

AIR POWER

FALL 2019 - Volume 66, Number 3
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The Air Force *Historical* Foundation

Founded on May 27, 1953 by Gen Carl A. “Tooey” Spaatz and other air power pioneers, the Air Force Historical Foundation (AFHF) is a nonprofit tax exempt organization. It is dedicated to the preservation, perpetuation and appropriate publication of the history and traditions of American aviation, with emphasis on the U.S. Air Force, its predecessor organizations, and the men and women whose lives and dreams were devoted to flight. The Foundation serves all components of the United States Air Force—Active, Reserve and Air National Guard.

AFHF strives to make available to the public and today’s government planners and decision makers information that is relevant and informative about all aspects of air and space power. By doing so, the Foundation hopes to assure the nation profits from past experiences as it helps keep the U.S. Air Force the most modern and effective military force in the world.

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Our Fall issue is blessed with a larger number of book reviews than has been our norm, twenty-three in all. We have been trying to play catch-up on our backlog of reviews, so please take a moment to look them over.

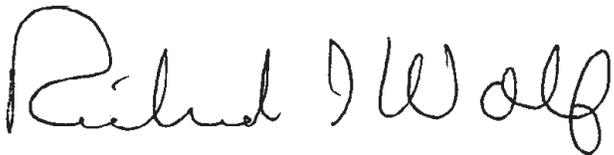
Our first article is adapted from a class outline and lecture given by Richard K. Smith while on the faculty at the University of Maryland. Richard Smith was one of the finest aviation historians, and he wrote prolifically and provided the rigor of analysis to the study of aviation and its progress. In this case, Smith wrote about the Anglo-French experience with their supersonic airliner, the *Concorde*, as well as the American brief flirtation with it. It was originally prepared in 1982, but its lessons bear studying.

Our next two articles are firmly embedded in World War II. The first one, by first-time contributor Tyler Morton, covers airborne linguists intercepting Axis radio traffic in World War II to provide real-time situational awareness for bomber missions. It's a real fine addition to the literature.

The other article is about logistic support to the USAAF in World War II. It's by David Loska, another first-time contributor. It's heavily illustrated with two dozen photographs and shouldn't be skipped.

Our departments at the back have shrunk recently as we try to provide as many reviews and articles as we can fit in each issue. In this issue, ninety percent of the magazine falls into those two categories. If there is something you would like us to include in our departments, send us an email with your suggestions. I can be found at the addresses on the facing page.

The President's Message is on the next page, and includes vital information on our upcoming awards function and banquet. We sincerely hope you can join us this year.



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From the President

Dear Members,

We recently added new members to the Foundation's leadership: Gen Ralph E. Eberhart, USAF (Ret); Maj Gen Charles W. Lyon, USAF (Ret); Maj Gen John L. Barry, USAF (Ret); and Col Stephen E. Newbold, USAF (Ret). They join other dedicated, energetic and selfless Board members and bring superb perspectives to the challenges and opportunities facing the Foundation. Lt Col Steve Gress, USAF (Ret) stepped up to serve as our Treasurer, in lieu of long-serving Tom Owens. I am grateful to departing Board members Gen Lloyd "Fig" Newton, USAF (Ret); Maj Gen T.C. Jones, USAF (Ret); and Col Dick Anderegg, USAF (Ret), who contributed in many significant ways to AFHF.



The Board and staff are working on a number of projects intended to honor and amplify the 75th anniversary of the Air Force in 2022. Among these projects are production of a commemorative coin and welcome updates on the Foundation's coffee-table-sized books. We are pursuing grant funding to realize the concept of a "plug-and-play" USAF history course that could be marketed to various professional military schools, ROTC, etc. We are excited about this and hope to see it to fruition.

In the immediate future, the Foundation will again have a booth at the Air Force Association Air Space and Cyber Conference, September 16-18 at National Harbor, MD. If this conference is on your calendar, please drop by and spend some time with us!

On October 9th, the Air Force Historical Foundation will present this year's prestigious awards at our annual Awards Banquet, which will be held at the Army Navy Country Club, 1700 Army Navy Drive, Arlington, VA beginning with a reception at 5:00 PM.

Honored for 2019 with the Doolittle Award for an historically outstanding unit is the 55th Wing, Offutt AFB, Nebraska; with the Spaatz Award for a lifetime contribution to the history of the Air Force, retired General John P. Jumper, 17th Chief of Staff; and with the Maj Gen I. B. Holley Award for a lifetime contribution to the documentation of Air Force History, Dr. R. Cargill Hall.

We would be most honored if you could attend the Banquet—and bring your fellow Foundation members and friends! Register online at our website www.afhistory.org. Our point of contact for assistance in signing up or any questions is Lt Col Jim Vertenten, USAF (Ret), AFHF Executive Director – ed@afhistory.org or (703) 395-7261.

The Foundation appreciates your loyalty, and it needs your support—in ideas, time, donations, or just forwarding "This Day in Air Force History" to others who might find the Foundation's work interesting and worthy of support. Airpower history matters, to Airmen and to America, and so does what we all do—for and *with* it!

Very respectfully,

A handwritten signature in black ink, which appears to read "Christopher D. Miller". The signature is fluid and cursive, written over a light-colored background.

Christopher D. Miller, Lt. Gen., USAF (Ret.)
President and Chairman of the Board

THE SUPERSONIC AIRLINER FIASCO: FRENZIED INTERNATIONAL AERONAUTICAL SAGA OF COMMUNICABLE OBSESSIONS, 1956-1976



Concorde being towed down the taxiway.

Richard K. Smith

The supersonic airliner is an example of politically sustained technology driven by xenophobia, chauvinism, and tribal mythologies in combination with the Technological Imperative: “What Can Be Done Will Be Done,” serving to produce a wholly unnecessary machine.

Great Britain and France spent fourteen years (1962-76) and more than two billion dollars producing twenty supersonic Mach 2 airliners of the *Concorde* type, only fourteen of which were used in airline service. Concurrently, the United States spent eight years (1963-71) and one billion dollars without producing an airplane of any description, the only result being a design which was not integrated even on paper.

The State of the Art: 1946-1956

A supersonic airliner became an inevitable subject of speculation shortly after the Bell X-1 research airplane made the world's first supersonic flight (Mach 1.06) on October 14, 1947. The speculation was shortlived; the mastering of flight in the transonic range of Mach 0.8 to 1.2 with small airplanes created more than enough problems to keep everyone busy for the next ten years. During the postwar decade the U.S. Air Force pressed ahead with a jet bomber program which resulted in the medium-range Boeing B-47 of 150,000 lbs. (first flight December 17, 1947), of which 2,060 were built, and the long-range Boeing B-52 of 390,000 lbs. (first flight October 2, 1952) of which 744 were built, while supersonic speed was achieved in the medium-range Convair B-58 of 160,000 lbs. (first flight November 11, 1956), only ninety-some of which were procured.

In this same period the Air Force developed its so-called “Century” series of increasingly high performance fighters, the North American F-100 which flew on May 25, 1953, was the first of the series. All possessed a supersonic capability. However, this was only a “dash” capability and in the category of combat emergency power; it could not be sustained beyond a few minutes.

Author's Note, July 2, 1990: This paper was put together in great haste for a History of Mechanical Flight class I taught at the University of Maryland in the autumn of 1982. It recently surfaced and it seems worth cranking into the word processor. For the class it was done up on a mimeograph stencil and used as a handout. It's date: November 18, 1982. Although there was a temptation to change some things in this copying of 1990, I thought it more interesting to leave it as it was written eight years ago. It's too bad it has no documentation, but I had enough difficulty in slapping The Thing together as-is to meet my own deadline for the class.

Editor's Note, 2019: At the cost of criticism, I have mildly edited for style, including dates and numbers, and a few other items.

Concurrently most of the airlines of the world were content to fly at less than 400 mph employing the demonstrated reliability and superiority of readily available American piston engine equipment which was constantly improved in performance during 1946-1958. Douglas refined its OC-4 of 1942 into the DC-6 (1946), the DC-6B (1950), the DC-7 (1953), and the DC-7C (1955); while Lockheed improved its L.49 *Constellation* of 1943 through the 649 (1946), the 749 (1947), and 1049 series (1953), culminating in the L.1649 of 1956, which was practically a new airplane.

British efforts displayed an almost inverse order of priorities, the first of its jet bombers, the Vickers *Valiant* of 140,000 lbs. not flying until 1951; the Handley Page *Victor* and Avro *Vulcan*, both of about 250,000 lbs. not flying until 1952, whereas de Havilland rushed ahead with its DH.106 *Comet* jetliner which flew in 1949. With this dramatic leap into the future the British held world leadership in jet airline equipment until 1954, when their efforts were betrayed by the *Comet's* inadequate pressure cabin. The *Comet* did not become a satisfactory airliner until 1958, by which time it was an old design and was transcended by the new Boeing 707. However, there was no inevitability in this turn of events. To some extent the British inflicted the success of the Boeing 707 upon themselves.

When the *Comet* entered airline service in 1952, the British had already started development of the Vickers VC.7, a 258,000 lbs. airplane that should have been competitive with the Boeing 707. Construction of the prototype was well along by 1955 with a first flight likely in 1956. But on November 11, 1955, for reasons blurred by the dark fogs of Britain's convoluted domestic politics, the VC.7 was cancelled and the prototype was reduced to scrap.

The British Trauma of 1956

Having thrown away their best chance of matching the Americans in the realm of subsonic flight, within a year of

Editor's Note: Cargill Hall furnished this essay from an unpublished manuscript by Richard K. Smith. For those of you unfamiliar with Dick Smith (1929-2003) and his seminal contributions to the history of aeronautics, let me say that this maritime engineer and graduate of the University of Chicago overturned the cherished paradigm of a "DC aeronautical revolution" that occurred in the 1930s. This he managed with a study that turned on airplane weights: "The Intercontinental Airliner and the Essence of Airplane Performance, 1929-1939." At first rejected for publication by the Society for the History of Technology, Tom Crouch of NASM intervened and explained to its reviewers just what Smith had wrought. The study subsequently appeared in Technology and Culture, Vol. 24, No. 3, July 1983. For those wanting to know more about this remarkable historian, see "Richard K. Smith, An Appreciation," which appeared in the summer 2004 issue of Air Power History.

cancelling the VC.7 the British decided to take a dramatic leap into the future as they had attempted with the *Comet*. This time the jump into the future would be in terms of supersonic flight technology: a Mach 2 airplane. In 1956, a Supersonic Transport Aircraft Committee (STAC) was created in Britain; its first meeting was on November 5, 1956. Not one but two types of supersonic airliners were proposed: a medium range airplane with a cruising speed of Mach 1.2 and one with an absolute transatlantic range of 3,600 miles and a speed of Mach 1.8.

November 1956 may not have been the best time for Britons to consider such a momentous project, especially when the factor of national prestige figured so largely in its basis. On July 26, 1956, as a result of a badly bungled U.S. foreign policy, Egypt nationalized the Suez Canal, an act which hurt the Anglo-French because the Canal had been owned by a private company that was mostly Anglo-French. In truth, the Anglo-French were less hurt than it was a case of their sensibilities being offended, but this made Egypt's action seem no less outrageous. After ninety days filled with threats, the Anglo-French acted in conspiracy with Israel to invade Egypt and seize the Suez Canal. The U.S. intervened politically and forced the Anglo-French to withdraw. It was a badly handled affair resulting in terrible public humiliation of the Anglo-French, stimulating bitter anti-Americanism in Britain and France.

The matter of "Suez 1956" (as this mess came to be known) dramatized the fact that Britain and France were no longer the powerful nations that they had been prior to 1939. The truth is often unpleasant and "Suez" inflicted national traumas that took the forms of almost hysterical determination to "do something" to "show the world," and especially to "show the Americans," that Britain and France were not truly "second rate" powers. Devices that would serve to restore "national prestige" suddenly entered the front rank of national priorities. One way to achieve this was to "beat the Yanks" by leading the world into the realm of supersonic flight with a Mach 2 airliner which would succeed where the subsonic *Comet* had failed.

By March 9, 1959, the British STAC had produced some 500 technical studies which supported the development of two types of supersonic airliners. In September, the Government let preliminary development contracts to Hawker-Siddeley for the medium-range model and to Bristol Aircraft for the larger and faster intercontinental type which had been uprated from Mach 1.8 to 2.0. Coincidentally, a few days later the American X-15 research airplane made its first powered flight, attaining a conservative 1,400 mph (Mach 2.3), which could only confirm the British in their judgment that they were moving in the right direction and none too soon.

The French Problem: 1940-1956

Concurrently, the French were suffering humiliation, not only from "Suez 1956" but also from bitter memories of their military defeat by Nazi Germany in 1940, the German Occupation of France, and having to be liberated by the Anglo-Americans in 1944. In 1954 they had lost their

colonial war in Indo-China. By 1956 they were locked into a costly insurrection in Algeria. Moreover, France had been excluded from the “special relationship” that existed between U.S. and Britain relating to nuclear weapons and related technology resulting from Anglo-American collaboration during World War II.

The French aircraft industry, seized and badly used by Nazi Germany and bombed by the Allies from 1941 through 1944, was a postwar ruin and the French had to rebuild it amidst terrible postwar confusion. The weakness of France’s Fourth Republic in which prime ministers and governments came and went with great frequency did not help matters. There was nevertheless great inherent strength in French aviation, although its brilliance was left badly tarnished by the nation’s wretched politics. This was an affliction that went back to the 1930s, although some observers would say it went back to events of 1789.

The French also had their own supersonic plans. During 1953-55, Sud-Aviation developed its SE.210 *Caravelle*, a medium size twin-jet airliner; initially 95,900 lbs., with more powerful engines it grew to 101,410 lbs. Its novelty was the placement of its engines at the rear of the fuselage, a French innovation that became commonplace with the British BAC 111, the Boeing 727, and Douglas DC-9 of some years later. The *Caravelle* was a commercially successful airliner; even the American airlines purchased a few *Caravelles*. This was a good test because American airlines demanded much more from their equipment than did Anglo-European operators.

The *Caravelle*’s only flaw was a conceptual one: its passenger cabin was only 126 inches wide. This was three inches wider than the de Havilland *Comet* but only one inch wider than the Douglas DC-4-6-7 of piston engine airplanes and it restricted the *Caravelle* to 2 plus 3 seating. If the French had thought out the airplane more carefully and taken a jump to 145-150 inches, the chances are that the *Caravelle* would have swept the world market for a medium-range jetliner. If it did not pre-empt Boeing’s development of the almost unbelievably successful 727 (more than 1,500 sold by 1982), a large cross-section *Caravelle* would have given serious pause to Boeing before it invested in the 727’s development.

Although there is a habit of mind that presumes Britain and France to be “equal” to the U.S., they are in fact relatively small countries. France encompasses 212,973 square miles with a population of about 55 million; Great Britain has only 94,209 square miles but a population roughly equal to that of France. On the other hand, the contiguous forty-eight states of the U.S. enclose more than two million square miles with a population of some 220 million persons. The state of Texas alone contains 262,398 square miles. Not having this vast, self-contained market of continental dimensions which pre-conditioned Americans to think globally, the Anglo-Europeans had a difficult time “thinking big.”

By 1958, the French were planning a supersonic “Super Caravelle” and a model of the proposed airplane, accompanied by preliminary data, were placed on exhibit at the Paris Air Show of 1961. It was another medium

range airplane; if developed into a flight article it would have been stone cold dead in the market even as its first metal was being cut.

The Anglo-French Connection

The further that the British and French worked into the details of their respective supersonic airliner designs, the more they discovered, much to their dismay, how frightfully expensive a Mach 2 airliner was going to be. In search of an industrial partner during 1960-61 both had sought an “American Connection” but without success. Although knowledgeable Americans admired British and French research and many of their development efforts, most were simply appalled by the peculiarities of Anglo-French production habits. Finding no interest in America, the British and French manufacturers turned to one another. Their discussions led to political overtures between the respective air ministries and finally to formalizing a cooperative effort.

On November 28, 1962, a formal agreement was concluded between Britain and France for joint development of a Mach 2 airliner with a fifty-fifty sharing of its costs. This was no ordinary executive agreement, it was a full-fledged treaty which was duly registered with the United Nations. Most extraordinary, it included no provision for either party withdrawing if such were found desirable or necessary.

The French wanted to include some proviso for interim termination but the British would not hear of it. World War II was still fresh in the minds of the political leaders of 1962; the British certainly recalled the French military and political collapse of 1940 and probably feared being left in the lurch again. Ironically, during 1964-68 it was the British who, more than once, attempted to squirm out of this agreement, and it was the French who stood fast, holding Britain’s feet to a Mach 2 fire and denying them access to an aeronautical “Dunquerque.”

The design and construction of the airframe was shared between Sud-Aviation (later reorganized as Aerospatiale) and the Bristol Aeroplane Co. (which in 1963 was merged into the present day British Aerospace Corp.) The engine work was divided between Bristol-Siddeley (later absorbed by Rolls Royce) and SNECMA (Societe Nationale d’Etudes et de Construction de Moteurs d’Aviation), a nationalized French corporation. The engine was based on the ten-year-old Bristol *Olympus* uprated from 9,750 to 20,000 lbs. of thrust during 1953-1961, to be further uprated to 30,050 lbs. (including 17 percent afterburning), for the Mach 2 airliner.

In a speech of January 13, 1963, President Charles de Gaulle of France’s new (as of 1958) Fifth Republic referred to the unbuilt airplane as the “*Concorde*,” coincidentally performing a public christening. In fact, this name is owed to the ten-year-old son of an official of the British Aerospace Corp.; although sneered at by French and British aviation bureaucrats, the 73-year-old de Gaulle thought the name was *tres bien!* And it stuck. However, until the British air minister decreed otherwise in 1967, British aviation bu-



The U.S. Air Force XB-70 Valkyrie.

reaucrats persisted in spelling *Concorde* without its French “e.”

If the Anglo-Europeans were going to beat the Americans to Mach 2 air travel they had to hurry—or so it would appear to any outside observer of the world aviation scene of the early 1960s. By 1959, the Americans had a Mach 2 bomber in the Convair B-58, a 165,000 lbs. airplane; an oncoming Mach 3 bomber in the North American B-70, a titanium and stainless steel giant of 550,000 lbs.; and after 1958, they were flying the North American X-15, a research plane capable of 4000 mph (Mach 6-plus).

It was generally known that the Americans were into multi-million dollar research efforts with liquid hydrogen and hydrogen-based fuels, hypergolic fuels, and high energy chemical fuels such as boron and that secret research had been ongoing for some years toward development of a nuclear powered airplane. Furthermore, when the Concorde Treaty was signed almost six years had passed since October 4, 1957, when the Soviet Union put its *Sputnik*, the world’s first artificial satellite into orbit. This marked the beginning of the “Space Age” and of the “space race”; and the Americans had long since embarked on multi-billion dollar efforts in the realm of space technology, leaving Europe far behind.

American aeronautical research appeared to be pointed directly at Mach 2—and beyond. And it was, but only in the most general way. It was in fact diffused to meet many *ad hoc* requirements: it had no focus in terms of an airliner until the Concorde Treaty was perceived as a challenge to U.S. aerospace superiority.

The American Reaction

The earliest Anglo-French efforts had not gone unnoticed in the United States and in November 1959, the U.S. Air Coordinating Committee, an interagency group that advised the President on aviation matters, created a Supersonic Transport Study Group. In December the Federal

Aviation Agency (in 1967 it was absorbed into the new Department of Transportation, after which “Agency” became “Administration”) which regulates the technical aspects of American civil aviation created its own study group. The former issued an optimistic report in February 1960 which said that if the U.S. were to go ahead with a supersonic transport (“SST” as it came to be called), it should exploit the very latest developments in the state of the art and be a titanium and stainless steel airplane capable of Mach 3 (1,800 mph).

Such technology had been used in the NACA’s (in 1958 reorganized as NASA), X-series of research airplanes and was being further developed as “hardware” in the B-70 and the still highly secret Lockheed A-11/SR-71 series of Mach 3 airplanes. The latter did not fly until 1962 and their existence was not made public until 1964. Although the B-70 was cancelled in 1959, in terms of a bomber program, provision was made for finishing two prototypes as research airplanes: the first flew on September 21, 1964. In May 1960, the possibility of an American Mach 3 airliner became public when Congress’s House Committee on Science and Astronautics devoted several days of hearings to the subject.

The Supersonic Airliner

Although a supersonic airliner might appear to be in the “natural order” of things, few things could be farther from the truth. There is nothing “natural” about mechanical flight of itself, and supersonic flight is absolutely freakish. Indeed, the realm of Mach 1-plus posed many technical problems which had not been resolved by 1960. The nominally “supersonic” military airplanes of the 1950s in truth possessed only a “dash” capability; the duration of their supersonic speed envelope was measured in minutes, not hours. The B-58 bomber was expected to fly to hostile territory subsonically, accelerating to Mach 2 only during the final twenty minutes its run-in to the target. As of 1961,



An Air France Concorde, in 1977.

before Lockheed's A-11/SR-71 had flown, there was no experience anywhere in the world with sustained cruising at speeds beyond Mach 1.

The Anglo-French restricted their *Concorde* to Mach 2.2 because it is within the limits of strength of conventional aluminum aircraft alloys. Beyond Mach 2.2 the heating effects from skin friction start to exceed 280°C (504°F) and the molecular structure of aluminum alloys start to break down into crystalline forms. Flight beyond Mach 2.2 calls for titanium and high grade steels and novel fabrication techniques. These are not only very expensive but the Europeans had little practical experience with these materials.

On the other hand, the Americans had a wealth of R&D experience that was already yielding desired results in the B-70 bomber and the secret A-11/SR-71. This was aside from a host of secret military projects which, although short-lived, nevertheless yielded much useful data before their termination. They also had a wealth of data produced by their X-series of research airplanes, and a quarter of a century of experience in the design and construction of large subsonic long-range airplanes.

By 1960, the Americans had also refined a concept known as “variable geometry,” a wing design in which the outboard wing sections are hinged from a central wingbox. The wings can be swept forward for operations in the subsonic flight regime and swept back for flight into the transonic range and beyond Mach 1. Its employment was expected in the Mach 3 SST.

Variable geometry was not new in 1960; it was an idea that went back to the earliest 1930s when there was no practical use for it. But when the airplane's speed envelope had become enlarged from 100 mph to Mach 1 and beyond, variable geometry—literally changing the shape of the airplane relative to its flight regime—clearly held out the promise of having the best of both possible worlds. Only later would it become clear that it was a luxury accompanied by severe weight penalties that only military air-

planes might afford. It was ten years (1960-70), before this unpleasant fact became locked into the conventional wisdom.

Besides the usual problems encountered in the design of an airplane that seeks to employ technology on a distant edge of the state of the art, the machine designed for sustained supersonic cruising created a whole new series of problems. This was especially the case with heat generated by skin friction; kinetic heating. Whereas journalists once prattled about the mythical “sound barrier” with respect to speeds beyond Mach 0.8, they now coined the expression “thermal thicket” to oversimplify the problems of flight beyond Mach 2.

Those parts of the airplane that generate the most heat were inevitably the nose, the wing's leading edge, and the engines' air intakes—the airplane's “cutting edges.” An artful use of titanium was necessary in these areas, combined with techniques that accelerated the transfer of heat from these high temperature areas to cooler parts of the structure. In some cases the on-board fuel may be used as a “heat sink,” coincidentally achieving preheating of the fuel before its injection into the engine.

In the *Concorde* the temperature on the nose at Mach 2 is typically 127°C (228°F), fading to 91°C (163°F) along the after fuselage. It is 105°C (189°F) along the wing's leading edge, fading to 90°C (162°F) at the trailing edge. On the Lockheed SR-71 Mach 3 photo-reconnaissance plane skin temperatures of 416°C (750°F) have been recorded.

Whereas the subsonic airplane goes through only one heat cycle per flight, a supersonic cruiser passes through two, a factor that must be given serious consideration in estimating the strength of its materials. A subsonic airplane loses heat as it climbs into the sub-zero temperatures at a cruising altitude of 35,000 ft. and remains “cold” throughout its flight, regaining heat when it descends to earth. The supersonic machine similarly loses heat during the climb to its cruising altitude, but then the process is dramatically reversed when it accelerates beyond Mach 1.



Roll-out of the first Boeing 747. Note the wide body shape of the airliner as opposed to the narrow tube shape of the SST (facing page).

It remains “hot” during supersonic cruise, loses heat as it slows into subsonic flight and becomes “cold” during descent into its terminal environment. Once on the ground it becomes rewarmed to the atmosphere temperature.

A further problem occurs with the airplane’s drag profile because that of a supersonic airplane must be as small as practicable. This dictates a “smallest” cabin cross-section and such a cross-section was an exception to the direction in which airliner cabins were going by 1960. As built, the Concorde’s cabin was only 110 inches wide. This is closer to the 97-inch cross-section of the Douglas DC-3 of 1935 than it was to the 125 inches of the Douglas DC-4-6-7 piston engine airliners of the 1950s. And it bears no comparison with the 148-inch cross-section of the Boeing 707 generation of jetliners that were starting to dominate the airways of the 1960s.

To withstand the rigors of flight at Mach 2, this small cross-section also had to be much stronger than the same in a subsonic airplane. More strength usually means more material which means more weight in the airplane’s tare. In the Concorde the overall result was an airplane of much higher density of structure than a subsonic airliner of similar gross weight; it meant a higher tare weight and a proportionate reduction of payload within the weight envelope.

The higher density of structure necessary in any supersonic airliner results in a machine that carries a payload which is about ten percent of its gross weight—and possibly less. In contrast, the subsonic Boeing 707 payload is about fifteen percent of its gross weight; the cavernous and less dense Boeing 747’s payload is about twenty percent of its gross weight.

To the world of the 1960s which had but recently become accustomed to the 148-inch width of the “giant” Boeing 707, the Concorde’s narrow “tube” was clearly regressive. However, it could be pointed out that at Mach 2 the passengers had to endure this tightness for less than half the time they would if aboard a subsonic airliner. But

at the end of the decade the Boeing 747 introduced the 255-inch cabin width and the so-called “spacious age” of air travel. The 747 transformed the Concorde to a claustrophobe’s horror.

The U.S. SST Commitment

In a speech at the U.S. Air Force Academy on June 5, 1963, President Kennedy committed the United States to the development of a supersonic airliner. This was interpreted as a response to a “European challenge.” He asked Congress for \$60 million in start-up funds; the cost of a prototype was estimated to be \$750 million. To fully appreciate this funding it must be understood that 1963’s dollar had four times the purchasing power of a 1982 dollar. In 1982’s inflated money the prototype’s estimate would be about \$3 billion.

Two years earlier on May 25, 1961, President Kennedy had committed the U.S. to putting a man on the moon by the end of the decade; this was achieved by the successful *Apollo 11* mission of July 1969. Concurrent to American astronauts walking on the moon, the President also looked forward to American air travelers hurtling across the sky in 1969 aboard American-built Mach 3 airliners. In the 1960s technology as euphoria had an iron grip on the U.S.A.; all things seemed possible.

But there was an inherent flaw in the American SST effort. In Britain and continental Europe aviation consisted of an interlocking and overlapping triumvirate of Government, the national airline, and a quasi-, semi- or wholly nationalized aircraft manufacturing industry. These were very cozy relationships. Initiative traditionally came from the Government and its agencies which exercised a heavy hand upon the airlines and manufacturers. This system had prevailed since World War I. By the 1960s these Anglo-European arrangements had been institutionalized for al-



The Boeing 2707, the American competitor to the *Concorde*. It never entered production.

most a half century. Except as it might occur within the scene of American military aviation, this was not true in the U.S.; and even with American military aviation there occurred many exceptions.

