapons is included. The book is well

illustrated with color photographs and maps.

Unfortunately, since the book was written in 2003, there is little insight into the Iraqi military experience and no description of the ongoing Coalition and Iraqi fight against the Sunni insurgency. Also, there are several minor errors, including misspelling the name of General Richard Myers, the Chairman of the Joint Chiefs of Staff.

The Iraq War: A Military History is recommended for readers interested in a straightforward military examination of the 2003 invasion. A complete history of the war, unfortunately, will have to wait until the final "end state" of America's involvement in Iraq is known.

Reviewed by Major Jeffrey P. Joyce, USAF (Ret.)



Isaiah's Eagles Rising: A Generation of Airmen: By Bernard Thomas Nolan. Alexandria, Va.: Bernard T. Nolan, 2002. Photographs. Diagrams. Charts. Appendices. Pp. 268. \$27.00 ISBN 1-4010-5309-2

They came in waves from factories, farms, and city streets—some driven by patriotism, but most with a dream in the aftermath of Pearl Harbor. Bernard Nolan was one of these young men and one of the nearly 200,000 U.S. pilots who earned wings during World War II. He relates his journey as a boy with a strong passion for flying airplanes, a poorly educated youngster from a fractured, almost dysfunctional home environment who finessed his way into the Army's Aviation Cadet Program in 1942. Beginning with his early life and its troubling challenges, Nolan has framed his experiences along the way with the vivid backdrop of history surrounding the fierce combat air battles of the U.S. Eighth Air Force over Nazi occupied Europe during the stressful years of 1943 and 1944. Assigned to the 487th Bomb Group (H) at Lavenham, England, Nolan successfully completed 33 combat missions in the B-24 and, later, the B-17.

His very articulate accounts explore the battle of attrition with the *Luftwaffe* in 1943 and continue as the tide was turned into triumph during the spring of 1944. In his mission accounts, he relates with gut-wrenching realism little known details of flying combat in those times. He concisely discusses the ever changing tactics of both sides; the prospects of a bomber crew surviving a full combat tour; the trauma of being shot down; and performance comparisons of the B-24 Libe-

rator and B-17 Flying Fortress.

Nolan vividly recalls his aviation cadet flying experiences—experiences many of us in pilot training encountered: airplanes we flew, instructors encountered along the way, “wash out fears,” and aspirations we had in hopefully getting to fly the combat planes of our dreams upon graduation. Nolan’s narrative about his operational days is excellent and well reviews the Eighth’s early combat trials and those of its bomb groups from the initial Combined Bomber Offensive plan set at the Casablanca conference (the USAAF’s case for precision daylight bombing), the tragic results of the 1943 Schweinfurt ball bearing industry and Regensburg enemy aircraft plant raids, and finally the “Big Week” mission efforts in February 1944 leading to the gaining of Allied air supremacy over the European skies and battlefields on the eve of D-Day, June 6, 1944.

Nolan went on to complete an Air Force career of 22 years before retiring in December 1965. He then joined NASA in program management assignments for 15 years before again retiring and becoming an independent consultant to NASA.

This book is extremely well written, easy to read, and very well articulated. Nolan’s historical research references and footnotes are scholarly throughout, factual and well documented. As an Eighth Air Force B-24 aircraft commander who flew 30 combat missions with the 392nd Bomb Group in England, I found this book extraordinarily interesting and memory-laden. It is one which I feel most every Eighth Air Force aircrew member would enjoy. His experiences in many instances paralleled my own, some very poignant to remember in those stressful times of our young lives during air combat with *The Mighty Eighth*. Without any qualifications whatsoever, this book is a must-read for every Eighth veteran and certainly for any air war historian regardless of age or era.

Col. Robert E. Vickers, USAF (Ret.), Director Emeritus, the Eighth Air Force Historical Society.



The Effectiveness of Airpower in the 20th Century: Part Three (1945-2000). By John F. O’Connell. New York: iUniverse, 2006. Tables. Notes. Bibliography. Index. Pp. xi, 193. \$16.95 Paperback. ISBN: 0-595-40353-0

As indicated by the subtitle, this is the third of a three-volume work that will cover air power in its first century of use. The series was written as a single volume,

but publishers felt it was too large. So, O’Connell broke it into three parts and decided to publish the most current section first. If this part is any indication of what is coming in the first two parts, I can’t wait until they are published. This is good history and marvelous analysis.

Although O’Connell was primarily a submariner during his long career, he shows a deep understanding of not only military tactics and strategy but also for national strategic goals. What most impressed me was the writing style. It is crisp and doesn’t contain a lot of extraneous information. He packs in a lot of history, backs it up with copious notes, provides analysis, and moves on. In this volume, he takes six major military efforts in which air power played a role during the last half of the 20th century and gives about as concise an overview of the war or campaign as I have read. Interwoven in this is an emphasis on air power operations and their effectiveness—some excellent, some not so good—on the overall objectives of the war. Many books have grandiose goals buried within their titles or subtitles: O’Connell hits his title’s avowed purpose right on target.

The chapters cover the Korean War, Second Vietnam War (as opposed to the French effort against the Viet Minh), and the USSR’s war in Afghanistan, Malvinas/Falklands, Gulf War I, and Kosovo. Each of these chapters is then broken down into distinct periods. For example, the Vietnam chapter’s sections cover Rolling Thunder, the change in administrations (and strategies), Linebacker I, and Linebacker II.

O’Connell’s analyses will undoubtedly not sit well with many air power advocates. Those looking for vindication of Mitchell’s or Douhet’s predictions that air power is the be-all and end-all of military operations are going to be sorely disappointed. In Vietnam, for example, Rolling Thunder resulted in more bomb tonnage being dropped than in all of World War II, yet airpower failed to stop the flow of supplies to the South. It did not do so in Korea either. Therefore, since the goal was to seriously hinder military operations in the South, air power was not totally effective. However, with the change in goals in 1972 to end American involvement in the war, airpower in the form of Linebacker II was highly effective. A short campaign drove the North back to the negotiations, and accords followed shortly thereafter. Only in Kosovo did air power by itself bring about a successful conclusion to national strategic desires. Air power is a tremendous tool that is an integral part of joint and combined operations. It has and will continue to have different degrees of applicability and effectiveness depending on many, many factors.

O’Connell well shows this.

My only complaint with O’Connell’s efforts is the lack of maps. One map for each of the chapters with the place names mentioned would have been a great help.

In summary, for those looking for a book with lots of rip-roaring dogfights and tales of bombing raids and the like, this isn’t it. I look at this book, and the two to come, as an order of magnitude above that. Plenty of books have explored the effectiveness of air power elements in detail in various scenarios. But for anyone wanting an excellent big-picture look at some of the combats of the last fifty years and how air power played in them, this is a book to read.

