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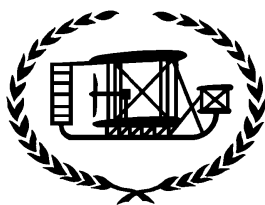
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In this issue we begin with a poignant account of valor during the Korean War. Col. Paul C. Fritz, USAF (Ret.) relates his personal experiences as a member of the famed Kyushu Gypsy Squadron of C-47s that was instrumental in the rescue of United Nations troops at the Chosin Reservoir. In the second article, also a personal account, aerospace historian Thomas A. Heppenheimer sheds bright new light on the origins of hypersonic propulsion research. He begins with a description of the early work on scramjets, follows developments on the Air Force's aerospace plane, on to the work of NASA's Langley Research Center, and concludes with why the space plane became unsustainable. Next, Col. Austin W. Stitt, USAF (Ret.) recounts the infamous Japanese attack on Clark Field, the Philippines, on December 8, 1941. In a 1974 letter, Stitt provides his personal recollection of the historic event, placing the reader on the scene. The story should appeal to those who prefer the "you are there" type of history, without the trappings of scholarly analysis or after-the-fact rationalization. In the fourth article, A. D. Harvey makes the case that the Italians' aerial bombing—in their 1915-1918 war against Austria-Hungary—had greater influence on the way air warfare theory developed than it did on the Western Front. We expect that this thesis will generate considerable discussion. Finally, John Clloe, the 3d Wing historian, finishes the story of the P-38 restoration that Robert F. Dorr began in the Winter 1999 issue of *Air Power History* [Vol. 46, No. 4]. It details the hard work involved and shows the Lightning fully restored in its new home at Elmendorf AFB, Alaska.

There are ten reviews of air power books—some new, some old. And there is a list of books received. Book review editor, Michael Grumelli, is actively soliciting new reviewers. If you feel qualified to review one or more of the books listed—in this or prior issues, or have an appropriate book that was not listed—please contact Dr. Grumelli. See page 52.

In the departments section we include the usual categories of "The History Mystery," letters, news, notices, and reunions. If you would like to express your views or advise readers of some upcoming event, please write or e-mail the editors. See pages 2, 55, or 56.

We note with sadness the passing of Eugene M. Zuckert, Secretary of the Air Force during the Kennedy administration. See pages 63-64.

Gen. W. Y. Smith, USAF (Ret.), president of the Air Force Historical Foundation, notes that the Foundation is now a beneficiary of the Combined Federal Campaign and asks that readers consider making a donation by designating No. 2138. See the inside front cover for details. He also invites members and trustees to attend the Foundation's 46th annual meeting in the Pavilion Room of Andrews AFB Officers' Club for lunch at 1145 on September 21, 2000. To reserve a place, please call Lt. Col. Binge at (301) 736-1959, or e-mail: afhfh@earthlink.net immediately.



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The Kyushu Gypsy



Squadron in Korea



Paul C. Fritz

(Overleaf) Hagaru-ri airstrip (looking north) during rescue operation in December 1950. C-119 overhead has just dropped supply parachutes, as C-47 begins takeoff and parked C-47 is being loaded. Hamlet is one-half mile to right, and Chosin Reservoir is beyond dike in the background. (USMC photo from Defense Audio-Visual Agency [DAVA].)

IT SOON
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RUGGED,
DEPENDABLE
C-47
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IN THIS
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GO OUT,
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EVER YOU
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ENOUGH TO
HANDLE

Early on Sunday morning, June 25, 1950, North Korea's Kim Il Sung unleashed his military forces across the 38th parallel to overwhelm and reunite South Korea and end the peninsula's division between the Communists and Allies since World War II. The United Nations Security Council approved an immediate armed intervention to stop the North Koreans. However the meager American occupation forces in Japan tried, they achieved only limited success in slowing the retreat southward. Airlift assistance from American forces at home was vital to sustain operations on the Korean peninsula. The area that soon would be known as the "Pusan perimeter" had no air bases or facilities of consequence. And it soon became obvious that the rugged, dependable C-47—which required minimal operational facilities, while carrying respectable loads—would be essential in this situation.

In-theater redeployment brought the 21st Troop Carrier Squadron (TCS), from Clark Air Base (AB), the Philippines, to Ashiya AB on Kyushu Island, in Japan, where it was reequipped with C-47s. The 21st gave up its four-engine C-54s to its sister squadrons, the 6th and 22d, all units of the 374th Troop Carrier Group (TCG) at Tachikawa AB, west of Tokyo.

For starters, eleven World War II vintage C-47s were removed from their "pea-patch" storage at Norton Air Force Base (AFB), California. They were fitted with fuselage fuel cells for 16-hours' endurance and issued to aircrews who arrived *en masse* at Norton, after receiving 72-hours notice to depart their previous bases. I and another captain—both with considerable World War II C-47 troop-carrier experience—represented Goodfellow AFB, Texas.

My assigned aircrew consisted of a copilot and a flight engineer, who had no C-47 experience, but were qualified in C-54s. The navigator had not navigated "seriously" since World War II and had never used the LORAN over-water navigation system. The radio operator was fresh from that specialty school. The skimpy skills available in this situation confirmed the depths to which American defenses had sunk. But despite the crew's lack of C-47 background for the tasks that lay ahead, they strove to perform their functions effectively and cooperatively.

My C-47 had what appeared to be an eighth-inch layer of hardened dirt on the upper surfaces of the fuselage, wings, and empennage. Its tires were severely checked from years of disuse. All

attempts to secure a "wash-job" and a set of new tires from the base personnel were met with shrugs of disinterest—despite my protests that the dirt reduced the plane's airspeed, resulting in increased fuel consumption, and possibility of tire blowouts at isolated bases en route to Japan. However, maintenance personnel had refurbished the engines carefully. Airmen at our departure base, Fairfield-Suisun (later-Travis) AFB, remedied the dirt and tire problems—we gained ten miles per hour airspeed with a clean bird.

We took off just before dark on July 21, 1950, headed westward over the Golden Gate Bridge. Soon, this beautiful sight faded into fourteen hours of inky blackness, en route to landing at Hickam AFB, Hawaii. The next morning it was off to Johnston Island to refuel for the ten-hour flight to Kwajalein Atoll, then westward to Guam, followed by the next day's flight northward to Tachikawa AB, Japan.

High above the western Pacific, my navigator came forward in the cockpit and announced, "Two Jima is ten minutes ahead." I looked out and spotted a tiny spit of land just ahead. Mount Suribachi, famed in photograph and statue, was standing vigil over the site where more than 4,500 Marine lives were given up in payment for the island's ownership. I could not have known then that those Marines, who gave their all to save B-29 crews returning from missions over Japan, would be recompensed man-for-man four months later by a few C-47 Kyushu Gypsies at Chosin Reservoir in North Korea!

Pusan Perimeter Days

Our aircrews and aircraft were welcomed heartily for relieving the strain that had befallen those stationed in the battle area. Our arrival helped the squadron to expand toward its normal strength of forty C-47s. Later, United Nations complements, from Greece and Thailand, would raise the total to forty-nine C-47s.

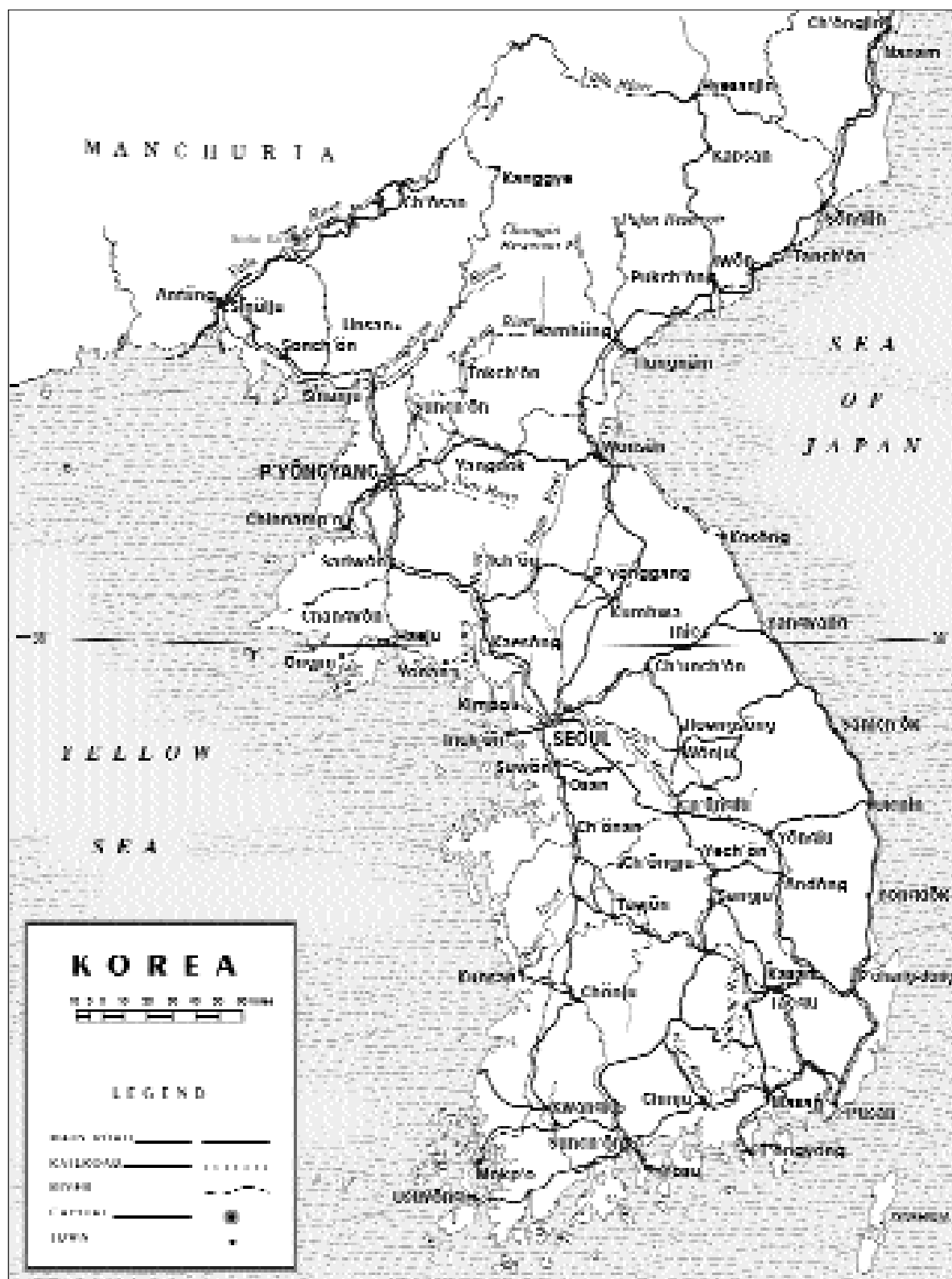
South Korean air bases were extremely primitive. They had no weather services, navigational-aids, runway lights, or effective communications between bases in South Korea or to Japan. Most airstrips were compacted rough dirt. The pilots' operational credo was: *Go out, take a look, and do whatever you believe you are pilot enough to handle.* No one was chastised for turning back. Ironically, that blank-check made the pilots more competent and enhanced their judgment.

Colonel Paul C. Fritz, USAF (Ret.) began his thirty-year military career in the Minnesota National Guard in August 1939, and was commissioned at Infantry OCS in June 1942. Pilot wings brought him to troop-carrier activities in the Pacific theater in World War II. During the Korean War he flew with the 21st TCS, from July 1950 to October 1951, the subject of this article. He completed Air Command and Staff School in 1956, and was then assigned to the faculty. Next came command of 11th TCS (C-119s) at Dreux AB, France, before serving as executive officer to the Deputy USCINCEUR in Paris. Duty on Air Staff and PACAF followed in base/force programs. The sole USAF officer inducted into the Infantry OCS Hall of Fame at Ft. Benning, Georgia, Colonel Fritz has published numerous articles in military magazines.

(Source: Robert F. Futrell,
United States Air Force in
Korea, 1950-53.)

WHEN
WEATHER
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THE PILOTS'
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THE PILOTS'
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LIFE AND
DEATH



A typical aircrew's day during the Pusan Perimeter period was to ferry supplies or troops from Ashiya AB to a South Korean base, then shuttle around to other bases until dark with various loads. When weather interfered, the pilots' intrepidity came into play. This meant staying below the weather and flying up one the many valleys, usually following railroad tracks. If the tracks went through a mountain tunnel and there was no open weather

above the tunnel's mountain, the pilot would make a panic spiral climb up to open weather. He would then return to the Sea of Japan to find a hole for a spiraling descent and return to Pusan to try another valley. While that type of flying was hard work, it proved satisfying to deliver wounded soldiers to a hospital in Japan—the pilots' capabilities and desires to provide prompt evacuations often meant the difference between life and death.

Vehicles loaded with casualties swarm to evacuation aircraft as Marine and Navy fighters patrol over this Hagaru-ri airstrip to suppress any interference by Chinese who occupy surrounding mountains.
(USMC photo from DAVA.)

MAJ. GEN. WILLIAM H. TUNNER, THE FAMED LEADER OF THE BERLIN AIRLIFT, ESTABLISHED HIS COMBAT CARGO COMMAND HEADQUARTERS AT ASHIYA

ALARMED AT THE COLLAPSE OF NORTH KOREA'S ARMY, CHINA RELOCATED ABOUT 500,000 TROOPS TO MANCHURIA, JUST NORTH OF THE YALU RIVER



The desperate days of July and August 1950, soon began to ameliorate. Ground, sea, and air forces built up capabilities to counterattack against the Communists. In early September, the 21st TCS moved from Ashiya AB to Brady AB, north of Fukuoka, to allow the deployment of the 314th TCG, equipped with the new C-119s, to Ashiya. In addition, Maj. Gen. William H. Tunner, the famed leader of the Berlin Airlift, established his Combat Cargo Command headquarters at Ashiya. At first, the general looked askance at our Gooney Birds and their capabilities, but before the year was out, we would become his “darlings.”

An NCO griped about the pillar-to-post basing for 21st TCS that was just beginning and declared that we were only a bunch of “Kyushu Gypsies.” Little did he know we would be relocated often in future months, and that this nickname would become a “proud handle” that remains to this day for the squadron’s veterans.

On September 13, the 21st TCS sent some first pilots back to Tachikawa AB to practice formation flying for paratroop drops. Then for nine days, weather permitting, they practiced formations in the Tokyo area. During this period, the breakout from Pusan Perimeter and the landing at Inchon occurred. The Allied offensives were making progress, and Seoul was recaptured after a major battle.

Meanwhile, alarmed at the collapse of North Korea’s army, China relocated about 500,000 troops to Manchuria, just north of the Yalu River. China’s sensitivity to a threat from across the Yalu stemmed from the 1930s. At that time Japan had constructed most of China’s manufacturing capability in Manchuria, when the Japanese had occupied the province. That capability relied on cheap, plentiful electricity coming from Japanese-built reservoirs (Chosin and Fusen) and associated power-plants in North Korea’s northeast mountains.

On October 15, 1950, General of the Army Douglas MacArthur, the United Nations Commander, met with President Harry S. Truman at Wake Island. They decided to proceed quickly up the North Korean peninsula with paradrop of the 187th Airborne Regimental Combat Team north of Pyongyang, supported by other ground units moving northward. Two days later, the 21st TCS was ordered to bring all forty of its C-47s to flyable condition, deploy to Kimpo Airport, at Seoul, and make the paradrop the following day. C-119 units from Ashiya would drop artillery pieces, vehicles, and the balance of troops beyond the capacity of the forty C-47s.

The C-47s made routine airlift flights to Korea on the October 19 and recovered at Kimpo, where the aircrews slept in their aircraft and ate C-rations. Dawn on the 20th arrived with rain showers at Kimpo. General Tunner reconnoitered the drop zone and reported good weather; Kimpo would improve by noon. The 21st TCS “max-effort” paradrop at Sunchon was performed skillfully—an example of expert pilots flying well-maintained aircraft. Along with the parallel paradrop at Sukchon by 71 C-119s, they combined to deliver 301.2 tons of equipment and 2,860 paratroopers, while sustaining minimal casualties.

One of the paratroopers’ missions—to intercept prisoners of war (POWs) expected to be moved north from Pyongyang—resulted in the discovery of a trainload of POWs hidden in a tunnel. However, following the paradrop, the POWs were cold-bloodedly machine-gunned beside the train. Fifteen of the POWs faked death and survived to be airlifted the next day from Pyongyang to hospitals in Japan.

Our paratroop drop was a highlight-event that followed the more diffident United Nations forces’ movement across the 38th parallel into North

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YONPO
AIRFIELD

Korea. Now, the world clearly knew the United Nations' strategic intentions, especially the Chinese "lying in wait" just beyond the Yalu River. They now were energized to move secretly into North Korea. What was to be one of history's most devilishly successful, major infiltrations was accomplished by a half-million Chinese troops while United Nations troops cruised northward unaware of the well-hidden enemies in all directions. Reconnaissance had failed to note the stealthy enemy forces, except for a few minor exposures.

Chosin Reservoir

With North Korea effectively defenseless, United Nations troops moved northward in relative safety. Their objective was the Yalu River and seemingly nothing could hinder their progress. Headly success, pleasant weather, and pretty autumnal foliage created the expectation of going home for Christmas. There was little concern for the severe North Korean winter aborning, nor for its demands for cold-weather clothing and equipment.

On the plains of western North Korea, the U.S. Eighth Army moved forward boldly. In the mountains of eastern North Korea, the U.S. X Corps, consisting of the 1st Marine Division and 7th Infantry Division, moved laboriously northward on unimproved mountain roads. Thanksgiving was only a few days ahead, when a miserable Siberian cold front began moving south to confront the Allied forces head-on. Ominously, the 500,000 Chinese troops—380,000 arrayed against the Eighth Army and 120,000 facing X Corps—were in-place, but unseen.

On Thursday, November 23, the Allied troops feasted on a hearty Thanksgiving dinner. But, on Monday, November 27, the Chinese attacked—coming with shock effect from virtually nowhere—to the tune of blaring bugles that energized enemy forces in human-wave attacks. Some United Nations divisions were virtually obliterated, while others such as 1st Marine Division survived thanks to the application of stringent discipline.

As the 1st Marine Division moved northward from its landing at Wonsan, it encountered and briefly battled a few enemy troops identified as Chinese. At the time, however, the Chinese were dismissed as "volunteers." Moreover, these few enemy troops did not deter X-Corps from continuing to push north. One Marine regiment—under Colonel "Chesty" Puller—later to become the Marine Corps' most decorated hero—was deployed at Koto-ri, high in the mountains, 40 miles north of Hungnam. The remainder of the division moved another 10 miles north to the hamlet of Hagaru-ri, at the southern tip of the Chosin Reservoir. They then detached one regiment 14 miles northwest to Yudam-ni, west of the reservoir, and a second regiment on the eastern side of the reservoir. Soon, this latter regiment would also move to the Yudam-ni area, and the 7th Division would thinly

deploy three infantry battalions and an artillery battalion to the eastern side of the reservoir.

Headquarters, 1st Marine Division, and its artillery and engineer units remained at Hagaru-ri. In addition to its mission of eventually advancing further northward, a regiment at Yudam-ni was directed to send light forces westward to establish contact with right-hand units of Eighth Army on the western plains. Fortunately, this force moving west from Yudam-ni had moved only a short distance when the Chinese attacked, and the Americans managed to recover from the ferocious, surprise attack.

As waves of Chinese tried to overrun the Marines, both sides sustained heavy casualties. Mountain cold, dipping down to minus 30°F, imposed a debilitating effect on all combatants. In the ensuing withdrawal from Yudam-ni to Hagaru-ri to consolidate their strength, the two Marine regiments demonstrated extraordinary prowess.

When the U.S. Army battalions, positioned east of the reservoir, were hit by the Chinese onslaught, their scattered deployment foreordained overrunning of the units. The estimated casualties rates for the Army battalions were as high as 75 percent. Many of those who survived were walking wounded who reached the frozen reservoir in darkness and proceeded to Hagaru-ri.

The British 41st Royal Marine Commando Battalion, under Lt. Col. Douglas Drysdale, had made it northward to Koto-ri before the Chinese attack began. Along with other small American units and personnel, they were ordered to reinforce Hagaru-ri. But only the lead elements of the convoy made it to Hagaru-ri. The main body was wiped out along the mountain road. The entrapment of the Marine and Army forces at Hagaru-ri and Koto-ri was complete.

Such was the situation on November 30, when I, the assistant squadron operations officer of 21st TCS, answered the telephone at Itazuke AB. General Tunner's transport mission control directed us to send eleven C-47s to Yonpo airfield early the following morning to evacuate wounded troops from Hagaru-ri. Our assignment was to last "for a week or so," and we were to maintain that level of in-commission C-47s there throughout the operation. To save valuable cabin space for casualties, nurses and corpsmen were not assigned to this mission, but worked aboard the C-54s from Yonpo to Japanese bases.

It piqued my interest and I put myself on the pilot list. That afternoon one of our pilots, who had landed at Hagaru-ri, briefed us on the locale and airstrip. The next morning, we took off early from Itazuke and headed up the east coast of Korea. Arriving at Yonpo, we loaded supplies for the Marines and again headed north, passing over Koto-ri with its short dirt airstrip that could handle only small, liaison-type aircraft. Beyond stretched a valley with a narrow, winding dirt road that led to Hagaru-ri. Behind a mountain, just short of Hagaru-ri, remnants of Colonel Drysdale's convoy—snow-covered trucks, ambulances, and

SEVERE
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AND MEN'S
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THE WORST
OF WAR

other vehicles—lay strewn about the trail like heaps of children's toys.