American airline equipment was a “private” matter between the manufacturers and their customers, the airlines. To be sure, the Government established minimum requirements for airworthiness, and policed air safety, but it did not get involved in the relationships between the seller and the buyer of commercial airliners. But in the case of the SST, the Government was the initiator and the primary customer—although the private airlines would actually operate the airplanes. There was no precedent for this. The result was a patchwork of unsatisfactory *ad hoc* arrangements with which no one was comfortable. It became a badly muddled affair.

The American Mach 3 airliner was not conceived in terms of any actual need; its primary purpose was to serve the chimera of “national prestige.” Whereas the Anglo-French politicians were obsessed by need of regaining prestige they felt they were losing or had lost, the Americans were obsessed by maintaining what they felt was theirs. The American SST was born of the politics of emotionalized incantation; eight years later it was killed by the politics of emotionalized denunciation.

The American airlines, burdened by the necessity of amortizing their huge investments in fleets of subsonic jetliners, were horrified by the prospect of an astronomically expensive SST. It would be an extraordinarily expensive airplane to build, very expensive to operate, and in practice it might prove to be only marginally more productive than a subsonic machine. However, no airline executive dared show less than cheerful “excitement” when the national leadership decreed that such an airplane was in the national interest. And in the 1960s it was extremely unfashionable to be skeptical about any instrument that had the label of “progress” pasted on it.

The American aircraft manufacturers were more inclined to succumb to the Technological Imperative represented by the SST than were the airline operators. But even they had more than a few “closet” skeptics.

“Cost Sharing” the SST

The Government expected the manufacturers to share twenty-five percent of the costs of an SST’s R&D and manufacturing. It expected the same from the airlines with respect to the unit costs of each airplane produced, i.e. to say the airplane’s nominal sale price. But the airlines whittled this down to ten percent. They would in effect be getting a ninety percent discount on each airplane, tax money covering that ninety percent. The fact that the Government did not feel able to impose a straight-forward fifty-fifty formula, and that the manufacturers and the airlines, the apparent beneficiaries of this project, grumbled about even the small percentages agreed upon, throws a harsh light on the manifold uncertainties of the American SST.

With much justification the manufacturers saw no reason whatever to share costs with the Government. They did not share the costs of a bomber built for the Air Force or Navy; so why an airliner? And especially when the Government was going to sell the airliner to the airlines at a 90 percent discount! This “cost sharing,” the fig-leaf of “free enterprise,” was never worked out to any party’s satisfaction. The controversy served to emphasize what a delicate hothouse plant a Mach 3 airliner was and render the project vulnerable to knowledgeable critics.

The SST Lurches Forward

The Federal Aviation Agency was put in charge of the project. This was a mistake. The FAA is a regulatory organization and not an R&D agency. The most complex system it had been called to create was the nation’s air traffic

control system, a ground network that employed validated hardware and was relatively simple as compared to a Mach 3 airliner.

Furthermore, it is the FAA that certifies a civil aircraft as airworthy. By placing it in charge of the SST's development it would ultimately have to sit in judgment in its own case. This was a flagrant conflict of interest. A similar conflict existed until the late 1930s when the Civil Aeronautics Authority (the FAA's predecessor) also investigated aircraft accidents, assigning a probable cause. This resulted in instances where it was called upon to criticize its own original judgment of an airplane it had certified. This conflict was resolved by assigning the responsibility for investigating aircraft accidents to a small section of the Civil Aeronautics Board which was otherwise a regulator of airline economics. This CAB function was transferred to the National Transportation Safety Board when it was created in 1967.

The National Aeronautics & Space Administration was the logical agency to have handled the SST project. But in 1963 NASA had its hands full with the space program which had not yet moved into high gear; it had no desire to multiply its problems with a Mach 3 airliner. The rational thing to do was to create a special SST Development Office on the lines of the Manhattan Project that developed the atomic bomb during World War II. But this did not happen. By default, the SST was given to the FAA. Without the engineering resources to handle such a complex project, the FAA was dependent on other agencies for too much of what was necessary to prosecute the development. The result was a multilateral bureaucratic tug-of-war that flawed the project from start to finish.

On August 15, 1963, the FAA issued a request for proposals to the industry. On August 26, it was given a shock when the Douglas Aircraft Co. declined to participate. The name of Douglas was practically synonymous with "airliner" and its refusal to have anything to do with the SST provoked serious second thoughts about the project's viability. President Kennedy asked Eugene Black, former director of the World Bank, and Stanley Osborne, chairman of the Olin-Matheison chemical empire to undertake an SST study. Black and Osborne were hard-nosed financiers; they could not be confused with agents of the "wild blue yonder" who viewed airplanes through a golden tunnel of enthusiasm.

The Black-Osborne Report was finished on December 19, 1963. It held no optimism; it urged great caution, all but saying that a Mach 3 SST made no sense except as an R&D project. Unfortunately, President Kennedy was assassinated on November 22, 1963, Lyndon B. Johnson was now President, and ever since his days in the Senate, Johnson had been an enthusiastic and chauvinistic supporter of an American SST.

Given the many cautions in the Black-Osborne Report it is likely that Kennedy would have waited until after the elections of 1964, and (if reelected), reduced the SST to an R&D project. It might even have been terminated for technical reasons, and no one had to look far for those. But events decreed otherwise. Although the Black-Osborne Re-

port was forgotten by the bureaucracy, over the next seven years its estimates grew into bitter truths, haunting the SST to its political end.

The Sonic Boom

Three serious problems afflicted the Mach 3 airliner: (1) its extravagantly high costs, so high that they could not be estimated within 50 percent of accuracy, and this basket of snakes was compounded by the question of who was going to pay how much for what; (2) the airplane's marginal operating economics which raised the question if the Mach 3 airliner could *ever* pay for itself; and (3) the sonic boom.

The first two problems were debated continuously during 1963-1971 without resolution. Everyone had their own set of "facts," studiously distorted to serve their own purposes. Whose "facts" were accepted as "Truth" depended on where one's prejudices were rooted. On the other hand, the sonic boom was a great noise about which there could be no dispute. Having the sonic boom for a problem, the supersonic airliner really did not need any others.

The sonic boom is an inescapable fact of physics. When any body—a bullet, artillery projectile, a missile, or an airplane—passes through the air at supersonic speed it creates a shock wave that trails behind it. The shock wave takes the shape of a horizontal cone, a 3-dimensional enclosure that radiates from the airplane's nose. The upper segment dissipates itself in the upper atmosphere; the lower segment trails on the ground. When this shock wave trails across water its path can actually be seen rippling across the water.

The conical shockwave is a result of the airplane's passage compressing the air ahead of it; the air along the leading edges of the cone is at a slightly higher pressure than the surrounding atmosphere while the air inside the cone is at a slightly lower pressure than atmospheric. The "boom" occurs after the airplane's passage, when the air suddenly equalizes the pressure differential. This pressure difference is small enough that it is measured in pounds per square foot (psf) and not inches (psi).

With some simplification, this shockwave may be compared to the bow wave a ship, sailing up a river. The further the bow wave moves away from the ship the less strength it has; but when the wave reaches shore it will nevertheless create a slapping sound. When the airplane's shockwave reaches the ground the sudden equalization of pressure creates a sound similar to a short thunderclap—a "boom."

The size of the boom is a function of the airplane's mass; the bigger the airplane the bigger the boom. The intensity of a boom varies with altitude; the lower the altitude the higher the intensity as measured in psf. As of 1960, sonic booms were created by only relatively small airplanes, usually fighters. The biggest "boom-maker" was the B-58 bomber, but relative to prospective supersonic airliners it was a small airplane. The Mach 3 SST promised to have at least ten times the mass of a B-58.

By 1960, the mechanics of the sonic boom were well understood and it was equally well understood that most

persons on the ground found a sonic boom disturbing. The experience of one or two sonic booms could be “interesting;” but to transform this into a multiple experience of daily life would be a terrible nuisance. During 1962, a series of “boom tests” were flown over St. Louis, Missouri, disguised as “training missions” of the Strategic Air Command. The booms were ballyhoo’d as the “sound of freedom.” Cloaked as they were by an appeal to patriotism, citizens tolerated them with a minimum of complaints. When it was ultimately discovered that this was a lie; that they had been used as guinea pigs to generate data for a commercial airliner, there was widespread anger, resentment and protest.

In 1964, the FAA and the Air Force conducted an intensive series of boom tests over Oklahoma City with its population of some 650,000 persons. The FAA has its largest office in Oklahoma City, commands a substantial payroll, and because of this it was assumed that local folks would be tolerant of the exercise. They were passive for a while, but after twelve weeks of six to eighteen booms per day, the city’s furies were soon aroused. The resultant overpressures of 1.5 to 2.0 psf caused extensive property damage—cracked and shattered windows, cracked plaster, and roof damage among other things.

The U.S. government has *never* been good, much less gracious, about compensating its citizens for damage done by its agents. The FAA’s bureaucrats had a vested interest in minimizing sonic boom damage and the aggrieved citizens of Oklahoma City were given less than justice; most of their claims were not satisfied until years after the event. Anxious to protect its SST project, the FAA claimed that the Oklahoma City tests were “inconclusive;” a tissue of lies created that kept the project alive for another six years.

That sonic booms could cause serious damage was well understood before the Oklahoma City tests. On August 5, 1959, during ceremonies that opened the new airport terminal in Ottawa, Canada, an F-104 fighter in an air display accidentally exceeded Mach 1 at low altitude. The shockwave measured 38 psf, extraordinarily high. It literally exploded the structure of the airport’s control tower, shattered glass throughout the new terminal building, and collapsed many of its internal non load-bearing “curtain” walls. It is amazing that no one was killed.

What remained undetermined and was undeterminable is how much damage would sonic booms inflict by attrition, over a term of years. And there was the long term effect on humans being “boomed” by two psf up to four or five dozen times a day. Joliet, Illinois may be taken as an example. With a population of some 80,000 persons 50 miles southwest of Chicago, Joliet is the site of an important VOR (Very high frequency Omnidirectional Radio range) beacon on a transcontinental airway. Practically every nonstop flight from cities in the Northeast to points west of the Mississippi River overfly the Joliet VOR, more than a hundred flights per day. If one half of these flights were SSTs it would mean fifty booms per day, an average of two per hour, and 18,250 booms per year. Aside from possible material damage by attrition, the repeated booming would make life on the ground intolerable.

There are hundreds of “Joliet” in the United States, most of whose citizens are blissfully unaware of that they are living beneath part of the nation’s vast web of busy but invisible airways. This ignorance and its bliss would be rudely shattered if and when supersonic airliners started booming along the airways.

In 1966 it was estimated that the American SST, if built, would create a “boom trail” sixty miles wide on the earth’s surface from a cruising altitude of 60,000 ft. Furthermore, even if routed around densely populated areas, the airplane would “boom” some five million persons. FAA bureaucrats hastened to dismiss this number as less than three percent of the nation’s population. It is nevertheless a substantial number of people.

Government proponents of the SST tried desperately to cover up the uncoverable: the sonic boom. They sought to minimize the problem with doubletalk, baffle-gab, and thickets of buzz-words, perversions of the English language that were raised to an artform in the 1960s. At one point the FAA even suggested that the sonic boom could be “designed out” of the SST, which is patently impossible.

It was quietly admitted in Government circles that the sonic boom nuisance would preclude the SST from operating in continental airspace; its operations would have to be limited to transoceanic air routes. Although not made public this eventually leaked out. It was bad news, describing a devastating predicament for any supersonic airliner. The estimates of the world market for SST sales varied from 650 to 1000 airplanes; if restricted to transoceanic routes the market shrank: to about 300 machines.

It was not until a knowledgeable, grass roots protest movement against the SST started to take form after 1967 that the public started to receive some intelligent information about the sonic boom. Eventually, the Government admitted that it “might” be necessary to restrict SSTs to transoceanic routes. In 1970, Congress took the matter out of the hands of the FAA bureaucrats by outlawing supersonic airliners from the continental airspace.

Vietnam: Bloody National Distraction

Meanwhile, from August 2-4, 1964, two destroyers of the U.S. Navy operating in the Tonkin Gulf off Vietnam’s coast, had a shooting affray with torpedo boats of the People’s Republic of Vietnam (PRV). The PRV was the Communist government that ruled North Vietnam, which was at odds for control of the whole country with South Vietnam whose government was a U.S. client. The strategists in the U.S. Department of Defense seized on this incident for an opportunity to “punish” the PRV with a short series of air attacks on its naval bases.

This “Tonkin Gulf Incident” (as it came to be called) was the overture to a massive U.S. military involvement in the war between the two Vietnams. It was a misadventure that cost some 50,000 U.S. combat deaths, had an insidious long term effect on the U.S. economy, burdening the nation with debt that is still being carried. The events of 1964-1972 cannot be understood without keeping in mind the social and political turmoil created within the United

States in this period. The war in Southeast Asia had a corrosive effect on *all* events: in America during these eight years. The U.S. forces finally withdrew in 1972, while the PRV overran the South in 1975.

Anybody Got a Mach 3 Airliner?

Meanwhile, work on an SST lurched forward. By the spring of 1964, the FAA had three concrete proposals. North American Aviation proposed an airliner variant of its B-70 bomber. It was technically the safest, but it was simply too small and quickly eliminated. Lockheed proposed a conservative and realistic design with a delta wing similar to the *Concorde* but much larger and possessed of Mach 3 performance. Boeing's proposal incorporated variable geometry, the novel "swing wing," and promised the most technologically advanced airplane. Of all the proposals, Boeing's held the most risks. At this date both the Lockheed and Boeing designs described an airplane of about 500,000 lbs.

A runoff took place between the Lockheed and Boeing proposals and the manufacturers were told to further develop and refine their designs. This process became bogged down in a network of Government committees and a quagmire of competing economic studies which concealed a wasteful game of bureaucratic one-upmanship. Incredible as it may seem, this stuttered on for *two years!*

It was not until December 31, 1966, that a decision was finally made in favor of the Boeing design, which by this time had grown to 650,000 lbs. It is said that when Boeing was announced as the winner, Lockheed engineers breathed a sigh of relief, and left the room laughing with the remark that "Boeing deserved it!"

In the spring of 1967 a contract was concluded for two prototype airplanes at a cost of \$1.444 billion spread across four years, an average of \$361 million per year. In 1963, the cost of one prototype was estimated at \$750 million; now it was expected to buy two for less than twice the original estimate. However, during the four years since 1963, the Vietnam War had accelerated inflation; 1967's dollar had less purchasing power than the dollar of 1963, and dollars of the next four years would have even less. Clearly, there was something essentially unrealistic about this contract.

The Boeing Dash-Dash-Dash-

Boeing's design, its Model 2707-100, was troubled from the first. Starting at 500,000 lbs. in 1964, it had grown to 650,000 lbs. by 1966. In August 1967, it was up to 675,000 lbs. and in September, as the revised 2707-200, its weight jumped to 750,000 lbs.

The design was caught up in a deadly weight-fuel spiral. As the gross weight is increased, to retain its original specified performance the airplane's fuel consumption increases. Tankage must be enlarged. The additional fuel has weight and may require more structure which will increase tare weight, may increase gross weight, which in turn increases fuel consumption—and the cycle begins again.

Eventually a plateau is reached where the weight envelope is brought into balance. But by this point the airplane's gross weight may have increased to a point at which the original engines have insufficient thrust: an uprated engine becomes necessary.

Clearly, everything with the -200 was getting out of control. Boeing was given a year to revise the whole design. This resulted in scrapping variable geometry. Most of the "swing wing's" problems came to focus in the "wingbox," a huge block of titanium of some twenty-five tons that was to carry the mobile outboard wing sections. There was also the powerful hydraulic system necessary to move the outboard sections. Hydraulic systems are not very interesting to behold, but they are notoriously heavy.

The revised Boeing design, the 2707-300, had a fixed wing of delta planform and was very similar to the Lockheed design that had been rejected. The -300 also bore a similarity to the *Concorde*. The news media criticized Boeing for its costly obsession with the complicated swing-wing. In truth, this was the customer's obsession. In the design and manufacture of airplanes the role of the customer rarely gets the attention it deserves. As a rule, the customer gets what he asks for.

In this case the "customer" was a swarm of Government aviation bureaucrats who had been determined to build the ultimate "prestige" airplane incorporating the latest and most dramatic novelties, even though they were unvalidated by a body of experience. The first production airplane with variable geometry was the Convair F-111, an Air Force attack plane. An F-111 did not fly until December 21, 1964, and it was afflicted by many teething problems. However, a fixed wing of delta planform that resulted in an American SST resembling the *Concorde* was *not* desired. For five years, form was as important as substance. In 1967 the "customer" had to come to terms with substance alone.

The delta wing 2707-300 came out on paper with an estimated gross weight of 640,000 lbs. as a prototype and 710,000 lbs. as a production airliner. Even if the latter experienced ten percent growth, unfortunate but not unusual, it would fly at more than the heaviest weight from which the swing-wing design had been continuing to grow.

SST—Kaput!

The -300 design was further improved in 1969 and the project started moving again. Meanwhile a noisy anti-SST protest movement had developed. Concurrently in Britain there was an anti-*Concorde* movement. The protesters rightly focused on the sonic boom and the supersonic airliner's inevitably higher noise levels. But with the passing of time they also claimed that the airplane would inflict a host of other social and environmental hazards, most of them far-fetched. They included everything except a cataclysmic increase in the world's birth rate and a melting of the Polar icecaps.

Meanwhile, the -300 design continued to be troubled. Worse, the whole project was now coming under criticism



Artist illustration of test runs of the Boeing 2707 SST, dressed in PanAm livery. PanAm had the largest order, which it ultimately cancelled.

by knowledgeable persons who had experience with the industry. The most devastating criticism came in 1971 from a corps of nationally known economists who questioned the economic viability of *any* supersonic airliner; never mind the FAA's badly botched dreamboat. These analyses reduced the SST to an economic ruin.

An effort in 1970 to terminate Congress's appropriations for the SST proved unsuccessful. But in a dramatic session of the U.S. Senate on March 24, the SST funds were killed amidst great noise.

From start to finish, in Britain, France, and the United States, the supersonic airliner was a flying machine that the world did not need; it was a political airplane. Its seed was the product of Anglo-French political frustration and emotions transplanted in American politics. By means of reprehensible prestidigitation, cloaked by flag-waving enthusiasm, the bureaucracies on both sides of the Atlantic built billion dollar hothouses for their pet project.

Both the airplane manufacturers and the prospective airline customers in the U.S. were quietly certain that a supersonic airliner was, at best, premature, but it was impolitic to say so in public. By 1970, all concerned wished that they had never heard of an SST. Meanwhile, from 1963-1971, a trifle more than a billion dollars was spent on the paper airplane, the only result being a fragmentary design that Boeing never got integrated.

The Folklore of Airplane Procurement

The ultimate costs of an SST were never determined with anything that approximated reality. On this point there are three items of wisdom from the folklore of airplane design and manufacturing that do not appear in textbooks; but like most folklore they hold powerful elements of truth:

1. Airplanes are like nails because you buy them by the pound; the heavier the airplane, the more it will cost.

2. Any design competition for a Government aircraft contract is a "Liar's Contest" because the customer agency really does not want to know what the project will ultimately cost. They want the "hardware," but know that if Congress is given accurate figures the shock may be so great that a year or two may be lost "studying" and "re-studying" the project before it inevitably goes ahead. Meanwhile, a year or two may be lost and the project has become even more expensive. The would-be contractor's task is to produce figures that are low enough to be acceptable *and* credible; the customer agency will be agreeable, those congressmen and senators "in-the-know" will nod their assent, reassure or fend off critics, and the project will go forward. The real costs will be met later, years down the line, when there will be a noisy *pro forma* denunciation of them as "cost overruns," and the contractor will be publicly vilified for doing what was silently expected of him. After the noise has died down the contractor is supposed to weep as he takes his money to the bank.
3. Airplane cost estimates for Government contracts are like bakery goods and may be reduced to "pie-and-cake." Realistic figures may be obtained by multiplying original estimates by Pi (3.146); and if the whole resultant program comes out at less than this, the whole experience has been a piece of cake.

How Good Airplanes are Bought

While the American SST was in its troubled gestation, Pan American Airways initiated talks with Boeing in the summer of 1965, aimed at development of a 700,000 lb, 400-seat subsonic airliner. In late 1965, these conversations came to focus in a letter of mutual intent by which Boeing worked up a detailed design and PanAm agreed to buy twenty-five airplanes at a unit cost of some \$20 million each. Four months later on April 13, 1966 a firm contract was signed.

The development of the resultant Boeing 747 was no love feast between Boeing and PanAm. As is the case with most new airplanes, the 747 had its problems with weight and most of them were serious. There were some bitter recriminations between builder and customer, including threats of lawsuits. Nevertheless, on February 9, 1969, thirty-three months after contract, the 747 made its first flight. And on January 22, 1970, within thirty-six months of contract, the 747 went into airline service with PanAm.

During its first year of service the 747's excessive weight caused severe problems with overloading its JT9D engines, with the turbines overheating and getting "out of round." This was resolved by uprating the JT9D. This uprating was planned for, but because of the 747's overweight it became necessary to accelerate the increase in thrust, an expensive experience. Nevertheless, the 747 flew on to become one of the finest airliners in the world.

As airplanes *per se* there is no realistic comparison between the Boeing 747 and a Mach 3 SST. The 747 was built on the apex of a pyramid of technologies that had their base in the earliest 1930s. The success of a Mach 3 SST was dependent on technologies that were conceived in the 1950s, were only in an advanced R&D status by the 1960s, and most of them wanted for validation by a broad body of experience. Compared to a Mach 3 SST, a 747 was a simple "old fashioned" airplane.

However, the techniques by which procurement was sought do bear comparison. At no time did the decision-making process in the 747's procurement involve more than a dozen persons from each company and it usually came to focus quickly in the persons of the respective chief officers. This is the way good airplanes are bought—not by overlapping Government committees whose political members come and go from the scene as the years spin out and anyone can wonder "who's on first?" Furthermore, most of these bureaucrats have only a marginal interest in the subject and none have direct responsibility for it. The primary function of committees is to diffuse and confuse blame; in Government this is an artform.

It is tempting to speculate that if procurement of the Mach 3 SST had been organized in 1963 on a basis similar to the 747's, a prototype airplane would have been flying by 1971. However, it is likely that it would have proved to have been so ridiculously expensive it never would have gone into production.

The Price of *Concorde* and *Grandeur*

While the American SST was in travail, the Anglo-French *Concorde* crept forward. The bi-national venture was novel and many ancient national prejudices, fears, and suspicions had to be overcome. It is said that Britain and the U.S.A. are a common people divided by a common language. The British and French are neighbors divided by twenty-two miles of salt water and 500 years of tumultuous history, even going back to "1066 and all that...." Meticulous care was taken to see that the *Concorde* work was divided fifty-fifty. This division, artificial in some instances, inevitably resulted in inefficiencies.

The question of where the airplane was to be assembled framed a chauvinist's nightmare, because the site of final assembly dictated the point of a first flight, and in the mass mind this would mark the airplane's "nationality." This was resolved by the extravagance of *two* assembly lines, one in Toulouse, France, the other in Filton, England. This meant that common parts and sub-assemblies manufactured in France had to be air-freighted to Filton for the British *Concordes* and those fabricated in Britain had to be air-freighted to Toulouse for the French airplanes. The symbolic gimcrackery of "prestige" is usually costly, but this arrangement was also very clumsy.

By October 1964, after two years of design work, the *Concorde's* estimated costs had long since spiralled upwards and out of sight. Final costs seemed beyond estimate. The British government had its fill of "prestige" and sought to cancel the project. But the French were determined to achieve Mach 2 *Grandeur* and the British found themselves trapped in the unbreakable agreement which they had themselves devised.

On December 11, 1967—five years after the treaty of 1962—the first *Concorde* prototype was rolled out at Toulouse; nine months later in September, the first British *Concorde* was rolled out at Filton. A first flight was expected in 1968, but both airplanes were afflicted by a rash of problems in their "systems;" flaws in the brakes gave no end of difficulties. Then on December 31, 1968, at Moscow, the Soviets hastily took up the Tupolev Tu-144 supersonic airliner for its first flight.

This was a typically Soviet stunt. By flying on the last day of the year, the "world's first supersonic airliner" flew in the Soviet Union in "1968." If the *Concorde* flew the next day it would be in 1969 and a "year" later. This was a history book triumph for the "Land of the Workers and Peasants." The Tu-144 turned out to be a patchwork fiasco which subsequently had to be re-designed; not just once, but apparently twice. In 1973, the Soviets flew a Tu-144 to the Paris Air Show at Le Bourget Airport, where, before the eyes of some 300,000 spectators, the pilot put it through a maneuver that overstressed the airplane. It started to break up in the air and was destroyed in a spectacular crash that killed its crew of five and eight persons on the ground. Not much has been heard of the Tu-144 since 1976.

On March 2, 1969, almost fifteen months after its roll-out, the French *Concorde* finally made its first flight. The British prototype followed on April 9. In June, both *Concordes* were exhibited at the Paris Air Show—where they were literally overshadowed by the massive presence of the first Boeing 747.

A few weeks later on July 20, 1969, at 4:18 p.m. EDT the lunar module of the *Apollo 11* space mission touched down to the surface of the moon and a few minutes later Neil Armstrong and Edward E. Aldrin, Jr., became the first humans to set foot on the moon. However, there were no supersonic airliners speeding travelers between the continents. The air traveler's "space age" was going to be what PanAm ballyhoo'd as the "spacious age," and it was to be found in the gracious interior of a Boeing 747.



The short-lived Soviet Tu-144 SST.

The overall form of the *Concorde* prototype was inadequate as an airliner. It was too small. Most of the airplane had to be re-designed; this included “stretching” the fuselage. This resulted in two (one French, one British) “pre-production” prototypes. This is called “getting it right on the second go-round.” It was almost three years before the first one flew, on December 17, 1971, the 68th anniversary of the Wrights’ first powered flight. The “pre-production” prototype cast the shape of the operational airliner.

The final *Concorde* crisis occurred in early 1973. Several airlines had taken options to buy *Concordes*. Pan American Airways had led the way, with options on six. Most observers were certain that PanAm was simply hedging its bets on the American Mach 3 SST, on which it also held options. But now the SST was dead. In January 1973, these options came due for action and PanAm cancelled. This sent a terrible shock through the Anglo-French governments. Worse, the PanAm cancellation rippled through the industry with all other airlines also cancelling.

Air France and BOAC (in 1974 it reorganized as British Airways), were “prisoners” of their respective governments which, together, had poured some \$2 billion into the *Concorde*. Air France and BOAC were going to sign up for *Concordes* if they liked it or not—and they didn’t. The only *Concordes* sold were to these “captive” national airlines. In fact, by means of convoluted financial arrangements duly obfuscated, the British and French governments practically made a gift of the airplanes to their respective national airlines. Clearly, these “sales” were essentially a matter of the governments taking money out of one pocket and putting it in another.

On June 17, 1974 Air France gave the world a spectacular performance which demonstrated what a supersonic airliner was “all about.” A *Concorde* took off from Boston’s

Logan Airport at the same time an Air France 747 bound for Boston took off from Orly Airport, Paris. The *Concorde* flew to Paris, landed, was serviced, and took off again, for Boston. It touched down at Boston before the 747 arrived in the airport’s terminal environment.

Everyone applauded this sensational demonstration, but no one rushed forward to buy *Concordes*. Besides the *Concorde*’s small capacity, it takes a lot of energy to push a supersonic airliner through the air. Any supersonic airplane is a fuel hungry beast. And 1974 was teaching the world some bitter lessons in the conservation of energy.

The New Costs of Mach 2

In 1973, taking advantage of the Arab-Israeli “Yom Kippur War,” the Organization of Petroleum Exporting Countries (OPEC) doubled, re-doubled, and doubled again, the price of crude oil, creating widespread confusion among nations that were dependent on imported oil. By 1973, extravagant consumption had burdened the U.S. with an oil deficit made up by imports. This confusion was compounded by a temporary Arab oil embargo selectively enforced against nations in the West which supported Israel.