Col. Scott A. Willey, USAF (Ret.), NASM Docent and Volunteer



The Fallacies of Cold War Deterrence and a New Direction. By Keith B. Payne. Lexington: The University Press of Kentucky, 2001. Bibliography. Index. Pp. xiv, 225. \$19.95 Paperback ISBN: 0-8131-9015-0

In this easy-to-read book, Payne asserts that U.S. policies have too often been shaped by the expectation that challengers would act reasonably and predictably, rather than by the available evidence on these challengers’ particular beliefs and filters. In other words, “leaders can hold to distorted, self-serving interpretations of reality, rely on dubious sources of information, be motivated by extreme emotions and goals, and esteem some values more highly than their own lives and positions.”

With respect to nuclear deterrence, ill-founded U.S. expectations, based on mirror-imaging assumption, could have catastrophic consequences. For example, Payne notes that during the Cold War the Soviet Union did not share the United States’ definition of rationality, deriving its expectations of U.S. behavior on Marxist-Leninist ideology instead. Luckily, no nuclear exchanges between the then two superpowers occurred. Payne argues that deterrence is essentially a psychological process. As such, how challengers would react to future U.S. deterrence policies is not likely to be based on force capability comparisons or well-informed and unbiased cost-benefit calculations, but rather on the beliefs and thought filters that define their thinking. This would be particularly true in crisis situations when “decisions tend to be based on fairly simplified cognitive structures, which tend to reduce the range of options perceived by the leaders involved.”

Rather than the deductive logic heretofore used in the formulation and assessment of deterrence policies, Payne proposes an inductive approach based on the analysis of key factors divided into six analytical steps (each with detailed subdivisions): (1) identify antagonists, issues, objectives, and actions; (2) identify and describe those factors likely to affect the adversary's decision-making in the context of this specific flashpoint and U.S. deterrent threats; (3) construct a strategic profile of the adversary with regard to the crisis in question; (4) assess whether the challenger is likely to be susceptible to deterrence policies in this particular case, and, if so, the nature of those policies; (5) identify available U.S. deterrence policy options; and (6) identify the gap between the likely requirements for deterrence and available U.S. deterrence policy options. Describe different, new, or additional military capabilities and policies that may be needed.

Payne tests his deterrence framework through the analysis of a potential U.S.-Chinese crisis over Taiwan. He shows that China would not necessarily act rationally in terms expected and understood by Washington, but rather in accordance with its particular beliefs and thought filters. To wit, "China appears to view Washington as vulnerable to Chinese deterrent threats with regard to Taiwan, based on the perceptions that the stakes involved are inherently lower for Washington." Therefore, Payne draws four lessons: (1) the U.S. must deter China's deterrent; (2) U.S. regional deterrence policies must reduce risks; (3) an empirical framework has more value than one based on mirror-imaging; and (4) prepare for the failure of deterrence because it is inherently unreliable. Indeed, as Payne concedes, a better understanding of an opponent's behavior may not necessarily lead to successful U.S. deterrence policies, but it can perhaps improve them.

Written before 9/11, this book proposes a useful framework that would merit being used in current debates on whether terrorist organizations can be deterred or not. Payne's argument is solid and should assure his book a lengthy shelf life. I recommend it to those interested in the problem of deterrence and intelligence analysis.

Mr. Stéphane Lefebvre is Section Head, Strategic Analysis, at the Centre for Operational Research and Analysis (CORA), Defence Research and Development Corporation (DRDC) Canada. The opinions expressed are his own and do not reflect the official position of the Government of Canada or any of its agencies.

Les Français du Ciel: dictionnaire historique. Edited by General Lucien Robineau. Paris: *la cherche midi* for the Académie Nationale de l'Air et de l'Espace, 2005. Photographs. Tables. Pp. 783. 35 Paperback ISBN: 2-74910-415-1 and **French Arms.** By Ronald L. Tarnstrom. Lindsborg Kans.: Trogen Books, 2001. Illustrations. Index. Pp. 850 ISBN: 0-922037-16-7.

These two books provide researchers and authors in French aviation history with the precise details that writers want and editors demand. However, they are very different in conception, structure, and contents. Further, Robineau's book is written in French and, thus, will not be of interest unless one is fluent in that language.

Tarnstrom's fifteenth volume in his Armed Forces Handbooks series includes the French-speaking peoples of Belgium and Luxembourg as well. The very brief history of the *Armée de l'Air* is set into the military history of France.

Robineau's contribution is much more concise in scope, but much more useful for French aviation history. Two important acronym lists are included. The first deals with schools and special institutions, while the second covers abbreviations with the dates when they came into being. In the work as a whole, 512 pages are devoted to over 2000 civil and military biographical sketches from the early aviation pioneers to participants in the present space program. The remainder of the book is devoted largely to thematic topics such as the evolution of the Air Ministry, military aviation with names and dates, Chiefs of Staff of both the *Armée de l'Air* and of the Defence Staff, and the like, together with the history of the air schools, air industry, and special organizations.

Compiling an encyclopedia or an historical dictionary is a daunting task, no matter how many collaborators cooperate. A long list of subjects has to be weeded, and in this case there is the burden of a lack of historical literature in the field. General Robineau has had the advantage of a career as a fighter pilot, from P-47s to Mirages, and then a tour as Chief of the *Service historique de l'Armée de l'Air*, and now as head of the historical section of the Académie Nationale de l'Air et de l'Espace. He has brought professional knowledge in two disciplines to this near definitive work.

Robin Higham, Editor Emeritus, Aerospace Historian, Kansas State University

OSS: The Secret History of America's First Central Intelligence Agency. By Richard Harris Smith. Guilford CT: The Lyons Press, 2005 [copyright 1972]. Photographs. Notes. Bibliography. Index. Pp. xxx, 413. \$16.95 Paperback ISBN: 1-59228-729-8

My only direct contact with the OSS was during a recon mission in Southern France to one of their teams which was supporting the Free French. I did, however, spend considerable time in intelligence and intelligence gathering, so I had high hopes of learning more about the Office of Strategic Services. I wonder what today's demand is for a reprint of a 30-year-old book, though the intelligence community has been in the public eye recently.

I'm not in a position to comment on the accuracy of the contents (though I found a few errors in areas where I have some familiarity), but I found it entertaining. I always enjoy a good historical novel and don't worry about exactness. The author makes the point that this is a realm of deception and subterfuge. His book is a collection of "war stories" but not a cohesive account of OSS operations and how they fitted into the larger picture; it's a series of disconnected vignettes. There is an unnecessary amount about that picture not pertinent to OSS which seems to fit the political orientation of the author rather than history. He has a liking for the ideological crusades that agents became involved in that had little to do with their assigned missions and were, in some instances, counter-productive. In his updated preface, Smith makes comments about very current intelligence issues which he attempts to relate to the OSS—with a certain amount of editorializing.

Repeated mention is made of such things as "operations in the Balkans" without elaboration of the nature or purpose. The obvious purpose of defeat of the Axis seems overshadowed and entangled with tales of political rivalries. Smith seems unaware of the preeminent principle of war of the "objective." He organized the book basically by geographical area/theater of operation. But these did not exist in a vacuum, and there is little effort to show the relationships among them. Each chapter is a history of its own, and the World starts over again. A chronology with parallel columns would have clarified the connections.