Hagaru-ri lay in a bowl formed by mountains in all directions, except on the north side, which opened to the reservoir, a long narrow lake extended northward. The hamlet and our newly hacked airstrip area were protected from excess water by a long east-west dike about twenty-five feet high. The airstrip was oriented north-northwest to south-southeast, with the north end pushing right up to the dike. These features dictated landings north, with a guarantee of no over-shooting, and takeoffs south.

A road grader smoothed the frozen dirt, which had a very slight rise toward the dike, adding a very minor advantage for landings and takeoffs. Significant blasting and bulldozing around the clock had brought the strip to its current status, but work continued for a day or two more to lengthen it to about 2,500 feet and clear a parking area for three C-47s. (Heavy equipment operators working at night under flood lights were shot routinely from their machines as they worked.)

The hamlet, about a half-mile east of the airstrip, was the site of Marine headquarters and warming tents for the troops. The open area between the hamlet and airstrip became the drop zone for C-119s. Marine and Navy fighter aircraft droned in lazy circles over the scene, ready to pounce on any untoward enemy actions. However, enemy positions were nowhere to be seen—they knew camouflage well, even in the snow-covered mountains.

I called the radio jeep for landing clearance and set up a tight pattern that was necessarily over close-in mountains infested with enemy. On final approach I noticed a small, scraggly tree growing just left of the airstrip. A hump on the approach end was not discernible, but I hit it and got a good bounce. I ate my chagrin and would find it useful also in a few days.

After parking, I learned that people can overcome unbelievable difficulties. To an ex-Minnesotan and ex-infantryman/officer, this was a composite of a disaster and catastrophe. Severe cold greeted us, with a horrible stench—a pungent combination of vehicle exhausts, fired gunpowder, smoke from bonfires, and men's bloody clothing over unwashed bodies.

The men huddled speechless in knots, their eyes vacant from witnessing untold horrors, unshaven for days, and wearing blankets draped over their shoulders. Many hobbled about with walking poles or canes fashioned from tree limbs. Some were barefoot with bright-red or gangrene-blackened feet. One man who boarded my C-47 flipped away all of his toes like rotten apples before getting aboard. Not a word was spoken—a brief flicker in their eyes was their thanks for our “magic-carpet” that would whisk them away to safety and medical attention. Such was the reality at Chosin Reservoir, a name that will live in history, alongside Valley Forge and Antietam, where brave men endured the worst of war.

We pilots did not need prodding for what lay ahead, our mission was simply to transport these men as fast as possible to Yonpo for emergency care and then via C-54s on to hospitals in Japan. Unfortunately, we could operate only from dawn to dusk. But we also recognized that we had a great responsibility in this undertaking because our C-47s were the only aircraft that could operate into the crude airstrip, yet carry significant loads.

Load size was important, and every pilot set his own level of safety. Each soldier kept his rifle and ammunition. This pleased me because if we were forced to crash land, we could give a good account of ourselves. The DC-3—the civilian version of the C-47—carried 19 to 21 passengers and had at least 5,000 feet of runway. We had half the runway and likely double the load weight. Our plane had 27 bench seats, with safety belts in the cabin. However, no one objected to sitting on the floor for the 30-minute hop.

I tested 30 passengers as my first load and it worked well enough to raise my standard to 35. After a few days, as we neared Hagaru-ri for the last trip of the day, my flight engineer said, “Captain, we’ve been carrying the largest loads all the time, but yesterday so-and-so took out 38. Let’s do 40.” I responded that we were not trying to set any records, just to get the job done. When he persisted, I said, “OK, we’ll try 40, but I’m going to count.”

Standing at the door as the trucks backed up with their loads, I reached a count of 40—the cabin bulged. Two men left on the truck bed walked back to the front to sit on each side, glancing furtively at me, then away. They knew and I knew that those few feet of truck bed meant the difference between another night in the war or possible safety and care at Yonpo. I could not be that heartless and beckoned, “OK, come on!” Reaching the cockpit, I found we also had our radio-repairman aboard. Including the crew, we had 46 souls aboard!

As I taxied out, my transport seemed to groan. I began the takeoff and we chugged noticeably slower; gaining flying speed proved much more laborious than normal. Without much conviction, the copilot chirped, “No sweat.” As the end of the strip came closer and closer, I finally hit that “wonderful” hump. It catapulted us into the air to mush along for a few seconds, but long enough to get the gear up, then our bird flew properly. We had made it, but thirty-five would be our limit for the future. The flight engineer had all the bragging rights he would get.

Shortly after a Hagaru-ri takeoff with a contingent of wounded troops, one of our pilots was hit by enemy ground fire. With the plane's elevator control cables severed, he quickly decided that the only way to land was to use the elevator trim tab wheel, while his copilot controlled the power. Their skillful landing attracted the attention of a *Time Magazine* reporter, who included the unusual display of airmanship in his article.

One morning we arrived over Hagaru-ri at sunup as a battle was in progress. Because our

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fighters were late arriving, we watched the grim battle unfolding below. Tracers from rifles and machineguns defined an elliptical front line pattern drawn around the eastern segment of the hamlet; it then came out and arced around the ends of our airstrip. Supporting artillery spit their loads with commanding belches of fire and smoke. But, the minute the fighters came into sight, the enemy fire ceased. Our troops, who had lain prone on the ground, stood up to wander back to the hamlet, perhaps for breakfast. Such was the defensive ground war in daylight with adequate direct air support.

Another day a half-dozen C-47s arrived over Hagaru-ri and found the entire bowl engulfed in thick smog up to about 500 feet. We droned around until one pilot proposed to call out radar-control type instructions from overhead if anyone was willing to try a landing. I piped up, "Sure, I'll try it." I dived down and got in position on the downwind leg, then turned onto the base leg, descending into the bowl, with zero forward visibility. Soon my controller had me turn on final approach. I had done it here many times—it was routine. He gave me minor heading corrections and likely altitude heights. I could see the ground straight below running faster and faster as I descended, and continued with an extra 10-mph airspeed in case I decided to abort. I was getting close to committal time, imposed by the well-known dike at the end of the airstrip. It convinced me to count off three seconds, then abort, if I was not ready to land: one, two, thr... Hey, there's the scraggly tree in perfect position outside my window. I eased back on the power to kill the extra airspeed, then to no-throttle as the wheels kissed the deck. The usual heavy tromps on the brakes got us stopped in time, but the dike seemed to loom in front of us with more disdain than ever. I glanced at my young copilot—he could not have seen the tree—his eyes were like saucers as he stared at the dike. I had to make a joke or two before he relaxed. We were getting a head-start on the loads we could carry that day.

Several times we were peppered with enemy rifle fire as we flew the pattern for landings or took off and climbed up through the valley. One afternoon, I became particularly irate when I found new holes very near a main wing tank. I knew that the shots had come from a discernible knoll on the downwind leg. I walked over to the radio jeep and told the operator. He called down two fighters and each dropped a napalm tank on the knoll. Blood-curdling screams rose up as the deadly liquid rolled downhill.

After that show of air superiority, I returned to my C-47 and got aboard. As my eyes transitioned from bright sunlight to dim interior light, I eyed my load: a significant number of men lay frozen as they had fallen, with their extremities cast in all directions and faces contorted statues of severe pain. They were stacked and intertwined on each side of the cabin, secured with ropes for flight. I would be flying an aerial hearse, but to do it with dignity I flew extra smoothly.

Late on the fifth day, as we flew down the valley toward Hagaru-ri, we saw the troops breaking out from their entrapment. Single columns of men moved down the spines of the ridges on each side of the valley. Vehicles and larger groups of men were on the valley road.

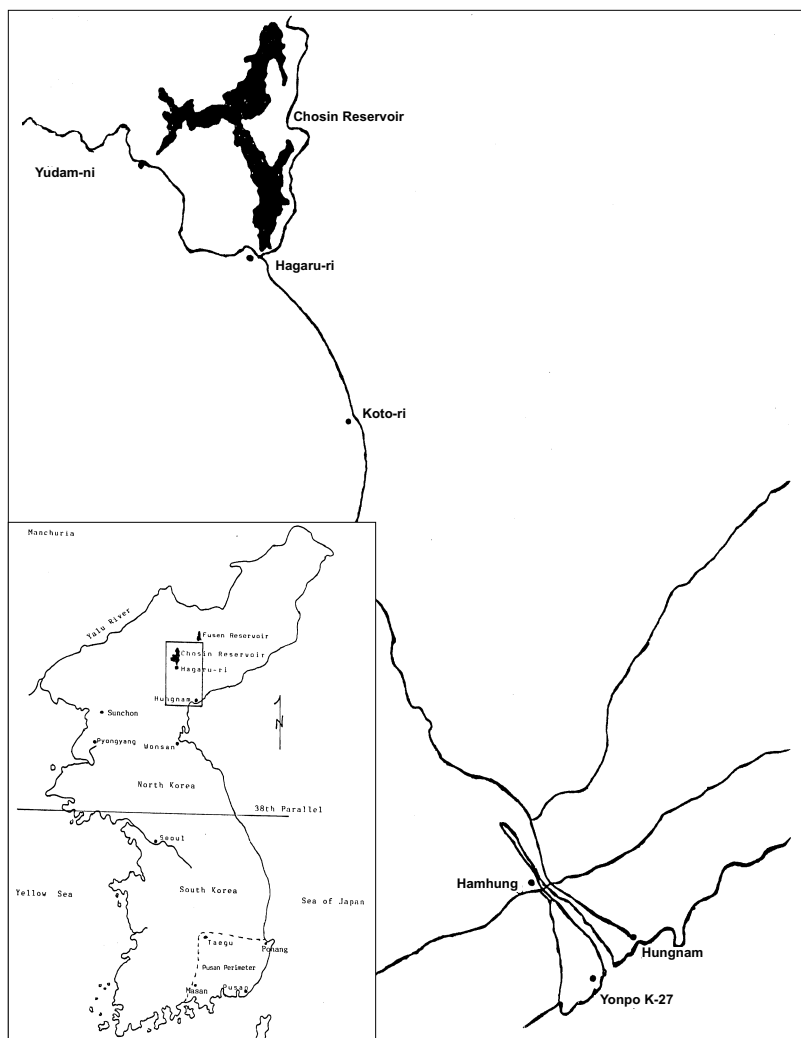
One more day and we would be finished at Hagaru-ri. However, we would lose another C-47. I was making my final, late-afternoon flight when I spotted the C-47 ahead of me in the traffic pattern seemingly losing fuel from the right inboard cell. We later discovered that a cylinder head on the right engine had broken loose and all the oil lost. Since there was no chance of repairing or replacing the engine before nightfall on our final day of operations, we arranged for a Marine lieutenant to blow up the plane with a hand grenade or two before they departed. The six days of operation there had cost us two C-47s, but we had saved thousands of lives with more to go.

The night of December 6 and morning of the 7th saw significant snowfall in the area. The troops fighting from the trap were without close air support, and we could not land at Koto-ri until the December 8. Our aircrews welcomed the respite. We had been flying for six days straight from before dawn to after dusk, using every available minute of daylight at Hagaru-ri to maximize the rescue.

After lunch on December 7, word came that doctors at Koto-ri needed some special medicine, so I flew up and paraded it to them. I also got a closer look at our new destination. The airstrip had been extended to about 2,000 feet. It now was packed snow that could be plowed. However, landings were going to be very difficult because a huge slag pile was located just off the south end. The wind came down the valley from the north, so that would be our landing and takeoff direction. The final half of the extended airstrip was out in no-man's-land.

The next day we got to try our skills for landing, here even more difficult than at Hagaru-ri. My procedure was to virtually roll my tires on the slag pile, chop the power, and dive for the end of the strip, but recovering at the last moment with a slight boost of power. The surface was very slippery, but I managed to stop in time. I noted a single-engine Navy torpedo bomber was being loaded with a litter patient—what a poor "return for the investment" when we could carry nearly three dozen wounded per load, fewer if litters usurped cabin space.

Some of our pilots preferred to approach by coming around the side of the slag pile, then making a very low final turn to the airstrip. I tried it once, but decided that over-the-top was better. On a later landing there, a gust of crosswind hit me. My C-47 swerved to the left and only a blast of left engine kept it from going beyond the pile of snow along the airstrip. After parking, someone came up and pointed out that I had narrowly missed an old well-hole. I came close to ascribing a third C-47 to the cause.



**FOR THREE
DAYS, WE
CONTINUED
THE EVACUA-
TION FROM
KOTO-RI**

For three days, we continued the evacuation from Koto-ri. The troops moved on through, but there would be another dramatic airlift action, this time by C-119s. A few miles south of Koto-ri, a major electrical plant generated power using Chosin Reservoir water. A lone bridge had spanned the deep gulch at the plant, and its loss would mean no vehicles could pass. The Chinese blew up the bridge, and airlift again came to the rescue. Eight sections of steel bridging were rigged for paratroop and delivered by C-119s. Engineers installed the spans that permitted saving vast amounts of major ground force equipment.

Epilogue

Our C-47 aircrews waited at Yonpo for two days until the ground troops were secure in the Hungnam area for sealift to South Korea. Late on December 12, we returned to Itazuke and counted results. We had flown evacuation flights for nine days, rested on the snow day, and waited for two days. Our eleven C-47s, with assistance from three Marine/Navy R4Ds had evacuated 4,689 men from the two airstrips, and air-landed 273.9 tons of cargo.

Time Magazine was especially generous with its coverage of the Chosin Reservoir story. Its

December 18, 1950, issue honored General Tunner with his cover photo and story that emphasized our airlift mercy-mission and the figurative and literal aerial bridge that the C-47s and the C-119s had provided.

The first USAF Presidential (then-Distinguished) Unit Citation, a combat-only award, was presented to the 21st TCS, the 314th TCG (flying C-119s), and 801st Medical Air Evacuation Squadron for the U.S. Air Force segment of the Chosin Reservoir operation. Pilots on the 21st TCS mission received Distinguished Flying Crosses, copilots and flight engineers were awarded Air Medals.

The Marines at Chosin Reservoir sustained 8,741 casualties, including 751 killed, died of wounds or missing in action and presumed dead; 2,891 wounded in action; and 5,099 non-battle victims. U.S. Army unit after-action reports indicated that more than 2,600 casualties were suffered by the force of some 3,500 men, with the majority classified as missing in action. U.S. Navy airmen, Royal Marine, and South Korean army losses were at various lower levels. The USAF had no casualties. Enemy losses at Chosin Reservoir, substantiated by enemy testimony, have been estimated officially as 37,500, with 25,000 killed and 12,500 wounded.

My respite at Itazuke lasted only a few days before General Tunner sent us back to Hungnam to prepare a seaside airstrip atop a dike, in the event that another airlift of casualties would be required before the sealift was completed. On December 16, my crew and I flew to Hungnam, where we found a road grader leveling the top of a dike south of the city and perpendicular to the sea-coast. The inland end was adjacent to a sprawling nitrate-gunpowder factory that our B-29s had leveled, except for a corner where the roof remained, and it became our "office and quarters."

We could see Yonpo clearly and watched the C-119 airlift operation that salvaged equipment assets in the area, while we "luxuriated at our private airstrip" as the ground troops embarked on their ships. Hungnam harbor was clogged with a flotilla of various military and civilian ships from the battleship USS *Missouri* on down. Troops and their equipment were evacuated to South Korea, along with 98,000 North Koreans, who "voted with their feet" to abandon Communism.

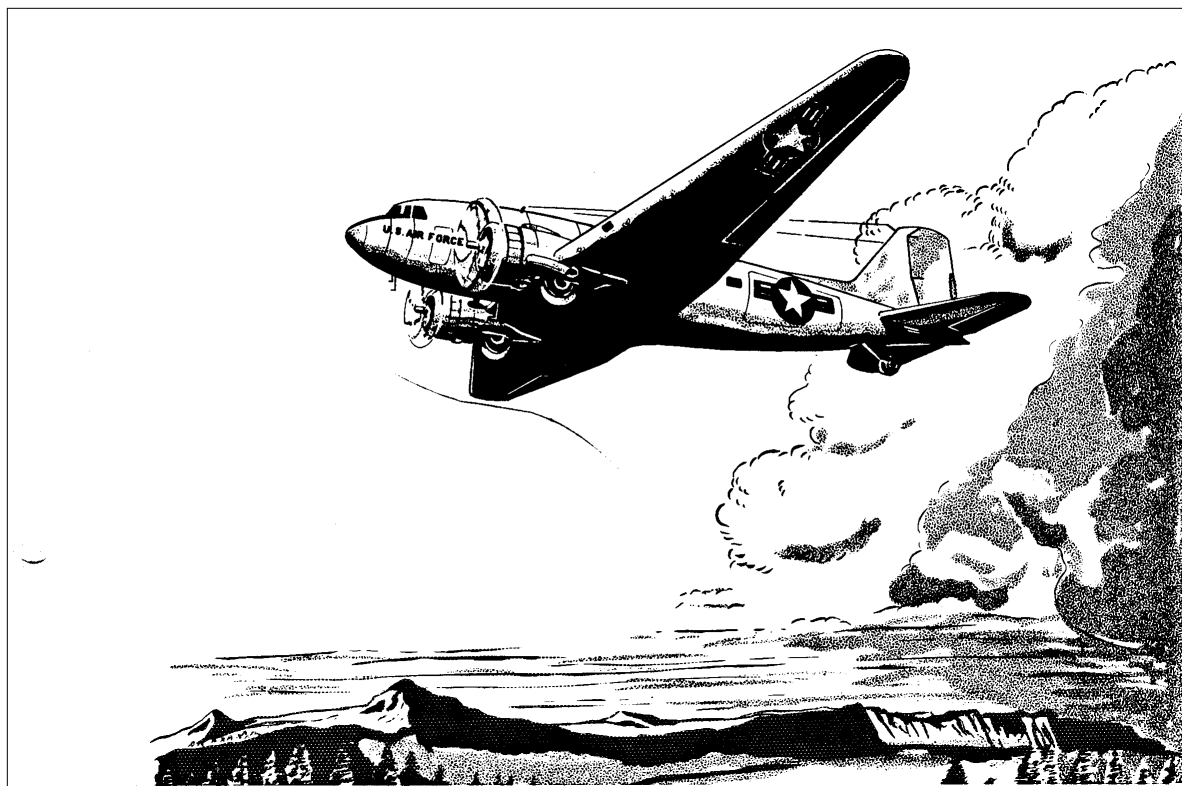
Finally on December 20, 1950, as the Hungnam defense perimeter was being constricted, leaving my airstrip out in no-man's-land. We packed up, "turned off the lights" for the Air Force on the ground in North Korea, and headed home to Itazuke.

Chinese entry into the war in November and December 1950, caused severe setbacks for United Nations forces who were forced to retreat into the northern areas of South Korea. Defensive stands formed new front lines in the Seoul area and across the peninsula. The reality was that United Nations forces had reduced their supply lines, while the North Koreans, with Chinese support, and limited transport capability faced longer logis-

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tic routes in a region of ox-cart type roads. Thus, Chinese involvement had given the Communists little chance of success, but complicated and reenergized the war.

USAF deployment of its fighting and airlift forces required major revision. When Itazuke AB became a prized location, the 21st TCS once again donned its gypsy garb and moved to Tachikawa for the winter. Direct support of the war was much extended, but continued at a lesser pace. In mid-April 1951, I established a forward operating detachment for the squadron at Kimpo. We installed a tent camp on the west side of the air-drome, opposite the heavily-shelled civilian terminal on the east side. About fifteen in-commission C-47s were kept with the detachment to satisfy northern South Korea remote-area airlift requirements. USAF bombers had post-holed the Kimpo runway early in the war, so landings and takeoffs were made on a taxiway.

Communications was a major problem for this Kimpo-based operation. Combat Cargo Command at Ashiya would attempt to telephone our daily frag-order for the next day's airlift, but normally the system failed. Another problem was the fluidity of the war. Many times we were directed to remote airstrips that had been retaken by the enemy. Fuming pilots would return with tales of impossible situations, where frag-orders "guaranteed" the area was in friendly hands, but in fact was not.

As time passed, our tent camp was fitted out with many amenities, including a shower, an electric generator, and tent frames and floors. After these improvements, it was only a matter of time until someone claimed priority for basing there. In

this instance, it was a Royal Air Force squadron of Meteor jets that needed to enter the war for combat testing. In August 1951, the RAF received our facility at Kimpo and we were reunited with our squadron at Ashiya, having come full circle since our arrival in mid-1950.

With distinction and verve, the *Kyushu Gypsy* squadron had performed every mission given them, from the routine, non-glamorous daily movements of men and materiel to the brief moments that made headlines. In the performance of these missions, they were ably supported by that marvelous and venerable flying machine known officially as the C-47, but to all who flew her as the "Gooney Birds."

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Origins of Hypersonic Propulsion:



A Personal History



Thomas A. Heppenheimer

(Overleaf) The X-15, with a dummy hypersonic engine on the lower fin. With Capt. William "Pete" Knight as test pilot, this flight set a speed record of 4,250 mph (Mach 6.7) in 1967. (Photo courtesy of Boeing.)

FERRI, IN SEPTEMBER 1944, QUICKLY ESTABLISHED HIMSELF AS A LEADER IN THE INFANT FIELD OF SUPERSONIC RESEARCH

ALEXANDER KARTVELI, CHIEF ENGINEER AT REPUBLIC AVIATION WAS ONE OF THE NATION'S LEADERS IN AIRCRAFT DESIGN

FERRI AND KARTVELI MADE GOOD SPARKS

It is not easy to be ahead of the times. For a number of years, that stood to be the fate of a small community of propulsion experts.¹ They had invented and nurtured the scramjet, an engine that they knew would offer a path to the ultimate airplane—one with no practical limit on speed or altitude. Such aircraft, indeed, could someday fly from a runway to orbit.