By 1974, the airlines were extremely conscious of fuel consumption. During a flight from Paris to New York with a full load of 100 passengers a *Concorde* consumes about 160,000 lbs. (24,240 U.S. gal.) of fuel, which amounts to 1,600 lbs. per passenger. A Boeing 747 with 350 passengers over the same route consumes about 175,000 lbs. (26,515 U.S. Gal.) or 500 lbs. per passenger. Even with only 175 persons on board a 747’s consumption is only 1,000 lbs. per passenger.

The maximum take-off weight (MTOW) of the *Concorde* is 408,000 lbs.; that of an early model Boeing 747-

100 was 735,000 lbs. Measured relative to MTOW the *Concorde's* fuel consumption is .39 lbs. of fuel per pound of gross weight; the same for a 747 is 0.23, a 41 percent difference.

But what is more, besides its passengers and their baggage, a 747 also carries a highly profitable payload of lower deck cargo. The weight limited *Concorde* does well to carry its passengers' baggage, never mind cargo. Indeed, on one occasion a British Airways *Concorde* was accidentally overbooked and overloaded. The passengers were given the choice of some getting off the airplane, or all staying aboard and everyone having their baggage follow them in a subsonic airplane. They all chose to go and let their baggage follow. In the 1920s the airlines used to make each passenger stand on a scale while holding their baggage so they would know exactly what each "passenger" weighed. It never got this critical with the *Concorde*, but almost.

Mach 2 Flying Services

On January 21, 1976, Air France and British Airways inaugurated the world's first supersonic airline services. Air France flew from Paris to Rio de Janeiro, Brazil, via a fuel stop at Dakar on the bulge of West Africa; the British from London to the oil center of Bahrain on the Persian Gulf nonstop. Fourteen years had passed since the *Concorde* Treaty of 1962.

On May 24, 1976, the two airlines jointly inaugurated North Atlantic nonstop supersonic services from Paris and London to Dulles Airport near Washington, D.C. with a flying time of about four hours. The one-way *Concorde* fare from Paris to Dulles was \$827; \$1654 for a roundtrip. This was extraordinarily expensive in a day when an economy seat aboard a subsonic airliner cost something like \$350 for the North Atlantic roundtrip.

Concorde services to New York City were delayed by grandstanding politicians catering to publicity-seeking "environmentalists;" for more than two years they noisily refused to give the *Concorde* a landing permit at JFK airport. The Anglo-French airlines found it necessary to bring suit against the Port Authority of New York. Ridiculous as it may seem, the case had to go all the way to the U.S. Supreme Court which, on October 17, 1977, found in favor of the airlines. And on November 22, 1977, *Concorde* services from Paris and London were inaugurated to New York City.

Flying westbound to North America, the *Concordes* are genuine "time machines." Time does not just "stand still," it moves backwards. The *Concorde* out-races the sun in its passage, delivering its passengers to their destination an hour *before* they left. This is in terms of "clock time." Inevitably, this is a fascinating experience and a marvelous demonstration of what supersonic transportation is supposed to be all about.

Eastbound, however, *Concorde* schedules are not only less satisfactory but there is an element of futility to them. None seem able to create a rational integration of ordinary life as it is lived in the two hemispheres. Leaving New York at 9 a.m. (2 p.m. in London), arrival in London is at 6 p.m., when all offices have closed. The traveler is ready for lunch;

the British are preparing for dinner. At two o'clock the next morning the *Concorde* traveler feels as if its only 9 p.m., and is still wide awake. Leaving New York at noon (5 p.m. in London) the traveler arrives at 9 p.m., too late even for the theater. To arrive in London for the start of business day at 9 a.m. (4 a.m. in New York), the *Concorde* traveler has to leave New York at midnight. Eastbound, the air traveler is better off buying a first class seat on a subsonic airplane; it's not only cheaper but they will see a movie, be fed twice, and gain enough sleep that that they can fool themselves into believing that they've not crossed five time zones.

Inflation has inevitably increased *Concorde* fares, and as of November 16, 1982, they are:

	One-Way	Round-Trip
Wash., D.C. -London	\$2062	\$4293
London-Wash., D.C.	\$2231	\$4293
N.Y.-London	\$2027	\$4218
London-N.Y.	\$2191	\$4218
Paris-N.Y. or N.Y.-Paris	\$1980	\$3960

For some unexplained reason the British fares reveal a seven percent surcharge on westbound flights. Most of the people who travel aboard the *Concordes* are doing it on someone else's money; they are business folks with generous expense accounts.

Whereto Mach 2 Air Travel?

More than a few knowledgeable persons quietly feared that after a year or two of operations one of the *Concordes* would experience some kind of a structural failure and disappear over the ocean. An airplane that comes apart at Mach 2 is simply shredded; the wreckage decelerating from 1200 mph and falling from 60,000 ft. would be scattered over a corridor three miles wide and more than 100 miles long. Not much would be found. But the Anglo-French engineers have built well. The *Concordes* have been relatively trouble free, even on small counts.

However, the *Concorde* remains a severely weight limited airplane with seats for only 100 persons. Although a *Concorde* can lift a full load from London or Paris to New York, Washington, D.C. which is some 200 miles further poses problems, especially for the French because Paris is 165 miles east of London, making the total differential almost 400 miles. Cabin loads from Paris for Washington are usually limited to 85 or 90 passengers.

The Air France operation to Washington has never been satisfactory in its results and it was "suspended" on October 29, 1982, probably never to be resumed. British Airways continues to serve both New York and Washington, but the operations of both airlines are absolutely dependent on government subsidies. The French cut their losses by terminating the Washington service. The British government is seeking to reduce its subsidies; if the reduction is large enough it may signal the beginning of an end.

A total of twenty *Concordes* were built: two prototypes,



While providing more front-to-back legroom than twenty-first century airliners, the narrow width of the passenger cabin shows clearly here.

two “pre-production” prototypes, and during 1973-1977 all four of these were consigned to museums. Two production models were retained by the manufacturers; only fourteen airplanes, evenly divided between the two airlines, are in scheduled service. It seems likely that after the 10th anniversary of *Concorde* services in 1986 they will also be candidates for museums.

The known costs of the *Concorde* program exceed \$2 billion and may well prove to be somewhat more than \$3 billion. It is probable that no one in the British or French governments really wants to know the total cost. Twenty years have passed since the *Concorde* Treaty of ‘62; sleeping dogs are best left alone. If a conservative figure of \$2.5 billion is assumed, the fourteen working airliners cost more than \$178.5 million each. The unit cost was originally estimated at \$15 million. The overrun not only exceeds the factor of Pi; it exceeds multiplication by Pi squared.

A political airplane from its conception, the *Concorde* has been sustained only by the political instrument of taxation and continues to operate only by virtue of the politics of national prestige. Having observed the fifth anniversary of its scheduled services in 1981, and with most of the airplane’s original proponents gone from the many, many of them deceased, the *Concorde* could be consigned to history “with honour” at any date in the immediate future.

A Subsonic Sideshow

When the *Concorde* pre-production prototype was rolled out to drums and trumpets at Toulouse on September 28, 1968, it was also rollout day for the A300 Airbus, a subsonic twin-engine airliner of 295,000 lbs. which has a cabin cross-section of 222 inches, seventy-four inches more than a Boeing 707 but thirty-three inches less than a Boeing 747. The Airbus was also a “political” airplane in that

it represented the efforts of France, Germany, the Netherlands, and Spain combined in Airbus Industrie, S.A. to produce a large-capacity medium-range airliner. But there occurs a profound difference.

The British government was invited to join the consortium, participated for a moment but then withdrew. However, Hawker-Siddley (later combined into British Aerospace Corp.), had the wit to remain as a “private” associate of this otherwise government sponsored enterprise. Later, West Germany joined the consortium. The A300’s constituent pieces are manufactured in the member countries and are then air-freighted to Toulouse for final assembly. The A300 was originally powered by General Electric CF.6 engines, and later made available with Pratt & Whitney JT9D and Rolls Royce RB.21 options. This served to make the A300 “politically acceptable” in the United States—and made it a truly “international” airplane. By no means clear in 1968, the European Airbus venture can now be read as the starting signal for an increasing number of international aircraft design and manufacturing arrangements and the beginning of a quasi-internationalization of the industry.

The *Concorde* was the star of the show on that September day in 1968; the unexciting A300 was practically ignored. But over the next ten years this “plain Jane” developed into the greatest success story of European aviation of the 20th century. It took the Europeans a quarter of a century to learn, but they learned. Most significant, the A300 venture transcended Europe’s many national boundaries to establish a truly *European* aircraft industry. It has become an eminently successful airplane; it launched a new “family” of airline equipment; it has proved to be the lusty rival to the “American hegemony of the skies” that 1962’s architects of “*Grandeur*” expected the *Concorde* to be. But that is another story.



Always a graceful aircraft, the *Concorde* was ultimately a technological triumph and an economic uncertainty. Wide-body airliners took over.

The Mach Z Zeppelin

Everything relating to the supersonic airliner from 1956 to our own times—twenty-six years, a shade more than a quarter of a century—suggests that average air travelers are flying as fast as they are going to, for many years to come. After the *Concordes* are retired air transportation will retire absolutely from the “excitement” of Mach 2 to the serenity of Mach 0.85. Only the appearance of a fuel that is of substantially less weight per gallon, or is possessed of significantly greater energy per pound, or cheaper than conventional fossil fuels will revive the supersonic airliner. Such a fuel is the stuff that dreams are made of: otherwise the supersonic airplane is an economic nightmare. Happiness may be Mach 0.85.

The *Concorde*'s Mach 2 performance, cutting the flying time between Europe and North America in half is dramatic. However, in 1936, the German Zeppelin *Hindenburg* reduced the transatlantic passage from a fiveday steamship voyage to a 48-hour flight. In terms of relative achievement, the Zeppelin's is marginally greater than the *Concorde*'s.

The Zeppelin-type airship was another extraordinarily expensive aircraft—costing millions in a day when big

transoceanic piston-engine airplanes could be had for only a few hundred thousand dollars. And its construction and operations were absolutely dependent on government subsidies. The *Hindenburg* was another vehicle of national “prestige.” Even if the *Hindenburg* could have operated at maximum capacity until the outbreak of the European War in September 1939, it could never have paid for itself. It is possible that the *Concorde* deserves comparison with the Zeppelin-type airship more than it does to any subsonic jetliner, and that *any* design for an airliner that seeks to exceed Mach 1 will produce what is, essentially, a supersonic Zeppelin.

Editor's Postscript: The *Concorde* stopped flying in 2003. While British Airways claimed profitability, Air France incurred losses, both in spite of the fact that their respective governments had ultimately underwritten the development costs. On July 25, 2000, a chartered Air France *Concorde* ran over debris on the runway during takeoff, blowing a tyre and puncturing a fuel tank. The subsequent fire and engine failure caused the aircraft to crash, killing all 109 people aboard and four people and injuring one in the hotel on which it crashed. While not the immediate cause of *Concorde*'s demise, it certainly didn't help. ■



LINGUISTS GET THEIR WINGS: AIRBORNE VOICE INTERCEPT OPERATORS IN WORLD WAR II

Tyler Morton

B-24s from the 392d Bomb Group.

Allied victories in North Africa during 1942 and 1943, created a dilemma for British and American signals intelligence (SIGINT) collectors. As German and Italian forces withdrew from the African continent, the Allies lost the ability to collect the tactical voice communications of Axis ground and air units. This capability loss left the Allies virtually blind to moves being made by German and Italian forces as they fell back to the European continent. Unaware of to where or in what force sizes the Axis forces were dispersing across the Mediterranean complicated planning for future Allied operations. Desperate to regain the insight the tactical voice communications intelligence (COMINT) provided, the Allies looked for innovative ways to reestablish collection. For the first time in history, this included placing German- and Italian-speaking soldiers and airmen on aircraft flying near – and over – enemy territory to listen for enemy voice communications. This first use of airborne linguists was the genesis of a program that continues to provide high-value tactical and strategic intelligence to warfighters and decision makers today.

Airborne SIGINT collection began during the Battle of the Beams in 1940, when the British explored ways to identify, locate, and develop countermeasures to the Knickebein radio guidance system the Germans were using to direct *Luftwaffe* bombers. To find the signal, the Royal Air Force (RAF) formed the world's first airborne electronic intelligence (ELINT) collection outfit – the Blind Approach Training and Development Unit (BATDU).¹ Using Avro Anson aircraft outfitted with American-made Hallicrafters S-27 ultra-high frequency/very-high frequency (UHF/VHF) radios, on June 19, 1940, the BATDU conducted history's first airborne ELINT mission flown in combat.² During its third operational sortie on June 21, 1940, the BATDU successfully collected the Knickebein signal and located its origin. The BATDU accomplishment proved the concept of airborne SIGINT collection. Using data collected by BATDU, the British developed countermeasures that helped minimize Knickebein's effectiveness. Though narrowly focused on Knickebein, BATDU's success planted the seed for future airborne intercept operations.

British use of airborne linguists began in the summer of 1942. During missions flown from RAF Kabrit in Egypt, the RAF placed linguists on No. 162 Squadron's ELINT-equipped Vickers Wellington aircraft to search for and collect the voice communications of *Luftwaffe* night fighters.³ Initially conceived as a way to track *Luftwaffe* activity, the linguists quickly became valued for their ability to advise aircrews of the locations, origin, and intent of enemy aircraft. After a year of experimentation and success in the Mediterranean, the British decided to expand the program to the United Kingdom. On June 17, 1943, officials from the Air Ministry, the British "Y" Service, and No. 192 Squadron discussed the possibility and brainstormed ideas.⁴ After some debate regarding the dangers of putting untrained airmen on bombers over enemy-held territory, the group dedicated two German-speaking linguists to the effort. The next day, Wing Com-



Orbit location for the first voice intercept flight on June 20, 1943.

mander R. K. Budge, the commanding officer of the RAF “Y” Service, dispatched Flight Officer Ludovici and Sergeant Clark to No. 192 Squadron at RAF Feltwell in Norfolk to begin operational testing.⁵

Ludovici and Clark outfitted a No. 192 Squadron Handley Page Halifax with two S-27 receivers and on June 19, the linguists flew a forty-minute orientation flight to familiarize themselves with air operations and to flight test the S-27.⁶ On the following day the Halifax took off from

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RAF Feltwell, crossed the English coast, and established an orbit over the North Sea approximately one hundred miles northwest of the Dutch coast.⁷ From that position, the linguists intercepted voice communications of *Luftwaffe* fighters and their ground controllers operating in the 38.2 to 42.6 megahertz frequency range.⁸ Initially targeting the *Luftwaffe* fighter control bases at Schipol and Leeuwarden in Holland, the airborne linguists discovered they could hear air activity from deeper inside occupied Europe; the abundance of *Luftwaffe* communications taught them the need to prioritize targets so they would not be overwhelmed by the sheer volume of enemy activity.⁹

The RAF next arranged to have the Halifax listen in on *Luftwaffe* reaction tactics during an American VIII Bomber Command daylight bombing mission.¹⁰ On June 25—only five days after the first experimental sortie—the British Halifax accompanied B-17s of the 306th Bombardment Group on a mission to Hamburg, Germany.¹¹ As the attacking force approached the German shoreline, the Halifax peeled off and established an orbit about seventy-five miles north of the coast.¹² From there, the airborne linguists were able to hear the reacting *Luftwaffe* fighters as they attacked the B-17s. These initial linguist missions



The S-27D Hallicrafters UHF-VHF receiver.

showed the value of having an intercept capability in the bomber formation. On this first foray, Ludovici and Clark learned *Luftwaffe* airborne intercept tactics, techniques, and procedures (TTPs) and were able to pass that information to intelligence officers and aircrews upon their return to England.¹³

Eager to obtain similar intelligence, the Americans followed the British lead and began programs of their own. By at least August 1943, Lieutenant General Carl Spaatz, then commander of the Northwest African Air Forces (NAAF), had ordered German-speaking linguists to fly on Mediterranean-based B-24 ELINT aircraft.¹⁴ In October 1943, Major General James Doolittle, then commander of Twelfth Air Force, began placing linguists on B-17s during bomb raids into Italy and Germany.¹⁵ Additionally, the Combined Operational Planning Committee (COPC) asked the Americans to investigate the possibility of conducting collection from Great Britain-based B-17s and B-24s.¹⁶ In a September 25, 1943, letter to the Air Ministry, Brigadier General Orvil Anderson, Chairman of the COPC, formally requested VIII Bomber Command support.¹⁷ In response, VIII Bomber Command commander, Lieutenant General Ira Eaker, petitioned Air Vice Marshal Frank Inglis—the RAF Assistant Chief of Air Staff for Intelligence—for assistance in equipping VIII Bomber Command bombers for airborne COMINT collection.¹⁸ Attesting to the anticipated intelligence gain the Allies expected from the added capability, Eaker speculated that the recording of *Luftwaffe* communications “should give us useful knowledge of the disposition, tactics, and control of the enemy fighter force.”¹⁹

Within a week, the Air Ministry and VIII Bomber Command met to devise a plan. Unlike the NAAF and Twelfth Air Force tactic of adding linguists to the crew, VIII Bomber Command’s preferred method was to install voice

recorders on the bombers; Command officers worried that putting non-aircrew personnel over enemy territory would create vulnerabilities in both crew integrity and operational effectiveness.²⁰ Beginning in the fall of 1943, VIII Bomber Command planned for a series of operational tests to prove the feasibility of their idea. Underlining the high demand for all types of equipment, the two types of recorders deemed suitable by the Air Ministry—the General Electric magnetic reel-to-reel wire recorder model B.20 and the Amertype recorder-graph “Commando” model—were not available in the United Kingdom and had to be ordered from the United States.²¹ To expedite the equipment delivery, Eaker communicated the requirement directly to the commanding general of the United States Army Air Force (USAAF), Henry “Hap” Arnold.²²

In December 1943, having grown impatient from the equipment delay, VIII Bomber Command borrowed a B.20 recorder and two receivers from the British.²³ Attesting to the urgency of the requirement, rather than wait for professional installation by scientists and engineers from the American-British Laboratory-15 (ABL-15), airmen improvised an installation to ensure the equipment tests could begin.²⁴ After completing the makeshift installation, the airmen conducted three test flights to help prepare for the upcoming series of official experiments. During these flights, they learned that aircraft engine noise interfered with the recorders and that screening of the aircraft engines would be essential for future tests and operations.²⁵

In February 1944, the new equipment from the United States began arriving. With the assistance of ABL-15, Eighth Air Force installed two captured German Funkgerät 16 VHF transceivers and two B.20 recorders onto one of its B-17s.²⁶ On February 20, 1944 the COMINT-configured B-17 flew an operational mission over Germany to test what Eighth Air Force called Plan A



Linguist Edward H. Bubolz of the 95th Bomb Group - Killed in Action.



Linguist Alvin G. Bader of the 303d Bomb Group - Killed in Action.

(recorders only) and Plan B (the use of an airborne intercept operator (linguist) to manually tune *Luftwaffe* frequencies during the mission).²⁷ The results of this operational test were definitive. Plan A limited the number of collected frequencies as there was no airborne operator to tune to active frequencies during the mission. Also, Plan A did not account for the simple fact that equipment often malfunctioned; without an airborne operator monitoring the equipment to fix problems, far too many missions would have been unproductive. Plan B also had problems. The airborne operator had difficulty using the equipment due to the extreme cold—cold hands struggled with the dials on the radios and the connection cables between the receivers and recorders grew brittle and snapped. Despite these challenges, the test operator determined Plan B to be the best course of action.²⁸

Eighth Air Force proceeded with Plan B, and on 15 March 1944 Major General Doolittle—then commander of Eighth Air Force—ordered his three bombardment divisions to implement airborne voice intercept operations.²⁹ In a detailed memorandum, Eighth Air Force outlined the technical aspects of airborne COMINT collection and provided precise instructions to the bombardment divisions. Details as specific as the frequency range to be collected and instructions for the post-mission processing of the intercepts were included. Doolittle's order also identified the ten German-speaking linguists who would comprise the initial Eighth Air Force airborne intercept cadre. Within three weeks of the order, Doolittle's bombardment divisions began flying with linguists on board their B-17s and B-24s.³⁰

Meanwhile, at Fifteenth Air Force Headquarters in Bari, Italy, intelligence professionals and operators discussed airborne voice intercept operations. At a March 1944, meeting, one of the earliest airborne linguists, Sergeant Kurt Hauschildt, described the methodology used by

the airborne linguists.³¹ Using only paper and pencil to take notes during flight—no recording or playback ability was installed on the Fifteenth Air Force aircraft at the time—the airborne linguists identified the number and origin of reacting *Luftwaffe* fighters. The linguists used this information to inform the bomber formation when enemy fighters were airborne and could also determine the approximate range of the reacting German fighters based on the signal strength of the monitored frequency.³² When combined with the linguists' knowledge of the *Luftwaffe* reaction TTPs, the information gave the bombers enhanced situational awareness allowing them to better prepare for the reacting fighters.

The linguists' understanding of *Luftwaffe* tactics saved lives and aircraft. As the Northwest African Strategic Air Forces (NASAF) operational research section—and flight experience—had determined, the Germans preferred to attack bombers that had detached from the main formations. From intercepted communications, airborne linguists knew when German fighters were trailing the groups waiting for stragglers; the linguists used this information to warn the aircrews to tighten their formations.³³ The NASAF Director of Operations, Brigadier General Charles Born, confirmed the tactical value stating his pilots had been impressed by the value of airborne COMINT and preferred flying with the “German-speaking fellas” onboard.³⁴

In addition to protecting the aircraft in which they were flying, the linguists' awareness of *Luftwaffe* activity provided American fighter aircraft an asymmetric advantage. First Lieutenant Roger Ihle, a B-24 airborne electronic warfare officer, stated, “We had these German speaking boys we had monitoring all of the aircraft frequencies of the Germans, so when they heard the Germans starting to scramble, why, they told the [American] fighters what was happening.”³⁵



Airborne Linguist Technical Sergeant Jakob Gotthold.

Though the tactical value the linguists provided was important, their contribution to the assessment of the *Luftwaffe's* order of battle was also significant. At the same Fifteenth Air Force meeting where Sergeant Hauschildt reviewed tactical airborne intercept operations, the group also discussed its strategic value. British Flight Lieutenant J. D. Simmonds believed that NASAF had not historically appreciated the strategic value of airborne intercepts but felt the sharing of information between Fifteenth Air Force and the RAF's No. 276 Wing had started to change opinions.³⁶ NASAF and RAF intelligence analysts began using the linguists' logs to calculate *Luftwaffe* order of battle and reactor base locations. This knowledge enhanced the Allies' overall understanding of German operational and strategic strength and provided a quantifiable method to measure the effectiveness of the overall strategic bombing campaign.³⁷

During the same meeting, Brigadier General Born and the NASAF director of intelligence, Colonel Young, lobbied for an expansion of the airborne linguist program. After much discussion, the meeting attendees agreed that two linguists would accompany each mission and that four aircraft from each bomb group would be outfitted with the S-27 receiver.³⁸ The group also discussed the need for additional German linguists. Colonel Young mentioned a previous higher headquarters offer of one hundred German speakers, but Flight Lieutenant Simmonds advised him to be cautious, stating that the success rate of prospective linguists to that point had been poor and that to successfully complete the qualification process an airborne linguist had to be "thoroughly fit physically, quick on the uptake, and at the same time reasonably phlegmatic."³⁹

Back in the United Kingdom, after the initial training build-up and implementation, the Eighth Air Force used as many as twelve linguists per mission spread across its



Airborne Nisei linguists receive Air Medals.

three bombardment divisions.⁴⁰ While the intelligence the linguists collected was similar in both air forces, Eighth Air Force did not allow its linguists to share information outside the aircraft in which the linguist was flying; Eighth Air Force worried the Germans would intercept the interplane communications and discover the new airborne COMINT capability.⁴¹ As early as November 1, 1944, airborne linguist Technical Sergeant Jakob Gotthold made recommendations for the development of an interplane signaling system, but the USAAF did not incorporate his idea before the end of the war.⁴²

Despite the benefits, airborne COMINT in the European theater was hamstrung by the lack of S-27 receivers and a shortage of trained personnel. The topics were discussed at length in a January 1945, meeting of Eighth Air Force commanders and directors of intelligence. Colonel Edmundson pointed out that only four of the one hundred S-27 receivers his group requested had arrived, with the other ninety-six having been given to the Navy.⁴³ In the same meeting, Colonel Samuel Barr added that the lack of trained linguists was his biggest problem.⁴⁴ Faced with the same hazards and appalling attrition rate as every other aircrew member, any loss of a linguist hurt particularly bad. Sergeant Gotthold also highlighted these problems in a summary of airborne COMINT in November 1944. To mitigate the aforementioned concerns, Sergeant Gotthold recommended the use of recorders on all sorties and lobbied for the creation of a comprehensive training program to ensure standardization across the airborne linguist program.⁴⁵

Even with the problems, the innovative linguists ensured airborne voice collection continued having tactical and strategic impact.⁴⁶ An Eighth Air Force report sent by Major Herbert Elsas to Brigadier General George McDonald concluded the information derived from airborne



The B-24, "We'll Get By" from the 392d Bomb Group, dropping bombs.

COMINT collection was "the only basic source material of signals intelligence originated by Eighth Air Force."⁴⁷ Additionally, in a report on the effectiveness of airborne COMINT, the Eighth Air Force A-2 stated, "The airborne 'Y' [COMINT] project can be considered to have produced highly successful results."⁴⁸

While airmen in the European theater of operations honed their airborne COMINT collection capabilities, a similar effort developed in the Pacific theater. In the early stages of the war, there was little need for an airborne collection capability in the Pacific. Ship- and ground-based units intercepted Japanese communications and were deemed adequate to meet the services' requirements. When Operation Matterhorn – the use of air bases in China and India to conduct bombing missions against Japan – began in spring 1944, planners looked to improve tactical intelligence collection.⁴⁹ To do this, XX Bomber Command's 58th Bomb Wing began using Japanese-American, or Nisei, airmen on their Boeing B-29 Superfortress missions to provide the same type of intelligence the German-American airborne linguists provided in the European theater.⁵⁰ These Nisei from the 6th Radio Squadron Mobile (RSM) were ground linguists, but many volunteered for flying status.⁵¹ Little is documented about the linguists' effectiveness during these operations, but at least two of the Nisei, Ser-

geant Kazuo Kamoto and Sergeant Masaharu Okinaka, were awarded Air Medals for their work.⁵²

As the war in the Pacific progressed, the island-hopping campaign provided new air bases for the USAAF. By November 1944, B-29s of the XXI Bomber Command were attacking the Japanese homeland from bases in the Marianas. Hearing of the airborne linguist success in XX Bomber Command, XXI Bomber Command sought ways to take advantage of the new capability. Due to a shortage of Nisei, the Command first installed recorders on their B-29s and asked ground-based Japanese linguists to transcribe the collection post-mission.⁵³ This provided some strategic value, but intelligence officers knew they could do more. Seeking the tactical value having linguists on board provided, XXI Bomber Command tasked the 8th RSM to provide additional manpower.⁵⁴ Arriving in Guam on November 10, 1944, the 8th RSM brought additional Nisei linguists to fly on bombing and B-24 ELINT missions.⁵⁵

After going through aircrew training and waiting for the B-29s to be equipped with the S-27 receiver, ten 8th RSM Nisei began flying operational combat missions on B-29s and B-24s in the spring of 1945.⁵⁶ While few specific details exist regarding their missions, commendation letters from senior leaders reflect the importance of their con-

tributions. In a memorandum from the Chief of Staff of the United States Army Strategic Air Forces in the Pacific, Brigadier General Kenneth P. McNaughton, to the Commanding Officer of the 8th RSM, McNaughton stated, “Production of this information [tactical intelligence] placed our forces at a definite advantage over the enemy and, therefore, the contribution of the 8th Radio Squadron Mobile in this war cannot be overemphasized.”⁵⁷ Further highlighting their impact, the squadron also received a congratulatory letter from Commander in Chief, Pacific Ocean Areas, Admiral Chester Nimitz stating: “Joint operation of the 8th Radio Squadron Mobile and the Navy Supplementary Station in Guam . . . proved to be a very profitable arrangement. . . . The proficiency developed by the officers and men of the 8th Radio Squadron Mobile in their field of signal intelligence, and hence their share in the victory over Japan, can well be a source of pride to them.”⁵⁸

In addition to the Nisei of the 8th RSM, a similar effort was conducted by V Bomber Command from Clark Air Base in the Philippines. Between April and July 1945, Nisei airmen of the 1st RSM flew on at least five B-24 bombing missions over Formosa and Kyushu.⁵⁹ Flying in a modified position in the bomb bay of the aircraft, the airmen listened for Japanese air or anti-aircraft activity that would help keep the bombers safe. To underline the importance of their contributions, many of the 1st RSM Nisei were awarded Bronze Star Medals for their contributions.⁶⁰

The USAAF continued flying airborne voice intercept missions over Europe and Japan until the end of the war. While the impact can be debated, the fact that such significant advances were made in scarcely three years must be commended. Over the course of the war airmen of the USAAF and RAF created a capability that protected aircrews, gave the Allies unprecedented insight into enemy tactical operations, and, perhaps more importantly for the impending battle for United States Air Force independence, was something that could not be replicated by the Army or Navy. Additionally, the groundbreaking work of these intelligence pioneers enabled success in the coming Cold War. Beginning almost immediately following V-E and V-J days, the American airborne reconnaissance force provided the vast majority of the available intelligence on the Soviet Union; this intelligence often gave air planners and the national command authority the decision advantage needed to stay one step ahead of the Soviets and other ideological adversaries.