There is a problem with the dual (and often conflicting) missions of the OSS and CIA: intelligence gathering and covert operations. That dichotomy is not well covered. As today's CIA is only one in the network of intelligence agencies, in World

War II OSS was also not alone in that field. In particular, there could have been more about relations with Army G-2 and the Office of Naval Intelligence. Maj. Gen. "Wild Bill" Donovan tapped a wide range of talent from capitalists to communists. There was a mystique about the Abraham Lincoln Brigade, an outfit which had many idealists but also more than their share of adventurers and social misfits. Contrary to popular opinion, they weren't trained in guerrilla warfare or intelligence gathering, though they had some tough fighters. Donovan fitted such disparate parts into an effective whole though there were inevitable cases of disharmony. Trouble with other agencies (e.g., FBI, State Department, US military services, and the British Special Operations Executive and MI-6) was a problem, although there was begrudging recognition on most sides that the others served some purpose.

The book ends with a chapter on the OSS and CIA. Smith suggests that the political activities of the former were a prelude to the invisible government of the latter, where the influence on US foreign and military policy has continued. The footnotes give a fascinating view of what happened to many individuals mentioned in later years, but not all (which is frustrating). The photos are mostly casual group shots rather than formal portraits, but it might have been more meaningful to show more of the main actors. Maps aren't essential but would have been handy. There is an extensive bibliography which always suggests research in depth. Obviously, much anecdotal material was mined, but the writer didn't have access to many official records. Though the index is 21 pages long, it has some surprising omissions.

Despite being critical in spots, I enjoyed this work and extracted some nuggets of trivia for my collection. Smith did a diligent job of bringing material together. His short employment with the CIA aroused his interest in the predecessor ISS as a subject for his master's thesis, and he has provided some background about it. This is not the definitive history or even history in a strict sense, and it is certainly not a secret one with its heavy reliance on open sources.

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



The Dauntless Dive Bomber of World War Two. By Barrett Tillman. Annapolis, Md.: Naval Institute Press, 1976 [paperback edition 2006]. Photographs. Appen-

dices. Notes. Bibliography. Index. Pp. x, 232. \$19.95 Paperback ISBN: 1-59114-867-7

This book is a paperback reprint of a Naval Institute Press hardback book copyrighted in 1976. It has been reprinted at least once before this version. Mr. Tillman is a well known author on aviation matters, concentrating on United States Naval Aviation. This is one of a series of his books about World War II naval aircraft. Others are the Grumman F4F Wildcat and the Grumman TBF Avenger.

Tillman starts with the U.S. Navy's design competition in the summer of 1934 for a light scout-bomber. Northrop Aviation won the competition with the XBT-1. However, Northrop could not meet the Navy's production requirements. As a result, the Northrop design and plant were sold to Douglas in 1938. The XBT-2 became the XSBD-1, with a production contract for 144 SBDs. In keeping with the Douglas policy of naming their planes with words starting with the letter "D," the SBD was nicknamed "Dauntless." In addition to the physical plant, many personnel left Northrop to go to Douglas, including the chief engineer.

The book follows the SBD through the six versions which enjoyed a total production run of 4,923 aircraft. In addition, the U.S. Army bought 1,013 A-24s, their version of the SBD. The first XBT-1 was designed and built for \$85,000, while the last production SBD cost \$29,000. The book is full of such interesting items. Other examples include how to operate the diving and landing flaps together (as opposed to just the landing flaps); why optical aiming telescopes did not work and were replaced by reflecting sights; where the very few surviving SBDs were in 1975; and what the American pilot record for combat dives is (107 is the answer).

The main thrust of the book, however, is the Pacific naval campaigns. The SBD was the only aircraft type to participate in all of the five major carrier battles. In 1942, it was responsible for sinking six Japanese carriers, the record. All of the major engagements are described with dates and action descriptions, along with the personnel who accomplished the deeds. But the SBD also participated in Atlantic operations, and these are also included.

All in all, for readers interested in Naval Aviation, particularly in the Pacific in World War II, this is an excellent read.

James A. Painter, Docent, National Air & Space Museum



The Iraqi Perspectives Report: Saddam's Senior Leadership on Operation Iraqi Freedom from the Official U.S. Joint Forces Command Report.

By Kevin M. Woods, et al. Annapolis, Md.: Naval Institute Press, 2006. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Pp. xxi, 205 Paperback ISBN: 1-59114-457-4

What were Saddam Hussein and his closest advisors thinking and doing as war clouds gathered over Iraq on the eve of Operation Iraqi Freedom (OIF)? The Iraqi Perspectives Report figuratively puts the reader into Saddam's shoes to better understand the rationales that drove Iraqi decision-making not only in the period immediately prior to OIF and continuing until Iraq collapsed, but also during much of Saddam's stormy relationship with the United States. His misjudgments about America's willingness to use force are better understood in light of his inadequate assessment of U.S. performance in Vietnam, Somalia, the air campaign against Serbia, and Operations Desert Storm and Desert Fox.

Why is an understanding of Iraq's actions and military operations important now that the Saddam regime is gone? His Iraq in many ways resembles other problematic regimes that remain a part of the current geopolitical landscape. Perhaps a better understanding of the decision-making process common to authoritarian regimes will better enable this country to more effectively react to challenges from that quarter. On the operational level there is valuable insight into why an authoritarian regime maintains alternate paramilitary formations and, importantly, how they should be addressed in the planning for a military campaign against such a country.

What goal did the United States Joint Forces Command (JFC) have in producing this valuable study? The authors of this report paralleled the JFC's Lessons Learned Report on the conduct of major combat operations during OIF but, in this case, from the adversary point of view. Consequently, OIF lessons learned are enhanced by an appreciation of the foe's decision-making process and employment of forces and, thus, better understood. This study draws heavily on informed interviews with senior Ba'athists and Iraqi general officers and is supported by Iraqi documentation. To assist the reader, the opening section provides a brief cultural immersion in Ba'athism, Saddamism, and the geopolitical environment in which Iraq existed leading up to OIF.

U.S. national security strategy is driven by vital national interests and by per-

ceived threats to this nation's well being. In this context, Iraq was no different in that it (Saddam) determined similar concerns. The authors explore the interests and threats that were driving Saddam and his closest advisors in the formulation of policy. Saddam's highest priority was preservation of his regime. In his view the US was not a concrete threat to regime survival. He concluded that the U.S. would rely on air campaigns to punish Iraq, a method of warfare that in his estimation could be weathered and did not constitute a threat to his hold on power. He did not believe that it was in the U.S. interest to launch a major ground offensive into Iraq in light of perceived U.S. intolerance for large-scale casualties. The threats as assessed by Saddam were, in descending order: an uprising within Iraq; a military coup; an invasion by Iran, an

attack by Israel, a U.S.-led air campaign against Iraq, and lastly, and unlikely, a U.S.-led coalition ground attack ultimately targeting Baghdad. All of this drove regime policies and military planning.