The concept held daunting technical difficulties, but for a few years the Air Force and the National Aeronautics and Space Administration (NASA) took their ideas seriously, and these people flourished. Then, amid budget cutbacks, their projects were cancelled and their efforts faded into obscurity. Still these specialists kept their hopes alive, as if they were keeping a flame that never quite died out. Then during the mid-1980s their hopes blazed anew, as President Ronald Reagan launched the National Aerospace Plane (NASP) program.

The leader of this community was Antonio Ferri. During World War II, he was director of one of Europe's most advanced wind tunnels, a supersonic facility at Guidonia, near Rome. In 1943, the Nazis took over Italy. Ferri had received military training, and left his research center to lead a force of guerrillas that fought with considerable effectiveness. The Allied advance drove back the Germans; the Office of Strategic Services, predecessor to the Central Intelligence Agency (CIA), sent an agent to find Ferri and brought him to the United States in September 1944. Here, he quickly established himself as a leader in the infant field of supersonic research.

Ferri lectured on this subject to other engineers, then collected his notes and wrote one of the first textbooks in this field, *Elements of Aerodynamics of Supersonic Flows* (New York: Macmillan, 1949). He had already been on the faculty at the University of Rome; now he returned to the academic world. In 1951, he joined the Brooklyn Polytechnic Institute, where he built up an aerodynamics research laboratory. Soon he was consulting for major companies, drawing in so much work that his graduate students could not handle the load. Ferri responded by setting up his own company, General Applied Science Labs (GASL). With financial backing from the Rockefeller family, GASL grew into an important center for research in high-speed flight.²

Ferri was a formidable man. A former student, Robert Sanator, recalls that "you had to really want to be in that course, to learn from him. He was very fast. His mind was constantly moving, redefining the problem, and you had to be fast to keep up with him." Another ex-student—John

Erdos, now the president of GASL—adds that he was "somewhat intimidating, until you got to know him. From the depth of his technical knowledge, he could make you feel you knew nothing at all. If you had been a student of his and later worked for him, you could never separate the professor-student relationship from your normal working relationship." He always was Dr. Ferri to his old students, never Tony, even when they rose to become company officials.

During the 1950s, Ferri's work as a consultant brought him into a close association with Alexander Kartveli, chief engineer at Republic Aviation. Kartveli was one of the nation's leaders in aircraft design, having crafted the wartime P-47 fighter as well as the F-84, one of the Air Force's first jet fighters. When Kartveli began working with Ferri, his focus of attention was the proposed XF-103 interceptor. It was designed to use a ramjet for propulsion and to reach speeds of 2,500 mph (Mach 3.7) and altitudes of 75,000 feet.³

Louis Nucci, a longtime colleague of Ferri, recalls that Ferri and Kartveli "made good sparks. They were both Europeans and learned men; they liked opera and history. They were friends." They complemented each other professionally, Kartveli studying designs for new airplanes, Ferri emphasizing the details of difficult problems in aerodynamics and propulsion. As they worked together on the XF-103 they fed off each other, each stimulating the other to think bolder thoughts. Among the boldest was a belief that Ferri first put forth and that Kartveli then supported with more detailed studies: that there was no natural limit to aircraft speeds or performance.⁴

This meant that Air Force jets might fly with unrestricted speed and altitude to outrun or outclimb any foe. Better yet, it could bring the advent of spaceplanes, flying from a runway to orbit and offering vast improvements over the use of rockets. Rockets carried liquid oxygen in a tank, which added weight. Yet all the while there was oxygen in the atmosphere, free for the taking. If it could be tapped and used in advanced jet engines, then space flight might be accomplished with vehicles resembling a supersonic airliner.⁵

The key was to be a new type of engine, an advanced type of ramjet. Ramjets were the simplest engines in use, amounting to carefully-shaped ducts with fuel injectors. They rammed into the air at high speed, compressing it; the air heated up from the burning fuel and expanded out the back to give thrusts. This gave plausibility to the fantastic speed of the proposed XF-103. Advanced ramjets were already in flight, powering

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The promise of the scramjet. Calculations indicated that a hydrogen-fueled scramjet could operate well above Mach 6, while vastly outperforming a rocket. (Image courtesy of William Escher.)

the experimental X-7, an unmanned missile. It reached 2,881 mph (Mach 4.31), setting a speed record for jet planes that stands to this day.⁶

To Ferri and Kartveli, however, even the ramjet was not fast enough. The airflow had to slow down within its interior, dropping below the speed of sound, to burn its fuel. As the air slowed down it heated up—and when the internal flow became too hot, it could not gain additional energy by burning fuel, for combustion no longer was feasible. Above 4,000 mph, this internal heating set a speed limit for ramjets. By contrast, it took 18,000 mph to get to orbit.

There was a way around this. Just as a slower internal airflow was hotter, so a faster flow would be cooler. Such a flow would be supersonic; by burning fuel within it, a ramjet might reach far higher speeds. Ferri, thus, proposed to fly to orbit by burning fuel in a supersonic internal airflow within a ramjet.⁷

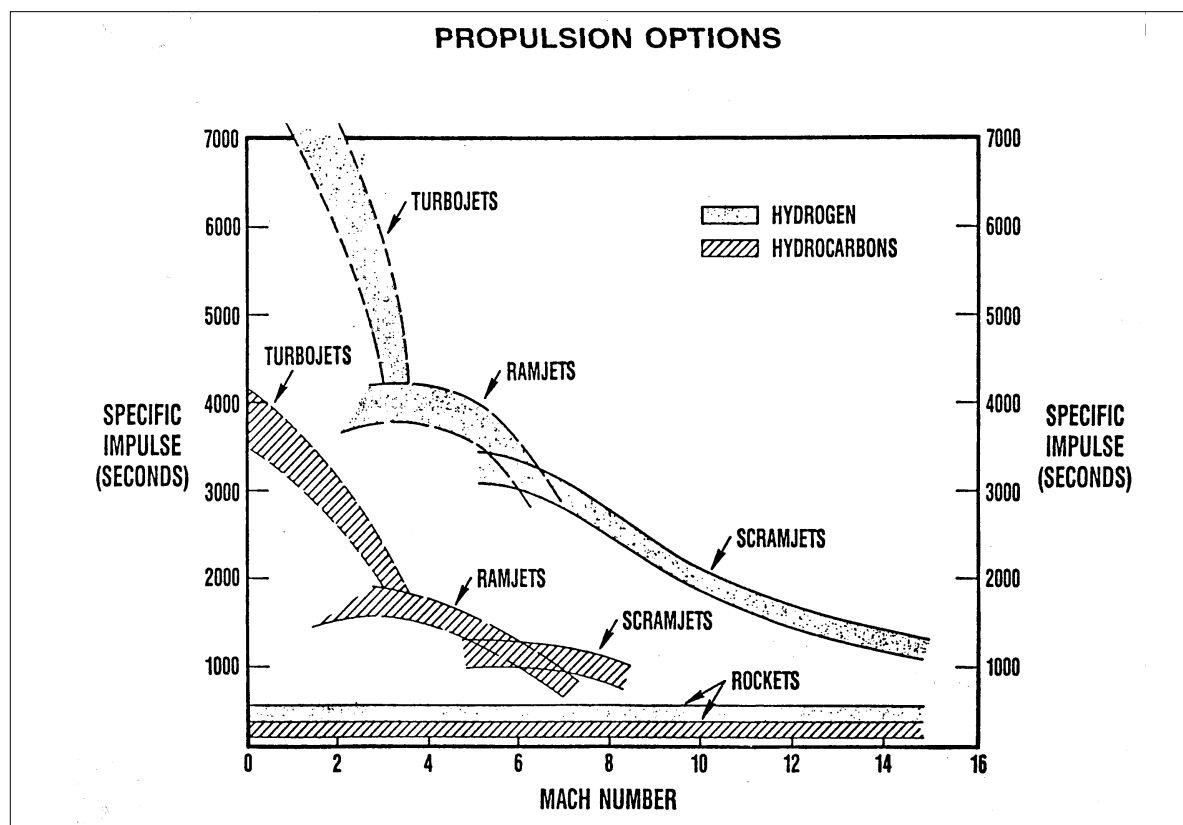
This approach raised a host of difficult technical issues, that Ferri did not solve. But, he asserted that it was possible to address them, giving examples of approaches that looked promising. He pointed out the powerful advantages that such engines would offer, attending international conferences and bringing these ideas to a wider technical audience. His strong professional reputation ensured that he would be taken seriously. He went on to conduct experiments at GASL, seeking to prove his claims. His efforts helped to turn such engines from an idea to an invention, that might be developed and made practical. In turn, his studies gave strong encouragement to other propulsion specialists.⁸

Near Los Angeles, the firm of Marquardt was strongly involved in ramjets, building test versions that were flying on the X-7. As early as 1957, when the launch of Sputnik brought urgent appeals for new rockets that could match this achievement, some people at Marquardt already were looking beyond rockets as they made calculations on ramjet-powered boosters with supersonic internal airflow. "We were claiming back in those days that we could get the cost down to a hundred dollars per pound by using airbreathers," recalls Art Thomas, who directed this work. "We were extremely excited and optimistic, that we were really on the leading edge of something that was going to be big."

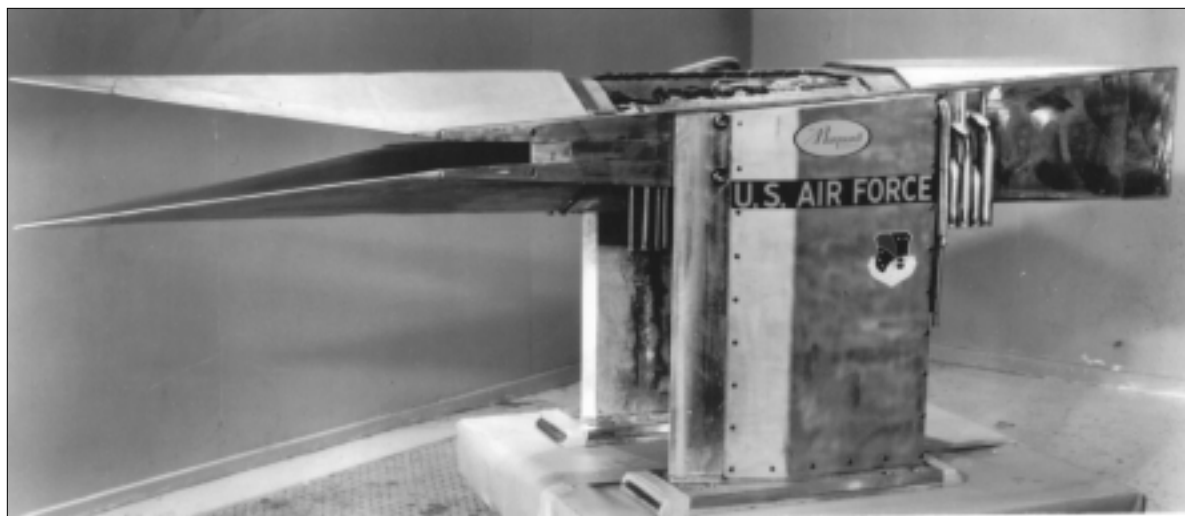
Within a Navy research center, the Applied Physics Laboratory of Johns Hopkins University, a small group led by William Avery was also making calculations. They raised eyebrows, and interest, by asserting that a ramjet-powered craft of a type they specified could produce useful thrust even beyond orbital velocity. One of Avery's analysts, Fred Billig, spent weeks at his desk with a Friden adding machine, as he struggled with his equations in that pre-computer era.

Billig soon gave the new engine a name. "We need a snappy name," said Avery, his boss. Billig sat down with a set of lettered tiles and came up with SCRAM—Supersonic Combustion Ramjet—a designation that reflected its reliance on burning fuel in a supersonic airflow. At Marquardt, other people picked up this name and modified it into scramjet.⁹

Still another man was stirring the pot: Weldon Worth, technical director of the Aero Propulsion



Experimental scramjet tested at Marquardt in the mid-1960s. (Photo courtesy of Marquardt.)



BEGINNING ABOUT 1960, HE BUILT UP A PROGRAM OF BASIC RESEARCH CALLED AEROSPACE-PLANE

WHATEVER PROBLEM THERE WAS IN AEROSPACE ... AEROSPACE PLANE HAD IT. IT WAS A LIFETIME WORK AND IT HAD IT ALL

Laboratory at Wright-Patterson Air Force Base. He had sponsored Air Force work on ramjets after the war and he had launched the beginnings of Air Force studies of hypersonic propulsion as early as 1957. Hypersonic flight represented the next step beyond the supersonic; it called for flight beyond Mach 5, in a realm where problems due to aerodynamic heating stood in the forefront. In 1959, Worth invited specialists to give papers on hypersonic propulsion at the "Second USAF Symposium on Advanced Propulsion Concepts," held in Boston. This amounted to one of the first conferences in this new field.¹⁰

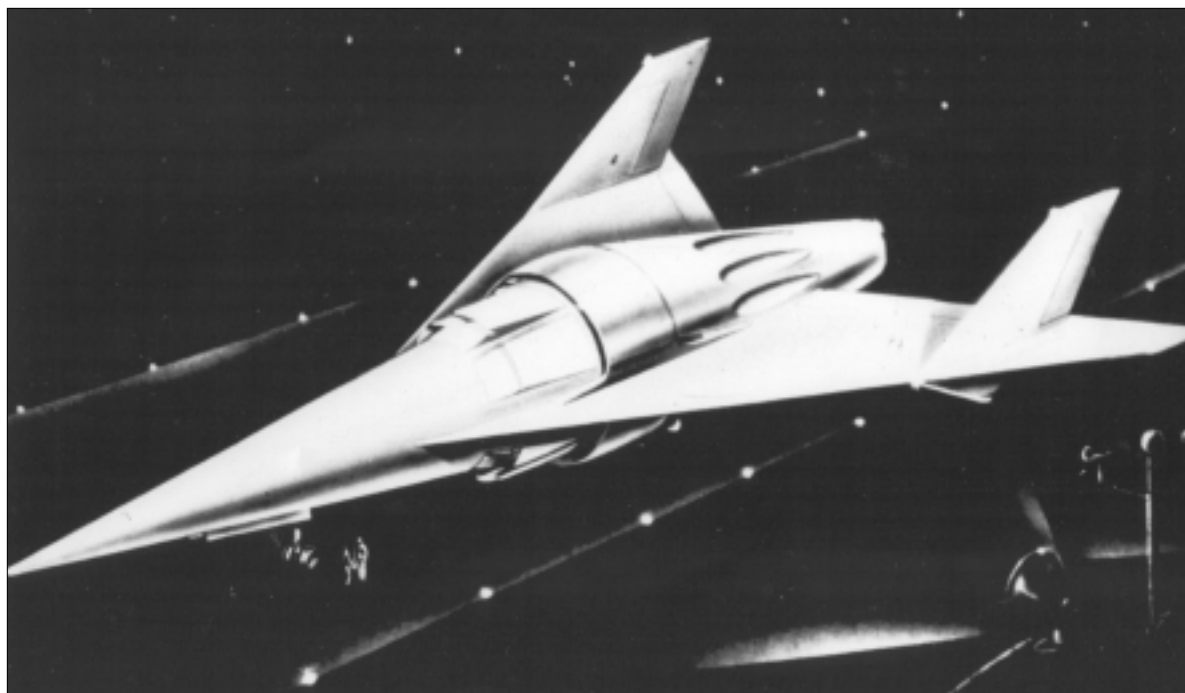
Beginning about 1960, he built up a program of basic research called Aerospaceplane. It did not aim at anything so specific as a real airplane that could fly to orbit. Rather, it conducted design studies and supported basic research in advanced propulsion, seeking to build a base for the development of such aircraft in the distant future. Marquardt and GASL were heavily involved, as

were General Dynamics, Republic, North American, Lockheed, and Douglas Aircraft.

Paper airplanes quickly emerged. Some advanced thinkers called for inflight refueling at Mach 6, with the spaceplanes flying close formation while avoiding each others' shock waves. Such designs took shape at Douglas and at North American, with the Douglas spaceplane mounting a deployable boom to a wingtip.¹¹

At Republic, Kartveli's group presented a concept that was virtually all scramjet. The engine wrapped around the entire vehicle, which had auxiliary turbojets to provide an initial boost. Robert Sanator, one of Kartveli's colleagues, recalls the excitement of the work: "This one had everything. There wasn't a single thing in it that was off-the-shelf. Whatever problem there was in aerospace—propulsion, materials, cooling, aerodynamics—Aerospaceplane had it. It was a lifetime work and it had it all. I naturally jumped right in."

Aerospaceplane concept of the 1960s, studied at Republic Aviation. (Photo courtesy of Robert Sanator.)



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Marquardt collaborated closely with GASL, merging for a time into a single company with Ferri as vice-president. Art Thomas continued to direct the effort. As he recalls, "Ferri would swing by and would give me and my staff about four times more work than we could accomplish. I complained about this to one of Ferri's colleagues, who replied, 'He knows that; he only expects you to accomplish one-fourth of what he gives you. Your problem is to figure out which one-fourth does he want.'"

The concepts proved too hot to keep under wraps. A steady stream of disclosures brought continuing coverage in *Aviation Week*. At the *Los Angeles Times*, the aerospace editor Marvin Miles developed his own sources, which led to banner headlines: "Lockheed Working on Plane Able to Go Into Orbit Alone"; "Huge Booster Not Needed by Air Force Space Plane."¹²

Amid the hype about flight to orbit, substantive propulsion research took place at introductory levels. A key area of activity focused on LACE, Liquid Air Cycle Engine, that was to power the spaceplane concepts of Lockheed and General Dynamics. The LACE concept was developed at Marquardt; the independent inventor Randall Rae held the basic patents, though Marquardt's Charles Lindley also claimed to have been the inventor.

LACE was an airbreathing rocket, using air instead of tanked liquid oxygen. The problem was to get the air into the thrust chamber, which had an internal pressure far too high for any combination of inlet compression and turbocompression, as in a jet engine. Rocket engines overcame this by using liquid propellants, with compact turbopumps readily achieving the necessary high pressures. LACE sought to do this as well, using liquid hydrogen in a heat exchanger to liquefy incoming air. This liquid air then could be pumped to rocket pressures, like any other propellant.

In tests at Saugus, California, during 1960 and 1961, Marquardt engineers successfully tested a LACE installation that used heat exchangers built by the Garrett Corp. A film of these tests—shown

at a conference of the Institute of the Aeronautical Sciences in 1961 and now a collector's item—shows liquid air coming down in a torrent, as observed through a porthole. In a succession of tests, Marquardt operated small rocket motors with thrust up to 275 pounds for durations of more than five minutes. Specific impulse, a key measure of performance, was in the range of 650 to 900 seconds. The latter value was more than twice that of the best conventional rocket engine of the day, the hydrogen-fueled RL-10 of Pratt & Whitney.¹³

The overall Aerospaceplane effort died during Fiscal Year 1964. In October 1963, the Air Force Scientific Advisory Board noted the program's "erratic history," stating that "today's state-of-the-art is inadequate to support any real hardware development, and the cost of any such undertaking will be extremely large." Two months later, Defense Secretary Robert S. McNamara cancelled the manned Dyna-Soar program, for which Aerospaceplane had been widely viewed as a follow-on. In the wake of this cancellation, Congress and the Air Force declined to give further support to Aerospaceplane.¹⁴

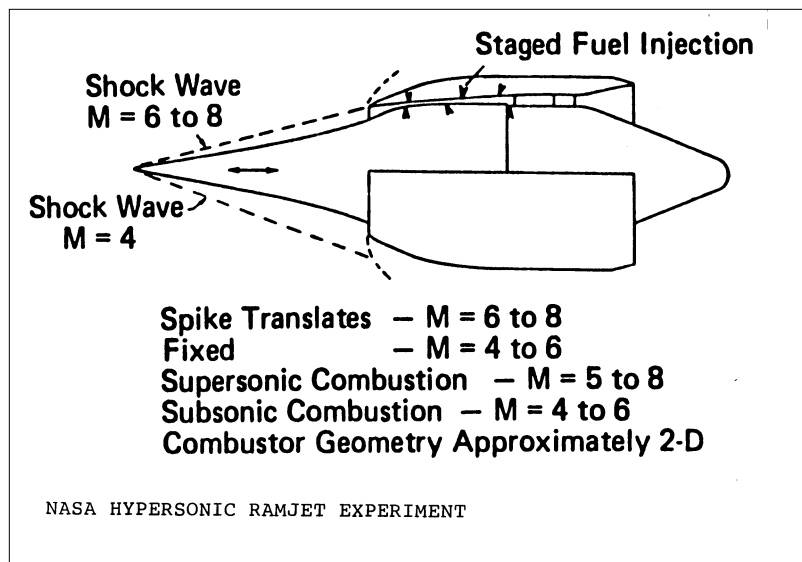
A separate effort, the Incremental Scramjet, continued for a time. It was a proposed flight engine that grew out of work at GASL, which had built small scramjets and tested them in wind tunnels. GASL, led by Ferri, undertook to develop it. Marquardt was to add equipment for fuel supply and control. Lockheed set out to build a small hypersonic aircraft that would carry four such engines. It was to ride atop a solid-fueled Castor rocket, that would boost it to a speed of 6,000 feet per second (ft/sec). Then, the scramjets were to kick in, adding an extra 600 ft/sec.