The story does not end there, however. The seed corn planted during World War II is still being harvested today. At any given moment around the world, airborne linguists are flying on today’s modern airborne collection platforms gathering the same types of information their 1940s-era predecessors did. Whether delivering tactical intelligence directly to ground troops or by providing strategic intelligence to high-level decision makers, today’s airborne linguists are inextricably linked to those who came before. ■

NOTES

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7. Flight Officer Ludovici, “Report on Airborne Search for German V.H.F. R/T—Dutch and Frisian Area,” 21 June 1943, AIR 40/2717, TNA.
8. “Airborne Interception of VHF/RT,” AIR 40/2717, TNA.
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12. “No. 192 Squadron flight reports.”
13. “No. 192 Squadron flight reports.”
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15. Alexander S. Cochran, Robert C. Erhart, and John F. Kreis, “The Tools of Air Intelligence: ULTRA, MAGIC, Photographic Assessment, and the Y-Service,” in *Piercing the Fog: Intelligence and Army Air Forces Operations in World War II*, ed. John F. Kries (Washington, D.C.: Air Force History and Museums Program, 1996), p. 97.
16. The United States and Great Britain established the Combined Operational Planning Committee in June 1943 as an agency to coordinate all aspects of the strategic bomber offensive. “Air Ministry: Combined Operational Planning Committee: Papers,” AIR 42, TNA.
17. Brig. Gen. Orvil Anderson to D.D.I.4, Air Ministry, memorandum, 25 September 1943, AIR 42/15, TNA.
18. Lieutenant General Ira C. Eaker to Air Vice Marshal Frank F. Inglis, letter, “Extension of ‘Y’ Service,” 13 October 1943, AIR 40/2717, TNA.
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22. Lt. Gen. Ira C. Eaker to Air Vice Marshal Norman H. Bottomley, letter, 2 November 1943, AIR 40/2717, TNA.
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25. “Airborne Recorder Tests.”
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27. “Airborne Interception of Enemy Fighter R/T.”
28. “Airborne Interception of Enemy Fighter R/T.”
29. Maj. Gen. James Doolittle, Commander, Eighth Air Force, to Commanding Generals, 1st, 2nd, and 3rd Bombardment Divisions, memorandum, “Intercept of Enemy Fighter R/T Traffic,” 15 March 1944, 40/2717, TNA.
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31. Hauschildt was a native-born German who had immigrated to the United States with his family shortly after his birth. This was typical of the first batch of airborne linguists as there was limited German language training available in the United States and native speakers were far more fluent than the linguists produced by the War Department schools. For Hauschildt’s enlistment record see RG 64, box 1400, film reel 6.166, The U.S. National Archives and Records Administration (NARA).
32. “Airborne R/T Interception by N.A.S.A.F.,” 1, 21 March 1944, AIR 40/2717, TNA.
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35. William E. Burrows, *By Any Means Necessary* (New York: Farrar, Straus, and Giroux, 2001), pp. 85–86.
36. “Airborne R/T Interception by N.A.S.A.F.” No. 276 Wing was the RAF organization responsible for coordinating SIGINT operations in North Africa and the Mediterranean, “Headquarters No. 276 Wing RAF: Operations instruction number 1,” 7 December 1943, HW 41/432, TNA.
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41. Major Herbert Elsas, “Outline History of Operational Employment of ‘Y’ Service,” 6 June 1945, 3, Spaatz Papers, Box 297, LOC.
42. Gotthold, “Report on Airborne Interception of Enemy R/T Traffic,” 4.
43. Gotthold, “Report on Airborne Interception of Enemy R/T Traffic,” 2; Minutes, HQ USSTAF/Directorate Intel, “Meeting of A-2s of American Air Forces in Europe, Held 0900–1800 Hours, Jan 23, 1945,” Spaatz Papers, Box 121, LOC. Unfortunately, the meeting notes do not include the full names or positions held by the officers who attended the meeting.
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45. Gotthold, “Report on Airborne Interception of Enemy R/T Traffic,” 18.
46. “The Contribution of the ‘Y’ Service to the Target Germany Campaign of the VIII Air Force,” report, Eighth Air Force Director of Intelligence, 4, 18 March 1945, Spaatz Papers, Box 297, LOC.
47. Maj. Herbert Elsas to Director of Intel HQ 8 AF, report, 5 May 1945, Spaatz Papers, Box 297, LOC.
48. “The Contribution of the ‘Y’ Service,” p. 4.
49. Haywood S. Hansell, Jr., *The Strategic Air War Against Germany and Japan: A Memoir* (Washington, DC: Government Printing Office, 1986), p. 142.
50. James C. McNaughton, *Nisei Linguists: Japanese Americans in the Military Service During World War II* (Washington, DC: Department of the Army, 2006), p. 371. The unanswered question here is whether XX Bomber Command got the airborne linguist idea from Eighth Air Force or if the idea was generated indigenously. Second Lieutenant Gotthold, in his aforementioned report, speculated whether the linguist capability could be transferred to the Pacific theater, but I have found no documentation that discussions were happening between 8th AF and XX Bomber Command.
51. “Unit History, 6th Radio Squadron Mobile,” SRH-397, September 1944–December 1945, call number 35019428, National Defense University Library, Washington, DC.
52. “Win Medals for B-29 Missions,” *Pacific Citizen* 20, no. 25 (23 June 1945), <http://ddr.densho.org/ddr/pc/17/25/>.
53. “21 Bomber Command Mission Statistics,” 1 October 1944–1 March 1945, 702.308, AFHRA.
54. “OP-20-G File, Communication Intelligence Organization, 1942–1946,” SRH-279 (describes the function of USAAF intelligence units on Guam and specifically, the 8th Radio Squadron Mobile), 34–36, Reel 5, Frame 310, Cryptologic Documents Collection, U.S. Army Heritage and Education Center, Carlisle Barracks, Pennsylvania.
55. “The Story Behind the Flying Eight Ball,” 8th Radio Squadron Mobile, 1 November 1942–2 September 1945, 25, author’s copy provided courtesy of Mr. Larry Tart.
56. While only ten Nisei actually flew, according to the 8th Radio Squadron Mobile history, all fifty volunteered; see “The Story Behind the Flying Eight Ball,” 39; Kenneth P. Werrell, *Blankets of Fire: U.S. Bombers Over Japan During World War II* (Washington, DC: Smithsonian Institution Press, 1996), 191.
57. Brigadier General K.P. McNaughton, to, Commanding Officer, 8th Radio Squadron Mobile, letter, “Commendation,” 16 October 1945, in “The Story Behind the Flying Eight Ball,” p. 40.
58. Admiral Chester Nimitz, Commander in Chief, U.S. Pacific Fleet and Pacific Ocean Areas, to Commanding General, U.S. Army Strategic Air Forces, “Contributions of the 8th Radio Squadron Mobile to the Joint Army-Navy Radio Analysis Group,” in “The Story Behind the Flying Eight Ball,” pp. 40–41.
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Eighth Air Force Depot Maintenance & Logistics Leadership in World War II



David A. Loska

Base Repair Depot BAD 1 Site Sign, Source: Aldon Ferguson

Contemporary histories of the Army Air Forces (AAF) in World War II acknowledge that the deployment of depot maintenance and logistics operations enabled the rapid assembly, development, and reconstitution of bomber and fighter aircraft in the ETO. The resultant tactical agility proved vital to achieving air dominance over the Luftwaffe and defeating the Third Reich. Seldom do these histories capture how the AAF accomplished this feat, however. Rarer still are examinations of the individual contributors to this success. The stories of these maintenance and logistics forerunners beckon resurrection amidst the high-octane output of a hundred thousand cranking engines infused in the icy fog of obscurity.

Origins

In September 1941, following the combined Anglo-American strategy of the Argentinia conference, General Henry H. Arnold directed Maj General George H. Brett, a seasoned materiel officer and commander of the Air Corps, to conduct a study of the maintenance of American planes, supply lines, equipment and training supporting Lend-Lease requirements in England and Northern Ireland. This was to be followed by a survey of logistical efforts in Northern Africa. Brett bid farewell to his wife and young son “Rock,” who would many years later grow to become Commander of Allied Air Forces Southern Europe. As Brett boarded his LB-30 Liberator aircraft, he told his son “I want to introduce you to a very special individual.... Captain LeMay. He will lead our formation through uncharted territory to resupply the Middle East.”¹ Curtis LeMay’s mission, though concurrent to Brett’s, was singularly significant to theatre logistics as it would establish the ferrying and supply route into North Africa. He would fly a southerly route, first to Brazil and then across the Atlantic and through western Africa to Cairo and return. Brett traveled onward from Cairo to England but would eventually return to Northern Africa for further surveying; leading to the establishment of a depot at Gura in Eritrea.² Brett’s mission was critical; survey and report a detailed account of theatre maintenance and logistics. Time was unimaginably of the essence.

The U.S.’s early investigatory mission in the U.K., the Special Observers Group, known simply as “SPOBS” led by General James Chaney, were directed to test and observe American equipment in the campaign, study British operational methods and manage the exchange of personnel and the standard and experimental equipment between the British and U.S. militaries. Chaney, who was present during the Battle of Britain a year prior, knew the logistical limitations of Rainbow 5 and the earliest war plans. These plans were built in an environment handicapped by Lend-Lease neutrality, devising an end strength that was roughly only one-fifth of what would be required during the inter-theatre operational



Facility Construction Langford Lodge, Lockheed Overseas Corporation Annual Report 1942-1943. 1943, National Archives

peak. Chaney had for some time considered the establishment of a depot facility for repair of American aircraft at Langford Lodge, an airfield located twenty miles west of Belfast in Northern Ireland.³ SPOBS furnished this opinion to Brett, and after his survey, Brett reported to Arnold and the War Department proposing:

“...The AAF set up mobile repair depots manned by civilians to service American aircraft operated by the RAF in the United Kingdom; the AAF ultimately take over the management of existing British facilities for repair of American built equipment and provide for their expansion as required, using initially civilian personnel; specifically, and as quickly as possible, Langford Lodge be established as a depot for third echelon maintenance; and if American air units should operate from bases in the United Kingdom, the United States assume responsibility for third echelon repair facilities for all U.S.-built planes operated by the RAF and AAF, and for the supply of spare parts.”⁴

Brett’s forethought recommendation for the overall transfer of maintenance responsibilities from the RAF would cause some consternation in the War Department and was summarily rejected by Arnold due to the manpower constraint on the embryonic AAF. Arnold would, however, agree that the Langford Lodge depot be established as quickly as possible for third and what would ultimately become fourth echelon, major overhaul maintenance. During Brett’s survey, he inspected other

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sites for probable depot operations, selecting a site called Warton that had once been rejected for aerodrome construction by the British as an unsuitable marsh, then later earmarked as a site for an RAF satellite base at the outbreak of the war.⁵ Warton, near the sleepy agrarian seaside village of Freckleton, was twenty-five miles north of Liverpool and its location advantageously provided access to shipping docks and England’s Lancastrian industrial base.

The Japanese attack on Pearl Harbor and Adolf Hitler’s subsequent declaration of war against the United States less than a week after Brett’s report was submitted, alloyed the malleable logistics planning efforts of the War Department. Though the absence of logistics preparations for “services” during the early stages of the planning effort would become evident in the coming months of execution, America was no longer in doubt over its mission. On January 26, Arnold notified General Chaney of the plan to base in the UK:

“20 Groups of B-17’s or B-24’s, 12 Groups of B-29’s, 22 Groups of B-29’s or other heavy bombardment planes, 10 Groups of pursuit planes, 10 night fighter squadrons, 10 photo recon squadrons”⁶

The planned number of bomber groups would fluctuate varying through the early months of the war before being stabilized by the Joint Chiefs of Staff in October 1943, reaching their maximum strength in the summer of 1944 at forty-one heavy bomber, eight medium bomber, three light bomber, thirty-three fighter and fourteen troop carrier groups.⁷

Deployment

On January 19, 1942, the War Department activated the 8th Air Force at Savannah Georgia. Also activated was the VIII Air Force Service Command (redesignated from 8th AF Base Command), the logistics arm of the 8th. General Ira C. Eaker arrived in England the following month. After reporting to the U.S. Air Forces in the British Isles (previously SPOBS), Eaker was directed to:

“Make a thorough study of bombing operations being conducted by the RAF Bomber Command and submit to this headquarters recommendations covering the training, equipment, tactical doctrines and methods of employment of units required to conduct an effective air offensive... and... a plan covering the reception and assignment to stations of bombardment and auxiliary service units and the administration and supply of such units”⁸

The lack of preparedness and planning for critical logistical factors was immediately apparent to Eaker. In his view, this complex problem had two options with only one objectionable choice. He could fully construct facilities and develop an independent logistics organization before initiating combat operations, or he could have his forces rely on the British to undertake bombing missions soonest. Ideally, Eaker would have built the required depots, and equip



Eighth Air Force Base Air Depot Locations: Burtonwood, Warton and Langford Lodge, adapted from, Eighth Air Force Installations August 1942, Taken from Craven & Cate, 1948

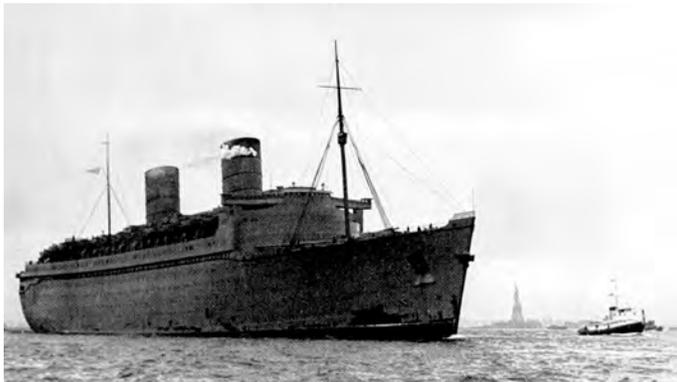
them for the overhaul of engines, aircraft, instruments, and ordnance. He could complete and prepare them entirely. Optimistically, he could have this done before the year was out. Eaker and his staff estimated that the Warton site, not far from Blackpool, could be developed within nine months. Realistically, construction and preparations for any depot facilities had not even begun. Nor had any effort been made to prepare any basing for the reception of troops. Eaker would “compromise” his ideal vision and have the 8th borrow from their hosts. This was difficult to stomach for a man who’d entered military service at the twilight of World War I and witnessed the air arm going hat-in-hand to the French. However, closing on the enemy earlier would add nourishment to the cheapened sustenance of a hand-to-mouth existence. The immature supply lines would have to be accepted; waiting was just too dangerous. The AAF would develop the operational bases that had been made available to them by the British government. Though the stations would still require a lot of work, they could be available almost immediately and, by Eaker’s estimate, could have three bomber groups begin familiarization training for missions by the early summer.

For this to work, the 8th would also need to share and borrow depot facilities to overhaul aircraft until their own could be constructed. Eaker initiated a search for existing facilities that could be put to immediate use. That April, Eaker and Colonel A.J. Lyon, who had been immersed in

logistics planning with SPOBS, inspected and selected the Burtonwood Repair Depot. Eaker forwarded his decision with Chaney’s strong endorsement, and upon receipt, Arnold immediately put into motion the necessary measures for securing the site for American use.⁹ This act cast the mold that would ultimately forge the trident of 8th Air Force depot logistics lethality; Burtonwood, Warton and Langford Lodge subsequently designated Base Air Depots or “BADs” 1, 2 and 3 respectively.

The first forward echelon of the 8th Air Force departed from Boston on the H.M.T. Andes leaving a trail of depth charges behind. The ship cut through dense fog on the River Mersey before disembarking in Liverpool on the 12th of May.¹⁰ On the 3rd of June, the main body of the 8th departed New York on the Queen Elizabeth. Because of the speed of the vessel, there was no need for the standard trail of depth charges. It would arrive before the second advance echelon that set sail three days prior aboard the USS Munargo. On the 9th of June, the main body of Service Command troops arrived. One of the first Americans to arrive, Glen Lundquist, describes his experience:

“I had been working as an aircraft mechanic in sub-depots in the states. Seven of us volunteered from Chanute Field, Illinois. We trained at Kelly Field Texas. We shipped out in the Queen Elizabeth, landing in Scotland near Glasgow, taken by train to Burtonwood. I was first at Site 4 then to



Queen Elizabeth passes the Statue of Liberty at New York, National Archives



P-38 Lightning Maintenance, Burtonwood Source: Aldon Ferguson



US and British personnel check the instruments on a P-51 Mustang at Burtonwood, 1942, © IWM (FRE 14819)

*Site 1, I was assigned to armament inspection on A Site. I was now doing a job after about three months in the Air Force.*¹¹

The expeditious training of technicians was the norm for the Airmen that would come to make up the depot personnel. Maj. Gen. Hugh J. Knerr, who would come to exercise theatre-wide authority of AAF ETO logistics by assuming the “dual-hatted” position of both deputy commanding general for administration as well as commander of the VIII AFSC under General Carl Spaatz, would later say that it was providing and sustaining trained mechanics that was the most considerable logistics challenge of the war. Knerr would recall, “Early in 1943 there were not enough crews trained or untrained, and those sent over after having been trained in this country fell down.”¹² Knerr would later recall that it was during a flight with General Arnold to Prestwick, that Arnold decided to address the need for trained mechanics by furnishing more personnel to be trained on the in-theatre production lines under control of an experienced technician rather than by increasing the quality of training before deployment. “That process trained men in small jobs, larger and larger so that eventually we had all the trained men we needed.”¹³ Although August 17, 1942 saw the 8th fly their first mission, in the early parts of 1943, it would be made manifest that the combat units had outpaced their logistical tail.

Relationships and Leadership

The composition of personnel at each depot was a criss-crossed patchwork of British and American civilians and military. Nowhere was this more uniquely pronounced than at Langford Lodge. Initially conceived as a depot repair facility, Langford Lodge Air Depot quickly grew into the most extensive design, assembly, test and engineering mission in the theatre. Intending for the depot’s eventual management under the military, the War Department contracted the Lockheed Corporation to run the site initially.



The World Flight crews at Sand Point, Washington, before the start of their round-the-world journey. Staff Sgt. Henry Ogden (Second from left) Source: National Air and Space Museum, Smithsonian Institution (SI 81-8960).

This leveraged the relationships that Lockheed had built during its tenure operating an assembly plant for the British near Liverpool. Civilian and military men and women from Great Britain, Ireland, America, and a small group of workers from Poland, were employed on the two-runway air base off the east shore of Loch Neagh. The local men and women arrived to work via train disembarking at Gortnagallon marshaling yard, while the American civilian and military personnel lived and worked on-station out of “Butler Shed” hangers, pole-barn style rectangular buildings roofed and sided in corrugated metal. Base Manager Henry H. Ogden, who was uniquely qualified to manage complex international aviation materiel and logistics operations, having inaugurated the field himself primarily, led the operation.

In 1924, at age twenty-three, Staff Sergeant Ogden served as assistant supply officer and co-pilot as one of two non-commissioned officers on the eight-man team of U.S. Army Air Service pilots; the first ever to circumnavigate the globe in an aircraft. The group departed Seattle in four Douglas World Cruiser aircraft to open air routes for the Army. The feat required the prepositioning of fuel, replacement engines, and spare parts around the world. The planes could only carry 300 pounds of supplies each so Ogden, responsible for the materiel management of the team, made tough decisions about what to bring along, excluding even precious parachutes and life-preservers.¹⁴

After 175 days, seventy-four stops, one crash and the forced landing of Ogden’s initial aircraft in the Atlantic, flying a total of 27,550 miles of serpentine routes through Indochinese jungle, the deserts of Iraq and Jordan, and dodging icebergs as low visibility drove their cruising altitude terrifyingly close to Atlantic wavetops, the team arrived back in Seattle. Ogden, for his resourcefulness, was awarded the Distinguished Service Medal and later Staff Sergeants Ogden and Alva Harvey were commissioned as Second Lieutenants. Shortly after, Ogden left the service and ventured into entrepreneurial roles in aviation, leading to his employment with Lockheed. Nearly twenty years after his round-the-world expedition, Ogden led the BAD3 team that would rapidly grow to 1,200 diversely qualified



Henry H. Ogden, Base Manager, Base Air Depot 3, Lockheed Overseas Corporation Annual Report 1942-1943. 1943, National Archives

support professionals before the end of his first year, and 7,600 at the war's peak.¹⁵ Again performing the role of pathfinder, this time on an industrial scale.

Sharing a similar culture, and both a common enemy and language, relationships between Americans and British at the depots were overall friendly and cooperative. Nevertheless, there were occasional frictions. During the early period that Burtonwood was still under the control of the British, and was carrying the majority of the workload while the other depots came on line, the hastening expansion of American capabilities stirred conflict with the British shop technicians. Upon his arrival in August of 1943, USAAF Captain K. McGee had trouble making heads-or-tails of the production difficulties in his Metal Manufacturing Department. A surprising 50% of all his parts were discarded after failing inspection. The equipment in his shop was the most apparent problem; sixty of the seventy-five machining tools being used were clearly obsolete. McGee quickly put in requisitions for new machine tools, lathes, milling machines, and grinders. Here too he ran into trouble, a tangle of bureaucratic red-tape, as his orders were rejected from the U.S. citing that the machines were "too heavy" and therefore ill-equipped for work in the ETO. Now, insistent upon remedying the root cause of the failure of his production line, McGee found in one of the corners of his shops three brand new screw machines covered in dust. He learned that they were delivered earlier that Spring, but had not been used or even wired for service because the British Labour unions had complained that the machines were too fast and would put men out of a job. McGee could not understand this objection and, despite the controversy, he ordered them put to use. By the end of Sep-



Mary Ann Site, Burtonwood, Photo: Lawrence Sutton, Source: Aldon Ferguson

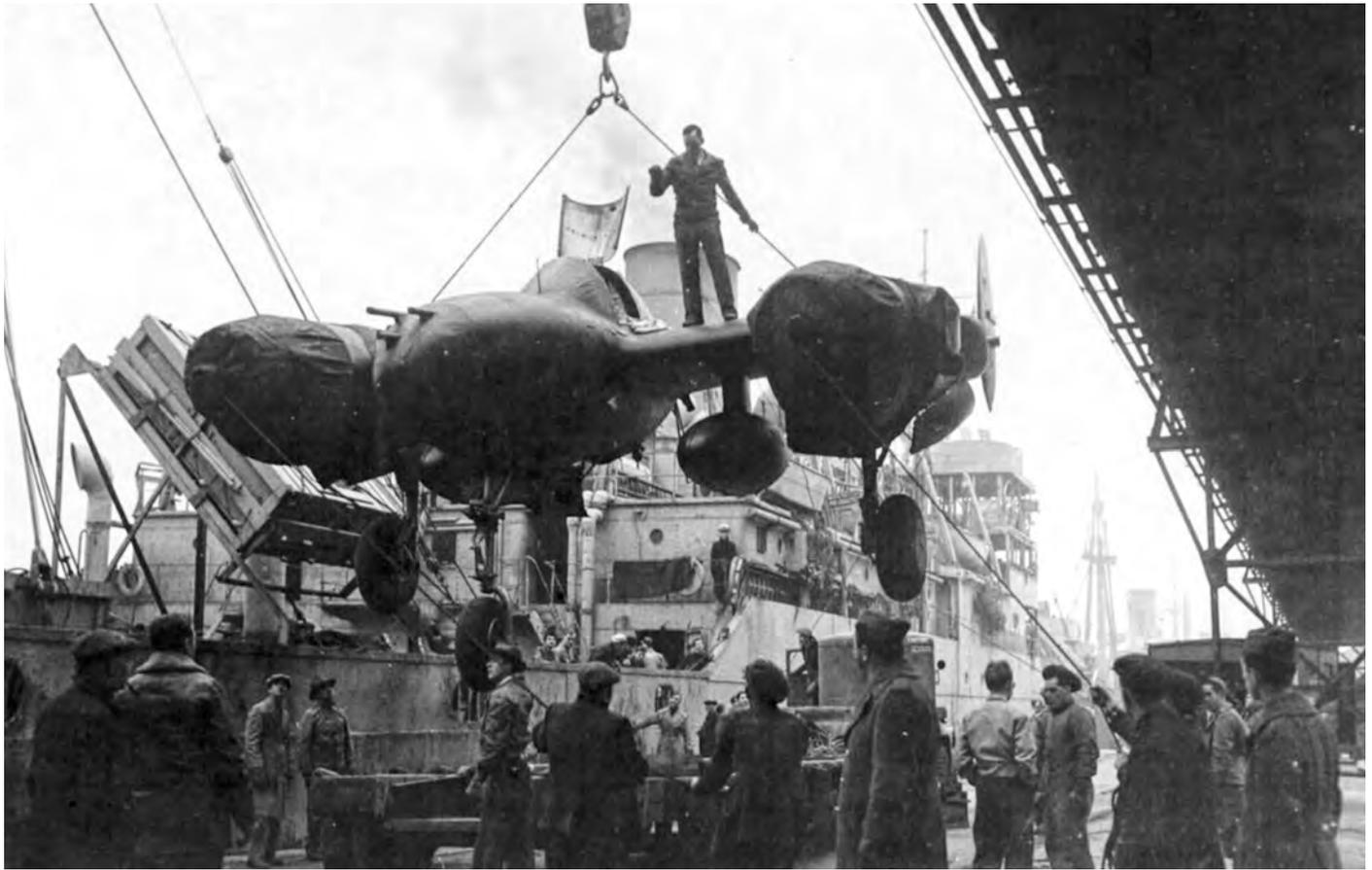
tember, the three screw machines were operational and before the years end 200 total production machines were up and running. With that, the shop that was initially envisioned to address minor battle damage repair was now mass-producing orders of parts over 1,000 items.