This leads to the issue of Weapons of Mass Destruction (WMD) and the dilemma Saddam faced as he attempted to accommodate his two mutually exclusive policies. The two most threatening nations from Saddam's perspective were Iran and Israel, nations that possess WMD. He sought to intimidate those countries by creating ambiguity about Iraq's WMD program. Additionally, WMD had been used in suppressing Shiite and Kurdish resistance to his regime, again proving their value as weapons of intimidation. On the other hand, he wanted to end WMD-driven UN sanctions. To do this he had to conclusively demonstrate that

all such weapons no longer existed in his arsenal and that WMD development had ended. This study, while not focused on WMD, does shed light on how Saddam incongruously attempted to accommodate the two opposed objectives.

Another question that is addressed concerns the origins of insurgent presence in Iraq. The authors could find no evidence that Saddam had constituted paramilitary forces (i.e., the Fedayeen Saddam, the Al-Quds Army, and the Ba'ath militias) for the purpose of counter-occupation operations, simply because he did not anticipate that Iraq would be occupied by Coalition forces. Yet, one might conclude it was inevitable that highly motivated and fanatical irregular forces trained in guerrilla operations and possessing numerous caches of munitions throughout Iraq would continue the struggle with growing confidence against an under strength occupying force.

Kudos to JFC for producing this valuable work and making it available to a general readership. It provides a more complete understanding of important dynamics at work in Iraq before and during the campaign against Saddam's regime. Having said that, the inclusion of an index would have improved the utility of this book. Cross referencing issues raised by one interviewee with the same issues raised elsewhere in the book was difficult without an index.

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



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Books Received

Bowman, Martin W. *Clash of Eagles: American Bomber Crews and the Luftwaffe, 1942-1945*. Barnsley, South Yorkshire, UK: Pen and Sword, 2006. Photographs. Glossary. Index. Pp. xi, 254. \$50.00 ISBN: 1-84415-413-0

Brokaw, Tom. *The Greatest Generation*. New York: Random House, 1998. Photographs. Index. Pp. xxx, 412. \$34.95 ISBN: 0-375-50202-5

Davis, William E. *A Navy Pilot's Story—Sinking of the Rising Sun: Dog Fighting & Dive Bombing in World War II*. St. Paul, Minn.: Zenith Press an Imprint of MBI Publishing, 2007. Illustrations. Photographs. Pp. 304. \$25.95 ISBN: 0-7603-2946

Fields, Kenney Wayne. *The Rescue of Streetcar 304: A Navy Pilot's Forty Hours on the Run in Laos*. Annapolis, Md.: Naval Institute Press, 2003. Photographs. Pp. xviii, 311. \$29.05 ISBN: 1-978-1-59114-272-0

Graham, Thomas Jr. and Keith A. Hansen. *Spy Satellites and Other Intelligence Technologies that Changed History*. Seattle: University of Washington, Press, 2007. Photographs. Notes. Appendices. Glossary. Bibliography. Index. Pp. xvi, 159. \$14.95 Paperback ISBN: 978-8131-9275 03 176

Hilliard, Jack B. *Capronis, Farmans and SIAs: U.S. Army Aviation Training and Combat in Italy with Fiorello La Guardia, 1917-1918*. Trento, Italy: LoGisma in collaboration with Museo Aeronautico. Illustrations. Photographs. Notes. Appendices. Glossary. Bibliography. Pp. 615 E 27,00 Paperback ISBN: 88-87621-60-8

Holloway, James L., III. *Aircraft Carriers at War: A Personal Retrospective of Korea, Vietnam, and the Soviet Confrontation*. Annapolis, Md.: Naval Institute Press, 2007. Photographs. Glossary. Index. Pp. xiii, 479. \$34.95. ISBN: 1-978-1-59114-391-8

Kaufman, Robert G. *In Defense of the Bush Doctrine*. Lexington: The University Press of Kentucky, 2007. Notes. Appendix. Bibliography. Index. Pp. ix, 251. \$35.00 ISBN: 978-0-8131-2434-6

Lebensen, Len. *Surrounded By Heroes: Six Campaigns with Divisions Headquarters, 82nd Airborne Division, 1942-1945*. Philadelphia: Casemate, 2007. Photographs. Pp. 213. \$32.95 Paperback ISBN: 1-932-033-58-8

Leversedge, T.F.J. *Canadian Combat and Support Aircraft: A Military Compendium*. St Catherines, Ont., Canada: Vanwell Publishing Ltd., 2007. Tables. Photographs. Bibliography. Pp. xv, 348. \$50.00 (Cdn) ISBN: 1-55125-116-7

Rabasa, Angel, et al. *Ungoverned Territories: Understanding and Reducing Terrorism Risks*. Santa Monica, Calif.: RAND, 2007. Maps. Tables. Diagrams. Illustrations. Notes. Appendices. Glossary. Bibliography. Index. Pp. xxxii, 352. \$44.00 Paperback ISBN: 0-8330-4152-4

Statler, Kathryn C. *Replacing France: The Origins of American Intervention in Vietnam*. Lexington: The University Press of Kentucky, 2007. Notes. Bibliography. Index. Pp. xii, 378. \$45.00 ISBN: 978-0-8131-2440-7

Watt, George. *Escape from Hitler's Europe: An American Airman behind Enemy Lines*. Lexington: The University Press of Kentucky, 1990. Photographs. Index. Pp. 158. \$17.95 Paperback ISBN: 978-0-8131-91768

Wilson, James. *propaganda Postcards of the Luftwaffe*. UK: Pen and Sword, 2007. Photographs. Appendix. Bibliography. Pp. 224. \$32.95 ISBN: 1-84415-491-2

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:

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* Already under review.

Coming Up



Oct 16-17

The **Air Force Historical Foundation** will hold a seminar in the Washington, D.C. area on the theme "The Evolution of Air and Space Power: Know the Past, Prepare for the Future." See <http://afhistoricalfoundation.org>

Oct 18-21

The **Society for the History of Technology** will hold its annual meeting in Washington, D.C. See <http://www.historytechnology.org/annualmtg.html>

Oct 24-28

The **Oral History Association** will hold its annual meeting at the Marriott Oakland City Center in Oakland, California. The theme is: "The Revolutionary Ideal: Transforming Community through Oral History." See http://omega.dickinson.edu/organization/oha/org_am.html

2008

January 3-6

The **American Historical Association** will hold its annual meeting in Washington, D.C. See <http://www.historians.org>

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

The Best of 2006

The Best Article

A team of three judges has selected Lt. Col. John Plating's "Cannon, Egg, Charlie and Baker: Airlift Links between World War II and the Chinese Civil War" as the best article to appear in *Air Power History* during 2006. Lt. Col. Mr. Plating's article appeared in the Fall issue of the magazine.

Seven articles were nominated for this year's award, with the judging being very close. In the end, only a few points separated the top three in the scoring, with the judges noting that each of the articles presented important new information on air operations worldwide, not just of the U.S. Air Force.

This year's judges were Lt. Col. Raymond Fredette, USAF (Ret.); General Hansford T. Johnson, USAF (Ret.), of the Institute for Defense Analyses; and Dr. Perry Jamieson, of the Office of Air Force History.

The Best Book

We have completed the judging for the 2006 Air Force Historical Foundation Book award. The winner is *Sabres over MiG Alley*, by Kenneth P. Werrell.