Lockheed built this small aircraft at its Rye Canyon facility, then flew it in a successful test flight—but without the scramjets. These engines were still on the lab bench at GASL, where the builders were shooting for a thrust of 644 pounds. They got 517, 80 percent of what they wanted, but they failed to deliver completed engines to Marquardt before the funds finally ran out. Years later, Art Thomas still was miffed at GASL for this.¹⁵

Meanwhile, NASA pursued its own effort, which grew out of a proposal from North American Aviation to modify the X-15 for use with experimental hypersonic engines. This proposal won support at NASA's Flight Research Center, which was part of Edwards AFB, and at NASA's Langley Research Center, which had nurtured the X-15 during its formative days. Kennedy Rubert, a Langley manager, arranged to have the first test engine designed as a scramjet. The program that resulted, the Hypersonic Research Engine (HRE), got under way during 1964.¹⁶

The chief designer of the HRE was Tony duPont, a member of the famous duPont family in the chemical industry. He was a casual and easygoing man who had already shown a keen eye for the technologies of the future. As a student, as early as 1954, he had applied for a patent on a wing made

NASA's Hypersonic Research Engine in cut-away. It was to boost its performance above Mach 6 by capturing all the airflow that passed through its oblique bow shock. (Image courtesy of John Becker.)





Test flight of the X-15, with a dummy Hypersonic Research Engine on the lower fin. (Photo courtesy of Boeing.)

CLIFFORD GARRETT OF GARRETT AIRESEARCH, WHO HAD A STRONG INTEREST IN SCRAMJETS, RECRUITED DUPONT

THE PREMIER HYPERSONIC GROUND-TEST FACILITY WAS THE NAVY'S ORDNANCE AERO-PHYSICS LABORATORY, IN DAINGERFIELD, TEXAS

of composite materials. He flew as a copilot with Pan American; he managed studies of Aerospaceplane at Douglas Aircraft. However, Douglas was building jet airliners and had little interest in advanced technology. As he recalls, "They bootlegged the DC-9 mockup against my charge number!"

He wanted to work on hardware, not merely on paper studies. He found his chance when Clifford Garrett of Garrett AiResearch, who had a strong interest in scramjets, recruited duPont to direct his own company's efforts. Neither of these men had ever built such an engine, and in seeking the HRE contract, they competed with three major propulsion firms: Marquardt, General Electric, and Pratt & Whitney. But duPont pulled it off, winning the selection.

He did it in part by avoiding some of his competitors' mistakes. Marquardt lost points by proposing to use some of Ferri's technical concepts. These were unfamiliar to NASA; they promised an excessively complex engine, and Marquardt's proposal looked like a rehash of what that company already had been doing for the Air Force. General Electric (GE) lost in part because it submitted a budget and schedule that, in effect, warned of overruns ahead—a candor for which GE was judged "unresponsive." By contrast, duPont's design promised simplicity. He also won by being fast on his feet.

At that time, the premier hypersonic ground-test facility was the Navy's Ordnance Aerophysics Laboratory, in Daingerfield, Texas. It stood close to the Lone Star Steel Company, which had a large air-separation plant to provide oxygen for its steel-making. Often its air compressors were not needed for this purpose, and the Navy took advantage by using those compressors to run this wind tunnel with a continuous hypersonic flow. By contrast, most other high-speed wind tunnels used compressed air from a tank, for run times of less than a minute. But the Daingerfield facility could run for hours if necessary. It accommodated test engines up to two feet across, with these engines burning fuel in flow velocities up to Mach 5.

NASA's managers offered an opportunity to the HRE competitors. They could spend a month in Daingerfield testing hardware—if they could build scramjet components on short notice. DuPont responded by constructing a scale model of an

HRE combustor, in sixty days. This itself was important because it suggested that the full-scale combustor would be easy to build. His colleagues took this model to Texas, where they obtained over five hours of test data. This was unprecedented; a subsequent NASA effort, using tank-fed wind tunnels, proceeded for nearly a decade and accumulated only about three hours of total run time. NASA's source selection board was impressed both by duPont's initiative and by his massive quantity of data, and made its decision accordingly.¹⁷

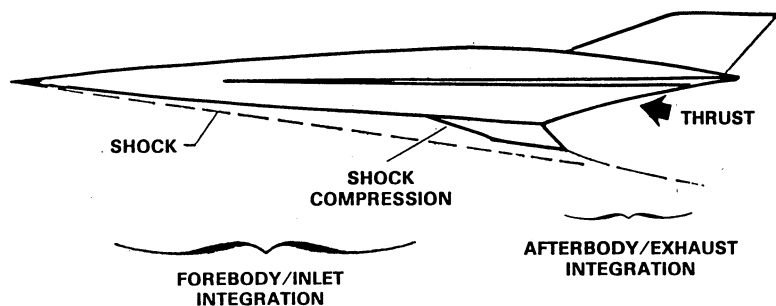
This contract award came in mid-1966. By then, though, the scramjet was in serious trouble. The Vietnam War was escalating, squeezing funds for research. There was no clear need for an airplane that could fly to orbit; rockets would do the job for as far into the future as anyone could see. Eugene Fubini, the Pentagon's director of research, had already cancelled Aerospaceplane. Now McNamara decided that the Air Force would not continue to support research with the X-15.

That left the X-15 entirely in NASA's hands. This agency, with budget problems of its own, responded by sharply cutting back its planned schedule of flights. With this, the HRE effort had to change direction as well. Rather than focus on a flying test engine, this program shifted emphasis toward versions that would undergo test only in wind tunnels.¹⁸

Still there was the opportunity to do one more thing: to build a dummy HRE engine, with the proper size and shape but without fuel burning, and to mount it to the X-15 for a few of its fastest flights. Maj. William "Pete" Knight was the pilot on the mission that set the speed record of 4,520 mph (Mach 6.7). "It was a very exhilarating flight," he recalls. "I didn't have much time to look out the window; the maximum altitude was 100,000 feet. The view from the altitude flights—250,000, 300,000 feet—was much more impressive. But this was the culmination of a test pilot's profession, in terms of 'this is the ultimate and I am one who has been selected to do this.'"

Knight was flying full tilt into unexplored realms, and he encountered an unusual form of aerodynamic heating. Superhot air burned through the lower fin that was supporting the dummy scramjet. "We burned the engine off," he continues. "I was on my way back to Edwards Air Force Base; my concern was to get the airplane

BLENDING ENGINE/AIRFRAME



Concept of the airframe-integrated scramjet. The aircraft forebody was to serve as part of the inlet. The afterbody, curving upward, was to function as a nozzle. (Image courtesy of NASA.)

THE VIETNAM WAR WAS ESCALATING, SQUEEZING FUNDS FOR RESEARCH

Cutaway view of the airframe-integrated scramjet concept of NASA-Langley. (Image courtesy of Garrett AirResearch.)

back in one piece. I didn't know that I had lost the engine at all."

It was symbolic of the rapidly diminishing fortunes of the leaders who had pursued the scramjet in its time of promise: Ferri, Billig, Thomas, and duPont. They had hoped to be pioneers, inventors who could open a new road into space. They all had dedicated their professional lives to this. But with the demise of Aerospaceplane and the redirection of the HRE into ground test, these visionaries faced redirections of their own. They had to find other things to do, even as they tried to keep alive their vision of flight without limits.

Antonio Ferri was the first to face this. Aerospaceplane had been GASL's mainstay; when that was lost, he left the firm. New York University recruited him, offering him an endowed professorship. He proceeded to build up a new supersonic-research lab, this one in the Bronx. But his new facilities were far less extensive than those he had used at GASL, and his opportunities were correspondingly reduced. Nucci declares that this "was

like having only half a body. Ferri's love was to do experiments."¹⁹

For Marquardt's Art Thomas it was worse. "I was chief engineer and assistant general manager," he recalls. "I got laid off. We laid off two-thirds of our people in one day." No one else had a scramjet group that he could join, but he hoped for the next best thing: conventional ramjets, powering high-speed missiles. "I went all over the country," he continues. "Everything had collapsed." Solid-fuel rockets had taken their place. He had to settle for a job working with turbojets, at McDonnell Douglas in St. Louis.

Fred Billig was able to go forward, but he had less to start with. His research group had never been a major participant in either the Aerospaceplane or HRE. The Navy kept him going; his sponsors thought that someday they might want scramjet-powered missiles, so they kept him around. At times he had only enough money to support a handful of people in his group, but he kept plugging ahead.²⁰

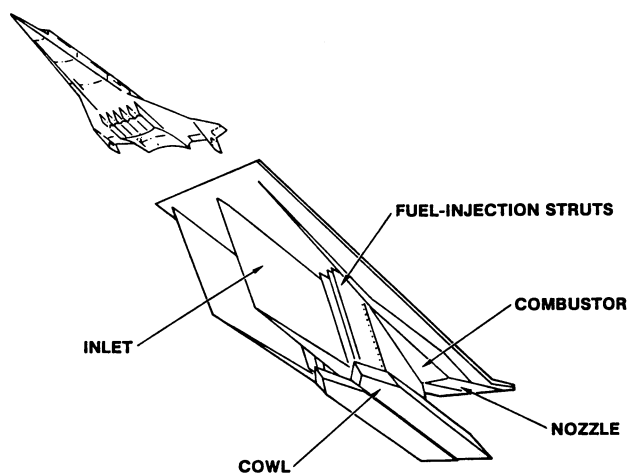
Tony duPont also did not give up. He proceeded to invent a new type of scramjet, one that might take off from the ground under its own power. Takeoff was a real problem; the scramjet needed a boost to Mach 3 before it could begin to give thrust. This demanded auxiliary propulsion. For the Aerospaceplane this had taken the form of turbojets, but these were heavy and represented dead weight when not in use.

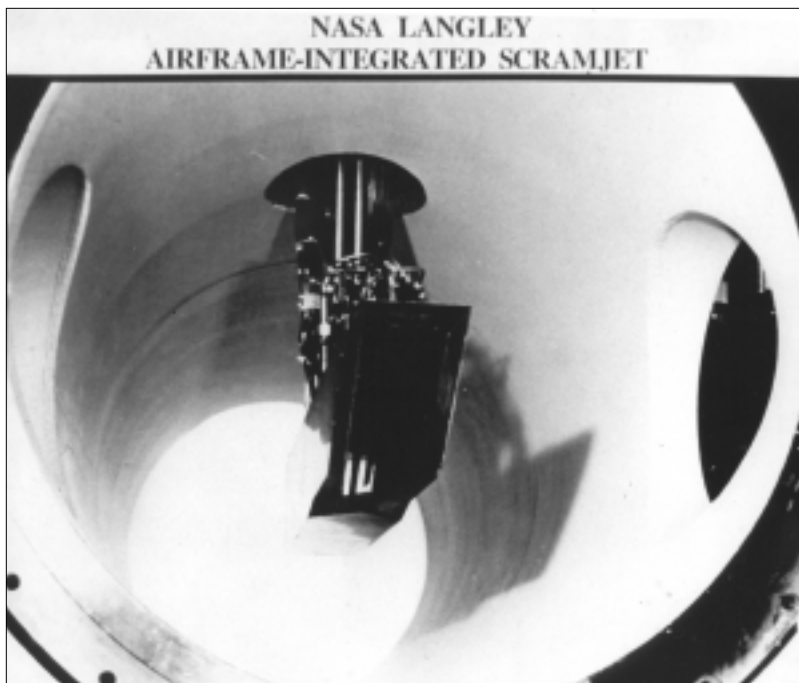
DuPont proposed to provide this initial boost by building his engine as an "ejector scramjet." The ejector was a small rocket thrust chamber set within the flow path of the main engine, with its plume entraining additional airflow, to burn more fuel and increase the thrust. Ejector scramjets were not new; they had been studied at Marquardt during the mid-1960s. However, there are several ways to build such an engine, and duPont believed that his approach offered superior performance. He patented his concept and set up his own consulting firm, hoping to win support from NASA or the Air Force.²¹

He went forward with what came to hand. "We did whatever we could," he recalls. "Some years I could bring in consulting income." At every turn, he promoted his scramjet that could take off from the ground. NASA's John Becker, a longtime leader in hypersonics, wrote that duPont "aggressively peddled this proposal throughout NASA, to the congressional staffs, to the Nixon White House staff, and elsewhere. He was a skillful and brilliant salesman and manipulator of arguments."²²

He did not get very far. By the late 1970s he was reduced to building a small model of his engine, using wood and plexiglas. He tested it in a friend's backyard, using an air compressor that he bought at Sears. By then he was becoming well known at the Pentagon's Defense Advanced Research Projects Agency (DARPA), where he hoped to win funding. He wanted to build a larger version of this backyard engine and to test it at GASL, but even this seemed out of reach.²³

SCRAMJET CONCEPT





Airframe-integrated scramjet in a wind tunnel. Predicted test results were calculated to adjust for lack of a fuselage forebody and afterbody, which would have been too large to include. (Photo courtesy of NASA.)

FERRI, BILLIG, DUPONT, AND THOMAS HAD BEEN KEEPERS OF THE FLAME, NURTURING AND HOLDING TO THE IDEA OF THE SCRAMJET ACROSS A NUMBER OF LEAN YEARS.

Did these people ever doubt the value of their work? "Never," says Billig. Nucci gives the same answer for Ferri: "Never. He always had faith." These people had full confidence in the scramjet, but they had to overcome the doubts of others and find backers who would give them new funding. From time to time a small opportunity appeared. Then, as Billig recalls, "we were highly competitive. Who was going to get the last bits of money? As money got tighter, competition got stronger. I hope it was a friendly competition, but each of us thought he could do the job best."

Amid this dark night of hypersonic research, one small candle still flickered. This was the Hypersonic Propulsion Branch at NASA-Langley, which continued to conduct wind-tunnel experiments with the HRE. In the early 1970s even this work faded, but the Langley group did not give up the scramjet. By then these researchers, led by John R. Henry, were busy with a new effort, small in size but highly significant. Indeed, it amounted to reinventing this engine.

The HRE had featured podded designs, which followed experience with podded ramjets on the Bomarc anti-aircraft missile. But at hypersonic speeds, such pods produced excessive drag and were hard to cool. The HRE had emphasized high values for specific impulse and thrust coefficient—which it achieved by deleting any requirement for it to produce more thrust than drag. Indeed, its net thrust proved to be close to zero, which led some NASA officials to withdraw support for the HRE.

The new Langley program broke with podded configurations by introducing an airframe-integrated scramjet. The aircraft forebody was to serve as part of the inlet, with the bow shock providing initial compression of the airflow. To the rear of the engines, an upward-flaring fuselage was to act as a nozzle, allowing the exhaust to expand and to add to the thrust. Henry, along with his successor

Robert A. Jones, arranged to build experimental engines and to test them in wind tunnels at speeds as high as Mach 7. These engines were small, but they were well suited for research.²⁴

This new program brought Ferri back into the scramjet world. His GASL had merged with Marquardt, but a corporate reshuffle brought the return of GASL to its original owners, including Ferri, who came back in 1972 as its president. GASL had stayed alive doing whatever came to hand: pollution studies, coal-combustion studies, high-speed trains, low-drag wings. But Ferri wanted to lead the firm back into scramjets. He succeeded in winning the NASA contract to design and fabricate the small new scramjets of Langley. It was not much, not after the high hopes of the Aerospaceplane. But, at least Ferri and his long-time colleagues were once again doing the work they loved. Ferri, nevertheless, did not enjoy it for long. He died late in 1975, struck down by a heart attack at age sixty-three.²⁵

Ferri, Billig, duPont, and Thomas had been keepers of the flame, nurturing and holding to the idea of the scramjet across a number of lean years. But after 1980, circumstances changed dramatically. Their flame blazed anew and became a powerful fire, as scramjets came again to the forefront.

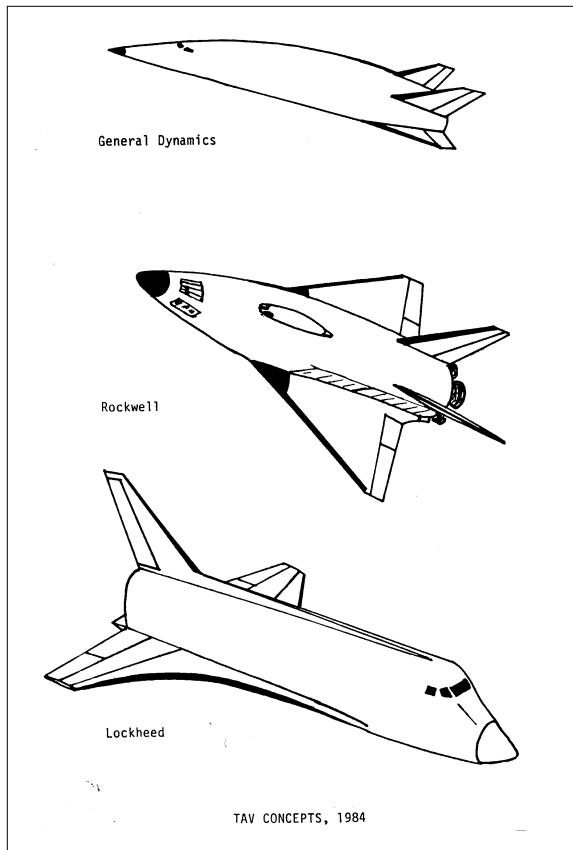
An important reason lay in Air Force dissatisfaction with the space shuttle. It made its first flight in April 1981, but it was a NASA launch vehicle, which meant that the Air Force did not control it. Lt. Gen. Lawrence Skantze, commander of the Air Force's Aeronautical Systems Division at Wright-Patterson AFB, Ohio, responded with studies of potential replacements. These were rocket-powered craft known as Trans-Atmospheric Vehicles (TAVs). The results did not please him, for they showed no easy way to improve on the shuttle. Later, when presented with the concept of the scramjet, he embraced it with open arms.²⁶

The director of DARPA, Robert Cooper, also was interested in new ideas. He wanted to build experimental aircraft. One such effort was already under way: the X-29, with a highly innovative array of wing designs, control systems, and advanced materials. Cooper was open to suggestions regarding other such projects.²⁷

In addition, the early 1980s were years of President Reagan's defense buildup. The Pentagon had plenty of money, and was receptive to new proposals. Reagan himself became a strong booster of space projects. He showed this by taking the lead in launching the space-based Strategic Defense Initiative. He also supported NASA's plan for a space station.²⁸

The technical scene offered new opportunities as well. Scramjets had faced a serious obstacle in developmental testing, for whereas turbojets and rockets could undergo static test in simple ground facilities, scramjets demanded test in wind tunnels. This brought difficulties, for even the largest high-speed tunnels, as at Daingerfield, generally could accommodate only subscale models.

But the rise of supercomputers, running



(Below) Computational fluid dynamics advanced strongly across three decades. Solid dots indicate increasing performance of central processors. Hollow dots and squares show that new mathematical methods brought similarly dramatic advances in the performance of algorithms. (Image courtesy of Victor Peterson, NASA-Ames.)

advanced programs for aerodynamic simulation, now offered a way out. Existing wind tunnels might test and validate the correctness of these “flow codes”—and these programs, running on the new computers, could calculate solutions that would model the flows within an engine, to assess

the merits of a scramjet design. NASA's Ames Research Center was active in this area and was building up a specialized lab, the Numerical Aerodynamic Simulator, that was preparing to work with Cray X-MP supercomputers.²⁹

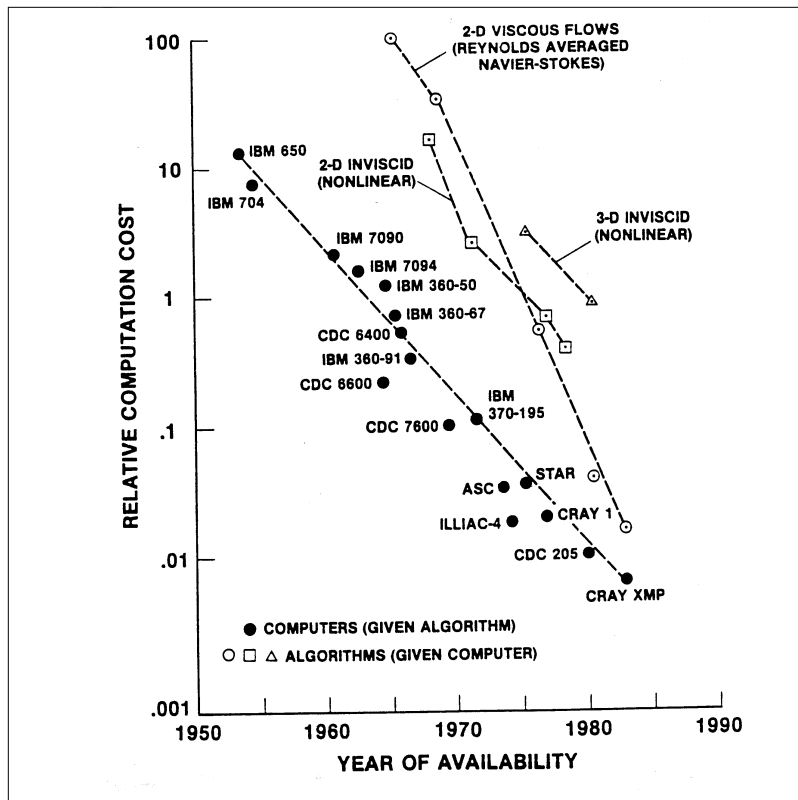
“Certainly the inlet flow [of a scramjet] is well within today's state of the art,” Victor Peterson, director of this Ames effort, told this writer in 1983, “In the combustion section, you have to introduce equations to treat the chemical combustion. This expands the magnitude of the problem.” However, while flow in the combustion chamber would still require test, such flows would be supersonic rather than hypersonic. The pertinent wind tunnels were larger and might accommodate combustors of full size. In addition, flow in nozzles could also be calculated. “Patching together solutions is certainly feasible,” Peterson continued. “Do computations where you can, do experiments to fill in where you can't do the computations, then patch the two together.”