Maintenance

The average bomber spent 204 days in the ETO: 19 days engaged in operational missions, 96 days on operational status but not engaged in operations, 21 days in non-operational training, and of those 204 days in the ETO, 68 were committed to repair maintenance and modification.¹⁶



B-17G Undergoing Maintenance, Source: Aldon Ferguson



A Lockheed P-38 is lowered from the USS Delmorte on to a waiting trailer by U.S. Army soldiers and Lockheed Aircraft Corporation workers at Dufferin Docks in Belfast Port. Northern Ireland. Nov. 25 1942. National Archives.

The depots were assigned the modification, battle damage repair, supply, reception, and dispatch of all aircraft. The specialization of each location was both deliberately planned or developed out of necessity. Bomber aircraft, for instance, were flown directly to their combat units after being flown to the depots from the states for modification. Fighter aircraft, however, required shipment. These aircraft were shipped to ports in Liverpool or Glasgow and were transported and assembled at Speke and Renfrew aerodromes, then transported to the depots for modifications before being dispatched to their operational squadrons.¹⁷The processing of radial engines was primarily performed at Burtonwood, while the processing of in-line engines was performed at Warton. Battle damage repair and heavy maintenance were for the most part conducted at Warton and Burtonwood. Langford Lodge was inaccessible to most units, and so only flyable aircraft could be taken there for repair. Langford Lodge, therefore, became specialized in engineering and test and took on a large share of the modification and design program early on in the war.

Knerr in a memo to the War Dept. describes operations as follows.

"...Langford Lodge is essentially a civilian operated aircraft factory functioning under military management, Warton is an engine overhaul and airframe repair activity, and Burtonwood is essentially a supply depot and engine repair

*shop. In addition, each is capable of doing some of the work of the others"*¹⁸

Moreover, the depots specialized in maintenance by subsystem. Langford Lodge was responsible for the fabrication of modification kits and certain modifications as well as the overhaul of some propulsion components. Warton was responsible for v-type in-line engines and aircraft, instruments, hydraulic and electrical accessories, and armament equipment such as gun turrets and computing gun sights. Burtonwood was responsible for radial type engines and aircraft, propulsion systems and components, radios, and rubber components such as fuel cells, deicer boots, and self-sealing oil tanks.¹⁹

The Base Air Depot Area (BADA) was instated near Burtonwood to establish oversight of the depots. BADA acted as a small headquarters that was sometimes called upon to shift backlogs of workload between the three depot locations. The Bradley-Knerr Commission recommended the establishment of BADA for "centralized control and decentralized operation" of the independent operations of the three depots. This was to ensure that the "...independent operations should be tied together by one management, which by continuous contact with daily problems involved could take immediate action therein without time consuming reference to a headquarters several hundred miles away, and, in the case of Langford Lodge, across the Irish Sea."²⁰ BADA and its repair and supply network would



50-Calibre Section, Base Air Depot 1, Source: Aldon Ferguson

grow to an end strength of nearly fifty-thousand personnel as set forth by the Bradley-Knerr commission. At the depots, this included roughly fifteen-thousand at Burtonwood, ten-thousand at Warton and over six-thousand civilians with more than a thousand military personnel at Langford Lodge.²¹ Command of BADA was entrusted to Brigadier General Isaac "Ike" Ott, who had previously commanded BAD1.

Ott's tough-as-nails leadership is the stuff of legend. Ott was so demanding that he was outright hated by many depot personnel, especially at Warton where he was particularly overbearing toward the BAD2 base commander.²² During his first visit to Warton since the beginning of his



Personnel of the 322nd Bomb Group inspect a battle-damaged B-26 Marauder, © IWM (FRE 4527)



Burtonwood ramp 1944-1945 Source: Clifford Creaney /Aldon Ferguson

generalship, Ott demanded the expedited relocation of the Internal Supply Section to the partially constructed facilities intended for the unit's future use. Section personnel immediately set to work and over the next twelve hours relocated all of the stock bins, parts, and equipment to the incomplete building during a week of weather that produced gale force winds over 75 mph.²³ This surprising order must have come with some frustration to section personnel. However, depot maintenance production efficiency increased as quickly as the next morning as the hangar space that was previously occupied by parts bins, was now utilized to modify aircraft.²⁴ Two months later, in May 1944 with a "backlog" of B-24s increasing to 166, and with 75 aircraft arriving daily, 55 of which were more B-24s, Ott established a 7-day workweek at BAD1. Perhaps foreseeing the necessity of the decision to prepare for the Allied invasion that was to occur in less than one month.²⁵

Contrasted in their approach to the demands of leadership was Ike to his trusted cousin Lt Col Walter "Dewey" Ott. Assigned to BAD1 as Chief of Flight Test, "Dewey" Ott was responsible for the test of newly assembled and overhauled aircraft before their delivery to operational bases. Dewey Ott was protective over the pilots in his care. He would often fly the most doubtful of the unproven aircraft himself, earning him the dedication of his crew.²⁶ Dewey's warm and outgoing nature also made him a favorite amongst celebrities traveling into theatre, and he was chosen to shuttle VIPs such as Cagney, Crosby, Rooney, and Hope. Dewey Ott became Bob Hope's preferred pilot during his many visits to the ETO, and the two struck a friendship that endured after the war.²⁷

Nearly as early as its first missions, the problem of battle damage challenged and perplexed maintenance operations within the 8th. However, by the summer of 1943, it had reached a crisis. This prompted General Fredrick Anderson, Commander of VIII Bomber Command, to remark that he was "disturbed over the possibility of the number of crews available exceeding aircraft available in the near future."²⁸ The real danger in materiel support falling be-



Burtonwood Aug 1945 A-20 bone yard between hangars on E Site. Photo: Ray Zimmerman, Source: Aldon Ferguson

hind operational need was heightened as 25%-50% of aircraft coming back from missions into Nazi-held Germany were returning with battle damage. General Eaker complained, "This places a burden on repair establishments which had certainly not been recognized in peacetime planning and for which there was no adequate organization."²⁹ The cannibalization of parts from non-operational "hangar-queen" aircraft became invaluable to the reconstitution of mission-ready aircraft. However, due to the inadequate provisioning of spares at the onset of war, the practice began to get out of hand. New assemblies such as landing gear, turrets and starters, arriving from the U.S. were stripped of their sub-components and their carcasses sent to the depots with a repairable tag. This led General Miller, Commanding General VIII AFSC to intervene into the cannibalization problem borne out of necessity, "...the practice violates existing regulations and must be curbed." To address the battle damage problem, the spring of '43 Bradley-Knerr commission recommended the establishment of a network of sub-depots to extend repair capabilities and supply closer to the operational bases. These sub-depots were activated and would later become further decentralized into advanced depots.³⁰ As some bomber formations were singled out during missions, the need for battle damage repair fluctuated greatly between the bases and depots. The network of sub-depots and advanced depots absorbed the 3rd and 4th echelon overhaul repair through roving work parties between stations.

The weaving repair network and its evolving terminology of *air depot*, *sub-depot*, *advanced depot*, *mobile depot* and *service centre* developed to such a complex state that by July of 1942 General Spaatz wrote in a letter to Arnold "This constant changing of terms leads to too much confusion."³¹

One innovation that by the end of 1943 General Eaker would recall as "One of the principal technical achievements of the Eighth Air Force during the year..."³² was the development of the Mobile Repair Unit. In autumn of 1942, weighing the need for mission-ready aircraft and the man-



Mobile Repair Units, Source: Lockheed Overseas Corporation Annual Report 1942-1943. 1943 National Archives

hours required to produce them, coupled with the sheer difficulty in disassembling large aircraft for transport to repair bases, the 8th decided to devise a means to deliver repair capabilities to the aircraft. This would restore the aircraft to a safe-for-flight condition for travel to a depot for further reconstitution. The Lockheed Overseas Corporation designed and fabricated the first of the units, and with a successful design, was awarded a contract for the construction of 50 units in February of 1943. The units consisted of two semi-trailers outfitted with tooling and repair facilities and one or two trucks or jeeps to ferry personnel and supplies. Initially, one of the trailers was designed to house its 16-19 specialist personnel, but it became clear that the personnel would be better off finding lodging in local amenities and the trailer was adapted to hold more repair equipment and parts.

In another clever attempt to overcome the challenge of access to repair capabilities, engineers and mechanics at Langford Lodge experimented with the conversion of a WACO Glider into a mobile aircraft repair shop, known as the "Mechanikite."

The BADs serviced the myriad network of fighting and support bases in the U.K. through the dedication of Truck Transport Battalions and Companies comprised of segregated Black American troops. Later organized under the 8th Air Force's Combat Support Wing, these transport units navigated England's harrowing carriageways packed with bombs, ammunition, and supplies. Ashamedly failed by the myopic policies of leaders who were dealt complex problems resulting from old prejudices, the AAF as an occupying force instituted segregation in a land where beforehand it could not be found. This led to infamous firestorms of conflict such as that at Bamber Bridge near Warton. It also led to a formalized lack of human decency. After round the clock, arduous distribution missions between bases, often through rain and fog, many of the truck transport servicemen were not afforded a bed or a warm meal at the stations they serviced; instead, they found rest only on the cold bench seat of their utility truck.³³ In the



“Mechanikite,” Source: The Papers of Maj Gen Hugh J. Knerr, Clark Special Collections Branch, McDermott Library, USAFA

same selfless and proud legacy of the segregated military units serving the U.S. during WWII, the truck transport units of the 8th Air Force’s Combat Support Wing diluted the logistical veins of the 8th as the lifeblood of ETO lethality.

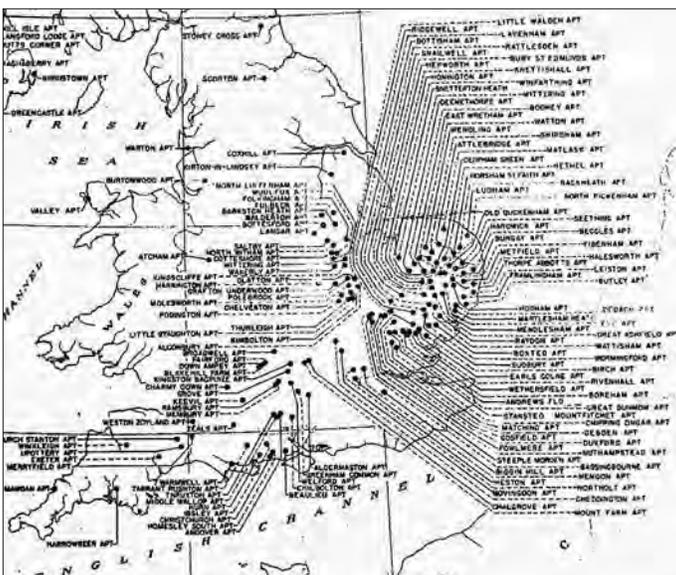
One of the most unique stories to actualize from the battle damage crisis was that of 1st Lieutenant Edward Hall. As an engineer and Officer in Charge over the repair of battle-damaged aircraft at BAD2, Hall invented a method and the special tooling required for substituting press-fitted hollow steel tubes in place of drive bolts, enabling faster repair of aircraft and requiring less personnel. The timeliness and magnitude of this development, earned Hall the Legion of Merit. This was one of only a few such medals base historical records document were pinned, one other presented to General Ike Ott in early 1944, near the close of the war.³⁴ Hall’s depot successes, background in mechanical and chemical engineering, and a knack for the



Truck Transport units of the 8th Air Force’s Combat Support Wing, Source: The Papers of Maj Gen Hugh J. Knerr, Clark Special Collections Branch, McDermott Library, USAFA.

technical, led to his introduction into missile technology near the end of the war. Hall was assigned to acquire intelligence on the propulsion work of the Nazi’s through the V-2 rocket parts that had either exploded or were retrieved through networks of spies.³⁵ At the war’s end, he also led efforts to research underground Nazi missile production facilities for the Air Force. It was during this time that Hall developed a fascination for rocket and missile technology that defined the rest of his military career. In 1957, Colonel Hall, recognizing the limitations of liquid fuel missile propulsion, developed and promoted a solid-fuel rocket technology that led to the development of the intercontinental ballistic missile (ICBM) under Chief of Staff Gen Curtis LeMay. In 1960, for his work on solid-fuel, Colonel Hall was awarded his second Legion of Merit and would subsequently become known as the Father of the Minuteman ICBM program.³⁶

Leadership and coordination of the daily operations and production planning within the functional departments of the depots were primarily conducted by the Maintenance Division, under the direction of the Maintenance Division Chief. To coordinate depot operations, Production Control sections within each maintenance department collected and reported production data to the centralized Statistical Control office, who further collected status and production data to generate reports.³⁷ These offices were located in rooms surrounded by blackboards covered in statistical data. At Warton for example, 2 officers and 16 enlisted men staffed Statistical Control. Data compiling aircraft arrivals, backlogs, man-hours both available and used, modification programs, parts manufacturing, and assembly and overhaul statistics was organized and reported. This data culminated in the depot’s report to HQ BADA of their statistics covering final delivery and output. Lt Col Billy Arnold, Chief of the Maintenance Division, was uniquely experienced at leading both of the mainland depot operations having transferred from Warton to Burtonwood February 15, 1944.³⁸ Arnold’s Maintenance Divi-



Army Air Forces Stations During World War II, adapted from: United Kingdom and Iceland Bases, Taken From: Anderson, 1985



Colonel I W Ott (Centre) Lt Col Billy Arnold (Far Left). Source: Aldon Ferguson

sion Weekly Activity Reports to HQ BADA never missed an opportunity to highlight record-breaking production metrics and output. Arnold's unique origin and technical background made him unusually adept to the rigors and undaunting pace of depot operations. Before joining the Army a week after the attacks at Pearl Harbor, Arnold was employed by the Chrysler Corporation.³⁹ Years earlier, Arnold studied for a baccalaureate in mechanical engineering at the University of Illinois before taking up car racing. Between the years 1930 and 1932, Arnold led almost every lap he raced at the Indianapolis 500. In 1930 at age 24, Arnold became the first to win the Indy 500 in under 5 hours and the first to finish at a greater than 100 mph average speed without relief help. He also led all but the first two laps of the race, 198 out of 200 or 99% of the total laps, a record and metric that has yet to be surpassed even to the day of this writing.⁴⁰

Modification

The U.S. learned the importance of keeping an agile modification program in order to seize and retain the air offensive early in the war, even prior to the Battle of Britain. In a SPOBS report dated 13 June 1941, Lyon wrote:

"The lessons of the past year have demonstrated that aircraft must be constantly modified and changed during its life to meet the requirements of modified tactics and specialized operations. The RAF has recognized the necessity of modifications and changes in their planning and maintenance organizations. It is recommended that plans for Base Repair Units and Maintenance include provision for a technical staff and manufacturing facilities adequate to undertake modification of aircraft and its components op-

*erated by American Forces in the United Kingdom"*⁴¹

During the Battle of Britain, modifications were the mechanized lethality of the RAF combat squadron. RAF mechanic B. Edwards of St Albans, having arrived at Burtonwood the previous spring, would later recall, "Most of the work I was employed on at this time was in fact embodiment of various mods."⁴² During the fall of 1940, the highest priority modification was to equip the Merlin engines of the Spitfire with Constant Speed Units and Propellers. The parts were manufactured by Rotol (a joint venture of Rolls-Royce and Bristol), 125 miles to the south in Gloucester. This system increased the Spitfire's maneuverability at all altitudes, maintaining the advantage over Luftwaffe bombers. Modifications during the early days of the war included installing armor plating and nose and fuselage guns on Hampden, Buffalo and Oxford aircraft. Though the distance of Burtonwood from England's south coast or the RAF's East Anglian operational bases was far enough to limit air attacks, it did not eliminate them entirely. On September 6, 1940, during the early period that Burtonwood was still managed by the RAF, two JU88's flew far enough inland to perform a low-level incendiary bombing mission over the airfield. However, after dropping several bombs, no damage to aircraft or airfield resulted. The newly invented Identification Friend or Foe (IFF) system was installed on nearly all model aircraft during this time, and was fixed with an explosive device in the rear fuselage in case the aircraft was to come down in enemy territory. "The aircraft went out to squadrons practically as quickly as the mods were embodied," Edwards remembered.

Of the 68 days in maintenance the average bomber aircraft spent in the ETO, an average 12 days were consumed by modification.⁴³ Early AAF policy categorized modifica-



Billy Arnold, Source: Indianapolis Motor Speedway Museum

tions between those that were necessitated by military or combat requirements, those needed to correct original design errors, and those required to divert aircraft to tactical use other than initially intended.⁴⁴

As operations were strained to adapt to emerging tactical needs, much of the engineering and design modification workload fell to the Lockheed Overseas Corporation based at Langford Lodge⁴⁵ When originally conceived, the Engineering Department at Langford Lodge was only staffed to handle “Shop Contact Engineer” workload, defined as that which would “...develop repair design, approve material substitution, justify a necessary departure from aircraft specifications, and to prepare unsatisfactory reports and very minor modifications.”⁴⁶

The fall of 1942 saw the introduction of the design, engineering and modification workload at Langford Lodge, transferring the primary responsibility of this work from the British engineers at Burtonwood. Lockheed relied on whatever design capabilities their small staff could muster, and recruited whatever engineering help they could find locally. This amounted to only two Polish, one British and one Irish engineer.⁴⁷ Lockheed filed emergency requisitions to its Burbank office for engineering personnel to meet the growing requirements as the mission of the base transitioned from that of a repair depot to the center for the manufacture and design of modifications.

The difficulties in adopting a standard policy for modification programs was a result of the shifting nature of the program. This was, in effect, responsive to the shifting natures of tactical demand and of enemy attack. Communicating technical plans, specifications, and prototypes between depots based in America and England created a tug-of-war on resources and communication. In July of 1943, Maj General Henry Miller, who was then Commander of the VIII AFSC wrote to General Eaker:



B-24 for Carpetbagger Project 1944 Mary Ann Site, Photo: Col D Ott, Source: Aldon Ferguson

“With the shortage of trained personnel in this theater and...the requirements for the sustained air effort, the Materiel Command must realize its responsibilities insofar as it pertains to modification of aircraft...As you know, we have been struggling with the P-47 which has taken 4-months to get into combat ...Recommend the modification centers in the United States must be stepped up to ensure the arrival of aircraft ready for combat. Modifications in this theater are being accomplished at the expense of maintenance and supply, and we cannot hope to continue to rob Peter to pay Paul indefinitely.”⁴⁸

The balance was ultimately between the comparative value of man-hours at home and abroad; civilian versus military labor between that of the Air Service Command Maintenance Division in the U.S. and VIII AFSC in England. It was General Clements McMullen, Chief of the Maintenance Division of the Air Service Command who ultimately suggested to Arnold on July 19, 1943, that a heavy bomber in the completely modified form be sent back monthly from the UK to guide the modification program at home.⁴⁹ This practice was adopted by VIII AFSC and reduced the discontinuity between modification programs at home and abroad.

Modifications ranged from the complex to the simple, from those directed by headquarters to those originating from the technicians that employed them; from the mods that failed to those that succeeded.

In June of 1944, 2d Lt Bill Clearwater departed Warton on a routine test flight of a P-51D. Observers from the airfield watched as the Mustang’s wing detached and the aircraft began to dive vertically toward the earth from 3,000 feet. Test pilots could not determine the cause of the failure and concluded it was a one-off occurrence.⁵⁰ In the same month, 2d Lt Burtie Orth crashed in another P-51D accident after witnesses on the ground reported having seen his right wing detach during straight and level flight shortly after climb out. The wreckage of Orth’s P-51D was taken back to Warton. The P-51 experts of Hangar 5 found that on both crashed Mustangs, the brake lines had bent around the undercarriage shock absorbers leading them to



P-51 Mustang in 5 Hangar at BAD2 Warton, Source: BAD-2 Association

believe that the landing gear, having been wholly twisted around, had dropped from their stowed position during flight. The Hangar 5 technicians devised a test by placing a P-51D on jacks and exhausting the pilot's checklist, but to no avail. Leaving the aircraft in a condition of cruise flight with the gear up and undercarriage lever in neutral, they went to take a coffee break. On their way out, one of them noticed something curious, one of the wheels was resting on the wheel door, causing it to drop down slightly. It was later discovered that, due to the addition of features to the P-51B and C models, such as an extra machine gun in each wing, the undercarriage uplocks on the earlier models had been removed as a weight saving measure. This relied on the hydraulic pressure alone to hold up the landing gear, and any surge would allow them to bounce freely in the carriage. This condition would cause enough fatigue to induce structural failure. The findings were quickly reported and the uplocks of earlier models were retrofitted to all P-51D aircraft and incorporated on newly manufactured Mustangs.

Other modifications originated from the creativity of depot technicians, desiring merely to prove they *could*. The Experimental Department at Burtonwood led an effort to modify a CG-4A Waco Glider by installing two engines to determine if it was possible to produce kits to convert them into self-propelled aircraft. Although the project was discarded midstream, the department's enlisted technicians had already committed a great effort and begged for the opportunity to prove that it worked.⁵¹ They were allowed to complete the conversion of one glider, and upon test, the Waco Glider took flight under its own power. In another instance of depot ingenuity, Warton's P-51 technicians petitioned base commander Colonel John G. Moore to allow them to use their free time to rebuild a P-51B that was damaged during shipment and "written-off" by engineers. To their surprise, Moore approved their request but only to fly the aircraft as a "station-hack," solely for local flying. After sourcing sections from five other aircraft, removing the oxygen system and command radio to modify the



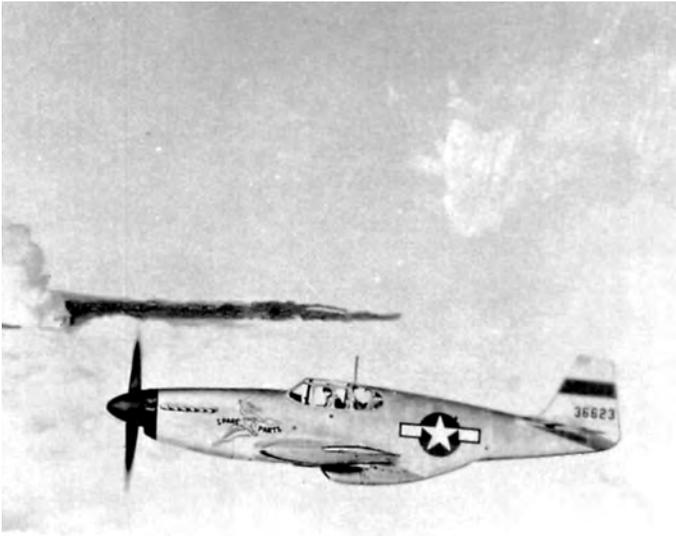
CG-4A converted to powered aircraft Burtonwood, 1945, Photo: Dick McClune Source: Aldon Ferguson

fighter with a rear seat, the aircraft was designated "*Spare Parts*" before it was test flown successfully. *Spare Parts'* primary missions were "whiskey-runs" to Glasgow, and the aircraft provided a morale-boosting opportunity for the ground crew to climb into the back seat through the detachable rear window and experience flight in their own modified Mustang.

Sorrow

American bases in England benefited from a high degree of security as compared with the AAF in other theatres during the war, primarily due to the infrequency of Luftwaffe bombing attacks. Further, as compared to their non-combat personnel peers in other theatres of the war, the USSTAF accounted for only 13% of the total overseas non-combat crew losses. That is also an even smaller percent as compared with their combat crew peers in the same theatre, accounting for 60% of all AAF battle casualties. In fact, AAF ground crew in England were not subject to enemy fire until they began to move into France in June 1944.⁵²

There were exceptional safety incidents, however. The testing of aircraft was inherently hazardous and occasionally resulted in the accidental death of aircrew. Deaths to the ground crew were rare, but did occur infrequently. Langford Lodge reported only one death during its first year due to a loss at sea from a man falling overboard during transit. Because of the threat of German U-Boats, the ship's crew could not attempt a rescue and, "threw him a raft with a flare on it, and kept going,"⁵³ Lockheed later counted the loss as "non-industrial."⁵⁴ Warton boasted a generally flawless safety record up to the second half of 1943, despite an accidental wing clipping of a P-51 by an alert crew vehicle. Nevertheless, the first months of 1944 would not be so kind.⁵⁵ The month of April was particularly bad in terms of safety for Warton. On the evening of the 16th, a night-shift electrician accidentally blasted all eight guns of a P-47 Thunderbolt, disintegrating part of the



BAD2's own P-51 Spare Parts, pictured on a flight over North Wales, Source: BAD-2 Association

hangar roof. The following day technicians accidentally fired the top turret guns of a B-24, spraying the entire area with 50-caliber bullets and shells. Fortunately, in these two incidents no one was hurt, but that same day a civilian contractor named Frederick Cooke was killed while riding in the back of a lorry after being struck by the propeller of a taxiing P-51. Later that year Private Edward Farow died of his injuries while on night shift after walking into the spinning propeller of a P-38. Considering the austerity of the depot conditions, the lack of training and experience, and the sheer number of personnel, casualties to the ground crew were quite rare and allowed for largely uninterrupted progress of industrial depot practices.

And yet, despite the relative safety of these industrial sites, it was at the depots that on the 23rd of August 1944, the Allies would suffer the single most significant loss of the war.

Early that morning in Freckleton, teachers prepared their lessons as students at Holy Trinity School listened attentively. Patrons of the adjacent *Sad Sack Cafe*, a popular restaurant for locals and for Airmen looking for a better alternative to the mess hall, enjoyed an early meal.

1st Lt. John Bloemendal of BAD2 took off in the B-24 named *Classy Chassis II* for a post-maintenance check ride. Lieutenant Peter Manassero, commanded a second B-24. While airborne, the two pilots discussed a rapidly developing storm formation that Manassero later called "a very impressive sight and looked like a thunderhead."⁵⁶ To calm the children after the sudden dark and stormy shift in weather, school teachers at Holy Trinity had the young children place their heads on their desks and read them fables. General Ott at BADA headquarters, aware of the developing storm, telephoned BAD2 ordering the immediate grounding of aircraft and the suspension of flight operations.⁵⁷ At 500 feet in altitude, Bloemendal and Manassero approached for landing. With zero visibility, both decided to abort. Manassero was successful, but the turbulence and downdrafts of the thunderstorm grabbed hold of *Classy Chassis II* and sent it cartwheeling down



Ground personnel clear rubble from a school in Freckleton that was destroyed in crash by a B-24 Liberator (serial number 42-50291) nicknamed "Classy Chassis" of the 486th Bomb Group., 1944 © IWM (FRE 11566)

narrow Lytham Road. The wreckage demolished homes and the *Sad Sack Cafe*, and the impact immediately killed its patrons and Bloemendal. The momentum of the crash carried the wreckage farther still, slamming the B-24's nose turret into the infant's wing of the school, creating a 2,793-gallon tidal wave of flames. The flames rolled down the narrow street as the small schoolhouse of Holy Trinity Church became enveloped in violent flashing tongues of yellow and red. One of the few survivors later recalled watching his teacher Ms. Louisa Hulme engulfed in flames as the air was sucked from his lungs. Hulme and teacher Jennie Hall along with 38 young children, fell victim to the firestorm. Three of those children during previous months had been moved from London to Freckleton during Operation Rivulet to protect them from V-1 and V-2 rocket bombings. Foreseeing her own demise, Hulme expressed to hospital workers her desire to be buried with her students.