Judges this year were Major Lawrence Spinetta, USAF; Dr. Torger Anderson, of the Institute for Defense Analyses; and Col. William Erikson, USAF (Ret.), of the Institute for Defense Analyses. The judges were unanimous in selecting *Sabres*, citing the book as dealing not only with the F-86 Sabrejet, but more fully representing an exploration of the air war in Korea. Dr. Werrell's book is an exceptionally well documented work that brings up questions that could have relevance now and in the future on how conflicts are prosecuted. The book also explores how well the military and political leaders prescribed the geographical employment limits of air power in the Korean War, and what characteristics distinguished between "good" and "bad" combat pilots.

All of the judges praised the readability of *Sabres over MiG Alley*, recommending it for anyone interested in understanding modern air warfare.

AIR FORCE HISTORICAL FOUNDATION

Election of Members of the Board of Directors October 17, 2007

The Bylaws of the Air Force Historical Foundation call for a Board of Directors of 18 members, elected in three classes of six each; the terms of six Board members (the “Class of 2008”) will expire at the annual meeting in Spring 2008. A Nominating Committee of at least three members not currently serving on the Board, chosen by the Chairman of the Board, is responsible for nominating a slate for each election. The Nominating Committee is appointed by the Chairman of the Board, and this year consists of General Hansford T. Johnson, USAF, (Ret), Herman Wolk (Air Force civilian historian, retired), and Lt Gen Raymond Johns, USAF. According to a June 4, 2007 letter from General Johnson, “the Committee believes that the Foundation’s future for the near term would be best served by the continuance of these board members.” Therefore, the Committee recommended that the following six directors be nominated to a full three-year term on the Board:

Col Kenneth J. Alnwick, USAF (Ret)
Lt Gen Russell C. Davis, USAF (Ret)
Mr John F. Kreis
Maj Gen Charles D. Link, USAF (Ret)
Lt Gen Michael A. Nelson, USAF (Ret)
Lt Col Lawrence A. Spinetta, USAF

A pull-out post card is enclosed in this (Fall 2007) issue of this journal, and the Board of Directors urges you to fill it out, mark your vote, and return it to the Foundation office before the next Board of Directors meeting on October 17, 2007, where the votes will be counted and announced. The results will be announced in the Winter 2007 issue.

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Tuesday, October 16 and Wednesday, October 17, 2007

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The Program

Tuesday, October 16, 2007

7:30	Registration, Coffee, and Networking	
8:30	Introductions and Welcome:	Col Jere Wallace, Symposium Chair
	Opening Remarks:	Lt Gen Michael A. Nelson, President and Chairman of the Board, Air Force Historical Foundation
	Keynote Address:	Dr (Col, USAF, Ret) Philip Meilinger
9:00	Panel A:	War in the Shadows
	Chair:	Maj Gen Richard L. Comer, USAF (Ret)
9:05	Paper 1:	Dr Michael P. May <i>The Forgotten Air Force Strategy for Limited Wars</i>
9:30	Paper 2:	Major Gregory P. Roberts <i>Jolly Green and the Long War: Asymmetrically Leveraging USAF Combat Search and Rescue Capability across the Range of Military Operations</i>
9:55	Paper 3:	Dr John A. Glover <i>Whither Aviation Foreign Internal Defense: An Update and a Way Ahead</i>
10:20	Break	
10:50	Paper 4:	Dr Timothy R. Keck, <i>Operation Unified Assistance: A Historical Assessment of the 2004-2005 Tsunami Humanitarian Relief Operation</i>
11:15	Questions & Answers	
12:00	End Panel A	
12:30	Buffet Luncheon	
	Luncheon Address:	Gen John D. W. Corley, Vice Chief of Staff, USAF (Nominated Commander, Air Combat Command)
2:00	End Luncheon	

2:30 Panel B:

	Conventional War
Chair:	Mr C. R. "Dick" Anderegg, Director, USAF History and Museums Program
2:35 Paper 1:	Lt Col Christopher M. Rein <i>General John K. Cannon and the Twelfth Air Force in the North African Campaign</i>
2:55 Paper 2:	Dr Thomas Hughes <i>The Cactus Air Force in World War II</i>
3:15 Paper 3:	Dr Paul D. Gelpi, Jr. <i>To Shape the Postwar Debate: "Opie" Weyland, the Far East Air Force, Air University Quarterly Review, and Tactical Airpower, 1951-1954</i>
3:35 Break	
4:05 Paper 4:	Dr Alan D. Meyer and CMSgt David Anderson <i>The Air National Guard's Evolving Role in Low-Intensity Conflict: Engaging Non-State Actors both at Home and Abroad</i>
4:25 Paper 5:	Dr James D. Perry <i>Aerospace Power and the Sanctuary Problem</i>
4:45 Questions & Answers	
5:30 End Panel B	
6:00 Reception	
7:00 Banquet	
Introduction of SecAF:	Lt Gen Michael A. Nelson, President and Chairman of the Board, Air Force Historical Foundation
Remarks:	The Honorable Michael W. Wynne, SecAF
Dinner Served	
Banquet Address:	Mr Keith Ferris, famed aviation artist
Award Presenter:	The Honorable Michael W. Wynne, SecAF
Air Force Historical Foundation's – First Annual General Carl "Tooey" Spaatz Award.	The award is presented to an individual or group for extraordinary, sustained contributions to the making of Air Force history.
10:00 Banquet Ends	

Wednesday, October 17, 2007

- 7:30 Coffee and Networking
- 8:30 Start Second Day of Symposium
- 8:30 **Panel C:** **Space and Cyber War**
- Chair: Ms Natalie Crawford
- 8:35 Paper 1: Dr Robert M. Dienesch
MIDAS: The Birth of Early Warning
- 9:00 Paper 2: Dr David G. Smith
DARPA Rising: The Race for Space and the Early Years of the Advanced Research Projects Agency, 1958-1960
- 9:25 Paper 3: Mr Chris M. Mayse
High Altitude ISR, Meeting the Needs of the War Fighter: An Evolution in Operations
- 9:50 Break
- 10:30 Paper 4: Dr Rick W. Sturdevant
From Satellite Tracking to Space Situational Awareness: The USAF and Space Surveillance, 1957-2007
- 11:00 Questions & Answers
- 11:45 End Panel C
- 12:00 **Buffet Luncheon**
- Luncheon Address:** **Gen T. Michael Moseley, Chief of Staff, USAF**
- Award Presenter:** **Gen T. Michael Moseley, Chief of Staff, USAF**
- The Air Force Historical Foundation's – First Annual Major General I. B. Holley Award.** The award is presented to an individual or group for extraordinary, sustained contributions to the documentation of Air Force history.
- 1:30 End Luncheon
- 5:00 End Displays in Atrium
End Symposium

Symposium Registration Fees:

Register online at www.afhistoricalfoundation.org/symposium

The registration fees depend upon military status and membership in the Air Force Historical Foundation (AFHF). Members of the military in uniform, from any service or any nation, are charged lower prices, as are members of the Foundation.