Tests of the new Langley scramjets also showed promise. There had been concern that at Mach 4, a scramjet would show “unstarts,” with flow in the inlet breaking down. Experimental results put such issues to rest. At Mach 7, the limit achievable with the available facilities, it proved possible to mix and burn hydrogen fuel in a duct of moderate length, without having the flame blow out. These findings not only were important in themselves; they showed that it was possible to design and build scramjets that would perform as specified.³⁰

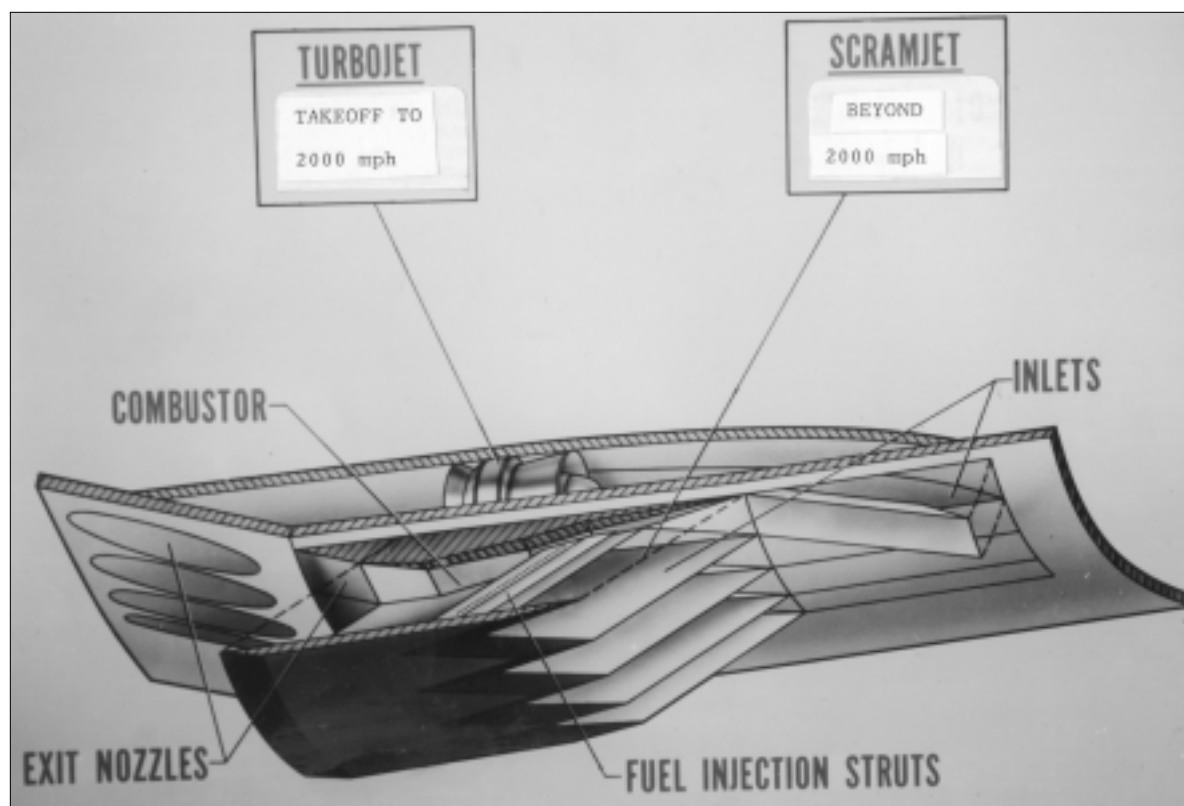
DARPA had new work of its own, having supported the development of new methods in powder metallurgy known as “rapid solidification.” Phil Parrish, who had managed this work, declared in 1986 that “at DARPA we now view rapid solidification as an established technology, along with ingot casting or drop forging.” Other research was producing thin structures of carbon-carbon composite, protected by coatings against oxidation. Such composites were very light in weight and showed promise of withstanding temperatures as high as 3,500 Fahrenheit.³¹

In reviving the scramjet, General Skantze's studies proved critical, as he continued to seek a next-generation shuttle. He was particularly interested in an airbreathing launch vehicle, but no suitable engines existed, even on paper. DuPont thought that his engine might help, and learned that Tony Tether was the DARPA man who was attending the pertinent meetings. DuPont met several times with Tether, who finally decided to send him up to talk with the boss, Robert Cooper. Cooper listened to duPont and then asked one of his best aerodynamicists, Robert Williams, to check him out.

Williams was a longtime Navy expert in helicopters. He also had a wide range of interests, particularly in high-speed flight. He was interested in the Outer Air Battle missile, a proposed tactical weapon that might use a scramjet. This had brought him into discussions with Billig, who had educated him. As a result, Williams became known



Conventional concept of boost propulsion relied on a turbojet, which would represent dead weight above 2000 mph. (Photo courtesy of NASA.)



WILLIAMS SPENT MUCH OF 1985 GIVING BRIEFINGS TO SENIOR FEDERAL OFFICIALS

within DARPA as the man to talk to if anyone was interested in scramjets.

He had his own hopes for airbreathing flight to orbit, but one he knew could tell him of an engine that could do it. William Escher, a Marquardt man who had nurtured ideas similar to duPont's, recalls a lengthy phone conversation in which he was unable to satisfy Williams's hopes—a phone call in which Williams had become so engrossed that he missed an airline connection. Williams now raised this issue with duPont.

He telephoned duPont and said, "I've got a very ambitious problem for you. If you think the airplane can do this, perhaps we can promote a program. Cooper has asked me to check you out." "He gave me three days," duPont recalls. "I stayed up all night; I was more and more intrigued with this. Finally, around 7:30 a.m., I called him back: 'Okay, Bob, it's not impossible. Now what?'"

DuPont had spent that night making calculations; Williams responded by giving him \$30,000 to prepare a report. Soon Williams was talking with Art Thomas: "How'd you like to work on hydrogen-powered scramjets?" "Hydrogen!" Thomas replied. "You've got to be out of your mind! There's no application!" "Well, I'm not so sure," Williams answered. "I have a report...." It was duPont's. This started a snowballing process, for duPont's conclusions were encouraging enough to permit Williams to go to his management and break loose more funding, to sponsor more research.³²

Late in 1983, Cooper convened a classified meeting in La Jolla, near San Diego, with a number of specialists spending several days discussing airbreathing flight to orbit. "I went into that meeting with a high degree of skepticism," Cooper recalls.

However, the technical presentations brought him around: "For each major problem, there were three or four plausible ways to deal with it. That's extraordinary. Usually, it's—'Well, we don't know exactly how we'll do it, but we'll do it.' Or, 'We have a way to do it, which may work.' It was really a surprise to me; I couldn't pick any obvious holes in what they had done. I could find no reason why they couldn't go forward."

This brought an expanded program of studies and analyses during 1984, a \$5.5-million effort known as Copper Canyon. Its conclusions appeared promising, and Cooper elected to seek funding for a full-scale program. Williams spent much of 1985 giving briefings to senior federal officials, working to win their support. One of the most important of these meetings came in July 1985. Cooper accompanied Williams as they gave a presentation to General Skantze, who since 1982 had headed the Air Force Systems Command (AFSC).³³

They gave their talk within a darkened office, projecting viewgraphs on a pull-down screen. As Cooper recalls, "He took one look at our concept and said, 'Yeah, that's what I meant. I invented that idea.'" He certainly had not invented the scramjet, but he had come to understand that he wanted something like it—and here it was. "His enthusiasm came from the fact that this was all he had anticipated," Cooper continues. "He felt as if he owned it." His support was vital, for he headed the AFSC.

Skantze wanted more than viewgraphs; he wanted to see duPont's engine on a test stand. Funds from Copper Canyon had allowed duPont to build a small version that was under test at GASL,

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and Skantze wanted to go there and watch. "I called in my motley crew of technologists," says Williams. "We had a countdown for our engine run. A young technician got a little too excited and forgot to throw the igniter switch. Hydrogen poured into the engine. Then, realizing his mistake a little too late, he threw the igniter switch into a very hydrogen-rich mixture inside the engine. There was a very strong detonation. The thrust gauge went slamming off scale, amid a tremendous roar from the engine. I jumped about two feet in the air. The general remarked, 'This engine sure does develop thrust, doesn't it!'"

With this, Williams adds, "the Air Force Systems Command began to move with the speed of a spaceplane. In literally a week and a half, the entire Air Force senior command was briefed." Later that year the Secretary of Defense, Casper Weinberger, granted a briefing. Members of Weinberger's staff were there, along with senior people from NASA and the military services. Williams brought a blue-and-white model of a spaceplane, with a needle nose and wings that resembled fins on a dart.

Weinberger had just returned from a meeting in Brussels, and still was weary from jet lag. Williams recalls that as he started the presentation, "I was appalled to see that the Secretary was very tired. I grabbed the spaceplane model and slid it across the table, almost impaling him and somewhat alarming his staff." Williams certainly had no thoughts of harming Weinberger, however: "I was determined that he get a good look at the model."

"We finished our briefing," Williams continues. "There was silence in the room. The Secretary said, 'Interesting,' and turned to his staff. Of course, all the groundwork had been laid. All of the people there had been briefed, and we could go for a yes-or-no decision. We had essentially total unanimity around the table, and he decided that the program would proceed as a major Defense Department initiative. With this, we moved immediately to issue requests for proposal to industry."

Weinberger had the clout to make this commitment, for there was support at the White House as well. Williams had met with Reagan's science advisor, George Keyworth, who had responded with enthusiasm. When Reagan prepared his State of the Union message, which he delivered early in 1986, Keyworth was among the presidential appointees who contributed to it. In this address, Reagan declared that he personally supported this new program, which took the name of National Aerospace Plane (NASP).³⁴

It would be pleasant to state that with this broad base of endorsement, NASP went ahead with strong budgets and solid success. It did no such thing, for from "Day One," it had rested on optimism. DuPont was the chief optimist, winning strong support from Williams. Indeed, the main point of the Copper Canyon studies had been to come up with concepts and results that would vindicate duPont's conclusions. Williams was quite

firm on that point; he committed himself to duPont's ideas, and established them as the baseline. When other contractors responded with doubts, Williams replied that if people worked hard enough, they could achieve duPont's goals.³⁵

Billig disagreed. He knew a great deal about inlets, which were to play an essential role. A scramjet inlet was to capture the onrushing hypersonic airflow, compress it while slowing it, and channel it to the combustor that burned the fuel. Billig had been studying such inlets since his days with the Friden calculator, back in the 1950s, and he insisted that duPont's claims for inlet efficiency were out of reach. For this and for similar sins, Williams froze him out of the program, even though Billig was among the nation's most knowledgeable scramjet specialists.³⁶

Some of the nation's best designers avoided NASP entirely. Ben Rich had succeeded Clarence "Kelly" Johnson as the head of Lockheed's Skunk Works, and had attended the 1983 conference in La Jolla. Even so, six years later he still was saying, "I've never seen a scramjet producing net thrust." Scott Crossfield, who had ridden to glory as a test pilot and had flown the X-15, met with Johnson and told him that he was working on NASP. The following discussion ensued:

Johnson: Separate yourself from that damn thing.

Crossfield: Kelly, you told me that about the X-15.

Johnson: Yes, seems like I did. That turned out pretty well, didn't it?

Crossfield: I remember when you said, all it would do is prove the bravery of the pilot.

Johnson: Yes, I did say that, didn't I? I remember that meeting.

Yet, while Johnson did not press his criticism with Crossfield, who was an old friend, he remained unconvinced.

From the start, NASP emphasized the development of technology for a new experimental airplane, the X-30, that was to fly to orbit. This reflected political reality; such an airplane could draw broad support, whereas a mere engine project could not. It also reflected the wishes of General Skantze, who had set his eyes on TAV.

During the mid-1980s, with duPont riding high, Cooper envisioned the X-30 at around 50,000 pounds, the weight of a fighter plane. But studies at major aerospace firms found that overall performance would fall far short of duPont's hopes. The vehicle would need far more fuel, making it considerably heavier and more costly.

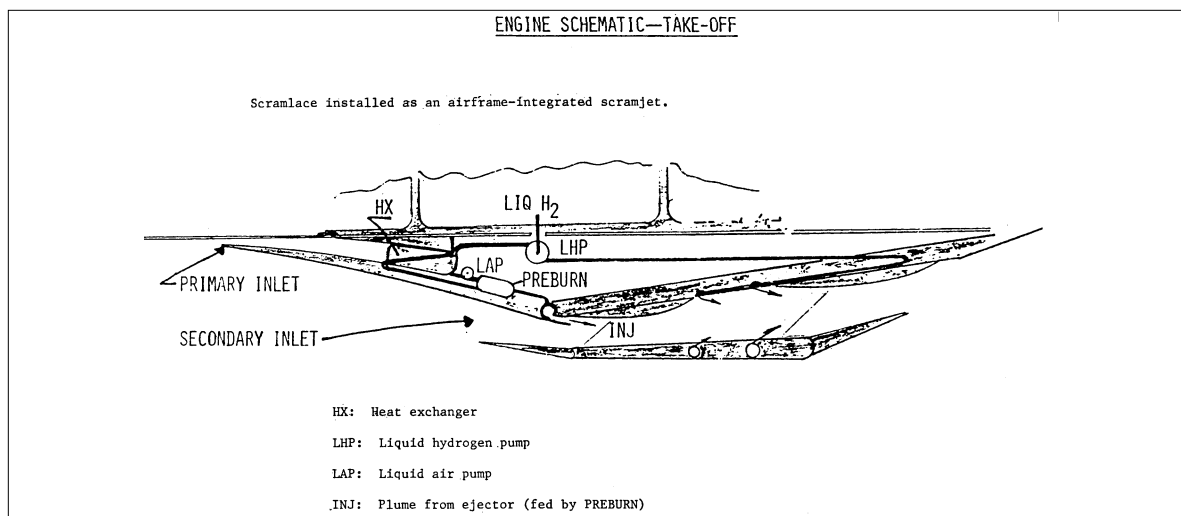
This point was critical, for NASP had won support on the basis of duPont's estimates. Its promise did not lie in the hope of winning success someday, after everyone had retired. Instead, Cooper had drawn on the work of Copper Canyon and had touted the idea of a spaceplane that could be ready in as little as three years. As time passed

Anthony duPont's ejector scramjet concept installed a small rocket within the engine duct, to produce thrust for takeoff. (Image courtesy of GASL.)

DUNCAN QUICKLY DECIDED THAT WILLIAMS WAS TO BE FIRED FROM HIS POST AS NASP PROGRAM MANAGER

AS DESIGN STUDIES PROCEEDED, THE WEIGHT, COST, AND TIME FOR DEVELOPMENT OF THE X-30 ALL ROSE SHARPLY

THE X-30 NEVER GOT OFF THE DRAWING BOARD; ITS DESIGNERS BUILT NOTHING LARGER THAN A FUEL TANK



and as further work gave support to the skeptics, NASP lost favor and its budget came under attack.³⁸

Late in 1987, Williams became convinced that he needed someone with clout to stave off further cuts in his funding. He worked his way up the chain of command, but found no one who would help him. The reason was that Air Force Secretary Edward Aldridge had endorsed the cuts and anticipated further budget reductions as well. In desperation, Williams wrote a letter to Howard Baker, the White House Chief of Staff.

The letter never reached Reagan. Baker sent it instead to the Pentagon, where it went to the new director of DARPA, Robert Duncan. Duncan knew insubordination when he saw it, and quickly decided that Williams was to be fired from his post as NASP program manager. This suited the Air Force; it was paying most of the cost of NASP, but the program had been in the hands of DARPA. Program management now passed to Robert Barthelemy, an Air Force man who had recently been named to head the NASP program office at Wright-Patterson AFB. Barthelemy did not like duPont, whose influence swiftly faded.

The coming of the Bush administration, early in 1989, launched a round of cutbacks in the defense budget. The leading champions of hypersonics—Cooper, Skantze, and Williams—now were gone from government or greatly reduced in influence. NASP, nevertheless, continued to limp along. But as design studies proceeded, the weight, cost, and time for development of the X-30 all rose sharply.

When Williams met with Weinberger and slid his model down the table, late in 1985, that model had a slender shape. This reflected the expectation that the X-30 would need only a modest fuel supply. However, that configuration, designed by duPont, lacked such basic features as landing gear, orbital maneuvering rockets, and flight safety equipment. It also had no margin for error; it was to reach orbit with its last drops of liquid hydrogen. Inevitably, the demands of a valid aircraft design added weight.

In addition, as estimates of its performance fell

off, designers responded by making it fat with fuel. The configuration of 1990 called for a weight of as much as 300,000 pounds. Soon this also appeared optimistic. Program officials considered that to reach orbit, the X-30 would need a loaded weight of at least 550,000 pounds.

The program cost and schedule expanded accordingly. Estimates of 1986 had declared that the X-30 would cost \$3.1 billion, with flight tests beginning in 1993. When that year arrived, the cost estimate was five times greater, \$15 billion or more, and Air Force officials were hoping for first flight in 2004. This represented a slip of eleven years from the 1986 plan, put forth only seven years earlier.

The X-30 never got off the drawing board; its designers built nothing larger than a fuel tank. Like the HRE effort, NASP itself went no further than to test experimental scramjets in wind tunnels. Nor did it last long. It withered away amid further budget cuts, with participants delivering "last rites" early in 1995.⁴⁰

But, "hope springs eternal," and the scramjet still may see its day. It is a remarkable fact that despite decades of research, no scramjet has actually flown under NASA or Pentagon auspices. But that is about to change. A new NASA program called Hyper-X is about to achieve the first test flight of a working engine in an experimental aircraft, the X-43.

The flight-test program is quite limited, calling for two flights at Mach 7 and one at Mach 10. The vehicle is only twelve feet long and will ride a Pegasus rocket to the test speed. The scramjet engine then is to burn for only around seven seconds. Yet there is reason why these tests are to be both brief and few: The scramjet community already holds high confidence that such engines can be built to work as planned.

This confidence stands as a legacy of NASP. It stems from close agreement between data taken from wind tunnels, and computational simulations. This reflects the quality of good mathematical models that capture the details of hypersonic flows. The power of these computer programs, which calculate those details, enables NASA to

learn much from only a few flights of the X-43. Those flights are to supply experimental data that will be compared with the computed results, and NASA's researchers anticipate good agreement.⁴¹

The scramjet, and its promise of airbreathing flight to orbit, stands today as an unresolved issue for the new century. Despite decades of research, even a successful X-43 will not demonstrate credibly that anything like the X-30 can be built today in an attractive form, inexpensive and modest in

size. Significantly, a decade of NASP-sponsored work in key areas—materials, computational fluid dynamics, and engine design—showed that as people learned more, the prospects for an X-30 grew weaker rather than stronger.

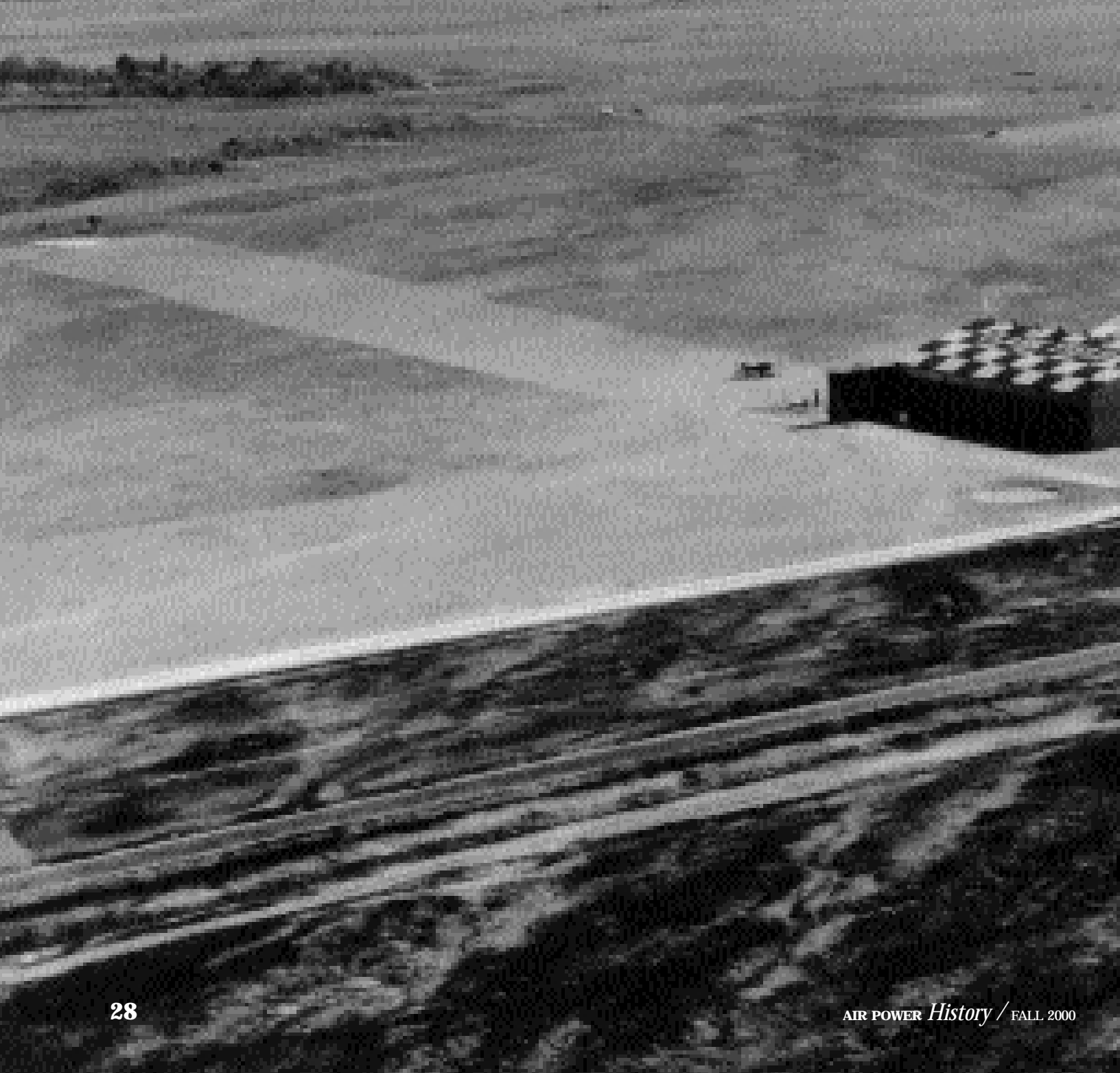
The concept of the scramjet remains alive, ready to entice a new generation. However, the experience of NASP suggests that even if the X-43 meets its goals, it may be a long time before the scramjet truly sees its day—if that day ever arrives. n