Three days later BAD2 Officers and Enlisted Airmen served as pallbearers during the funeral procession, lowering caskets into the communal grave they had earlier dug in the shape of a "T," placing a memorial headstone at the top of the grave, completing the form of a cross. The body of schoolteacher Ms. Hall was lowered into one of the arms of the cross, and Ms. Hulme later laid along its vertical frame. The small caskets of the children were each laid within the grave's outstretched arms as if to embrace and comfort the heavily burdened mourners and to beckon the stranger come, see the proof in the scars of the hands and feet and to know better the cost. General Arnold in Washington, so saddened by the news of the tragedy, requested that General Ott represent him at the funeral. The gravity and burden of command so profoundly fell on this exacting prefect of air war production. This island was not estranged to suffering, but this was too much for anyone to bear. Only five days prior, representatives from the ETO had flown back to the U.S. to meet with the War Department to initiate logistical redeployment plans in preparation for the defeat of Nazi Germany.⁵⁸ Ott was already preparing for the



Funeral procession for the children who died in the Freckleton Air Disaster, Source: BAE Systems

flow of equipment and the end of the war. The conclusion of it all was in sight, the timing of this tragedy made the suffering all the more desperate and unnecessary. And yet, they could not by sheer strength of will cause a more expedient completion to the war. As Ott stood unwaveringly beside his men, watching the tiny caskets lowered into their grave, the olive drab of their Class-A uniforms flickered at the cold but resolute Lancastrian wind.

Resolve

During the spring and summer of 1944, plans and personnel were ever more committed to the successful completion of the war.

In a subtle but remarkable gesture expressing their commitment, depot personnel of BAD2 organized a unique war bond drive intending to raise enough money to pur-



Dedication ceremony of three P-51's during a war bond drive at Base Air Depot 2, Lancashire, England. P-51C's "Mazie R" 42-103601 and "Pride of the Yanks" 42-103502. P-51D "Too Bad" 44-13335. June 3 1944. National Archives



Maj Gen Hugh J Knerr shakes hands with a member of BAD 2 during a war bond drive where three North American P-51's were dedicated. note the nickname "Mazie R" England, June 3 1944. National Archives

chase two P-51 Mustangs for employment against axis powers, at the cost of \$114,000.⁵⁹ One aircraft would be named "*Too Bad*" commemorating the depot, and the other would be designated by an enlisted man chosen through a raffle. The chance of naming the P-51 increased through each purchase of a \$25 bond. To the astonishment of depot leadership, the personnel raised enough money to purchase *three* P-51 Mustangs. The men who named them, Pfc Stanley Ruggles and Pvt Stanley Silverman, in a Memorial Day ceremony overseen by Maj Gen Knerr, Brig Gen Ott, and Col Moore, unveiled the aircraft and their names, "*Mazie R*" and "*Pride of the Yanks*."

Advanced echelons of 9th Air Force personnel, composed of a considerable number of men previously assigned

to the 8th, forward deployed to the European continent during the cross-channel landings at D-Day. Most of their supplies transferred through the 9th AF's BAD4 at Baverstock, near a railway at Dinton, Wiltshire. By June 10, more than 6,000 men and 1,000 vehicles from the 9th AF had landed in France, virtually all of them on OMAHA Beach.⁶⁰ Among the units ashore by that time were engineer battalions, airdrome squadrons, truck companies, signal units, and other service organizations that would prepare the way for the later arrival of the combat groups. By June 20, more than 18,000 men and 4,000 vehicles had left England for the continent. Plans were to establish a depot in France as early as July 1944. In December of that year, Brig Gen Ike Ott was transferred to establish and



B-17 Flying Fortresses, one of the 306th Bomb Group and a B-24 Liberator at a repair depot in France. A censor has obscured the faces of the personnel in the foreground, and the aircraft in the background. Passed by the censor 1 Mar 1945, © IWM (FRE 4374)



Burtonwood, 2nd Air Depot Group, Winter, 1942 Photo: Chris Vandiver, Source: Aldon Ferguson

command the Continental Air Depot Area (CADA) in Compiègne, France, which was two months later re-designated as the *Central Air Depot Area*. Further advancing the depot maintenance and logistics capabilities from England to the continent, empowered the AAF to lower the strategic mountains, raise the valleys, and close with tactical agility against the Axis enemy, ultimately leading to victory.

Legacy

The stories of these depot-maintenance and logistics leaders recall the earliest warriors of democracy, where the ancient Athenian navy operated complex shipyards enabling

rapid deployment and reconstitution of trireme warships. These drydock ship-sheds were the depots of their day, equipping the Athenians to defy the odds when outnumbered, achieving victory at the Battle of Salamis, the first great naval battle in recorded history.⁶¹ Together, all social classes fought onboard the technologically advanced warships, creating the social bonds that historians say were the turning point in establishing the world's first democracy.⁶² Inextricably linked to these forerunners of freedom, the depot leaders of the 8th Air Force and the Allies fought together to preserve the ancient democratic liberties of the world, strengthening a foundation for independence, and contributing a legacy of leadership for generations to follow. ■

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Bold Venture: The American Bombing of Hong Kong, 1942-1945. By Steven K. Bailey. Lincoln NE: University of Nebraska Press,. 2019. Illustrations. Photographs. Appendix. Notes. Bibliography. Index. Pp. 344. \$34.95 ISBN 978-1-64012-104-1

Steven K. Bailey is an associate professor of English at Central Michigan University, where he teaches nonfiction writing courses and specializes in writing-program administration. He has published articles on wartime Hong Kong in the *Journal of the Royal Asiatic Society Hong Kong Branch* and is the author of *Strolling in Macau: A Visitor's Guide to Macau, Taipa, and Coloane* and *Exploring Hong Kong: A Visitor's Guide to Hong Kong, Kowloon, and the New Territories*.

The book tells the story of the American airmen, their aircraft, and their combat missions over not only Hong Kong, but also Japanese-held airbases in occupied China during the Second World War. Bailey describes the American military campaign against Japanese forces from the organization of the American Volunteer Group (AVG—*Flying Tigers*) in 1941 through to the multi-squadron Army and Navy air strikes against Hong Kong during 1945. Bailey relates the various air operations—both support and assault—in the China-Burma-India Theater during the period, with the focus on Hong Kong. Chapter by chapter he captures the spirit of the American airmen and maintenance personnel in both victory and defeat. These are individual stories supported by in-depth research that dramatically show what participant—from both sides—faced in air combat, the decisions they had to make in rapid order, and the sometimes-fatal results of those decisions.

Along with other page-turning vignettes, Bailey covers Gen Claire Chennault's early efforts to establish the AVG; the saga of India-based transport aircraft flying the Hump; early AVG operations and strategies against often superior-performing enemy aircraft; differences in missions and risks faced by the pilots and crew of bombing, strafing, and covering aircraft; night raids; principle military targets and civilian collateral damage; what it looked like from Chinese and interned civilian and POW viewpoints; Japanese air defense and strategy, including the Ichigo operation; misfortunes of downed pilots captured or "walking out"; and, lastly, raids from Naval Task Force 78 and Philippine bases (e.g., Fifth Air Force and the 345th Bombardment Group) that supported in-country (Fourteenth Air Force and the Chinese-American Composite Wing) air-assault capabilities.

Bailey's book provides sobering insight into the sometimes-overlooked air war in China. It is a dynamic and quite readable account and will be an excellent addition to the bookshelf of aviation enthusiast and historian alike.

Frank Willingham, NASM Docent



South Pacific Air War Volume 1: The Fall of Rabaul December 1941 - March 1942 By Michael Claringbould and Peter Ingman. Kent Town, Australia: Avonmore Books, 2017. Appendices. Maps. Photographs. Bibliography. Index. Pp. 252. \$44.95 (Paperback) ISBN 978-0-9945889-4-4 and **South Pacific Air War Volume 2: The Struggle for Moresby, March - April 1942** Same data as above, but copyright 2018 and Pp. 232. ISBN 978-0-9945889-7-5.

Michael Claringbould is a three-dimensional, digital aviation artist and globally recognized expert on Japanese aviation. He is a contributing editor for *Flight Path* magazine and is the author of several books on the Fifth Air Force and World War II Pacific history. He is a member of Pacific Air War History Associates. While growing up in Papua New Guinea in the 1960s, he became fascinated with Pacific air war aircraft. He has assisted with both the recovery and identification of such aircraft and has helped both the United States and Japanese governments to identify missing aircraft crews.

Peter Ingman, acclaimed military aviation historian, is a former business executive with a key interest in the early stages of the Pacific war. Ingman has traveled widely throughout northern Australia and the South Pacific conducting research for his books. He is the chairman of the South Australian Aviation Museum History Group and has written five widely acclaimed history books on Australia in the Second World War.

The first volume (of a trilogy on the early war in the Pacific) chronicles warfare mainly in New Britain and New Guinea from December 1941 until March 1942. It provides an almost a day-by-day account of the initial aerial encounters between Australian, Japanese, and American forces (including supported land and sea operations). The second book begins where Vol. 1 left off and chronicles aerial warfare mainly in the territories of Papua and New Guinea during March and April 1942. It begins with the March 10 U.S. Navy carrier strike against Lae and Salamaua that caused the Japanese to postpone their southeastern advance until their own carriers were available. Instead, they turned their offensive on Port Moresby, employing an unrelenting air assault by their *Betty* bombers and *Zero* fighters.

In Vol. 1, the authors discuss the fact that, because of the prior commitment of forces from Australia and New Zealand to the war in Europe, there were insufficient resources to mount a satisfactory defense of their South Pacific Mandated Protectorates against superior Japanese land, sea, and air forces. In addition, those ground forces first assigned to the defense of Rabaul and New Guinea were generally poorly trained, motivated, and equipped. Aircraft available to initially counter the Japanese onslaught were, primarily, the Lockheed Hudson Mark IV, Commonwealth Aircraft CA-3 Wirraway (North American AT-6 equivalent), and Consolidated PBY-5 Catalina. Claringbould and Ingman maintain that both luck and

general timidity on both sides played important roles in the outcomes of these early engagements.

Vol. 2 describes how Allied land-based fighters and bombers finally arrived at Port Moresby. These were led by Royal Australian Air Force 75 Squadron P-40 Kittyhawks, backed up by USAAF A-24 Banshees, B-17 Flying Fortresses, B-25 Mitchells, and B-26 Marauders (making their combat debut). New Bofors anti-aircraft (AA) guns provided an effective defense of airfields against strafing *Zeros*. This mixed force took the fight to the Japanese, resulting in a complex aerial campaign. Key lessons were learned by both sides including how to deal with constantly changing weather across the theater of operations and the hindrances of the mountainous terrain separating the Japanese forces at Lae/Rabaul and the Allied forces at Port Moresby and northern Australia; the relative ineffectiveness of high-level bombing by both sides; and the advantages of low-level bombing and strafing. The Allies needed were bombers with heavy forward-firing armament that could suppress AA fire during low-level bombing runs. Later, the strafing-bomber concept was developed by the USAAF, using primarily B-25, B-26 and A-20 aircraft. This proved to be very effective against Japanese land and sea targets. Throughout this two-month period, the background was set for the planned Japanese offensive to capture Port Moresby and Tulagi, two bases of strategic significance. Joint US Navy and Australian naval forces would oppose this offensive resulting in a historically significant action in which aircraft carriers first engaged each other. This is to be covered in the third volume, *Coral Sea & Aftermath May-June 1942*.

It is important to note that during the five months of war through this period, there had been just one day of sustained land fighting between allied and Japanese forces and no naval engagements. The greatest activity on both sides was employment of aircraft. The authors provide well-researched data on personnel involved on both sides. The important role played by aircraft carriers to both support and interdict land assaults is also presented. Of interest is the role played by lesser-known Japanese float planes and flying boats, as well as early deliveries of the A6M2 *Zero*. There are excellent data on primary aircraft involved in the conflict, both throughout the text and in appendices, showing three-views, key performance, and liveries. Ample, sometimes rare, photographs are employed throughout. Several good theater maps are provided, but at least one map of larger scale could have been provided to enable the reader to more accurately follow the engagements addressed in the text. The three-dimensional graphic portrayals of aircraft in action are particularly well-done and add much to the total presentation.

All-in-all, these are both excellent books: well-written, easy to comprehend, and excellent sources for aircraft- and Pacific-war enthusiasts alike. I'm looking forward to the

final volume.

Frank Willingham, NASM Docent



Moscow's Game of Poker: Russian Military Intervention in Syria 2015-2017. By Tom Cooper. Warwick UK: Helion & Company, 2018. Maps. Tables. Diagrams. Illustrations. Photographs. Notes. Glossary. Bibliography. Pp. 72. £16.95. ISBN: 978-1-912390-37-3

Helion typically produces short, multicolor, picture-centric treatments of a wide variety of military topics. A previously reviewed volume on Brazil's participation in World War II was both informative and well done, covering a lesser known aspect of that conflict. This book delivers up to that same standard, within some serious limitations. Knowing little about the Syrian War, I was curious about Cooper's qualifications to present this very divisive subject. He is an Austrian author, historian, journalist, and illustrator who is interested in modern military aviation and had travelled extensively in the Middle East during a career in worldwide transportation. His writing and research indicate a strong grasp of Syria's confused and constantly changing circumstances. He relies on first person accounts of what he calls "eyewitnesses" (his quotes) versus participants. This and his practice of checking these accounts against second- and third-hand sources gives the narrative an immediacy and ring of authenticity.

The book focuses on a very specific segment of a larger and terribly complex conflict. The short length leads to what is a necessarily superficial treatment of the broader and very complicated situation to lay the groundwork for focusing on Russian combat flight operations. The brief overview describes the plethora of groups involved and their activities, which, given the book's length, is about all one can expect. However, for anyone without a strong grounding in the war's background and history, context is seriously lacking. This is most evident in Cooper's very obvious bias against all things Russian. While this bias is painfully obvious, openly acknowledged, and strong enough to interfere with objectivity, the book is not at all pro-Western—just very anti-Russian. A key example is Cooper's use of the term "Axis" to describe the Assad regime, the Russians, and their various allied groups. It seems this term was selected deliberately for its pejorative implication of the World War II Axis powers' war crimes and blatant disregard for humanity. I don't in any way defend the Assad regime or its allies' behavior (including purported gas attacks against their own people), but one should expect a work of history, not propaganda. This book skirts the line.

From a research perspective, Cooper's methodology is fine, as far as it goes. The weak bibliography cites only twenty-two sources, none of the interviews conducted, six

other works by him on mainly technical aircraft subjects, and several newspaper articles.

The book's main strength, and weakness, is the laser focus on Russian flight operations. Most of the content focusses on Russian activity, with just enough information about surrounding events included to make this something more than a daily sortie count. If that is all one is interested in, this is a quick and informative read. The other strength is the myriad pictures and color plates throughout.

There are, however, several other weaknesses. The first is the paucity of maps. There are only three: a very generic Middle East overview and two that don't cover even the entirety of Syria and are insufficient to give the necessary context. The second is the inconsistent presentation of technical information. When first describing the fighter bombers deployed by the Russians, Cooper provides detailed information on each of the air-to-air weapons carried (but never used) with no mention of the various air-to-ground munitions actually employed. These munitions are described later without the benefit of the side-by-side comparison used for the air-to-air weapons. Given the variety of munitions used, a table outlining specifics of such items as type, uses, and aircraft employing them would be very helpful. In the same way the UAV discussion mentions multiple airframes with no specifics on any of them (capabilities, purpose, limitations, etc.). Someone unfamiliar with Russian equipment is at a loss. Again a table with specifics would add tremendously and cost very little space.

Ultimately, given its relatively modest price and high-quality illustrations, this book will find a place with both the modeler and hard-core aviation buff. It will appeal to those interested in the tools of this war. Anyone interested in a more comprehensive and nuanced description of this conflict must look elsewhere.

Golda Eldridge, Lt Col, USAF (Ret), EdD



Come Fly with Us: NASA's Payload Specialist Program. By Melvin Croft and John Youskauskas. Lincoln: University of Nebraska Press, 2019. Illustrations. Acknowledgments. Appendix. Sources. Index. Pp. xx, 436. \$36.95. ISBN: 978-0803278929

With this book's publication—the sixteenth volume in its *Outward Odyssey: A People's History of Spaceflight* series—the University of Nebraska Press once again has delivered a product sure to interest both academic and popular audiences. As the title indicates, Croft and Youskauskas focus specifically on space shuttle missions that involved a new, elite type of astronaut—the payload specialist (PS). Chosen by organizations hosting experiments or payloads delivered to outer space via the shuttle,

PSs received an abbreviated training program on basic shuttle operations compared to fully trained NASA shuttle commanders, pilots, and mission specialists. During 1983–1986, the period *Come Fly with Us* covers in detail, 22 different PSs—scientists, engineers, a U.S. senator, and a teacher—flew on 13 different shuttle missions.

Of particular interest to *Airpower History* readers might be two chapters devoted to the STS-51C and STS-51J missions, which occurred in January and October 1985, respectively. Those included a unique PS subset—military Manned Spaceflight Engineers (MSEs). On STS-51C, Major Gary Payton oversaw a classified national security satellite launched from the shuttle's payload bay; on STS-51J, Major William Pailes handled a pair of Defense Satellite Communications System (DSCS) III spacecraft in the shuttle's payload bay. These two Air Force MSEs became the only two ever to orbit Earth as Air Force, not NASA, astronauts.

Croft and Youskauskas have chosen to present the early history of the PS program as a collective biography structured chapter-by-chapter in specific shuttle flights. They base their narrative on a variety of thoughtfully selected sources that include books, periodicals and online articles, interviews and personal communications, mission reports and press kits, and other NASA or Department of Defense (DOD) documents. Without the details and opinions obtained through interviews and personal communications, *Come Fly with Us* undoubtedly would lack the historical "spice" that sets a book apart from the average. Even so, I found tediously repetitive the somewhat rhythmic accounting of how individual PSs reacted to launch and reentry.

Especially interesting, with regard to the PS program, were the relationships between NASA centers and their senior officials, between NASA and DOD, and between NASA astronaut crews and their respective PSs. Croft and Youskauskas explain a tug of war between Marshall Space Flight Center (MSFC) and Johnson Space Center (JSC) over which organization should oversee the selection and training of PSs. Chris Kraft at JSC remained wary about the PS program and MSFC's role in it. At least in the beginning, uncertainty and confusion reigned about the roles of mission specialists and payload specialists, which turned out to overlap in practice. As for NASA-DOD relations, a "clash of cultures" occurred as the latter sought greater oversight of national security missions, until the *Challenger* disaster in January 1986 all but terminated DOD shuttle missions. Relations between NASA astronaut crews and their assigned PSs proved positive for the most part, despite initial misgivings.

As any worthwhile historical volume should, *Come Fly with Us* focuses on people, because they are the actors on the stage—both individually and in groups—who move things, for better or worse, through time. Croft and Youskauskas have done an admirable job in capturing and conveying to readers the characters and roles of the many

actors and in summarizing the importance of their accomplishments, both in the context of their own time and beyond.

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



Check Six! A Thunderbolt Pilot's War Across the Pacific. By James C. Curran and Terrence G. Popravak, Jr. Havertown PA: Casemate Publishers, 2018. Maps. Photographs. Appendices. Glossary. Bibliography. Pp. 334. \$19.95 paperback. ISBN: 978-1-61200-6543

Now we can add Jim “Jug” Curran’s tale to the library of fighter pilot memoirs from the Second World War in the Pacific. He joins Robert L. Scott, Samuel Hynes, Edwards Park, Don Lopez, and others in recounting what it was like to fly mission after mission from strips hacked out of jungle while subsisting under primitive conditions. Curran’s story is gripping, helping us connect to the reality experienced by these “kids” (throughout the war, he was in his early 20s).

This book had an interesting genesis; and, here, the co-author, Lt Col Popravak, played an important part. Curran wrote and re-wrote a memoir of his experiences flying in the Pacific theater with his only intent being to share these experiences with his family. Research into a B-25 mission in the Philippines in November 1944 led Popravak to one of the escorting P-47 pilots, Jim Curran and, thence, to his memoir.

Popravak took on the task of preparing Curran’s manuscript for publication. In doing so, he added substantial research, relying on contemporary resources. Especially important are his references to 348th Fighter Group squadron histories, particularly those of the 341st and 460th Fighter Squadrons. Curran was assigned to both of these units during his combat tour.

The memoir is arranged chronologically, sub-divided by Curran’s regular changes of station as the Fifth Air Force moved north and west toward the Philippines. Each chapter is accompanied by extensive footnotes prepared by Popravak that support or enhance the recollections in Curran’s memoir. The level of detail is impressive.

A couple of stories stand out in Curran’s memoir among the mundane day-to-day experiences of flying in the Southwest Pacific. One is the visit of Charles Lindbergh in November of 1944. Curran does not say that he met (or even saw) Lindbergh, but he discusses in detail Lindbergh’s prescriptions for fuel-saving engine management techniques. Clearly, this was a “big deal” for all involved. Another point of interest was the eventual conversion of the 460th to the P-51 Mustang. This event was not greeted with enthusiasm by the pilots involved. As Curran re-

counts, they loved their “Jugs” and trusted the aircraft to bring them home. As much of their work involved ground attack missions, they were very worried about the vulnerability of the P-51’s cooling system to damage from ground fire.

One reads this book with mixed feelings about the agenda provided by Popravak. On one hand, these offer a surfeit of important additional information that enhances the historical value of Curran’s memoir. On the other hand, the constant interruption of Curran’s story by out-takes from squadron histories becomes annoying. Perhaps a different format could have incorporated the useful information from the histories while allowing for continuity in the original story.

Curran “went West” on 3 June 2012, at 90 years of age. Popravak has done honorable work in bringing Jim’s memoir to us in an historically useful form. For any student of the air war in the Pacific, this is a useful work.

Frank Van Haste, Alexandria VA



Air Force One: The Aircraft of the Modern U.S. Presidency. By Robert F. Dorr and Nicholas A. Veronico. Minneapolis MN: Quarto, 2018. Photographs. Bibliography. Pp. 160. \$35.00. ISBN: 978-0-7603-5799-6

The late, great Bob Dorr and prolific aviation historian Nick Veronico teamed up on this informative and very readable update of Dorr’s original 2002 edition, packed with stories, technical details, and pictures of the aircraft that fly the president. It covers the full spectrum of aircraft and helicopters, specialized roles, and highly trained and dedicated people involved in this mission.

The design and construction of specialized aircraft to fly the president developed as the mission evolved. Franklin D. Roosevelt was the first president to fly while in office, crossing the Atlantic on the way to Casablanca in a Boeing 314 Clipper. President Truman acquired a C-118 he named the *Independence*. President Eisenhower flew in a VC-121E Constellation called *Columbine III*. Around 1956, air traffic controllers evolved the call sign “Air Force One” to simplify flight clearances. During the Kennedy presidency, the first of the aircraft regarded as Air Force One, a Boeing 707 (VC-137) came into use. President Kennedy ordered a unique marking scheme that would formalize the plane’s appearance as representative of the United States of America. Soon it became a symbol of U.S. power and authority. A 747 (VC-25A) replaced the VC-137 in 1990. As this was being written, Boeing was customizing the latest 747-8 for use as the new Air Force One.

Although the marquee aircraft receive their fair share of ink, the unit that flies the president, the 89th Airlift Wing, maintains many different types of aircraft, depend-

ing on the specific requirements for any given flight. These include such airliner designs as the 757 (C-32) and 737 (C-40), and such business jets as the Gulfstream V (C-37A) and Gulfstream IV (C-20). The aircraft also fly members of Congress, cabinet officials, and other VIPs.

Eisenhower introduced the use of helicopters. Wanted urgently at the White House when vacationing one day in 1957, he spontaneously flew in an HUS-1 Seahorse the first leg of the trip instead of driving. Soon he was often flying in helicopters and the mission was born. Operated by the U.S. Marine Corps, the helicopters that now fly the president include the VH-3D and VH-60D. Designated "Marine One" when the president is aboard, their origin, crews, technical details, and even the markings are pictured and discussed.

The mission of flying the president is not as simple as it may sound. Multiple planes, including C-17s and even an MV-22B, carry support staff, the press, limousines, and other equipment. Extensive security measures include clearing the runways and airspace, strategically placed snipers, and decoy aircraft. A secret flying command post—a Gulfstream IV C-20C—trails Air Force One wherever it may go, always lurking in the background. Reminiscences of aircrew on their selection for a spot on Air Force One, training, a typical mission, and the Presidents they served give the book a genuine feel.

This is an aviation buff's book, full of beauty shots framing the aircraft in favorable light, landing in the rosy glow of a summer evening, or cruising in a picture-perfect blue sky. No space is wasted: the cover, endpapers, and dust jacket all have different Air Force One photos. Interior shots cover the working and living compartments, cockpit, kitchen, President's quarters, and press compartment. No detail is too small: captions painstakingly identify the finer points of defensive systems and communications antennae on close-in shots of the plane. There are even depictions of Air Force One design competition losers, including a customized DC-10 and a long range 747SP.

An illustrated appendix lists the aircraft that served as Air Force One, along with a photo of each, their technical characteristics, and final fate. In the early days they were scrapped or even returned to regular Air Force service. More recently, each plane is spoken for long before retirement. One VC-137C that flew President Reagan is now a centerpiece in the museum accompanying his presidential library, its cabin preserved as it was in the 1980s.

The bibliography contains most of the recent works on this topic. Although original sources are not listed, the book appears to be well researched in official, private, and corporate archives. The juxtaposition of content from the 2002 edition with newly added material lends an uneven quality, with a lot on presidents through George W. Bush and less on Obama and Trump. Certain portions seem dated, although it is fun to spot such anachronisms as electric typewriters and televisions in older photos. There are a few typos and mismatched photo captions. However, this book

is a pleasure to read or just peruse and should have a place on every aviation enthusiast's shelf.

Steve Agoratus, Hamilton NJ



The Night Witches. By Garth Ennis, writer; Russ Braun, penciller; Tony Avina, colorist; and Simon Bowland, letterer. Annapolis MD: Spitfire Productions Ltd, 2019. Illustrations. Pp. 256. \$24.95. ISBN 978-1-68247-390-0

Garth Ennis has been writing comics since 1989. Credits include *Preacher*, *The Boys and Hitman*, with successful runs on *The Punisher* and *Fury* for Marvel Comics. He has also written his own war series *War Stories*, *Battlefields* and *Dreaming Eagles*, he recently revived the classic British aviation character Johnny Red, and has produced two series of *World of Tanks* for Wargaming.net.

Russ Braun has been working in comics for almost 30 years, with a seven-year break for a stint with Disney Feature Animation. Best known for his frequent collaborations with Garth Ennis on *The Boys*, *Battlefields*, *Where Monsters Dwell*, *Sixpack & Dogwelder* and most recently *Jimmy's Bastards*.

This comic book focuses the fictional story of Anna Kharkova, a female Russian pilot. It begins as teenage Anna reports for duty in the 599th Night Bomber Regiment. She is assigned to fly the Polikarpov Po-2, a general-purpose Soviet biplane, at night in order to harass the German troops on the Eastern front in 1942. The story follows Anna's growth to a seasoned pilot. It relates how she deals with male harassment from both commanding and political officers, battles Nazis in the air and on the ground, survives several shootdowns, and mourns lost comrades. Anna is ultimately promoted to captain in command of a flight of Yakovlev Yak 9s, the most mass-produced Soviet fighter of the war.

However, she is again shot down and imprisoned in a German POW camp with severe wounds. The camp is ultimately overrun by the advancing Red army. Anna is treated as a traitor (Stalin's policy for dealing with captured Soviet soldiers) and is put on trial, only to be saved by her past female mechanic who has risen to the rank of major. After the war, Anna is sent to the Korean "police action," where she steals a MiG-15 and shoots down a USAF F-86. Because of this brazen action risking possible capture of the newly designed aircraft, Anna is sent to a Gulag. But wait, the political prison camp is next to a secret airfield, where, years later in 1964, Anna steals a MiG-21! She meets two USAF F-4 Phantoms and they fly off into the sunlight together.