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Wednesday Luncheon	\$50
Banquet	\$65
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The Air Force Historical Foundation room block is open for registration on the Web through this Web site:

<http://www.starwoodmeeting.com/StarGroupsWeb/booking/reservation?id=0704113123&key=886A7>

The room rate is \$220 single or double, plus applicable state and local taxes, currently 10.25%, for a total of \$242.55 including tax. To get the best available rate, mention the Air Force Historical Foundation room block. Check-in time is 3:00 pm and check-out time is 12:00 noon. When the room block is full, many other fine hotels are available in the Crystal City area. To ensure availability, make your room reservation NOW.

Parking: Available in the hotel's underground garage at a special rate of \$10 per day. Vehicles over 6'8" cannot fit into the garage. Guest parking is on a space-available basis.

Metro: The Crystal City Metro Station exits onto 18th Street, two blocks from the hotel.

What to wear: For the business sessions and luncheons, military may wear the uniform of the day, either service dress, Class A, uniform informal, or utility uniforms such as BDUs, ABUs, or flight suits. Civilians will wear business attire. For the banquet on Oct 16, military will wear service dress, Class A, or uniform informal. Civilians will wear business attire. (NO mess dress or black tie.)

Info: execdir@afhistoricalfoundation.org

Register: www.afhistoricalfoundation.org/symposium

Letters

Tuskegee Airmen

Congratulations on the excellent coverage of the President's presentation of the Congressional Gold Medal to the Tuskegee Airmen [Air Power History, Vol. 54, No.2, summer 2007]. But I believe Dr. Gropman is unnecessarily hard on Roosevelt, citing the President's need to get re-elected as the only reason he approved establishing the Tuskegee experiment. How about the role Eleanor Roosevelt played after the ride she took with Chief Anderson, which some Tuskegee Airmen believe was the real impetus? How about just recognizing and acceding to the pressure from an oppressed minority?

Lt. Gen. Charles Cleveland. USAF (Ret.)

Atlas ICBM and PERT

As mentioned by book reviewer Dr. Rick Sturdevant, Chuck Walker, the author of *Atlas: The Ultimate Weapon* and a senior Convair-Astronautics (later General Dynamics) Atlas planning and control manager 1953-1963, points out that employment of the computerized Program and Evaluation Review Technique (PERT) required by the Air Force for activation of operational Atlas sites helped prevent schedule slips. [Air Power History, Vol. 54, No.2, summer 2007.]

That prompts me to recall another early use of PERT by the Air Force. In 1961-1962, PERT was implemented and operated with effectiveness in the development of the Satellite Interceptor (SAINT) at the then new Air Force Space Systems Division. The unmanned SAINT was being developed to rendezvous with a target satellite and inspect it with various sensors. I was a junior project officer in that program, Program 621A, and was involved in the PERT implementation. For the record, I would like to note that I think that the highly competent establishment and useful employment of PERT in the SAINT program were mainly the result of the excellent work of the Aerospace Corporation PERT implementation team, led by Michael Lesh. The prime contractor, RCA, also did very well in this.

As a separate historical observation on the SAINT program, just weeks before the SAINT's scheduled first launch in

December 1962, Secretary of Defense Robert McNamara canceled the program.

Maj. Gen. Richard T. Boverie, USAF (Ret.), West Palm Beach, Florida.

News

Dr. Dennis Floyd Casey 1941-2007

Dr. Dennis F. Casey died in New Braunfels, Texas on June 19, 2007 following a seven-month battle with cancer. He had retired from civil service in March, 2007.

Born on August 9, 1941 in Bakersfield, California, he attended California State University at Los Angeles, earning BA and MA degrees in history. He earned a PhD in Latin American history from the University of Kansas, where he was also named a Fulbright-Hays Research Fellow.

Dr. Casey became a staff historian at Fifteenth Air Force in 1976, and Chief Historian in 1983. Under Dr. Casey's leadership, the Fifteenth garnered the Outstanding USAF Numbered Air Force level History Program Award three years running from 1984 through 1986. He served

as a visiting faculty member with Air University and the Air Force Historical Research Agency, Maxwell AFB, Alabama, as well as an adjunct Professor at the University of Redlands.

In 1983, Dr. Casey moved to Randolph AFB, Texas, to join the HQ AETC history program. He researched and wrote *Reshaping the Future: from ATC to AETC*, which earned the Air Force Excellence in Historical Publications Award for 1994. He also worked as an adjunct Professor with the Alamo Community College District, teaching at both St. Philips and San Antonio Colleges. In 1995, Dr. Casey became the Chief Historian, HQ AIA in San Antonio. Where he developed and implemented the Air Force Intelligence Oral History Program. Dr. Casey also wrote and published three editions of the "USAFSS, ESC, AFIC AIA Continuing Legacy" brochure which outlines AIA's nearly six decades as the Air Force's air intelligence arm. Dr. Casey received the Outstanding Civilian Career Service Award and was the first recipient of the Grant Hales History Program Career Achievement Award.

Dr. Casey is survived by his wife of nearly 40 years, Suzy, son Andy and his wife Saori, grandson Dean and son Ryan. His son SSG David A. Casey, U.S. Army, (Ret.) preceded him in death in February 2003.





Ceremony Honors American WW II Plane Crash Victims

On June 14, 2007, the Embassy of Australia, in cooperation with the Bakers Creek Memorial Association (USA) and the Washington Sub-Branch of the Returned and Services League of Australia, hosted a ceremony at a memorial marker honoring 40 American servicemen killed in a tragic airplane crash at Bakers Creek, near Mackay, Australia, during World War II (**Above**).

Professor Robert S. Cutler of George Washington University, whose late father, Capt. Samuel Cutler, supervised the loading of the passengers on that fateful flight, wrote in his book, *Mackay's Flying Fortress* (CQU Press) that the incident originally was deemed a "military secret" to prevent wartime disclosure. "In recent years, however," Cutler said, "thanks to the tireless work of people in Australia and the United States, the full magnitude of the disaster finally was uncovered and there is increased recognition of this historic event." The marker stands as a symbol of the bond of friendship between Australia and the United States that started during the Second World War and has endured to this day.

Fifteen years ago, some fifty years after the tragic crash, citizens of Mackay, Australia, marked the crash site at Bakers Creek with a permanent memorial. Eight years later, in the United States, a group of retired U.S. military veterans and family relatives of the crash victims formed the Bakers Creek Memorial Association (USA). It took a handful of historians years to find out anything about the Bakers Creek crash. There was little to be found in military archives. The Association wanted to place a memorial marker in the United States, as one member put it — "to set the record right."

Rear Admiral Eugene B. Fluckey, 1913-2007

Rear Adm. Rear Eugene B. Fluckey, USN (Ret.), winner of the Medal of Honor and four Navy Crosses for the destruction of twenty-nine enemy ships in World War II, including several submarines, an aircraft carrier, a cruiser, and a destroyer died on June 28, 2007. He was ninety-three.