NOTES

1. This paper draws extensively on personal interviews conducted by the author between 1983 and 1989. Attributed quotes should be credited to these interviews, unless otherwise stated. Interviewees include: H. Lee Beach, Fred Billig, Robert Cooper, Scott Crossfield, Tony duPont, John Erdos, William Escher, George Keyworth, Col. William Knight, Ernest Mackley, Gen. Eric Nelson, Louis Nucci, Phil Parrish, Victor Peterson, Ben Rich, Robert Sanator, Art Thomas, and Robert Williams.
2. Intvw, Louis Nucci. See also Antonio Ferri papers in Box 1002, Record Group 255, National Archives (NA), Philadelphia.
3. Bill Gunston, *Fighters of the Fifties* (Osceola, Wisc: Specialty Press, 1981), pp. 184-85, 193-94.
4. Intvws, Louis Nucci and Robert Sanator.
5. *Republic Aviation News*, Sep. 9, 1960, pp. 1, 5.
6. William H. Avery, "Twenty-Five Years of Ramjet Development," *Jet Propulsion*, Nov. 1955, pp. 604-14; Jay Miller, "The X-Planes, X-1 to X-29" (Marine on St. Croix, Minn.: Specialty Press, 1983), p. 72.
7. "Here Comes the Flying Stovepipe." *Time*, Nov. 26, 1965, pp. 46, 51.
8. Antonio Ferri, "Possible Directions of Future Research in Air Breathing Engines," in *Combustion and Propulsion: Fourth AGARD Colloquium*, April 4-8, 1960. New York: Pergamon Press, 1961, pp. 3-15. See also Antonio Ferri, "Review of Problems in Application of Supersonic Combustion," Lanchester Memorial Lecture, *Journal of the Royal Aeronautical Society*, Sep. 1964, pp. 575-97; also Antonio Ferri, "Review of Scramjet Propulsion Technology," *Journal of Aircraft* (AIAA), Jan.-Feb. 1968, pp. 3-10.
9. Intvws, Art Thomas and Fred Billig.
10. Richard P. Hallion, "The Hypersonic Revolution," 3 vols, Bolling AFB, D.C.: Air Force History and Museums Program. Vol. 2, p. 751.
11. *Ibid.*, p. 949, T. A. Heppenheimer, "Hypersonic Technologies and the National Aerospace Plane." Arlington, Va.: Pasha Publications, 1990, p. 15.
12. Engineering drawings courtesy Louis Nucci; *Los Angeles Times*: Nov. 3, 1960, p. 3A; Jan. 15, 1961, p. 1.
13. *Aviation Week*: Oct. 31, 1960, p. 26; May 8, 1961, p. 119; May 22, 1961, p. 14; June 19, 1961, pp. 54-62; Nov. 6, 1961, pp. 59-61. Film and other data courtesy William Escher.
14. Hallion, "Hypersonic Revolution," Vol. 2, pp. 951-52.
15. "Scramjet Flight Test Program," Van Nuys, Ca.: Marquardt, Sep. 1965; Hallion, "Hypersonic Revolution," Vol. 2, pp. VI-xvii to VI-xx; data from Louis Nucci; Intvw with Art Thomas.
16. Hallion, "Hypersonic Revolution," Vol. 2, pp. 756-65.
17. *Ibid.*, pp. 765-78; Intvws, Tony duPont.
18. Hallion, "Hypersonic Revolution," Vol. 2, pp. 778-96.
19. Intvw, Louis Nucci.
20. Intvw, Fred Billig.
21. T. A. Heppenheimer, "Hypersonic Technologies and the National Aerospace Plane," pp. 166-69; U. S. Patent

- 3,690,102, Sep. 12, 1972; Intvws, Tony duPont.
22. Hallion, "Hypersonic Revolution," Vol. 2, p. 825.
23. Intvws, Tony duPont.
24. John V. Becker, "Prospects for Actively Cooled Hypersonic Transports," *Astronautics & Aeronautics*, Aug. 1971, pp. 32-39; J. R. Henry and G. Y. Anderson, "Design Considerations for the Airframe-Integrated Scramjet," NASA TM X-2895, Dec. 1973; Hallion, "Hypersonic Revolution," Vol. 2, pp. 765-70.
25. Intvw, Louis Nucci.
26. Intvw, Robert Cooper. See also Hallion, "Hypersonic Revolution," Vol. 2, pp. 1336-46; Vol. 3, pp. 20-22.
27. Intvw, Robert Cooper. See also Miller, "X-Planes," pp. 175-79.
28. Statements by President Reagan: Mar. 23, 1983 and Jan. 25, 1984.
29. Intvw, Victor Peterson. See also Gina Bari Kolata, "Who Will Build the Next Supercomputer?" *Science*, Jan. 16, 1981, pp. 268-69; Randolph A. Graves, "Computational Fluid Dynamics: The Coming Revolution," *Astronautics & Aeronautics*, Mar. 1982, pp. 20-28.
30. Intvws, Ernest Mackley and H. Lee Beach. See also Robert A. Jones and Paul W. Huber, "Toward Scramjet Aircraft," *Astronautics & Aeronautics*, Feb. 1978, pp. 38-48.
31. Intvw, Phil Parrish.
32. Intvws, Robert Williams, Tony duPont, Art Thomas, and William Escher.
33. Intvws, Robert Cooper and Robert Williams. See also Hallion, "Hypersonic Revolution," Vol. 2, pp. 1361-63; Vol. 3, p. 29.
34. Intvws, Robert Williams, Gen. Eric Nelson, and George Keyworth. Statement by Pres. Reagan, Feb. 4, 1986.
35. Hallion, "Hypersonic Revolution," Vol. 3, pp. 22-31.
36. Intvws with Fred Billig.
37. Intvw, Scott Crossfield. A reviewer of this paper notes that when NASP began, Johnson was severely ill with Alzheimer's and could not have spoken lucidly. Within this interview Crossfield was working from memory and may have confused a discussion of NASP with one that dealt with an earlier concept, such as TAV. Even so, this anecdote would illustrate Johnson's attitude toward advanced post-shuttle programs in general.
38. Hallion, "Hypersonic Revolution," Vol. 3, pp. 3-4, 22, 25-26, 30, 85; *Astronautics & Aeronautics*, Jun. 1984, p. 1.
39. Intvw, Robert Williams; Hallion, "Hypersonic Revolution": Vol. 2, pp. 1364, 1379-80; Vol. 3, pp. 84-86, 155-56.
40. Hallion, "Hypersonic Revolution," Vol. 3, pp. 7, 29, 199, 316; T. A. Heppenheimer, "Hypersonic Technologies." Arlington, Va: Pasha Publications, 1993, pp. 19-23.
41. "Dryden and the Hyper-X Program," *NASA Facts*, FS-1998-12-040DFRC; Hallion, "Hypersonic Revolution," Vol. 2, pp. VI-xxviii, VI-xxix.

Monday, December 8, 1941, at Clark Field





Austin W. Stitt

I WASHED
OUT THERE
AND WAS
IMMEDIATELY
SENT TO
BOMBARDIER
TRAINING AT
LOWRY
FIELD,
COLORADO

BRERETON
DID SAY
THAT WAR
APPEARED
INEVITABLE
AND THAT
THE 7TH
BOMB
GROUP WAS
COMING
OVER

SUNDAY, I
FLEW AS A
BOMBARDIER
ON A RECON-
NAISSANCE
FLIGHT UP TO
FORMOSA

It is hard to remember for sure, but this is the way one second lieutenant bombardier from the 19th Bomb Group remembers it. I was a small town boy from Frewsburg, N.Y. (Chautauqua County). I graduated from high school at age sixteen in 1933. I went for two years to Hobart College, Geneva, N.Y. Then, no more money. I had to go into the CCC [Civilian Conservation Corps]. Any interest I might have had in the Army dissipated there.

In the fall of 1936, I went to the University of Michigan and spent a year and a half in Ann Arbor, with more time used making a living and playing than in studying. For the first six months of 1938, I hitch-hiked all over the country. When Hitler went into Austria, I was in New Orleans and tried to become a flying cadet, but at the recruiting office I was advised my vision wasn't good enough, so I went my merry way toward San Francisco.

In the fall of 1938, I went to Michigan State, where ROTC [Reserve Officer Training Corps] was mandatory, since the college is a land grant school. I refused to take ROTC—primarily from my CCC experience—by telling them I was a conscientious objector.

Then came October 1940 and registering for the draft. I was working only part-time and not even bothering to go to school. The draft board told me that I was just the type of young man they were looking for. The next morning I applied at the recruiting office in Lansing for the Flying Cadets. They found that my eyes were perfect and, so, in December 1940 I was in Glenview, Illinois, going to flying school. I washed out there and was immediately sent to bombardier training at Lowry Field, Colorado, in the first service test class of officer bombardiers. As soon as we finished, we were sent right out to regular bomb groups as cadets. I went to March Field, California, to the 30th Bomb Squadron, under Maj. David Gibbs. We were at Albuquerque Army Air Base in September.

On September 15, 1941, I was commissioned. At the same time that Major Gibbs pinned the second lieutenant bars on my uniform he gave me the word that we were moving to Clark Field. I was to be the transportation officer for the ground echelon, but would fly over with him.

Now to the war and that first day. The ground echelon left Albuquerque on September 27, 1941. My wife and I were married the same day. We put our many friends on the train and started our honeymoon.

In mid-October, the air echelon left Albuquerque. We landed at Hamilton Field and there, I believe, we were briefed by General Lincoln. He stood on the stairway in base operations and told us that we were probably going to

war and would be crossing Japanese held territory with "hot" guns. He intimated that in his opinion war was inevitable and that the Spring of 1942 was the probable time. His last words were, "Good shooting." In Hawaii, we were given practically the same briefing by an admiral; it might have been Admiral Short. I honestly don't know. I wanted to get back to the poker game at the club and, besides, the general at Hamilton had said it all.

Now to Clark and the time immediately preceding December 8. General Brereton came out to Clark Field sometime in late November, or early December, and said practically the same things the Hamilton Field general and the Pearl Harbor admiral had said. Brereton did say that war appeared inevitable and that the 7th Bomb Group was coming over and would be stationed on Mindanao in the immediate future. Our most pressing need was early warning and more radar, in his opinion. Particularly, because of the lack of early warning, he advised us that our alert posture had to be of the highest degree. He expected all of us to be airborne in about ten minutes from the sounding of the alert. We were to wear helmets, gas masks, and side arms at all times. We were to dig slit trenches near all buildings and tents. He came out bluntly and predicted April for war, but said it certainly might come much earlier.

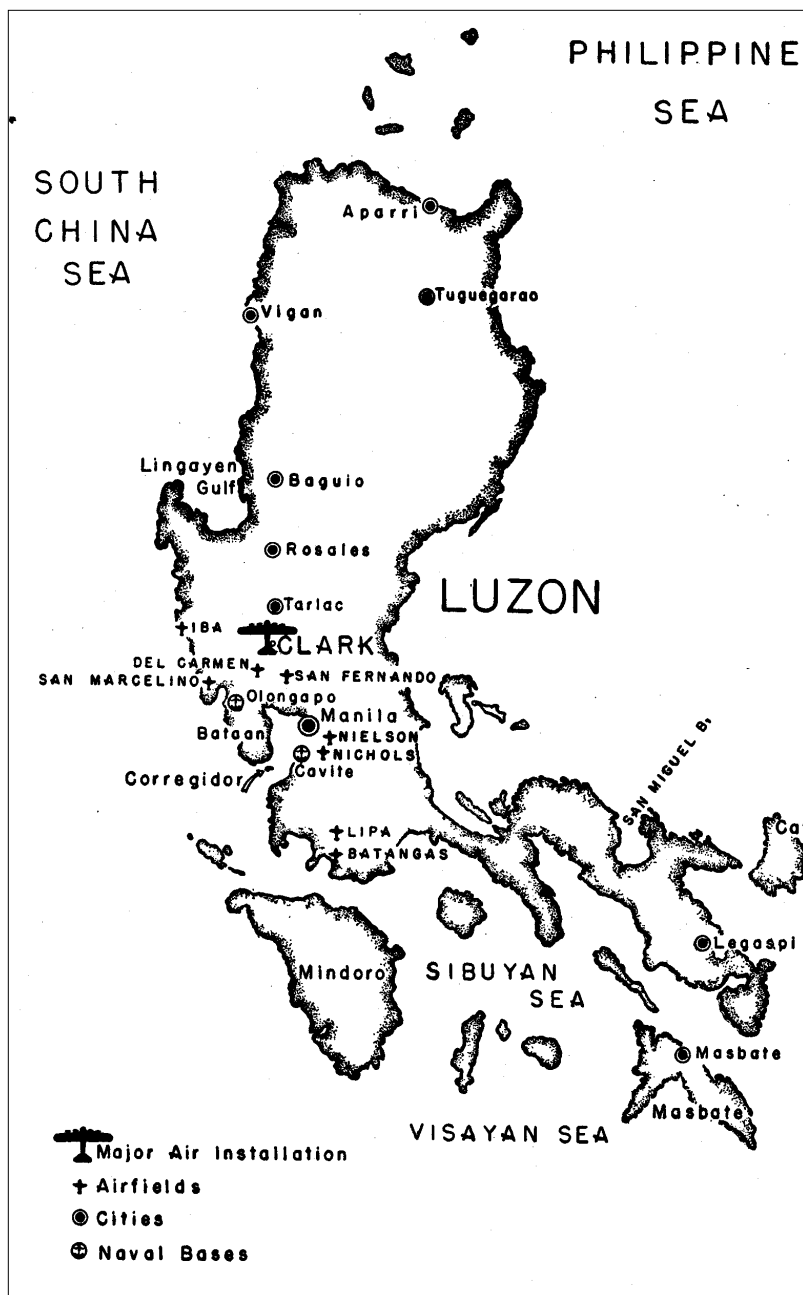
Saturday December 6, I was in charge of a group of enlisted men digging the last few trenches in the squadron area. Saturday evening I was in Major Gibbs' quarters, with "Shorty" Wheless, Ray Cox, Jim Connally, Bill Menaugh, and Lt. [Raymond Gehrig?] Gary. Connally and Gibbs were arguing high level strategy. Major Gibbs holding the view that if he were the Japanese, he would strike now—that very week-end—since the American, British, Chinese, and Dutch attitude left no room for compromise. Jim Connally said that the Japanese would back down; America was too strong. I wanted them to quit talking and play poker. Poker prevailed.

Sunday, I flew as a bombardier on a reconnaissance flight up to Formosa. We went North until we could clearly identify the island, then turned back South over the China Sea. A heavy squall line covered most of the sea, so our recon report was only of the weather. Our quarters were some Swali huts in the back of the officers club. Right after landing and debriefing, Sunday evening, I went to my quarters and listened to Don Bell, a radio commentator from Manila. He said it looked like peace would prevail in the Pacific immediately, since the great Japanese ambassador was now talking with Mr. [Cordell] Hull and President Roosevelt. I went to bed, sleeping soundly, thinking Major Gibbs was wrong.

At 5:30 or 6:00 am, Lt. George Markovich came running through our quarters saying that Pearl Harbor had been attacked and that at long last we would help the Russians—he was of Russian descent.

Our operations officer got us the word as soon

Note: On April 6, 1974, Col. Austin W. Stitt, USAF(Ret) wrote this letter, in longhand on yellow legal pad paper, to aviation writer Sky Beaven. Mrs. Beaven passed it on to Air Power History to enrich the historical record.



World War II map of the Philippine Islands

as possible. It seems to me it was at about 7:00 or 7:30 am that all the aircraft that had camouflage painting were to take off, holding to the immediate south of the field, until Colonel Eubanks could get better instructions. The two planes that were not camouflaged would be painted immediately. Gibbs' aircraft, No. 075, was not camouflaged. I was told to take the 075 ground crew plus some other people and paint it *now*. We had it in the corner hangar and were at it, probably at about 8:00 am, with spray guns and brushes. Everyone really went at it in a hurry. We were about done at 11:30 and I then went over to the club for lunch. I ate and started back across the field at about 12:10. I walked back with Lieutenant Berkowitz, a navigator, and Lt. Woodrow Holbrook, a communications officer; we were all "comedians." P-40s were landing and taking off, B-17s were landing, dust was flying all over. We put on our gas masks, made

faces at each other, horsed around, and generally played the fools that we were. It was about 12:25 when we got back to the hangar. I knew I was supposed to be at the hangar. I was in charge of that painting crew, but I wanted to hear the latest news and rumors, so I left the hangar and went to the operations tent with Berkowitz at about 12:30. On Manila radio, Mr. Bell again, was just saying that there was no news from Clark Field and that there had been none all morning, so quite possibly Clark was under attack. Lt. Jim Colouri or Lt. Ray Teborek was looking up at the sky. Berkowitz was standing beside me. The man looking up in the sky said, "What a beautiful navy formation, two Vees of twenty-seven each." I looked up and I knew it was too late. The bombs were already well on their way. I ran as fast as I could, with Berkowitz behind me, toward the big ditch between the tent and the hangar.

As I ran the few steps, I saw a fire truck and an ambulance parked beside the hangar. Two orderlies were jumping out of the ambulance, one on each side. A fireman had his hand on the fire siren—a hand crank type—on the fire truck and was starting to crank. I jumped in the ditch, just as the bombs were hitting. An Army PFC and I hugged each other as the earth trembled and debris fell. A leg came in on us, I think it belonged to Berkowitz, but I didn't know. It was a bloody mess.

The bombing lasted just a short time. I had seen the formation, so I knew that was all there was to it. I jumped up, full of a terrible [guilty] conscience, since I had not been at my duty station, in the hangar with 075. I ran past the two vehicles. The two orderlies appeared to be dead lying next to the fire truck, with one dead man still holding the siren crank.

In the hangar, a fire was burning in the back, holes in the roof with ammunition in boxes were burning and exploding, 075 seemed okay. Ray Cox came running up. He and I threw ladders, paint cans, pails, and compressors every which way. I jumped in and never having started a B-17 before, I tried to start all four engines at once. It can't happen, but actually two engines caught and were running when Ray got in and released the brakes, and we taxied out of the building. There were bomb craters all around, so we had to stop just outside. What I thought were P-40s were flying all over the place. Then I saw their red ball insignia. Ray and I jumped out of the airplane. He ran one way and I ran back toward the tents.

The next stupid thing I did—a la the movies—I got a box of ammo and a machine gun from the ammo tent and went back to the ditch. I had managed to get a .50 caliber and a .30 caliber guns. I threw them down in disgust. What went through my mind was that we were caught with our pants down. Gibbs was right and I am a vet just like the old GAR [Grand Army of the Republic] Civil War boys.

About then I saw a nearby B-17 that looked in good shape, but had some smoke coming from the



Clark Field in an earlier era, around 1929, looking much like a summer encampment.

I WAS RIGHT IN THE MIDDLE OF THE SHOOTING, THE JAPANESE FIGHTERS WERE STRAFING, DOING 180° TURNS, AND COMING BACK THROUGH AGAIN

cockpit. A truck was nearby that had a tiny fire extinguisher. I grabbed this little extinguisher, turned it on and was scared that the aircraft gasoline would blow up. I threw that little insignificant extinguisher in the cockpit window and ran as fast as I could toward the mountains. This got me out on the airfield past the tents. I saw an anti-aircraft installation, so I jumped in that. There were two soldiers there, one dead and the other poor fellow was trying to work his big gun, but it was jammed. He and I worked on that gun for an eternity, probably thirty seconds. Then he decided the breech was completely broken and could not be fixed. The gun was well dug in with the sand bags around the edge, but it also was full of ammunition. I was so scared and stupid, I jumped out of there and headed further out toward the center of the field.

It finally dawned on me that I was right in the middle of the shooting, the Japanese fighters were strafing, doing 180° turns, and coming back through again. It appeared they were just doing a pattern like knitting, north to south and south to north, kicking their rudders back and forth to spray everything in sight. I jumped in some tall grass, lay on my back, and futilely fired the two clips of .45 ammo I had for my side arm. Then, I finally had enough sense to pray and it ended.

I went back to the tent. Everything everywhere seemed on fire and dead. A bunch of us were running around helter-skelter. I found Woody Holbrook. A doctor had a truck and was getting the wounded aboard. We helped him until he was

loaded and started off in the direction of Stotsenberg.

Woody suggested we go to group headquarters and find out what we were supposed to do. He and I started out that way. Just outside the headquarters, I spotted Lt. Frank Bender—I hadn't known he was anywhere near the Philippines. He was a fraternity brother of mine at Hobart and a particular friend. In fact, his cards and letters, telling how great it was at Randolph and Kelly, were the main reason I had wanted to go in the Air Corps. After much back slapping and carrying on, I took Bender, his buddy, and Woody Holbrook over to our Swali hut, where I had a fifth of Johnny Walker Red Label.

We had to go back of the club to get to my hut. The kitchen of the club had been hit just as the Filipinos were eating their lunch. Many were dead and wounded. I saw one leg, obviously a female Filipino lying in the dust, then I knew that I hadn't seen Berkowitz since the beginning and that the amputated leg in the ditch with the PFC and me was poor George's leg.

The four of us drank the nearly full fifth of scotch in about five minutes. Bender said he had just gotten in with the 27th, but their planes weren't there. We all, at the same time, got the knowledge that we were truly lost. His airplanes weren't even in the area, probably at sea; ours had been destroyed.