The comic is obviously a fantasy but is based on known facts and real-life characters. The Afterword should be read first! In it, Ennis provides interesting background research information in support of his fantasy. This includes pre-war

inspirational Soviet female aviators, general portrayal of a Wehrmacht unit based on similar actual reported incidents, the extreme repression of the Soviet totalitarian government, and incarceration in Soviet punishment camps being the lot of many heroic Russian veterans. He makes the point that despite outdated equipment, inadequate training, and poor leadership, the Russians finally stemmed the German advance by sheer weight of numbers and low regard for human sacrifice. The cartoons and coloring are well done. Aircraft artwork in particular, shows very good proportion and detail. The comic is a quick read and quite captivating.

Frank Willingham, NASM Docent



Flying with the Fifteenth Air Force: A B-24 Pilot's Missions from Italy During World War II. By Tom Faulkner and David L. Snead, ed. Denton TX: University of North Texas Press, 2018. Photographs. Maps. Notes. Appendices. Bibliography. Index. Pp. 368. \$29.95. ISBN 978-1-57441-731-9 (hardbound); 978-57441-742-5 (eBook).

Tom Faulkner piloted a B-24 bomber in World War II as part of the Fifteenth Air Force based in southern Italy. He flew missions over Germany and German-occupied territories and received the Distinguished Flying Cross. He lives in Dallas, Texas.

David Snead is a professor of history at Liberty University in Lynchburg, Virginia. He received his PhD in history from the University of Virginia. He is the author of *The Gaither Committee, Eisenhower, and The Cold War* and has edited a number of other books.

Faulkner begins his story with a description of his early life. He lived through the Great Depression, withstanding the economic hardship suffered by his family. Snead points out that, in many cases, young people of this era had to grow up more quickly than children from earlier generations and assume responsibilities that were not normal for their age. The outbreak of war continued these lessons. American teenagers and young adults of the 1930s formed a truly unique generation that not only had to face extraordinary economic struggles, but also had to withstand the fighting in World War II. Faulkner began the enlistment process in the Army Air Force in January 1943, two months before his eighteenth birthday. By September 1944, he had flown his first mission, as a B-24 copilot, over the marshalling yards at Budapest, Hungary.

Faulkner discusses his experiences during his nine-month flight training in the United States. He and his crew were also responsible for flying a brand-new B-24 from San Francisco to Bari, Italy, and ultimately to San Giovanni Airfield, west of Cerignola, Italy. This was to be his home from September 1944 to March 1945. He describes each of his 28 missions throughout the period. His 28th

and final mission, to Augsburg, Germany, ended with two of his B-24G's engines being knocked out by flak. Rapidly losing altitude, he inadvertently flew across the Swiss border, where the aircraft was intercepted by Swiss Morane-Saulnier fighters and forced to land. The crew were interned, ultimately released, and returned to the United States. Faulkner ends his story with his postwar life including marriage, family, and a career in the insurance business. He was plagued throughout his later life by the thought that he had been considered a coward for landing in a neutral country. However, through the research of a friend, he found out that not only had he not been considered a coward; but, unbeknownst to him, he had been awarded the Distinguished Flying Cross, which he finally received in 2007!

This is an enjoyable book and a quick read. Faulkner blends his civilian life story with a military one of courage and anxiety in the skies over war-torn Europe. Snead's research is extensive and well-integrated with Faulkner's story. His many footnotes provide first-rate backup for the main points of Faulkner's story and offer readers many reference sources for additional research into this aspect of the European air war.

Frank Willingham, NASM Docent



Kangaroo Squadron: American Courage in the Darkest Days of World War II. By Bruce Gamble. New York: DeCapo Press, 2018. Maps. Photographs. Appendix. Notes. Bibliography. Index. Pp. 416. \$28.00. ISBN: 978-0-306-90312-0

Kangaroo Squadron is a fascinating account of one of the first combat squadrons to be deployed to the Pacific in the days after the Japanese attack on Pearl Harbor. Written by prolific military author and historian Bruce Gamble, a former naval flight officer, the book chronicles the history of the 435th Bombardment Squadron flying Boeing B-17 Flying Fortresses out of Australia in 1942.

The surprise Japanese attacks on Pearl Harbor and the Philippines on December 7, 1941 (December 8 in the Philippines) caught the United States Army Air Forces in the midst of reinforcing fighter and bomber units in the Philippines. Most of the B-17s already in the Philippines were destroyed, while a flight of B-17s heading to the Philippines from California faced both Japanese fighter attack and American anti-aircraft fire as they stumbled into the middle of the Pearl Harbor attack. Two of the latter were destroyed; the remaining ten landed at various fields on Oahu.

In the immediate aftermath of the attacks, the Army Air Forces scrambled to send whatever combat aircraft and crews it could manage to Australia after it became apparent the Philippines were already being overwhelmed by

the Japanese. This effort was the genesis of what became the 435th Bombardment Squadron, nicknamed the Kangaroo Squadron for being based at the Royal Australian Air Force (RAAF) airfield at Townsville in Northern Queensland.

Bruce Gamble has written extensively on World War II in the Pacific and does an excellent job of describing the experience of the B-17 squadron hastily sent to Australia in early 1942. He has a personal connection to the 435th: his late uncle, Captain John Steinbinder, was a B-17 navigator with the squadron. Gamble first introduced Steinbinder in his previously written trilogy on the Japanese base at Rabaul, a major target of the 435th. For readers not as familiar with World War II aviation, he also provides background information on the B-17 and aircrew recruitment and training before Pearl Harbor.

Though the 435th returned to the United States in late 1942, eventually reequipping with the Boeing B-29 Superfortress, Gamble ends the tale with the story of a B-17 nicknamed *Swamp Ghost*. After making a forced landing in a New Guinea swamp in February 1942, this B-17 was forgotten until rediscovered in the 1960s. It was eventually recovered and then moved in 2014 to the Pearl Harbor Aviation Museum on Ford Island in Pearl Harbor; I had the opportunity to see this amazing artifact in 2017. One of the few early war B-17s still in existence, *Swamp Ghost* is a fitting tribute to not only the members of the 435th, but also all the men and women who served during World War II.

(This review was based on an advance paperback reading copy of *Kangaroo Squadron* that included uncorrected page proofs.)

Jeffrey P. Joyce, Major, USAF (Ret)



Lectures of the Air Corps Tactical School and American Strategic Bombing in World War II. By Phil Haun, ed. Lexington KY: University Press of Kentucky, 2019. Maps. Charts. Tables. Photographs. Pp. 320. \$50.00. ISBN: 978-0-8131-7678-9

Historians seem to spend an inordinate amount of time on the WHAT of aviation history. What airplanes were used? What targets were attacked? What was the outcome of the engagement? Haun's book attempts to explain the WHY of America's strategic bombing campaign against Germany in World War II. He uses information contained in nine lectures presented at the Air Corps Tactical School in the late 1930s to show how the course content influenced the decision-makers who designed and conducted the strategic bombing campaign.

Haun is a skillful and entertaining writer. His introductions to the book and to each lecture are clear and concise and very important to tie the book together. In simplest

terms, he describes the earliest attempts to build a doctrine for the use of strategic airpower. Drawing on the works of Douhet, Trenchard, and Mitchell, Haun shows how the Air Corps Tactical School faculty acolytes of these theoreticians expanded on their work by adding detail and showing examples of the technical advances that occurred over the ensuing 20-plus years. Most importantly, he also talks about efforts to define the technical advances that had to occur in the future if the doctrine was to be achievable in the upcoming conflict.

The lectures and essays themselves, written by such notables as Fairchild, Hansel, and Kuter, were seen in their time as interesting and thought-provoking "think pieces." Today, most are a bit dry and written in the highly structured and mechanical style favored by military academicians throughout time immemorial. Looking backward from today to the 1930s, when the lectures and essays were originally written, perhaps the message was more revolutionary and impactful. Of Douhet, Trenchard, and Mitchell, only Trenchard escaped court martial for advocating on behalf of independent airpower; so the thoughts contained in these lectures and essays were revolutionary for their time. But looking back 80 years and considering how integral air power has become to combined arms warfare, the book is a bit anti-climactic.

I wonder if Haun considered comparing the lectures and essays and supporting documents to the findings of the United States Strategic Bombing Survey. That would be the true test of the efficacy of the doctrinal ideas espoused by the faculty of the Air Corps Tactical School.

Gary Connor, Docent, National Air and Space Museum



Gerhard Fieseler: The Man Behind the Storch. By Nigel Holden. Warwick UK: Helion & Company, 2018. Photographs. Notes. Appendices. Bibliography. Index. Pp. xlix, 328. \$49.95. ISBN 978-1-911512-74-5

Few people have probably heard of Gerhard Fieseler, although many know the famous Storch aircraft. This book well covers Fieseler, World War I aerial fighter combat, the evolution of aerobatics, the legacy of the Storch, a hidden battle between the V-1 and V-2 developers, and the aircraft industry in the Third Reich.

Fieseler had written an autobiography some years before he passed away in 1989, but it was not translated into English and was, apparently, not detailed. Holden did his homework well in learning about Fieseler's life, albeit some parts could not be absolutely verified.

Fieseler was born in 1896, the son of a print shop owner. His father tried to groom his son to learn the trade, but the son was completely focused on the emerging flying-machine technology. He built models, joined a model gliding club, and debated with his father while he contin-

ued to work in the shop. His father was convinced that aviation was going nowhere, but Gerhard believed otherwise and was not discouraged. He finished high school just as the Great War erupted. With a quick goodbye to his parents, he headed off to enter the service in hopes of becoming a fighter pilot.

He made it into the air corps and was sent to Macedonia. Holden details Fieseler's combat experiences well. Some German unit leaders were actually not aggressive fighter pilots and, in fact, shied away from combat. There were times Fieseler led pilots into combat and found he was left alone attacking the enemy aircraft. He thrived on flying and became a very competent pilot, surviving the war with twenty-one aerial victories.

Postwar he returned to the battle at home with his father. Young Fieseler did need to put food on the table and acquired his own printing business while marrying and starting a family. But he kept his fingers in aviation and went in as a partner in an aviation firm. He used his knowledge to help designers build better aircraft and was the flight tester and demonstrator. He then started performing at air shows all over Europe in the late 1920s and early 1930s. This soon became his livelihood. He won many awards and is considered by some to be the father of aerobatics. Eventually he started his own firm. While he was not the actual designer of the Storch, his input was invaluable in producing this famous STOL aircraft.

During his aerobatic days, he became a good friend of Ernst Udet, one of the most famous German aces. Since Udet was an officer of the new Luftwaffe, he helped broker the Fieseler Works into building military aircraft. This book addresses many details in how a company would accommodate Nazi guidelines and eventually be owned by the Third Reich.

Holden points out how a factory in the Third Reich had many upsides for Germans; but, once forced laborers were brought in, that changed. Factory managers had to deal with Gestapo-like tactics in making monthly goals. As with others, Fieseler had to go along with the Reich but did not like it. How far he objected is what cannot be determined exactly. In his autobiography he stated that he battled with the Nazis all the time, hated the salute and wearing a party uniform, helped forced laborers, and once helped a Jewish family escape to hide in the country. None of this could be corroborated.

Another interesting story in the book was the battle between the V-1 and V-2 developers. Fieseler's designers came up with the Fi 103 (the V-1) and demonstrated that it was an inexpensive weapon that could be easily and quickly built and deployed; while the V-2 was very expensive, complicated, and difficult to deploy. Fieseler tried to sell this to the German leaders without much success, as Hitler wanted the wonder weapon. The ballistic missile prevailed.

Nigel Holden's flowing style makes this biography an easy read; there were times I did not want to put it down.

Definitely a good book for the aviation enthusiast.

Tony Kambic, Fairfax VA, retired database administrator and NASM volunteer



Apollo in the Age of Aquarius. By Neil M. Maher. Cambridge: Harvard University Press, 2017. Illustrations. Acknowledgments. Notes. Index. Pp. viii, 360. \$29.95. ISBN 978-067497199-8.

When Neil Maher, a history professor at New Jersey Institute of Technology and Rutgers University–Newark, began his research for *Apollo in the Age of Aquarius*, he envisioned the book as “an environmental and technological history of the space race.” Then, one day, while reading Norman Mailer’s *Of a Fire on the Moon*, the “seeds of a different approach took root” in Maher’s mind. Realizing that *Apollo in the Age of Aquarius*, as originally conceived, did not adequately connect space technology to mainstream American history, Maher found himself posing a different set of questions, broadening the scope of his research, and writing a book that “reincarnated, is thus less an environmental and technological history of the space race and more a political history of the 1960s era.” His published narrative, consequently, explores the “shared history of the space race and the social and political movements of the 1960s era,” and he “argues not only that these two historical phenomena were mutually dependent on one another for popular and political support, but also that they represented two factions in a national debate regarding the present and future course of the United States.”

With respect to civil rights, the War on Poverty, and the urban environment, Maher elaborates by describing a meeting, in July 1969, between an African American group led by Southern Christian Leadership Conference activist Rev. Ralph Abernathy and NASA Administrator Thomas O. Paine, “with four mules as a backdrop and the Apollo 11 spaceship off in the distance.” He explains how the Poor People’s Campaign generated opposition to funding for the space program. Ultimately, this compelled NASA to create “both an equal employment policy, which exceeded the federal law’s requirements, as well as an Equal Opportunity Officer to implement it.” NASA also sought to apply its technology and skills to reversing deterioration of the urban environment, thereby uplifting the daily lives of many poor Americans.

Drawing evidence from a wide variety of sources, Maher similarly exposes how opposition by other interest groups to funding the space race caused NASA to make significant adjustments that benefited both those groups and NASA. When opponents of the Vietnam War protested against the space agency’s technological efforts “to help the U.S. military see better into, underneath, and around the jungles of Vietnam,” the resulting campus unrest and op-

position to classified academic research led, ultimately, to NASA's promotion of space technology for more efficient management of natural resources in Vietnam and other developing nations. Maher tells how *Whole Earth* environmentalism originated, at least in part, from NASA's belated response to *Whole Earth Catalog* editor Stewart Brand's LSD-induced vision on a San Francisco rooftop in 1966. Then, the historian devotes a chapter to the transitional relationship between "manned spaceflight" and the women's movement. He concludes, "By transforming NASA, feminists also altered their own movement, albeit in ways that were less obvious than decorating the nation's first female astronaut [Sally Ride] with a pink evening gown and sitting her next to a sheik."

Finally, Maher examines the rise of a "Conservative Crescent" that "arced across the Sunbelt from Cape Canaveral in the east to Southern California out west" and how it reacted to the "Hippie Counterculture." Relying, as he did in previous chapters, on many different sources—newspapers, clipping files, popular magazines, academic journals, books, government reports, conference proceedings, photographs, postcards, cartoons, and more—historian Maher describes the phenomena of "aerospace sprawl" and the "political ecology of space age suburbs." He concludes that "in reorienting NASA earthward, conservative praise for the space race also altered the New Right, first and foremost by giving conservatives a tangible point of contrast with the counterculture."

As any excellent historical narrative should, *Apollo in the Age of Aquarius* offers contemplative readers substantial food for thought. To reinforce this point, Maher leaves his audience with President Johnson's contention that "space was the platform from which the social revolution of the 1960s was launched," but he suggests the president failed to acknowledge that "this social revolution in turn brought the space race back down to Earth." This masterfully crafted volume earned its author the American Astronautical Society's Eugene M. Emme Astronautical Literature Prize for 2017.

Dr. Rick W. Sturdevant, Deputy Director of History, Air Force Space Command, Peterson AFB CO



Spaceflight in the Shuttle Era and Beyond: Redefining Humanity's Purpose in Space. By Valerie Neal. New Haven: Yale University Press, 2017. Preface. Illustrations. Notes. Index. Pp. xiv, 274. \$40.00. ISBN 978-03002065-7

Surely, no one should complain about a dearth in books about human spaceflight. Even a quick glance at any space enthusiast's bookshelves reveals an abundance of relevant titles, including many about America's space shuttle. The preponderance of the latter, however, indicates those vol-

umes approach the shuttle topic from such perspectives as engineering, political controversy, individual astronaut experiences, or catastrophic flights. Surprisingly, this book takes a refreshingly different approach, placing the shuttle in a richer historical context and presenting a sophisticated, scholarly analysis of its cultural significance.

Using an interdisciplinary lens, Neal describes Americans' struggle over the meaning of human spaceflight during the shuttle era. The fabric of her lens includes a substantial portion of rhetorical analysis, both verbal and visual, carefully tempered with social science concepts and constructs from linguistics, psychology, sociology, and anthropology, along with a philosophical infusion. Through this multifaceted prism, she perceives spaceflight as "an *imaginary* [italics added], a matrix of ideas and images that is widely shared and understood but not fully explicable." Historically, an *imaginary* evolves with society to reflect, and to affect, people's attitudes and actions. In the end, using the rearview mirror of memory, Neal discerns the various ways museums have begun to interpret the shuttle's significance, knowing that societal evolution will bring interpretive change.

Neal's analytical narrative provides ample details about how NASA officials, the media, and public opinion supported or resisted a changing human spaceflight imaginary during the shuttle era. To tell the story in such masterfully composed detail, this long-serving Smithsonian Air and Space Museum historian amassed and absorbed an impressive quantity and variety of pertinent documentation from NASA reports and brochures, newspaper stories and editorials, magazine articles, conference papers, and other sources cited in her endnotes. From cover to cover, the finished product supplies fresh, sometimes remarkably unique insights to space shuttle history.

Spaceflight in the Shuttle Era and Beyond "delves into human spaceflight in the shuttle era to identify the ideas and images that distill its meaning and to chart their formation and transformations." She explains how the spaceflight imaginary of the 1960s—pioneering a new frontier amidst a heroic contest with a dangerous adversary—underwent a transformation in the late 1970s and early 1980s, when perceptions of human spaceflight as routine and economical manifested themselves in a new imaginary—customer-oriented freight hauling and delivery. The shuttle-era astronaut imaginary also shifted from the male, military test pilots of bygone days to larger crews with racial, sexual, and professional diversity. Nonetheless, vestiges of old imaginaries persisted, as evidenced by the frequently negative portrayal of female astronauts in articles, editorial cartoons, and comics. The rhetoric and iconography of mourning after the *Challenger* disaster reframed astronauts from mere workers into valiant heroes and explorers. Gradually, the shuttle imaginary changed from space truck to scientific research vessel. It changed again when the shuttle became the deliverer of International Space Station modules, inhabitants, and supplies.

Finally, after 2005, the imaginary shifted toward the shuttle being a “geriatric patient.”

Near the book’s end, Neal offers some stimulating food for thought about the future of human spaceflight. First, she asserts, “The technical credibility of NASA’s visions for the future has not been the primary issue; cost and schedule have been the main points of contention, and to a lesser extent the motivating rationale.” According to her, the engineers who originated plans for the shuttle, unfortunately, never embraced that rationale with sufficient commitment to working through significant cost and schedule issues. She contends, “This suggests a basic weakness, if not failure, in framing the meaning of human spaceflight.” Plans for some future reusable craft might revitalize the imaginary for economically viable, routine human spaceflight, but its effective rebirth would have to “resonate with widely held beliefs and values” and, unlike the iconic shuttle, “track with reality.”

Dr. Rick W. Sturdevant, Deputy Director of History, Air Force Space Command, Peterson AFB CO



Flying, Fighting and Reflection: The Life of Battle of Britain Fighter Ace, Wing Commander Tom Neil DFC AFC AE. By Peter Jacobs. Barnsley UK: Greenhill Books, Pen and Sword Aviation, 2018. Photographs. Bibliography. Index. Pp 320. \$49.95. ISBN: 978-17848390-9

Very early in the book, Jacobs makes clear that then Flying Officer Neil did not like his squadron-awarded nickname of “Ginger,” referring to it as a “foul slur.” One can only imagine that the more he made his feelings known, the more often it was used. After reading Jacob’s book, I would offer a different sobriquet—“Lucky.” After surviving 18 months of uninterrupted operations during the Battle of Britain and Defense of Malta, followed by tours in the nascent UK Test Pilot program, and escaping all unscathed, Neil clearly led a charmed life.

Jacobs, using excerpts from Neil’s own numerous books on his experiences, paints a beautifully complex portrait of the boy and man. These excerpts became an organizational framework on which to “hang” quotations, stories, personal anecdotes, opinions and ideas to complete the canvas. There isn’t a great deal of new information in the story, but the fact that one man lived the entire story is extraordinary.

To both Jacob’s and Neil’s credit, they spend a great deal of time talking about Neil’s contemporaries, many of whom did not survive to tell their own stories. In some cases, Neil was very critical of his superiors, making his 25-year career in the RAF somewhat surprising and hitting a promotion wall at wing commander unsurprising. Most armchair historians are familiar with the “Big Wing” controversy during the Battle of Britain as a sterile aca-

ademic issue. Hearing the effects of attempts to implement the Big Wing from the perspective of a 21-year-old Hurricane II pilot whose life hung in the balance brings the issue to life. Relying on the hopelessly outclassed and under-gunned Hurricane II to defend Malta against the latest Luftwaffe Bf 109s and Regia Aeronautica Macchi 2000s virtually guaranteed high losses. Jacobs makes the case that had the Luftwaffe not withdrawn from the Mediterranean to prepare for BARBAROSSA, Malta would have fallen.

Flying, Fighting and Reflection is a bit unbalanced: the bulk of the book addresses the Battle of Britain, and Malta receives significant attention. But as Neil assumed non-combatant positions, the chapters describing them become shorter and a bit choppy. They are still filled with interesting anecdotes and observations. Most American readers will be interested in the time Neil spent working intimately with the Ninth Air Force staff during the later stages of the war and on the UK Embassy Defense Staff in the 1950s. Jacobs even works in a commentary on President Kennedy’s inauguration and the Cuban Missile Crisis.

I thoroughly enjoyed Jacob’s book. It is clear that he has deep respect, admiration, and affection for Wing Commander Neil. But it would be unusual to not hold such feelings for a man of such accomplishment. After reading this book, the first thing I did was check local libraries for Neil’s own books. This book is an excellent introduction to an extraordinary man.

Gary Connor, Docent, Smithsonian Air and Space Museum



Fuel, Fire and Fear: RAF Flight Engineers at War. By Colin Pateman. London UK: Fonthill, 2018. Photographs. Bibliography. Pp. 206. \$34.95. ISBN: 978-1-78155-675-7

This book is about the role of the flight engineer on RAF heavy bombers—the Lancaster, Stirling, and Halifax—in World War II. The RAF decided early in the war that the weight and space occupied by dedicated flight engineer stations in their heavy bombers would benefit mission capability. Highly trained flight engineers, with duties critical to operational success, occupied these stations. This crew member supervised pre-mission preparations including fueling and bomb loading. While in flight, he monitored and controlled the engines, transferred fuel, made in-flight repairs, filled in on the guns, and assisted the pilot as required. Upon landing he assessed the aircraft’s condition and supervised repairs and maintenance.

Colin Pateman is a specialist on the RAF in World War II. Subjects of his previous works include tail gunners, POWs, heavy bomber crews, and B-24 bridge busters in Burma. This book covers the origins of the flight engineer

role, recruitment, and training of RAF heavy bomber crews. Twenty chapters of individual combat experiences present a diversity of men, missions, and aircraft. The big three RAF heavies dominate (the Halifax is the most numerous), but there are a few stories on the B-24 Liberator, Short Sunderland, and even a PBY-5 Catalina. Pateman's goal is to help the reader understand the high cost of war. Accordingly, not every story has a happy ending; some of his subjects perished in combat. Ample space is devoted to monuments, cemeteries, and other memorials, not only in England but throughout Europe, dedicated to honoring and preserving the memory of those who gave their lives during the war.

Readers accustomed to studying Eighth Air Force World War II bombing operations will be fascinated at how RAF practice differed from that of the USAAF. Although a member of the crew was often designated for the role, the US did not install a dedicated flight engineer position in heavy bombers until the B-29. RAF crews were not assigned; they self-selected themselves during training. RAF heavy bombers generally had no co-pilots; the cockpit had a single seat. If the mission called for it, the flight engineer could set up a jump seat to act as "second pilot."

The photos focus on aspects of RAF heavy bombers as a flight engineer would see them. The engineer's instrument panel and controls, in or near the cockpit, are pictured. There are details upon which he would concentrate in mission preparation: bomb bays (the Halifax had additional bomb bays in the wing roots between the fuselage and inboard engines), fueling, and the amazingly complicated landing gear of RAF heavies. Pictures of the crew at their stations, ready for combat, with the flight engineer examining his instruments or adjusting controls, provide valuable context.

Pateman is not the first to write from a flight engineer's perspective, but his volume is the most thorough survey to date, expanding upon the attention to flight engineers in C.G. Jefford, *Observers and Navigators: And Other Non-Pilot Aircrew* (2014). A few memoirs offer a more personal perspective on the life of a flight engineer. Ted Stocker, *A Pathfinders War* (2009), flew over 100 missions, eventually becoming a Flight Engineer Leader. Humphrey Phillips, *RAF Flight Engineer on a Lancaster bomber* (2018), flew some of the most challenging RAF operations.

This book is sourced primarily from official RAF archives and a fairly robust selection of recent secondary works. Pateman identifies the documents he's quoting once in a while, but unfortunately there are no end notes, making it difficult to gauge use of sources. There is no index, although the division of the book into twenty-eight relatively short, topically-themed chapters minimizes the loss. The style is fairly readable, although some long excerpts from official documents disrupt the narrative. Despite this, the book is rich in detail.

Fuel, Fire and Fear is a welcome and needed addition

to RAF World War II historiography. I expect it to become the standard reference for its subject. The cover price is rather steep, but I'd recommend this book for anyone interested in the air war over Europe.

Steven Agoratus, Hamilton NJ



The History of Navigation. By Dag Pike. Barnsley UK: Pen and Sword Maritime, 2018. Maps. Diagrams. Illustrations. Photographs. Index. Pp. xii, 209. £25, £15 Kindle or e-book. ISBN: 978-1-52673-169-2

INS, GPS, LORAN, Decca, GLONASS. These acronyms are the modern shorthand of navigation. For the unfamiliar, they refer to the variety of systems fast replacing the traditional navigator, charts, sextants and other tools once used to fix our position on planet earth. These systems offer tremendous accuracy, instantaneous updates, and an ease of use unimaginable even 50 years ago. They allow anyone to get in their car, aircraft, or boat and launch toward the horizon with great confidence they will arrive at their destination. As any of us older than teenagers know, however, getting from here to there wasn't always so simple. Dag Pike is a maritime navigator with five decades of widely varied experience. He provides a concise, entertaining, and informative look at navigation from its very beginning millennia ago to those modern systems mentioned above.

The story begins with the first people brave enough to leave the safety of dry land and venture out onto the water. Common sense suggests they weren't fools, though, and probably didn't stray far from the land. In learning to travel along coasts, using landmarks as references, navigation was born. Pike arranges his narrative by focusing on navigation's challenges and the techniques and tools used to overcome them from the time of these earliest seafarers. His focus is global, and he starts by discussing early navigation. He acknowledges the advances made by the Polynesians, Chinese, and early Europeans. He then moves to the most basic challenge of simply knowing the character of the waters (depth, currents, tides). However, it took many years to figure out this rudimentary information and then, through trial and error, uncover effective navigation methods. The same went for maintaining a direction, figuring out speed, and determining position. All of these required a combination of practical experience and engineering talent to develop workable processes and devices of exceptional precision and durability such as the compass, chronometer, and sextant.

The discussion then transitions to the challenges of navigating larger and much faster ships through weather, close to land, and into and out of busy ports. Devices such as charts, buoys, lighthouses, and lightships and ships logs are all discussed. He concludes the book with a discussion of the modern systems mentioned above and the impact of

the human element in an increasingly automated system.