As commander of the submarine *USS Barb* in 1944 and 1945, he launched daring attacks on Japanese submarines and other ships along the China coast. Admiral Fluckey graduated from the Naval Academy in 1935. After the war, he was an aide to Fleet Admiral Chester W. Nimitz, Chief of Naval Operations. Later, Fluckey became director of naval intelligence and commanded amphibious units and the Navy's Pacific submarine force.

He wrote *Thunder Below* (University of Illinois Press, 1992) an account of his experiences as a submarine commander. In July 1995, Admiral Fluckey was the featured banquet speaker at a World War II symposium held at the Bethesda Naval Medical Center, which was co-sponsored by the Air Force Historical Foundation.

Reunions

The **C-7A Caribou Association** will hold a reunion September 6-9, 2007, in San Antonio, Texas. Contact:

Bill Buesking
(210) 403-2635
e-mail: wbuesking@satx.rr.com
web: c-7caribou.com/reuniondex.htm

The **27th Air Transport Group (310th, 311th, 312th, and 325th Ferrying Squadrons; 86th, 87th, 320th, and 321st Transport Sqdns; 519th and 520th Service Sqdns)** will hold a reunion September 27-30, 2007, in Washington, D.C. Contact:

Fred Garcia
6533 W. Altadena Ave.
Glendale, AZ 85304
(623) 878-7007

The **7499th Squadron, 7499th Group, 7405th Squadron, 7406th Squadron, 7407th Squadron, 7575th Group and 7580th Squadron of the United States Air Forces Europe** will hold a reunion October 4-8, 2007 at the Double Tree Hotel in Crystal City, Virginia. Contact:

Alan Brown at 703-455-3828, or
John Bessette at 703-568-1875
web: www.7499thgroupreunions.com

The **Air Force Officer Candidate School** is planning a reunion open to all who attended AFOCS from 1943 to 1963. The reunion will be held November 11-15, 2007, in Tucson, Arizona. Contact

Dave Mason
910-287-1754
e-mail: blokemason@atmc.net

2008

APT 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

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

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

General Howell M. Estes, Jr. 1914-2007



Air Force General Howell M. Estes, Jr. died on July 2, 2007, at his home in Bethesda, Maryland. He was ninety-two.

The son of an Army officer, he was born in 1914 at Ft. Oglethorpe, Georgia. He was a 1936 graduate of the U.S. Military Academy at West Point, N.Y. and was captain of its championship polo team. After receiving his commission in the Cavalry, he entered pilot training school in June 1939 and upon completion, transferred to the Army Air Corps in April 1940.

During World War II, he was a flight instructor and then director of training at Brooks Field, Texas. Subsequently, he was appointed Commandant of Cadets, Director of Flying, and Director of Training. In February 1944, General Estes assumed command of Blackland and then Lubbock Army Air Fields. In January 1946, he became Chief of Plans and Policy, Operations Division, U.S. Air Forces in Europe. After joining the newly-established U.S. Air Force in 1947, General Estes rose to Assistant Chief

of Staff Plans at USAFE. In June 1949, he completed the Air War College course.

During the Korean War, he was vice commander of the Far East Air Forces Bomber Command flew twenty-five combat missions in B-29s, with a total of 328 hours. After the war, he commanded Air Task Group 7.4 Joint Task Group Seven, which was responsible for the Operation Castle nuclear testing at Eniwetok Atoll in the Marshall Islands. He held numerous command positions in weapon system development and air defense, including Commander of the 22d Bombardment Wing, 44th BW, the 320th BW, and the 12th Air Division,

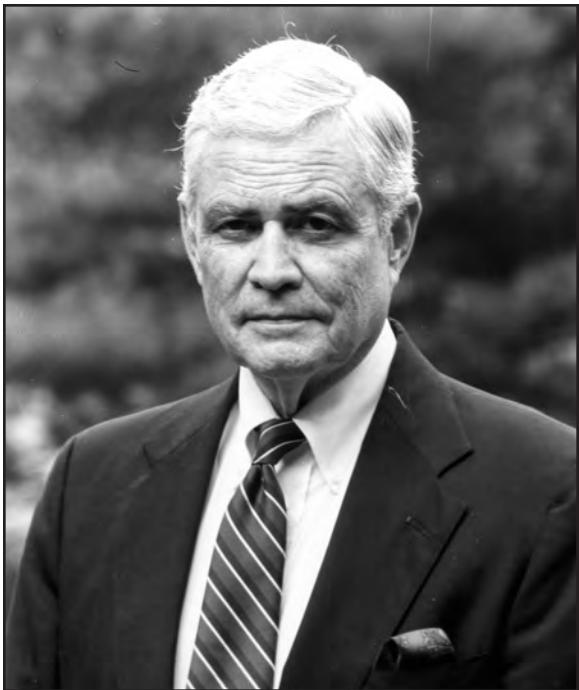
In 1961, as Deputy Commander Aerospace Systems (AFSC), he oversaw the construction of silos and installation of ICBMs. From 1964 to 1969, during the Vietnam War, General Estes led the Military Air Transport Service, (later Military Airlift Command and now the Air Mobility Command). In addition to responsibilities for air delivery of cargo, he had oversight of aeromedical evacuations, air rescue, air weather, photography, and mapping services world-wide.

Among his medals and decorations are the Air Force Distinguished Service Medal, the Army Distinguished Service Medal, three awards of the Legion of Merit, the Distinguished Flying Cross, and two awards of the Air Medal. In 1967, he was presented the general H.H. Arnold Trophy for outstanding contributions to military aviation and aerospace programs.

After his retirement from the Air Force, on August 1, 1969, he served brief terms as president of World Airways in Oakland, California, and the Federal Express Corporation in Memphis, Tennessee. General Estes was an active member of the Board of Directors of the Air Force Historical Foundation.

He is survived by three sons, General Howell M. Estes, III, Michael S. Estes, and Charles D. Estes; a sister, Katherine Estes; ten grandchildren; and eleven great-grandchildren.

Brig. Gen. Edwin H. Simmons 1921-2007



Brigadier General Edwin H. Simmons, USMC (Ret.) passed away on May 5, 2007. Born and raised in Paulsboro, New Jersey, he earned a BA degree in journalism from Lehigh University and an MA from Ohio State University. Prior to accepting his commission as a Marine second lieutenant on June 12, 1942, he held an Army Reserve commission.

During World War II, he trained at Marine Corps Schools, Quantico, Va. and Camp Lejeune, N.C., prior to serving overseas with the 5th Field Depot in the South and Central Pacific. He took part in combat during the capture of Guam and later served with the 7th Service Regiment on Okinawa and in China. He was promoted to captain in January 1944 and to major in June 1949.

Following the war, he served for three and one-half years as Managing Editor of the *Marine Corps Gazette*, then completed the Amphibious Warfare School, Junior Course, Quantico, in 1950. At the outbreak of the Korean conflict, he was serving with the Weapons

Company, 1st Battalion, 6th Marines, Camp Lejeune. In August 1950, with his unit (part of the 3d Battalion, 1st Marines), he was ordered to Korea and participated in the Inchon Landing that September. He continued in combat as a weapons company commander during the North Korean Aggression, the Communist China Aggression and the First UN Counter Offensive; and as a battalion operations officer and executive officer during the Communist China Spring Offensive.