Woody said he was going to his hut and get his valuables. Bender and his friend said they were going to find a way to get back to Manila and they

CLARK FIELD WAS DEAD AND SO PROBABLY WAS NICHOLS AND THE ARMY WOULD BE OF NO CONSEQUENCE WITHOUT AIRCRAFT

WITH SOMETHING TO DO, NO MATTER HOW FUTILE, YOU CAN KEEP FROM BEING SCARED AND WORRIED

I BLAME THE INTERSERVICE AND INTERDEPARTMENTAL RIVALRIES THAT KEPT US FROM HAVING A CENTRALIZED INTELLIGENCE EFFORT

left. I decided I wanted to die in good clothes and if I didn't die I would need good shoes. I changed to my best pants and shirt and put on a brand new pair of shoes that I had had made at Ft. Stotensberg. I left the hut and headed toward group headquarters.

At headquarters, no one knew anything. One captain told me to report to Lt. Sig Young on the flight line. I never found Sig. I think he actually was on Mindanao with the 93d Squadron and Major Combs. I did find Ray Cox and Holbrook. Ray said he was told by Gibbs to salvage parts. By now it was nearing sunset, Ray told us to take off away from the flight line and possible night bombing and come back to him to come dawn.

Woody and I went in the direction of Stotensberg and sat along the edge of the road listening to the tanks and Army units pulling out without lights going off to do battle, maybe to win the war. We hoped, but deep in our hearts we felt nothing but abject defeat. We knew the Japanese had the air battle already won. Clark Field was dead and so probably was Nichols and the Army would be of no consequence without aircraft. We slept by the side of that main road leading out of Ft. Stotensberg.

When dawn broke, it brought chaos, but by then Woody and I had hooked ourselves into Cox's army and we had a job to do. We had no effective warning of Japanese raids. Each job that two men normally would do, took six of us. A lieutenant in charge—me—a non-com, two watchers, and two men to do the work. The four of us non-workers would watch the four quadrants of the sky for the Japanese, while the remaining two would work.

It was easy. It kept your mind off your troubles. Ray got his orders from Gibbs; there were all desperate things. "Salvage all aircraft instruments, keep them in the tent until we have a safe place to hide them." "Salvage engines and put them close to the railroad tracks, so they can be moved quickly." "Try and keep the airfield operational, with or without the cooperation of the engineers." Ray's orders to me were always simple: "Austin go take five guys and pull all the instruments that are any good off 067 and bring them back to here." With something to do, no matter how futile, you can keep from being scared and worried. Those first few days passed, from then on it's a long story.

What were the beginnings? How could it have happened?

Jealousies between the countries—A-B-C-D (American, British, Chinese, and Dutch). Jealousies between the Filipino and the Americans. Jealousies between the Army and the Navy. Jealousies between the Army ground and Army air elements. In Washington, interdepartmental rivalry—too much empire building and organizational loyalty (above loyalty to our cause) all of the above really doomed us to poor intelligence.

What went on down in Manila on Monday morning, I doubt anyone knows. I can best describe the whole thing to you by reminding you of the day JFK [President Kennedy] was shot. The two situa-

tions were very much alike, if you can remember how you felt then, you will know how a second lieutenant bombardier felt at 4:00 pm, on Monday, December 8, 1941, at Clark Field.

The breakdown in intelligence, communications, command relationships, morale, even food was complete and unique: but that horrible pall of defeat and abject sorrow in both Kennedy's assassination and the December 8th fiasco were the most remembered feelings.

At the time you couldn't blame anyone, but everyone has to have someone to blame, to vent his frustrations on someone or something. Today in Xenia, Ohio, the people are really upset with the weather service's communication of their warning.

I now feel that the scapegoat for the particular Clark Field fiasco was General MacArthur and his staff for not laying on an immediate retaliatory raid against Formosa. To wait for an attack on the Philippines, after Hawaii had already been attacked, was criminal.

Beyond that, and probably much more important in the long run, I blame the interservice and interdepartmental rivalries that kept us from having a centralized intelligence effort that possibly could have kept President Roosevelt honestly informed.

The whole thing was too much an Army-Navy football game.

Lt. Roy Cox was killed in Java. Lt. Holbrook was taken prisoner on Mindanao and was killed when the Americans sank a prison ship late in the war. Major Gibbs was lost in a B-18 en route to Mindanao from Clark early in the war. He had left orders for me to come down by the following B-18 the next night. We made it. Lt. Bender was the pilot. I was picked up as a member of the 93rd Bomb Squadron and flew with the Earl Tash crew through the Java campaign and on into Australia. Bender was, for a long time, in the jungles of New Guinea in late 1942. He had had to bail out. He retired in 1965 or 1966 at Bergstrom AFB as the wing commander there and is doing something in the Houston area for John Connally, the politician.

This is absolutely the first time I have ever tried to put this in black and white—the way it was that day for me.

Fred Crimmins was down at the next hangar and had a bad experience. He had to have a steel plate put in his head and I heard somewhere that he died, not many years ago.

I saw Berkowitz in Sydney, Australia, in March or April 1942. He was in a bad way with his leg off at the hip, but I heard he got well and was active as a navigator instructor at Monroe, Louisiana, during most of the war.

In Edmunds' book, *They Fought With What They Had*, on pages 183 and 184, he tells about the morning mission we flew across the Japanese fleet at Lingayin Gulf. Mr. Edmunds has it just the way it was. I think he got that information from Art Hoffman, who was our navigator in Tash's airplane and was looking over my shoulder as we bombed.ⁿ

Bombing and the Italian Front, 1915-1918



Air War on the



A. D. Harvey

(Overleaf) Nieuport aircraft assigned to the American Expeditionary Force (AEF) await action in France.

(Right) Airpower theorist Giulio Douhet in the 1920s.

THE AIR WAR OVER THE ISONZO AND THE ADRIATIC HAD SEVERAL FEATURES THAT SUGGEST THE DESIRABILITY OF REVISING STANDARD ACCOUNTS OF THE EVOLUTION OF AIR WARFARE

GIULIO DOUHET, HAS SOME CLAIM TO HAVE BEEN THE ONLY SENIOR OFFICER OF THE FIRST WORLD WAR ERA TO HAVE ANY REAL VISION CONCERNING THE APPLICATION OF AIR POWER

During the First World War, air operations were on a much smaller scale on the Italian front than in France and Flanders. Italian fighter pilots claimed to have shot down fewer than one-tenth the number of enemy aircraft officially credited to German fighter pilots operating over the Western front.¹ Nevertheless, the air war over the Isonzo and the Adriatic had several features that suggest the desirability of revising standard accounts of the evolution of air warfare that are based on the experiences of the British Royal Flying Corps and the German *Luftstreitkräfte* farther north, particularly with regard to the use of bombing aircraft.

In 1911, the Italians had been the first nation to employ aircraft in warfare, during the course of their invasion of Libya—then part of the Ottoman Empire. On November 1, 1911, Lt. Giulio Gavotti dropped four bombs, each weighing two kilograms, on Turkish positions at Ain Zara and Tagiura.² Subsequent bombing attacks were denounced by the Ottoman government as contravening the Geneva Convention. In 1913, the Italian army's aviation battalion was placed under the command of a staff officer named Giulio Douhet, who has some claim to have been the only senior officer of the First World War era to have any real vision concerning the application of air power. Douhet made sure that the Italian government placed an order for several examples of the giant trimotor bomber designed by aviation pioneer Giovanni Caproni.

When war broke out in August 1914, Italy, at that time joined in a defensive alliance with Germany and Austria-Hungary, remained neutral and Douhet began writing commentaries on the war for the Turin newspaper *La Gazzetta del Popolo*. He read with interest press reports of the first bombing raids by single German aircraft, warning on December 12, 1914:

*Against the enemy that moves on the surface it is sufficient for safety to be in the rear of the battle line; against the enemy that is master of space there is no safety except for moles. Everything which is to the rear of the army and which makes it live is threatened and exposed; supply convoys, trains, railway stations, magazines, workshops, arsenals, everything.*³

Douhet and his colleagues seem to have been less interested in the first air-to-air combats. By the time Italy abandoned its prewar alliance and declared war on Austria-Hungary on May 23, 1915, several German aircraft had already been shot down by British and French two-seaters, in which the observer was armed with a machinegun, and the French pilot Roland Garros had notable



success in a single-seater Morane monoplane equipped with a machinegun fixed to fire through the arc of the propeller.⁴ During the first six months of the Italo-Austrian conflict, however, both sides confined themselves mainly to using unarmed planes on reconnaissance missions, partly because the additional weight of a machinegun and ammunition was found to be disadvantageous when flying over mountainous terrain. However, the Austro-Hungarians communicated their resentment for their former ally by bombing Ancona and Venice with naval flying boats during the first days of the war. In addition on October 24, 1915, four Austro-Hungarian aircraft raided Venice. Though causing no loss of life or limb, the raiders destroyed an important fresco by the eighteenth-century artist Tiepolo in the church of Santa Maria degli Scalzi.⁵ The Italians, for their part, began using their Caproni trimotors to bomb Austrian aerodromes, roads, and railways in August 1915, but quickly found that a three-engined aeroplane was at least three times likelier to be grounded by mechanical problems than a single-engined aeroplane.⁶

Meanwhile, the Germans had developed a single-seater fighter, the Fokker Eindecker, armed with a machinegun—later two machineguns—equipped with interrupter gear to enable the pilot to fire through the arc of his propeller without hitting it. (Garros had frequently hit his own propeller, but had it fitted with steel plates to deflect the bullets, which as it turned out was not an entirely practical idea.) Flying the Fokker Eindecker, Germany's first fighter aces, Max Immel-

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Airplane designer Giovanni Caproni in the early 1930s.

ALTHOUGH THE AUSTRO-HUNGARIANS ONLY HAD SINGLE-ENGINED BOMBING AIRCRAFT, THEIR AIR RAIDS ON ITALIAN TARGETS WERE OFTEN MORE SPECTACULAR IN EFFECT THAN THE ITALIAN ATTACKS



mann and Oswald Boelcke, began to make their reputations on the Western Front during the second half of 1915, and a small number of these machines were passed on to the Austro-Hungarians. On February 18, 1916, ten Caproni trimotors with the commander of the aviation battalion, Lt. Col. Alfredo Barbieri, among the crew, set out from Aviano to bomb Ljubljana. Three of the planes turned back with engine failure; the others were intercepted by Austro-Hungarian Fokkers, one of them flown by Capt. Jindich Kostřba, afterwards creator of the Czech air force. In a series of attacks lasting fifteen minutes, Kostřba fired all 500 rounds of his ammunition at the Caproni carrying Barbieri. Barbieri was killed along with one of the pilots; the other pilot, inter-

mittently blinded by blood flowing from a scalp wound, succeeded in bringing his aeroplane and his dead companions back to an Italian airfield. Kostřba had time to refuel and intercept the surviving Capronis on their way back from Ljubljana and helped shoot down one of them over Austrian territory.⁷

The Italians did not get their own back until April 1916, when Francesco Baracca, aboard a French-built Nieuport, shot down an Austro-Hungarian Aviatik that had just bombed a railway line.⁸ This was the first successful interception by an Italian pilot. Thus, one sees that whereas in France and Flanders the first aircraft to be attacked and shot down by other aircraft had all been on reconnaissance or artillery spotting missions, on the Italian front the first interceptions by either side were of bombing planes. In fact, three of the first four aerial victories claimed by Francesco Baracca, subsequently Italy's leading fighter ace, were over bombers, whereas it is questionable whether Germany's Baron von Richthofen or France's Georges Guynemer or Britain's Albert Ball and James McCudden ever shot down a bomber at all.⁹

Although the Austro-Hungarians only had single-engined bombing aircraft, their air raids on Italian targets were often more spectacular in effect than the Italian attacks. On February 14, 1916, for example, ten aircraft—each armed with eighty kilograms of bombs—flew from a base near Trento to attack Milan. This was fifteen months before the first raid on a town in Britain by German heavier-than-air machines flying as a group, though of course the Germans had already attacked London with airships. Orientating themselves by means of Milan's "white shimmering" cathedral (as the Austro-Hungarian commander described it) two of the attacking aircraft unloaded their bombs in the general direction of a power sta-

The Morane.



GIULIO DOUHET HAD BEEN PROMOTED BUT HAD NOT CEASED TO PRESS HIS IDEAS REGARDING THE USE OF AIRCRAFT AS A STRATEGIC WEAPON

DOUHET'S SUPERIORS WERE MUCH LESS INTERESTED IN HIS MEMORANDA THAN IN THE FACT THAT HE WAS SENDING COPIES TO POLITICIANS IN ROME ... HE WAS COURT-MARTIALLED AND SENTENCED TO ONE YEAR'S CONFINEMENT IN A MILITARY FORTRESS



tion, killing twelve people and injuring seventy. The other eight aircraft apparently became lost and scattered their bombs between Monza and Bergamo.¹⁰ On July 13, ten Austro-Hungarian aircraft dropped about 100 small bombs on Padua and managed to kill the army major commanding the city's air defenses.¹¹

On August 9, 1916, seventeen Austro-Hungarian aircraft bombed Venice, killing seven civilians and sank a British submarine docked at the Arsenal—probably the first submarine ever to be sunk by bombing from the air. Seven weeks later Austro-Hungarian flying boats sank a French submarine, the *Foucault*, while it was actually under way at sea. This seems to have been the second submarine ever to have been sunk by bombing.¹²

On November 11, 1916, a single Austro-Hungarian bomb killed ninety-three civilians sheltering in a casemate in the old fortifications of Padua. It was the worst incident involving civilians taking shelter from an air raid during the entire course of the First World War, although there had been an even greater death toll the previous June when a French reprisal raid on Karlsruhe had destroyed a circus during a matinee, along with most of the children in the audience.¹³

Altogether, more than 400 Italian civilians were killed in Austro-Hungarian air raids on towns in northern Italy; another sixteen were killed by bombs dropped on Naples by a German long range Zeppelin operating from Yambol, Bulgaria, on the night of March 10, 1918.¹⁴ These figures may be compared with the 1,414 civilians killed by German air raids on England, the 746 killed by British and French air raids on industrial centers in western Germany, and the 104 Belgian citizens who died as a result of the Royal Flying Corps and later the Royal Air Force's efforts to knock out the German U-boat pens at Bruges.¹⁵

The number of civilians killed by Italian air raids is not known. Giulio Douhet had been promoted away from the aviation battalion to become chief of staff of an infantry division in February 1915, but had not ceased to press his ideas regard-

ing the use of aircraft as a strategic weapon. In a memo written a few months after Italy entered the war he argued:

*Modern armies represent the armored shield behind which the nations at war work to prepare the means appropriate to feed the war: the powerful aeroplane is able to pass over such armor and strike at the nation itself in its centers of production and along the lines of supply running from the country to the army.*¹⁶

He advocated that an entire air army of 500 Caproni trimotors be maintained at the front. Unfortunately Douhet's superiors were much less interested in his memoranda than in the fact that he was sending copies to politicians in Rome, and in October 1916 he was court-martialled and sentenced to one year's confinement in a military fortress. Whatever enthusiasm his successor, Alfredo Barbieri, may have felt for Douhet's ideas came to an abrupt end in combat over Aisovizza, when Jindrich Kostřba intercepted Barbieri's Caproni en route for Ljubljana and killed him. After that the Caproni was used mainly for shorter-range missions against road and railway targets immediately behind the front line, and against Austro-Hungarian naval bases on the Adriatic coast. Other important strategic targets that were theoretically within the Caproni's range, such as the railway and armaments factories at Zagreb and the steelworks at Graz, were left undisturbed. In fact, although the Caproni trimotor was built in larger numbers than the British Handley-Page 0/400 bomber or the German Gotha GIV and GV—in larger numbers indeed, than any other multi-engine type until the 1930s. By no means an entirely satisfactory combat plane, the Caproni was so slow and unwieldy that the Austro-Hungarian naval ace Godfrey Banfield took a leading part in shooting down at least five Capronis, while piloting flying boats of exactly the same unaerodynamic configuration as the Supermarine Walrus flying boats used by the RAF for air-sea rescue during the World War II.¹⁷ In the end, the longest-ranged bombing mission carried out by

Italian aviators during the First World War, a return flight of nearly 320 miles across the Alps to bomb the railway station and shoot up the marshalling yard at Innsbruck on February 28, 1918, employed four single-engined Ansaldo SVA 5s.¹⁸ The same type was also used for the ten-plane mission to drop propaganda leaflets on Vienna on August 9, 1918. The one record set by Caproni was for the largest single air raid, on the night of August 2, 1917, when thirty-six trimotors attacked Pola (now Pula in Croatia); but this record lasted only until the following May, when forty-three German bombers, some of them four-engined Zeppelin-Staakens, struck at London.¹⁹

It is possible, however, that one of the more than 800 Caproni trimotors built inadvertently achieved a historic first that subsequent events could only make more noteworthy. In June 1918, a Hungarian pilot, Frigyes Hefty, having shot down a Caproni over Il Montello, scratched the words *Caproni (auf Il Montello)*, and the date *17.vi 1918*, on the windscreen of his Albatros DIII. Subsequent victories were marked in the same way.²⁰ Hefty seems to have been the first fighter pilot of any nationality to have marked his "score" on his aeroplane. This custom, though universal during the Second World War—even the Japanese adopted it—is not recorded before 1918. n

NOTES

1. Italian airmen claimed 530 aerial victories compared to 7,425 claimed by the Germans, who admitted to the loss of 6,830 aircraft. Rosario Abate, *Storia della Aeronautica Italiana* (Milan, 1974), p. 115; Erich von Hoeppner, *Deutschlands Krieg in der Luft* (Leipzig, 1921), p. 174, notes 1 and 2.
2. Abate, *Storia della Aeronautica Italiana*, p. 84.
3. *La Gazzetta del Popolo*, Dec. 12, 1914, reprinted in Giulio Douhet, *Le Profizie di Cassandra: raccolta di scritti* (Genoa, 1931), p. 244.
4. See L. A. Strange, *Recollections of an Airman* (London, 1933), pp. 74-78 and Jacques Mortane, *Carré d'As* (Paris, 1934), pp. 8-11 for British and French attacks on German aircraft in Oct. and Nov. 1914; Jacques Quellennec ed. Roland Garros, *Mémoires* (Paris, 1966), 254 foll. for the development and use of a Morane carrying a machinegun firing through the arc of a propeller fitted with deflector plates.
5. Peter Schupita, *Die k.u.k. Seeflieger: Chronik und Dokumentation der österreichisch-ungarischen Marineflieger 1911-1918* (Coblenz, 1983), pp. 169-70 for raids by Austro-Hungarian naval flying boats; Andrea Moschetti, *I Danni ai Monumenti e alle opere d'arte delle venezie: nella guerra mondiale MCMXV-MCMXVIII* (Venice, 1932), p. 47 for the Oct. 24, 1915 raid. A complete list of Austro-Hungarian raids on Venice is given in Giovanni Scarabello, *Il Martirio di Venezia: durante la grande guerra e l'opera di difesa della marina Italiana*, 2 vols., (Venice, 1933), pp. 1, 59.
6. Luigi Contini, *L'Aviazione Italiana in Guerra* (Milan, 1934), p. 48.
7. *Ibid.*, p. 58 and Martin O'Connor, *Air Aces of the Austro-Hungarian Empire, 1914-1918* (Mesa, 1986), p. 110.
8. Vincenzo Manca, *L'idea meravigliosa di Francesco Baracca* (Roma, 1989), pp. 172-77.
9. Detailed lists of the aircraft shot down by leading fighter aces are now available in a series of books published by Grub Street London during the 1990s: Christopher Shores, Norman Franks and Russell Guest, *Above the Trenches*; Norman Franks, Frank W. Bailey and Russell Guest, *Above*

the Lines; Norman Franks, Russell Guest and Gregory Alegi, *Above the War Fronts*; and Norman Franks and Frank W. Bailey, *Over the Front*.

10. For a personal account of this raid see Eugen Steiner-Götl Edler von Auring, "Österreichisch-ungarische Fliegen beim Angriff" in Georg Paul Neumann ed. *In der Luft unbesiegt: Erlebnisse im Weltkrieg: erzählt von Luftkämpfern* (Munich, 1923), pp. 50-56; see also *Corriere della Sera*, Feb. 15, 1916, 1d; *Times*, Feb. 15, 1916, 8d and Feb. 23, 1916, 7d; and Riccardo Caviglioli, *L'Aviazione Austro-Ungarica sulla fronte Italiana 1915-1918* (Milan, 1934), p. 74.

11. Guido Solito, *Padova nella Guerra (1915-1918)* (Padua, 1933), pp. 199-201.

12. Public Record Office, Kew, London AIR 1/2282/204/73/2 Harold C. Swan to J. H. Towsey Aug. 10, 1916; Schupita, *k.u.k. Seeflieger*, p. 192.

13. Solito, *Padova*, pp. 228-9 and fn. 1, cf. *Heidelberger Tageblatt*, Jun. 24, 1916, 1c. The victims of the Karlsruhe tragedy were buried in a group of individually marked graves that are still to be seen in the town's principal cemetery.

14. *Corriere della Sera*, Mar. 12, 1918, 1a, c.f. Douglas H. Robinson, *The Zeppelin in Combat: A History of the German Naval Airship Division, 1912-1918*, p. 295

15. Walter Raleigh and H. A. Jones, *The War in the Air*, 7 vols., (Oxford, 1922-1934) V 153, VI 152, Public Record Office AIR 1/678/21/13/2137

16. Giulio Douhet, *Diario Critico di Guerra*, 2 vols., (Turin, 1921), II, pp. 20-21.

17. Abate, *Storia della Aeronautica Italiana*, p. 107; Jean Marie Gustave Pédoya, *La Commission de l'Armée pendant la grande guerre* (Paris, 1921), p. 164n.; A. R. Kingsford, *Night Raiders of the Air* (London, [1930]), p. 129.