This book was a pleasure to read. Pike writes well and is an operational navigator with a reflective temperament and extensive real-world experience including everything from his first shipwreck as a novice seaman to his role in setting the surface trans-Atlantic speed record (50+ knots for the entire passage). The book is filled with pictures and illustrations, and the center section of color plates is excellent. The focus is on maritime navigation. While there is some discussion of aerial navigation, it is very limited.

Pike lets what looks like a personal bias slip through just a bit when he acknowledges the advantages of technology (e.g., GPS, INS) but shows a healthy skepticism of these systems' vulnerabilities. He is very concerned that an overreliance on technology has led to the deterioration or outright lack of human navigational skills he feels are necessary to back up these systems. Rather than argue for a return to more archaic methods, though, his final conclusion argues for more automation backed up with systems less reliant on satellites (e.g., eLoran, a shore-based radio navigational system with greater precision than previous versions).

Unfortunately, he doesn't address his concern about people who can't find their way out of the driveway without these systems; I would have liked to hear his suggestions on this topic. After all, how many of us can find our way in a new town without the reassuring tones of our GPS-enabled smart phone directing every turn?

Golda Eldridge, Lt Col, USAF (Ret), EdD



Messerschmitt Bf 109G with DB605A Engine. By Robert Peczkowski. Poland; Wydawnictwo Stratus, 2018. Illustrations. Photographs. Drawings. Pp. 160. \$35.00 paperback ISBN: 978-836528168-5 and **PZL 23 Karas.** By Tomasz A. Kopanski. Poland; Wydawnictwo Stratus, 2018. Maps. Diagrams. Illustrations. Photographs. Scale Drawings. Pp. 144. \$35.00 paperback. ISBN: 9788365281630

Publications addressing the wants and needs of aircraft modelers have advanced significantly over recent years. These publications have grown from homemade pamphlets and broadsheets to slick paperbacks with striking colors and illustrations, not to mention similarly improved monthly periodicals and magazines. While *Air Power History* doesn't often review primarily modeling books, these two recent publications from MMP Books are perfect examples of the "what is" and the "what is possible" for books serving the aircraft modeler market. The second of the two books is an excellent example of why these publications are often becoming the best historical books available on some very important aircraft types.

Messerschmitt Bf 109G with DB605A Engine is an excellent example of a typical high-end publication targeting

the aircraft modeler. Illustration-heavy, the large format pages on quality paper show the many drawings and photographs to great advantage. The narrative and text are sparse, offering little elaboration on the illustrations. This book assumes the reader has a significant prior knowledge of the Bf 109 family as well as the various modifications and weapon suites offered by the numerous manufacturers and sub-contractors. Many of the line drawing illustrations appear to be from technical documents but the lack of citations limits their use beyond modelling.

PZL 23 Karas demonstrates what an author can achieve with a book nominally targeting the modeling community. Kopanski offers the same kinds of modeling information for the PZL23 as Peczkowski did for the Bf 109. There is enough information in this book for a skilled modeler to scratch build this unique and little-known aircraft. The color profiles offer detailed livery information for types used by the Polish Air Force and several foreign users. There is a wide variety of photographs of the aircraft; most showing aircraft which came to grief as a result of accidents or enemy action.

But where Kopanski sets his work apart from the typical modeler's tome is in the research he presents on the Polish Air Force units that employed the PZL23 as a light bomber and reconnaissance aircraft. In doing so, he offers a primer on the organization of the Polish Air Force pre-1939 and demonstrates how ill-equipped and ill-organized they were to meet the German and Russian invaders. In discussing the aircraft's actual employment, he frequently provides details of specific sorties; identifying crew members, targets, and end results. He makes a strong case for all the factors which led to an astonishing 86% loss rate. The result is a book of equal use to the historian and the modeler. My only criticism is that many of the photographs have been reformatted and enlarged for publication and are very blurred. But given how rare these pictures must be, even degraded these images are useful.

I enjoyed both books. While I don't anticipate building a Bf 109 Gustav, I found the technical information interesting and clear. Kopanski's book, however, rises to a different level. There is enough information to satisfy both the amateur historian and the modeler.

Gary Connor, Docent, Smithsonian Air and Space Museum



Silent Warriors, Incredible Courage: The Declassified Stories of Cold War Reconnaissance Flights and the Men Who Flew Them. By Wolfgang W. E. Samuel. University Press of Mississippi, 2019. Table of Contents. Terms and Abbreviations. Photographs. Overflight Maps. Table. Notes. Bibliography. Index. Pp. 286. \$29.95 (Hardcover). ISBN-13: 978-1-49682-279-6.

Wolfgang Samuel is a German-born American author.

He was commissioned through Air Force ROTC at the University of Colorado in 1960 and is a graduate of the National War College. He served in the U.S. Air Force for thirty years until his retirement in 1985 as a colonel. He flew his first operational missions during the Cuban Missile Crisis of 1962, then flew many reconnaissance missions during the Cold War. He also flew combat during the Vietnam War. He was awarded the Distinguished Flying Cross three times and multiple Air Medals. He has written several military aviation-related books and has been published in military journals.

By the early 1950s, the United States had an urgent and growing need for strategic intelligence on the Soviet Union and its satellites states. In 1954 President Eisenhower authorized the Sensitive Intelligence (SENSINT) Overflight Program for secret peacetime overflights by military aircraft. At great risk, the US Air Force and Navy conducted peripheral reconnaissance and penetration overflights, employing air-refuellable reconnaissance bombers of the Strategic Air Command (RB-45C, RB-66, and RB-47E). The Air Force also modified high performance reconnaissance fighter airplanes (RF-86 and RF-100) by mounting cameras and extra fuel tanks for shallow penetration missions. In addition, the Air Force also contracted for reconnaissance versions of the British Canberra bomber (Martin RB-57A and D). The Navy employed the P2V-7 Neptune. These missions paid a high price in lives lost and increased international tension, which led to the development of the high altitude U-2 and, ultimately, the SR-71—both were efforts to “outfly” Soviet defenses.

This book covers reconnaissance efforts both in Europe and in Asia from the early 1950s through the mid 1960s. Samuel focusses on flights by U.S. and British aircraft around and into Soviet territory. He provides insight into the rationale, requirements, limitations, and risks faced by political and military planners and crews who had to protect the United States against hostile threat of the Soviet Union and its mainland Chinese and North Korean allies. These were closed societies, and intelligence regarding their military and industrial capabilities was paramount to aid decision-making for our country’s defense.

Samuel compiled more than twenty vignettes based on personal interviews and declassified presentations made by the men who flew the missions. These interviews were made at the Early Cold War Overflights Symposium, held at the Defense Intelligence Agency in Washington D.C, in 2001. Samuel has made only minor editorial changes and provided clarifying detail to this information. This was the first time that reconnaissance pilots and aircrews had the opportunity to talk freely about missions they had flown long before, and to hear what others had done. It was the first time they were made aware of the scope of the Cold War overflights program and those who had planned and authorized the missions flown. The stories cover flights over North Korea, the eastern and western Soviet Union, China, and Viet Nam. They relate the uncommon bravery,

flying skills, and heart-felt terror of a small group of dedicated men that kept our country safe during a period of extreme uncertainty. They are as good as any spy mysteries. Compared to these guys, Jack Reacher has a walk in the park!

Frank Willingham, NASM Docent, Vienna VA



The Vickers Viscount: The World’s First Turboprop Airliner. By Nick Stroud. Barnsley, South Yorkshire: Frontline Books, 2018. Tables. Diagrams. Illustrations. Photographs. Color Plates. Pp. 120. \$28.95 paperback. ISBN: 1526701952

This is a niche book for the serious aviation enthusiast or aircraft modeler who is looking for an attractive, well-done book on an iconic aircraft. As the title states, the Viscount was the first of the turboprop airliners using new technology to develop an entire class of aircraft still in service today. The book is short but packs a lot of information into a relatively small space. Stroud focuses on the aircraft’s development, customers (both civilian and military/government), and uses. With the exception of one chapter on the tragic loss of Ansett-ANA airlines Viscount VH-TVC in a severe thunderstorm, there are no accounts by or about the crews or personnel who built and maintained the Viscount. This is in line with this sort of publication which focuses on the technical aspects and pictorial representations for the aviation enthusiast.

In this respect, the book delivers everything one could want. There are pictures aplenty, both color and black-and-white, and a final section with outstanding profile views of the aircraft in the liveries of a variety of users. There is a comprehensive list of aircraft by manufacture date, registration number, and original purchaser and another which identifies surviving airframes on display around the world. Stroud has done his homework, and the information seems complete and accurate.

The book starts with the development of the Viscount and then moves through initial entry into service, technical aspects, military and government use by country, continuing development and service, and finally the status of surviving airframes. This treatment is not exhaustive but it is representative of typical programs and the important milestones in the aircraft’s development and use. One area Stroud does not discuss is the aircraft’s safety record. He identifies aircraft losses, but there is no list of or discussion of the reasons for the losses (e.g., aircrew error, design flaws, structural or powerplant failures). Given the issues faced by some other groundbreaking post World War II aircraft (the de Havilland Comet being the worst example) it would have been interesting to learn more about this key aspect. The one chapter on the loss of an airplane, VH-TVC mentioned above deals with an accident due to extreme

weather—a cause that wasn't specific to the Viscount. Stroud points out this accident served as the impetus for installing weather radar on commercial airliners, but that is incidental to the Viscount story. The only other complaint is that many of the captions associated with sidebars merely repeat the information included in the sidebar.

The price is reasonable for a book of this sort. For someone interested in this iconic aircraft, the book is a useful addition to their library.

Golda Eldridge, Lt Col, USAF (Ret), EdD



History of the Gloster Javelin: The First All Weather British Fighter. By Ian Smith Watson. Fonhill Media Limited. 2018. Tables. Diagrams. Illustrations. Photographs. Appendices. Pp. 223. \$36.95. ISBN: 978-1-78155-374-9

It is not uncommon for the aviation “bug” to find a home among the fertile imaginations of the very young. Long before understanding thrust-to-weight ratios, drag coefficients, and roll rates, a young imagination appreciates the shape and form of an aircraft, forming a lifelong bond bordering on love. The aviation target of my affection was the F7U Cutlass; 60 years after discovering the “Gutless Cutlass,” I still stop to admire its form even though, now, I realize that its inherent limitations compromised its operational utility and proved fatal to many of its pilots.

The Javelin was possibly a target of Watson's youthful aviation infatuation. The book is clearly a labor of love and portrays the “Flat Iron” in the most favorable light possible while grudgingly acknowledging its many limitations.

Watson does an excellent job putting the Javelin into the context of its time. Beginning with RAF operations in the early days of World War II, he presents a short synopsis of the British approach to night-fighter operations. He could have strengthened his story further by including information on the RFC's First World War efforts to defend against nocturnal incursions by Zeppelin and Gotha intruders. Expanding the scope of his introduction would show that the RAF made no meaningful progress in night-fighter tactics or equipment in the intra-war years. By 1939, the RAF was little better prepared to meet the nocturnal threat than its predecessor was decades earlier. But Watson does make an effective case for the rapid advances made throughout the Second World War, culminating in the very effective Mosquito NF.38. But the end of the war saw the loss of momentum for continued growth. The post-war drawdown saw major budget cutbacks in R&D such that the RAF was unable to field an effective all-weather night-fighter force at the beginning of the Cold War. The defense of the UK against aerial attack depended upon a shrinking cadre of day VFR fighters.

Watson clearly explains the chaos within the British aviation and government establishments in the 1950s, especially following the release of the infamous Sandys Report. In many ways, the actions that paper mandated continue to play out in the British defense establishment today. Regarding the Javelin program, the RAF attempted to simultaneously field up to five variants of the aircraft, most with insufficient avionics, engines, weapons and personnel. In fact, Watson points out that large portions of the Javelin program were funded by the United States; and, in response to the numerous program delays, the US Third Air Force assumed responsibility for the air defense of large portions of the United Kingdom.

The balance of the book sets the stage for detailed discussion of the technical and operational elements of the Javelin and its many variants. Watson includes many anecdotes provided by aircrew and maintainers. These personal stories offer a needed human touch to the discussion of hardware. The stories present a clear picture of a flawed design pressed into service well before it was ready to defend against the growing and evolving Soviet threat. These aviators and technicians faced the challenge of fielding an all-weather night fighter with significant limitations. So significant were these limitations, that the Javelin finished its short and unremarkable career in the far reaches of the empire, well away from the Soviet threat it was designed to counter.

This is a very good read on many levels. It presents technical and operational information in a clear and readable style, supported by detailed research and numerous anecdotes and photographs from personal collections. It places the Javelin in the context of its time and doesn't mince words when describing how government policies, procurement inefficiencies, and rapidly changing technologies limited the utility of this transitional design.

Gary Connor, Docent, Smithsonian Air and Space Museum, and former senior lecturer in Defense Studies at RAFC Cranwell from 1981-85



Comet: The World's First Jet Airliner. By Graham M. Simons. Barnsley UK: Pen and Sword Aviation, 2018 (first published 2013).. Tables. Diagrams. Photographs. Illustrations. Bibliography. Index. Pp. 288. \$32.95. ISBN: 978 1 52672 677 3

Englishman Graham Simons is a professional aviation writer, publisher, and historian. He has an engineering background and membership in several aviation societies. Additional books that he has written include *Boeing 707 Group*; *B-29 Superfortress: Giant Bomber of World War 2 and Korea*; *The Airbus A380: A History*; *B-17 Memphis Belle*; and *Boeing B-17: The Fifteen Ton Flying Fortress*.

In this book, Simons examines the course of the de Havilland Comet's evolution from concept development through production, testing, and first flight of the Comet 1. Comet-specific requirements for airline route development and crew training are also covered. Simons describes initial commercial service by British Overseas Airways Corp. (BOAC), the launch customer, covering various stage lengths from London to Johannesburg and from London to Karachi, Calcutta, Singapore, and Japan. He also reviews operational lessons-learned from this first jet passenger service. The Comet itself is described via numerous views of passenger layouts, cockpit and crew stations, and galley and cargo accommodations. Simons presents a lengthy and quite informative discussion of disasters that overcame the Comet, the comprehensive investigations of these incidents, and how fixes were applied to return the Comet to service. Three Comet 1 aircraft were lost in flight under similar circumstances. However, the wreckage of only one was recovered to the extent that provided causal information on structural fatigue failure. This ultimately led to re-design of the Comet's fuselage.

Simons goes on to describe how lessons from Comet 1 operations ultimately led to the development and production of follow-on designs—Comets 2, 3, and 4. These versions were operated by additional airlines (each overviewed in the book) and by the Royal Air Force. Improved performance and passenger-carrying capabilities of these enhanced Comet models also led to inauguration of the first trans-Atlantic jetliner service. Simons includes a chapter on Dan-Air, the world's largest Comet operator. He includes entertaining anecdotes of Dan-Air operations throughout the world and also includes a section on Dan-Air's lady pilots.

To conclude, Simons reviews the Nimrod, a maritime patrol aircraft, an extensively modified Comet. In addition to three maritime reconnaissance variants, two further Nimrod types were developed as an electronic intelligence gathering variant. An airborne early warning platform, the Nimrod AEW3, and an extensively rebuilt R.1 replacement, the MRA4, both had considerable development problems and were cancelled.

As in his book *Boeing 707 Group*, Simons begins by reminding us that "the British de Havilland DH.106 Comet was the world's first jet airliner...not the Boeing 707." He reminds us of this fact periodically throughout the book. I think this is a bit demeaning and probably unnecessary, since he provides ample evidence of the pioneering nature of the Comet development and operations, which in turn, led to introduction of the jet age. With this out of the way, any aviation enthusiast can settle down to a very good read.

I liked this book. It is an excellent source for the engineer, historian, and aviation enthusiast alike. It is replete with aircraft photographs, diagrams, and airline material that support the text. The book is well worth the price and will provide many hours of intriguing reading

and research support. It is a good addition to one's aviation bookshelf.

Frank Willingham, NASM Docent



The Empire Strikes South: Japan's Air War Against Northern Australia, 1942 to 1945. By Dr. Tom Lewis with illustrations by Michael Claringbould. Kent Town, Australia: Avonmore Books, 2017. Notes. Maps. Photographs. Appendices. Sources. Pp. 208. \$39.95 paperback. ISBN 978-0-9945889-1-3

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Dr. Tom Lewis served as an officer in the Royal Australian Navy, where he saw active service in the Middle East. He has written nine other books, mostly concerning World War II in Australia and the Pacific theater. In 2003, Lewis was awarded the Order of Australia Metal for meritorious service to the Royal Australian Navy, particularly in the promotion of Australian naval history. His collaborator, Michael Claringbould, is a three-dimensional, digital aviation artist and globally recognized expert in Japanese aviation.

This book is primarily concerned with Japanese offensive movements against northern Australia from early 1942 through mid 1944. It relates, day by day, more than 200 individual Japanese offensive air raids. Each entry chiefly recounts a Japanese mission: dates, departure times from Japanese bases of origin, number and type of aircraft, Japanese flight leaders, flight units (e.g., kokutai (air group with 27 to 54 aircraft), and chutai (9 aircraft sub-unit)), ordnance carried and dropped, Australian targets, damage assessments, number of Japanese aircraft lost or damaged, number of aircraft returning to base, and landing times. To a lesser degree, it covers allied defensive movements and encounters in response to individual raids. It describes the number of aircraft engaged, anti-aircraft fire results and searchlight use for night assaults, allied aircraft types and numbers, and allied pilot victories and losses.

Defensive results, perhaps because of the Japanese perspective presented in the book, appear somewhat less than totally effective, with only 62 Japanese aircraft lost during the two-and-a-half-year period. The effectiveness of the Japanese Zero against allied P-40s and Spitfires is highlighted. In separate chapters, Lewis describes operations for Darwin and its environs, Northern Territory coastal areas, Western Australia, and Queensland. Performance data and excellent aircraft illustrations of both Japanese and allied aircraft are provided. In order to provide this narrative log, Lewis has well-researched the Kodochosho, the record of Japanese imperial forces in World War II.

I found the book to be both compelling and disturbing. Lewis's purposes in writing this book were threefold: 1) to assure families of those Japanese who fought and died,

that they are regarded today with curiosity, respect, and pity; 2) to bring to Australian notice, a war largely unknown by the Australian people of today, who have little understanding of the extent of the conflict that raged across northern Australia; and 3) he asks us to “remember these [Japanese?] military men who fought far from home and fell in honorable battle. Lewis clearly has accomplished his second objective. However, after reading these accounts that highlight a war of aggression brought to Australian shores, it might be more difficult to honor an enemy that perpetrated these actions in order to further their objectives of empire!

From a purely military standpoint, this book is an interesting read. Yet, its reconciliatory tone reflects much on the fact that those who did not live through the war in the Pacific and who are ignorant of its horrors, are more easily able to forgive and forget!

Frank Willingham, NASM Docent



From Jacks to Joysticks: An Aviation Life—Engineer to Commercial Pilot. By Mick J. Patrick. Barnsley UK: Air World Books, 2018. Photographs. Appendix. Pp. xii, 188. \$39.95. ISBN: 978-1-52671-285-1

Mick Patrick recalls his nearly 60 years in aviation in this well-written autobiography that clearly captures his love of aviation, in general, and flying, in particular. For American readers less familiar with aviation in the United Kingdom and its former colonies, the work provides insight into life in the Royal Air Force in the 1960s for engineers (substitute “mechanics” for Yanks).

That experience proved invaluable. Leaving the military, he joined a maintenance outfit at Stansted north of London that specialized in multi-engine commercial aircraft. That led to a position with a cargo carrier. Desiring to fly, he first qualified as a flight engineer on the Canadair CL-44 and the Conroy CL-44 Guppy. The aircraft is probably best remembered for its relatively unique swing tail to accommodate cargo. For a variety of reasons, only 39 of the aircraft were built, even though the turboprop-powered aircraft proved to be reasonably inexpensive to operate in terms of fuel burn. Over time, parts became an issue; and, today, only a few of these aircraft are operating at various places around the world.

Moving on to British Caledonian Airways (absorbed by British Airways in the late 1980s), Patrick upgraded to jets, with considerable time logged on the Douglas DC-10. Along the way, he achieved instructor status. He also earned his pilot’s license. On his layovers in the United States, he frequently rented aircraft to build up his hours and also qualify on float planes.

Before the demise of the three-man crew because of encroaching automation, the flight engineer’s position offered

an opportunity to gain cockpit access. Many flight engineers progressed to the left seat, but some remained as career second officers. For example, my uncle served as a career flight engineer beginning with Consolidated C-87s during World War II and culminating with Boeing 747s in the early 1970s. Patrick’s stories provided a better appreciation of the responsibilities of a flight engineer, a topic seldom encountered in aviation literature.

Forced to take mandatory retirement but still young enough to work commercially, Patrick turned to flying air ambulances out of the United Kingdom all over Europe and sometimes into the Middle East and Africa. As of 2018, he is still involved in conducting safety and operational audits of airlines around the world for various organizations.

This is an easy read that in some ways reminds me of 1950’s novels by former commercial pilot Ernest K. Gann. Anyone with an interest in aviation and flying should find it enjoyable.

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



PROSPECTIVE REVIEWERS

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

Col. Scott A. Willey, USAF (Ret.)
3704 Brices Ford Ct.
Fairfax, VA 22033
Tel. (703) 620-4139
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Coming Up



Compiled by
George W. Cully

September 16-19, 2019

The **Air Force Association** will hold its annual National Convention and Air, Space and Cyber Conference at the Gaylord National Hotel in National Harbor, Maryland. For details, see the Association's website at www.afa.org/events/calendar.

September 25-28, 2019

The **Society of Experimental Test Pilots** will present its 63rd Annual Symposium and Banquet at the Grand Californian Hotel in Anaheim, California. For more particulars, see the Society's website at <http://www.setp.org/symposium/meetings/annual-symposium-banquet/>.

September 28, 2019

The **National Aviation Hall of Fame** will host its 57th Enshrinement Dinner and Ceremony at the Wings Over the Rockies Air & Space Museum in Denver, Colorado. For further information, see their website at <https://www.nationalaviation.org/>.

October 14-16, 2019

The **Association of the United States Army** will host its annual meeting and exhibition at the Walter E. Washington Convention Center in Washington, DC. For a program agenda and other details, see the Association's website at <http://ausameetings.org/2019annualmeeting/>.

October 16-19, 2019

The **Oral History Association** will hold its annual meeting at the Sheraton Salt Lake City Hotel Salt Lake City, Utah. This year's theme will be "Pathways in the Field: Considerations for those Working In, On, and Around Oral History." For more details, see the Association's website at <http://www.oralhistory.org/2019-call-for-proposals/>.

October 17-20, 2019

The **Mars Society** will host its 22nd annual convention on the campus of the University of Southern California in Los Angeles, California. For program information and registration details, see the Society's website at <http://www.marssociety.org/conventions/2019/>.

October 24-27, 2019

The **Society for the History of Technology** will hold its annual meeting in Milan, Italy. For additional information, see the Society's website at www.historyoftechnology.org/annual-meeting/2019-shot-annual-meeting-24-27-october-milan-italy/.

October 28-30, 2019

The **Association of Old Crows** will hold its annual convention at the Renaissance Downtown Washington D.C. hotel and convention center in Washington, DC. For more details, ping a crow at www.crows.org/page/annualsymposium.

November 8-10, 2019

The U.S. Army's **Center for Military History** and the **Dwight D. Eisenhower Society** will co-host their 1st Annual Conference on World War II at the Wyndham Hotel in Gettysburg, Pennsylvania. For registration use the website at www.americashistoryllc.com or email info@AmericasHistoryLLC.com.

November 12-23, 2020

The **National World War II Museum** will present its 2019 International Conference on World War II on the museum grounds in New Orleans, Louisiana. The theme of this year's conference is "June 1944: The Month That Changed The World." For schedule and registration details, see the Museum's website at www.nationalww2museum.org/events-programs/events/125032-2019-international-conference-world-war-ii.

January 3-6, 2020

The **American Historical Association** will hold its 14th annual meeting at the New York Hilton Hotel in New York City, New York. For registration and program details, see the Association's website at <https://www.historians.org/annual-meeting>.

March 18-21, 2020

The **National Council on Public History** will hold its annual meeting at the Westin Peachtree Plaza Hotel in Atlanta, Georgia. The theme for this year's assembly will be "Threads of Change." For registration and schedule details, see the Council's website at neph.org/conference/2020-annual-meeting/.

March 30-April 2, 2020

The **Space Foundation** will host its 36th annual Space Symposium at the Broadmoor Hotel in Colorado Springs, Colorado. For registration and other details, visit their website at www.spacefoundation.org.

April 2-5, 2020

The **Organization of American Historians** will hold its annual meeting and conference at the Marriott Wardman Park Hotel in Washington, D.C. The theme for this year's gathering will be "(In)Equality." For registration and other details, see their website at www.oah.org/meetings-events/oah20/.

April 22-24, 2020

The **Army Aviation Association of America** will host its annual Mission Solutions Summit at the Gaylord Opryland Hotel and Convention Center in Nashville, Tennessee. For more details see the Association's website at www.quad-a.org/.

April 30-May 3, 2020

The **Society for Military History** will hold its 87th annual meeting at the Crystal Gateway Marriott Hotel in Arlington, Virginia. The theme of this year's meeting is "Policy By Other Means." For registration and other information, see the Society's website at www.smh-hq.org/index.html.

May 4-7, 2020

The **Association for Unmanned Vehicle Systems International** will present Xponential 2020, its premier annual convention and exhibition at the McCormick Place Exhibition Center in Chicago, Illinois. For registration and other details, see their website at www.auvsi.org/events.

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

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History Mystery Answer



The Lucky Lady I through IV were the names of the aircraft. The significant aviation event was flying around the world. In July 1948, 3 B-29 flew around the world in 14 days (8 stops). Of the two airplanes to compete the feat, one was called "Lucky Lady" with the other named "Gas Gobbler." The following spring (March 1949) a B-50A named "Lucky Lady II" completed the first non-stop flight around the world in 94 hours and 1 minute. The feat required 4 air-to-air refueling. In January 1957, "Lucky Lady III" as a part of three ship of B-52Bs became the first jet to fly around the world nonstop. As part of Operation Power Flite, The three ship circumnavigated the globe in 45hours and 19 minutes. Finally in 1994 2 B-52Hs "Lucky Lady IV" and "Laissez le Bon Temps Roulez" took off from Barksdale AFB, Louisiana and flew around the world non-stop in 47.2 hours. In all four cases, the flights demonstrated the Air Force's Global Power.

The following links have additional information about the flights:

Lucky Lady I, II, III

<https://www.afhistory.af.mil/FAQs/Fact-Sheets/Article/458978/lucky-ladies-i-ii-and-iii/>

<https://www.youtube.com/watch?v=x9MIba677i0>

<https://www.youtube.com/watch?v=8G4QQUt8INw>

Lucky Lady IV:

<https://www.barksdale.af.mil/News/Article/634944/twentieth-anniversary-of-record-setting-flight-around-the-world/>

<https://www.youtube.com/watch?v=e4IO1MjFAdc>



This issue's quiz:

A military tradition is to give individual aircraft a name. Many historic aircraft names come to mind: The "Memphis Belle" (Capt Bob Morgan's B-17F), the "Enola Gay" (the first plane to drop an Atomic Bomb), and "Scat Cat XXIII" (Col Robin Old's F-4). Like Gen Old's "Scat Cat" name, aircraft names are often reused. Sometimes, like in the case of Robin Olds, it's because the pilot has moved to a new aircraft. Other times it's to pay tribute to those before us. Our question for this addition involves an aircraft name that has been used 4 times (I, II, III, IV) for the same type of significant/record breaking aviation event. To give a clue, the name was first used in 1948, then it was used again in 1949, 1957 and finally again in 1994. What was the aircraft name? What was the significant event?



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