Returning to the United States in July 1951, he served in various assignments with the Training and Replacement Command at Camp Pendleton, Calif.; with the Naval ROTC unit at Ohio State University; and with the G-4 Division at Headquarters Marine Corps. He was promoted to lieutenant colonel in December 1954. From August 1959 until October 1960, he served as Naval Attaché to the Dominican Republic. Prior to returning to the Dominican Republic in September 1961 as U.S. Military Liaison Officer, U.S. Embassy, Santo Domingo, he was assigned as Senior Editor, Publications Group, Marine Corps Schools, Quantico. In January 1962, he joined the Strategic Plans Section, G-3 Division at Headquarters Marine Corps, and in July 1963 was promoted to colonel.

From July 1965 until July 1966, he served in Vietnam, first as G-3 of III Marine Amphibious Force, and later, as Commanding Officer, 9th Marine Regiment. Returning from Vietnam, he was a student at the National War College for the next year prior to reporting to Headquarters Marine Corps where he served as Deputy Fiscal Director of the Marine Corps from August 1967 until May 1970. He was advanced to the rank of brigadier general on June 1, 1968.

General Simmons returned to Vietnam for another one year tour, and served as Assistant Division Commander, 1st Marine Division (Rein), and subsequently as Deputy Commander, III Marine Amphibious Brigade. He returned to Headquarters Marine Corps July 20, 1971, where he became Special Assistant to the Chief of Staff for Strategic Studies. On December 1, 1971, he

assumed duties as Director of Marine Corps History and Museums. He went on the retired list on July 1, 1972, but continued on active duty without interruption of service as Director of Marine Corps History and Museums. On July 1, 1978, he reverted to inactive status on the retired list. In late October 1978 he returned as a Civil Service employee to his previous position as Director.

General Simmons wrote for numerous military and general publications, including the *Naval Review*, *Naval Institute Proceedings*, *Marine Corps Gazette*, *Sea Power*, and *Army*. He is the author of the short history, *The United States Marines*, (published London, 1974, and New York, 1976) and has contributed extensively to various histories and standard works including the *Encyclopedia Britannica* and the *Dictionary of American History*. He was a fellow, governor, and treasurer of the Company of Military Historians and a member of the boards of trustees of the American Military Institute, the Marine Corps War Memorial Foundation, and the United States Commission on Military History. He is also a past president of the 1st Marine Division Association, a life member and past president of the American Society of Military Comptrollers, and a former vice-president of the National War College Alumni Association. In 1970, he received a Centennial Distinguished Graduate Medallion from Ohio State University.

Among his medals and decorations are: the Distinguished Service Medal, the Silver Star Medal, the Legion of Merit with Combat "V" and two gold stars, the Bronze Star Medal with Combat "V" and gold star, the Meritorious Service Medal, the Navy Commendation Medal with Combat "V", the Purple Heart, the Combat Action Ribbon, the Presidential Unit Citation with three bronze stars, the Navy Unit Commendation with one bronze star, the World War II Victory Medal, the National Defense Service Medal with one bronze star, the Korean Service Medal with one silver star indicative of five bronze stars, the Vietnam Service Medal with one silver star, and the Republic of Vietnam Cross of Gallantry with silver star and two palms.

General Simmons is survived by his wife, the former Frances G. Bliss of Denver, Colorado, two sons, Edwin H. Jr., and Clarke V., and two daughters, Bliss and Courtney.

Appreciation by Charles D. Melson, Chief Historian, U.S. Marine Corps.

Guidelines for Contributors

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

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

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

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

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



Our summer mystery aircraft, as many APH readers knew, was the Navy's McDonnell F3H-2 Demon fleet interceptor. First flown August 7, 1951, the initial Demon, built in XF3H-1 and F3H-1N versions, was crippled by the engine problems that stymied the Navy during the Korean War era. The Westinghouse J40 turbojet was plagued with reliability issues. In an unusual gesture that was tantamount to admitting the program was in mortal danger, McDonnell urged that the 9,300-pound thrust Allison J71 be installed in a completely revised version of the Demon.

Of 56 J40-powered F3H-1Ns, 25 never flew. Navy leaders made the difficult decision to ground all of them. They sent most to Memphis, Tennessee, for ignominious duty as ground instructional trainers.

On April 23, 1955, a Demon took off from the McDonnell plant at Lambert-St. Louis Municipal Airport, Missouri, powered by the J71. This "dash two" Demon had more power. "Dash two" Demons had broader wings with power-operated slats and large flaps that enhanced performance at high altitude and during carrier landing.

The Navy acquired 239 F2H-2, 142 F3H-2N,

and 80 F3H-3M Demons, a total of 461. They equipped 25 squadrons from 1956 to 1964. "It was an interceptor," said retired Comdr. John "China" Newlin, 69, of San Diego, California, who flew Demons in the early 1960s. "It was designed to go out and intercept raids by Russian Badger and Bear bombers." Newlin remembered that the APG-51 radar-guided weapons system that used the Sparrow air-to-air missile "was a fantastic system."

The Demon the first Fleet warplane to carry the AAM-N-6 Sparrow and AAM-N-7 Sidewinder missiles, later called the AIM-7 and AIM-9 and ubiquitous in Vietnam. When designations were changed in 1962, the F3H-2, F3H-2N, and F3H-2M Demons became the F-3B F-3C, and MF-3B respectively. The last Navy unit to operate the Demon exchanged its F-3B Demons for F-4B Phantom IIs in Sept. 1964. Demons are on exhibit at three U.S. museums today.

Our "History Mystery" winner, among the twenty-six readers who identified the Demon correctly, is retired Air Force MSgt. George Swanson of Dallas. Plane captain Allan Meyne took our follow-up photo of the Demon. Our new "History Mystery" photo comes to us from Thomas Hegre.

Can you identify our latest "mystery" aircraft? Enter our contest and become the owner of a new book on aviation history.

Last time around, two APH readers had to be disqualified because they didn't include a telephone number in their correspondence. Don't be one of those guys. Remember the rules, please:

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

2. Correctly name the aircraft shown here. Also include your postal mailing address and telephone number. Providing an e-mail address is optional but helpful.

3. A winner will be chosen at random from among those who correctly identify the aircraft, and

send the winner an aviation book.

This feature needs your help. Do you have a photo of a rare or little-known aircraft? Does anyone have color slides? We'll return any photos provided for use here.



This Issue's Mystery Plane

**Please vote for or against each candidate, marking clearly,
and sign and date the card prior to mailing.**

FOR AGAINST NAME

_____	_____	Col Kenneth J. Alnwick, USAF (Ret)
_____	_____	Lt Gen Russell C. Davis, USAF (Ret)
_____	_____	Mr John F. Kreis
_____	_____	Maj Gen Charles D. Link, USAF (Ret)
_____	_____	Lt Gen Michael A. Nelson, USAF (Ret)
_____	_____	Lt Col Lawrence A. Spinetta, USAF

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