18. Contini, *L'Aviazione Italiana*, pp. 151-52.

19. Abate, *Storia della Aeronautica Italiana*, p. 106, cf. Raymond H. Fredette, *The First Battle of Britain, 1917-1918: The Birth of the Royal Air Force* (London, 1966).

20. O'Connor, *Air Aces of the Austro-Hungarian Empire*, p. 180 reproduces part of Hefty's wind-screen.

Lightning Saved





John H. Cloe

(Overleaf) The P-38G, recovered from Attu Island in June 1999, was repainted in its original markings and rolled out of the paint barn on May 1, 2000. (USAF photo courtesy of TSgt Terry L. Blevins.)

LOCKHEED BUILT 9,925 P-38 LIGHTNINGS ... AND CONSOLIDA- TED VULTEE ANOTHER 113 ... TWENTY- TWO AIR- CRAFT REMAIN IN MUSEUMS OR PRIVATE OWNERSHIP

With over 70 years of maintenance experience between them, Don Delk (left), and Ed Lamm (right), accomplished the impossible. (USAF photo courtesy of TSgt Terry L. Blevins.)

Lockheed built 9,925 P-38 Lightnings at its Burbank, California, plant and Consolidated Vultee another 113 in Nashville, Tennessee, under license.¹ Today, approximately twenty-two aircraft remain in museums or private ownership. Only four are early model P-38s. The remainder are -38Js and Ls, many of those acquired as surplus from the War Assets Administration for \$1,500.00 apiece following World War II and used for aerial mapping. Very few of the surviving Lightnings flew in combat.²

Of these P-38s, only one G model exists. The fact that it survived can be credited to the foresight, tenacity, and vision of a few individuals. Otherwise, it would have remained on Attu Island in the western Aleutians, where it went down on New Year's Day 1945. Ted Spencer of Anchorage, Alaska, managed to have P-38G-10-LO, serial number 42-13400, listed on the National Register of Historic Places in 1979. It was the first of nine airplanes nation-wide to be included on the list. The list provided it federal protection, further reinforced by the fact that it was located in a National Wildlife Refuge and National Historic District.³

Capt. Steve Morrisette became interested in recovering the P-38 while he was assigned to Elmendorf AFB, Alaska, as a maintenance officer.

He approached Don Delk and Ed Lamm, two senior civilian aircraft maintenance superintendents with seventy years of experience between them. They visited the crash site in July 1991, and became convinced that they could restore the P-38.⁴ The approval process, however, took until early 1998, when Lt. Gen. David McCloud, who had just assumed command of the Alaskan Command, learned of it from his historian. His immediate response was "go get it."⁵

This set in motion a considerable amount of paperwork, including a memorandum of agreement between the United States Air Force, U.S. Fish and Wildlife Service, National Park Service, State Historic Preservation Officer, and the Advisory Council on Historic Preservation specifying the conditions for recovering and restoring the P-38. On May 27, 1998, the Advisory Council approved the relocation of the P-38 from Attu Island to Elmendorf AFB.⁶

Further steps involved requesting a special land use permit from the Fish and Wildlife Service, filing an environmental assessment, coordinating with an Alaska Native group, establishing a tax exempt non-profit foundation to pay restoration costs, and obtaining Air Force approval for the project. The Deputy Assistant Secretary of the Air



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Corrosion control personnel from the 3d Equipment Maintenance Squadron, under the leadership of SSgt Eric Bower, painted and marked the P-38G. (USAF photo courtesy of TSgt Terry L. Blevins.)

THE RECOVERY DEMONSTRATED THE COMMITMENT OF A COMBINED EFFORT BY FEDERAL, STATE, AND MILITARY AGENCIES TO THE GOAL OF RECOVERING A HISTORIC OBJECT

BRIG. GEN. SCOTT GRATION, COMMANDER, 3D WING, SET ASIDE AN UNDERUSED HANGAR

THE PROCESS INVOLVED THE EFFORTS OF ABOUT TWENTY-FOUR PART TIME VOLUNTEERS



Force for Environment, Safety, and Occupation Health, who also oversaw historic preservation, approved the project on June 2, 1999.⁷

The next day, the 210th Rescue Squadron, Alaska Air National Guard (ANG), launched two HH-60 Pave Hawk helicopters and an HC-130 from Kulis Air National Guard Base in support of the recovery operations. Don Delk and Ed Lamm led the effort, resulting in the retrieval of a one of a kind World War II fighter aircraft. Both had planned in detail how they would disassemble the P-38 in the field and prepare it for shipment from the U.S. Coast Guard LORAN station on Attu for shipment back to Elmendorf AFB. They focused on keeping to a minimum the number of personnel on the recovery team, limiting further damage to the Lightning, and making certain that archeological and historical documentation standards were observed.⁸

Their leadership resulted in a flawless recovery operation, hampered only by the harsh Aleutian weather. The recovery demonstrated the commitment of a combined effort by federal, state, and military agencies to the goal of recovering a historic object. The joint military-civilian effort was conducted under adverse conditions, with no personal injuries or loss of equipment, and at minimum expense. It also demonstrated the ability of the Alaska ANG to deploy its forces with minimal support, over long distances, and under adverse weather and environmental conditions.⁹

Following the recovery, Delk and Lamm, who had retired from Air Force civil service, immediately began restoration work. Thanks to the support of Brig. Gen. Scott Gration, Commander, 3d Wing, space had been set aside in an underused hangar. Don Delk credits General Gration as the

driving force behind the successful recovery and restoration. Some of those involved with the project felt that when General McCloud died on July 26, 1998, in the crash of his private aircraft, the P-38 project had died with him.

Fortunately, General Gration shared his predecessor's vision and sense of heritage and was willing to take a risk on a seemingly dubious project. He envisioned the recovery and restoration of the P-38G as a memorial to General McCloud, and planned to display it near the 3d Wing headquarters building.

Prior to the June 1999 recovery, Lamm and Delk completed the restoration of two P-38 outer wings and the horizontal stabilizer they had obtained from a dump on Amchitka Island, in the Aleutians, in 1993. The parts were needed in the restoration of the P-38G. Shortly after the crash, a salvage party had removed all usable parts from it including the outer wings, and the horizontal stabilizer had been badly damaged in the crash itself.¹⁰

The experience proved beneficial since it allowed time to gain knowledge and organize the restoration effort. They also arranged to acquire others missing parts with funds raised by the McCloud Foundation, the non-profit which had been formed to fund the restoration effort.¹¹

Following the recovery, the restoration team organized the various components and began work by taking them apart, checking and treating them for corrosion. The process involved the efforts of about twenty-four part time volunteers, who worked between several hours and several weeks on the project. A core of six full time volunteers, with more than 240 years of combined maintenance experience, performed the bulk of the work.

Earnest L. Mitchell, one of the six full time volunteers, bolts the right engine to its mount.



William J. Hudok, one of the volunteers, works on a prop spinner.



Three of the volunteers, William J. Hudock, Earnest L. Mitchell, and David Pratt, had worked in aircraft maintenance approximately forty years each before retiring. Don Delk estimated that it required approximately 12,000 hours to complete the project.¹²

The volunteers tackled the project by reassembling the components. Each volunteer was responsible for a specific component. Some of the work had to be sent elsewhere for completion, because the P-38 facility lacked the necessary equipment and expertise. The 3d Equipment Maintenance Squadron's metal technology shop restored the landing gear and completed more minor restoration projects. The squadron's corrosion control shop applied primer paint.¹³

By late January, the volunteers had bolted and riveted together the center wing section, the booms, and the tail section. On February 14, they bolted on the outer wings. After months of work on the components, the P-38 had taken shape. The engines were installed on February 24. By April 5, work had progressed to the point where the P-38 could be raised for the installation of the landing gear and propellers.¹⁴

The volunteers celebrated the completion of their work on April 15, with a party in Hangar Four where the restoration had taken place. Fittingly, the old wooden hangar, built in late 1940, the first hangar on Elmendorf AFB, was also the site of the P-38 restoration. The following Monday, the Lightning was towed to the corrosion control facility, better known as the paint barn, where it was painted and marked in a P-38G flown by the 54th Fighter Squadron.¹⁵

The newly painted P-38 was towed back to Hangar Four on May 1, where it was stored until

Ed Lamm (left), and Earnest L. Mitchell (right), direct the left engine installation on its mount.



completion of the McCloud Memorial ground work. The dedication of the memorial on July 26, with Mrs. Ann McCloud in attendance culminated

years of effort to save and preserve for future generations a piece of Alaska's military aviation heritage. n

The P-38G, freshly repainted, rolls down the apron past its more modern counterparts. (USAF photo courtesy of TSgt Terry L. Blevins.)



NOTES

1. Warren M. Bodie, *The Lockheed P-38 Lightning, the Definitive Story of Lockheed's P-38 Fighter*, Widewing Publishers, GA, 1991, p. 250
2. A. Kevin Grantham, *P-Screamers, The History of the Surviving Lockheed P-38 Lightnings*, Pictorial Histories Publishing Company, Inc., Mt, 1994; list updated by John H. Cloe from research of periodicals and Internet.
3. Notification, National Register of Historic Places, "Entries in the National Register State Alaska, Jul 26, 1979, with attached nomination form, Temnac P-38G Lightning (SN 13400); E mail Paul Lusignac, Historian, National Register of Historic Places to John H. Cloe, Historian, 3 WG, Elmendorf AFB, AK, "Aviation Resources," Apr 7, 2000.
4. Oral History Interview, John H. Cloe with Don Delk, 13 Apr 2000.
5. Point Paper, Office of History, Eleventh Air Force,

"Recovery of P-38G from Attu," 1 Feb 1998.

6. Memo, Advisory Council on Historic Preservation to Office of History, Eleventh Air Force, "Memorandum of Agreement for the Removal and Restoration of a P-38G-10-LO Lightning Fighter Aircraft (42-13400) from Attu Islands Unit, Alaska," 27 May 1998 with attached MOA.
7. Staff Summary Sheet, Director of AF Museum to SAF/MIQ, "Transfer of P-38," 14 May 1999, with four attachments.
8. Delk Interview, 13 Apr 2000.
9. *Ibid.*
10. *Ibid.*
11. *Ibid.*
12. *Ibid.*
13. *Ibid.*
14. *Ibid.*
15. *Ibid.*

Book Reviews

Irish Men and Women in the Second World War. By Richard Doherty. Dublin, Ireland: Four Courts Press, 1999. Photographs. Notes. Bibliography. Index. Pp. 319. \$35.00 ISBN 1-85182-441-3

The great alliance that defeated Germany in World War II did not include Ireland. Despite their country's official neutrality, many Irish fought for Britain. Doherty calculates that over 130,000 Irishmen served in Britain's armed forces, with many more Irish expatriates serving in the forces of other Commonwealth nations.

Irish Men and Women in the Second World War is the first of a planned two-volume set. The book is arranged in chapters collecting the heroic deeds of those in similar positions: infantrymen, seamen, airmen, chaplains, and doctors. The bulk of the book is taken up with anecdotes illustrating the courage of Irishmen serving in these fields. Those who were honored with the Victoria Cross (VC) always merit mention, but the volume also describes the bravery of many others.

Many Irishmen served with distinction in the Royal Air Force. Flying Officer Donald Garland was awarded the first VC of the war after the Irishman lost his life bombing a bridge that was facilitating Germany's 1940 advance into France. In another "he had to be Irish" anecdote, Doherty tells of Wing Commander Tony Lovell who felt obligated to go to confession every time he shot down an enemy plane. After Rome fell to the Allies in 1944, Lovell had an audience with Pope Pius XII, and then spent his leave at a retreat in a Dominican monastery. His piety apparently did not impede his effectiveness as a Spitfire pilot; Lovell shot down 21 enemy aircraft.

This volume belies its title in that it deals almost entirely with men. Women in the war were largely limited to roles that do not easily lend themselves to tales of valor. Still, Irish women served the Allies in traditional jobs like nursing and clerical positions. Despite the lack of combat action, the chapter devoted to the exploits of Irish women is compelling. Irish women rendered important clerical services for British code-breaking organizations, and Irish nurses bore their share of hardships. Irish women were war widows, of course, and Doherty touches on that suffering, as well.

The author cites numerous sources and carefully details when and why he departs from other published histories. He clearly loves his work and takes pride in getting the facts just right.

Irish Men and Women offers enough historical tidbits to keep general students of history engaged, and the story of the Irish always fascinates. The dauntless courage of

men fighting for a just cause in the face of hopeless circumstances cannot help but be stirring. This book is a must for military history students of Irish descent, and a solid read for anyone.

Gary D. Brown (B.Sc., Central Missouri State University; J.D., University of Nebraska; LL.M., Cambridge University) is a major in the United States Air Force. He is the staff judge advocate of the 422d Air Base Squadron, RAF Croughton, England.

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A Tour of the Arnhem Battlefields, 17-26 September 1944. By John Waddy. Barnsley, Yorkshire, UK: Leo Cooper, 1999. Maps. Photographs. Appendices. Glossary. Bibliography. Pp. 224. \$24.95 ISBN: 0-85052-571-3

This is a work that takes you on a tour through the Arnhem area of Operation Market Garden. It also includes historical analysis and exposition. Surprisingly, the book's high level of detail, in fact, obstructs its purpose, since it presents far too much information for one to read while actually touring the battlefields. What makes this book readable and somewhat enjoyable are the numerous first-hand accounts of the action, as remembered by the participants. Unfortunately, these personal accounts, except for those of a couple of Dutch civilians, are limited to Allied military personnel. The reader would have been much better served if the author had included accounts from German soldiers as well.

The book's organization and purely narrative approach makes it difficult to follow the flow of the operation in this area. Let me explain. The Arnhem battlefields are surrounded by approximately fifty tourist observation platforms. The author describes the operation by moving from observation platform to observation platform. However, by relying solely on a narrative format to explain the specific action at each place within the greater scheme of the battle, it is easy to become both disoriented and confused. The publisher could have easily corrected this deficiency by providing a map, of reasonable size, depicting the location of each of the observation platforms. Had this been done, the book's utility as a historical reference or short case study would have been greatly improved. As a result, the work has very little to offer the reader who was not there in person. The author's decision to concentrate on the British and Polish portion of the operation, leaving the American effort for another time and another work, was wise.

On balance, this book is not as effective as it could have been either as a guide or historical reference work. Works on airborne operations hold a special appeal for me—perhaps because both my uncle, who made a combat jump during the American portion of Market Garden, and I are paratroopers. Nonetheless, the shortcomings of the book overcame even my keen interest in the study of this aspect of military history.

Dr. Don MacCuish, Lt. Col., USAR (Ret.), Professor, Air Command and Staff College, Maxwell AFB, Alabama.

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Air Force Roles and Missions: A History. By Warren A. Trest. Washington, D.C.: Air Force History and Museums Program, 1998.

Do roles and missions matter, now that "jointness" has become the norm throughout the services? Warren A. Trest, a veteran of thirty years in the Air Force history program, thinks they do and in this modest, yet carefully researched and lucidly written monograph, he makes a convincing case that the services—the Air Force in particular—need to continue paying close attention. Simply put, roles and missions, or "functions" as they are sometimes called, can make or break a service. Budget shares rise and fall on functional assignments, so it is hardly surprising that over the years some of the most bitter and intense interservice quarrels have revolved around roles and missions assignments. As long as there are separate services, each with its own ethos and interests to protect, there will be competition over roles and missions.

While Trest's account covers familiar ground, it is a story worth retelling and his book brings it all together better than any I know. The treatment of the interwar period is especially illuminating, not only in exploring the origins of the post-World War II roles and missions battles between the Air Force and the Navy, but also in explaining the Air Force's unique institutional development, which made those conflicts all the more unavoidable. As Trest demonstrates, the rise of bombardment aviation and the strategic air role effectively recast Air Force doctrine, pulled it further and further from its Army roots, and reinforced the need for treating air power as a separate service. World War II confirmed these trends, so that by 1945 an air component built around strategic bombardment was a well established coequal part of the defense establishment.

The differences that surfaced between the Air Force and the Navy after World War

It might still have been manageable had it not been for one thing—the atomic bomb. Without the bomb, although the Air Force would undoubtedly have achieved the independent status it had long sought, its institutional position might well have remained that of an Army step-child. With the bomb, Trest shows, it had an inherent advantage over its immediate competitor, the Navy, for staking out a claim as the country's new first line of defense. The tight budget policies practiced by President Harry S. Truman in the late 1940s and emerging tensions with the Soviet Union added weight to the Air Force's argument that it should carry the major burden of national defense. That the Navy refused to give up without a fight is understandable, but it proved rather futile in the face of limited resources, strong public and congressional support for strategic air power, and the mesmerizing image of the atomic bomb, still an Air Force monopoly, as the ultimate weapon.

The roles and missions battles that followed those in the wake of World War II were less celebrated but still exceedingly divisive. Although the infusion of funds brought on by the Korean War helped reduce interservice competition, problems nonetheless arose between the Air Force and the Army over the allocation of responsibilities

for tactical aviation. Later in the 1950s, it was the missile controversy that caused much of the trouble. President Dwight D. Eisenhower expected the 1958 defense reorganization to lessen the grounds for interservice rivalry by creating a more closely unified defense establishment, with a more effective joint command. But as strategic missiles replaced long-range bombers and as conventional forces came back into fashion in the 1960s, the Air Force found itself taking a renewed interest in tactical aviation, which in turn led to a resumption of Air Force-Army feuds over the status of air mobility and assault forces. Trest suggests that as a result in Vietnam the United States wound up fighting a ground war for which it was largely unprepared, while squandering its most important and effective military asset—air power. Add friction over roles and missions to the long list of what went wrong in Southeast Asia.

After Vietnam, as Trest points out, the services seemed to find less to bicker about, even though pressure from Congress grew steadily for a more definitive clarification of service functions. Some of the most controversial issues were those between the Air Force and the Marine Corps over close air support, but compared with the roles and missions struggles of the late 1940s, this

was “pretty small beer.” Interservice agreements, including a comprehensive accord in 1982 between the Air Force and the Navy on joint maritime operations and the 1984 “thirty-one initiatives” between the Air Force and the Army, seemed to signal a maturity and readiness on the part of the services to resolve roles and missions problems on their own. Congress, however, wanted reassurance and in enacting the Goldwater-Nichols legislation in 1986 it required the Chairman, Joint Chiefs of Staff (JCS) to submit an in-depth report on roles and missions every three years.

Whether such requirements will be of much use in sorting out future functional assignments remains to be seen. Clearly, as Operation Desert Storm demonstrated in 1991, there is still room for closer coordination of air assets. The end of the Cold War brought predictable organizational changes and a scramble among the services to position themselves against impending budget cuts. But despite some initial skirmishing, the expected roles and missions battles have failed to materialize, largely because there has yet to occur any fundamental reallocation of resources such as that that followed World War II. This situation may change if peacekeeping, drug-interdiction, and similar missions continue to displace

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warfighting functions. However, for the time being the guidelines laid down over the past fifty years seem to be holding.

Trest deserves a lot of credit for taking on a difficult subject and treating it with a high degree of objectivity. Surprisingly, in a work of this complexity, the textual flaws were remarkably few, though I suspect that Admiral William A. Owens, who served as Vice Chairman of the JCS from 1994 to 1996, will be surprised to find himself elevated to the rank of Chairman. Still, I find the book basically sound and reliable. Were this study done from the Navy perspective, it would doubtless present a different picture and draw different conclusions. But I seriously doubt whether the treatment would be any more even-handed. The Air Force history program should be commended for publishing this book. Let us hope that we see more such monographs in the future.

Steven L. Rearden, Washington, D.C.

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The Quest: Haywood Hansell and American Strategic Bombing in World War II. By Charles Griffith. Maxwell AFB, Ala.: Air University Press, 1999. Pp. 238. \$16.00 ISBN: 1-58566-069-8

Charles Griffith's biography of Haywood Hansell helps fill a gap in the existing literature on U.S. strategic bombing in World War II. General Hansell participated in most of the major United States Army Air Forces (USAAF) planning efforts for both Europe as well as Asia, commanding both B-17s against Germany and B-29s over Japan. As a prewar instructor at the Air Corps Tactical School, and one of the architects of interwar Air Corps doctrine, Hansell entered the conflict with very specific ideas about the role of air power in warfare and an uncommonly strong commitment to Air Corps doctrine. All these features make his career an interesting window on the World War II AAF.

General Hansell lived for forty-three years after the end of the war and continued to take an enormous interest in air power, lecturing often and providing encouragement to students of air power history. He was also "a gentleman" and an intellectual who made a positive impression on the enormous number of people he met. It is, therefore, not surprising that historians have treated him kindly. He did his best to influence their writing by publishing three different memoirs about World War II. Unfortunately, Griffith follows Hansell's line too closely and echoes the general's own assessment of his career.

Griffith's thesis is that General Hansell "sacrificed his career over the concept of daylight precision bombing, resulting in his being replaced as commander of the XXI Bomber Command in January 1945, but the

book shows that this was in fact not the case. The evidence Griffith provides demonstrates, instead, that Hansell was widely regarded as, at best, a mediocre commander. In Europe, when Lt. Gen. Ira Eaker had to choose a new commander for the VIII Bomber Command, he passed over Hansell (one of Eaker's wing commanders) because he felt Hansell was not up to the task. When Gen. "Hap" Arnold considered giving Hansell the XXI Bomber Command in the Marianas, Hansell's closest friends on the Air Staff begged Arnold not to do it because they felt he was not the man for the job. After taking command of the XXI Bomber Command, Hansell impressed no one, and his subordinates, superiors, and even Congressmen, tried to get Arnold to fire him. And yet, in the face of all this pressure, Arnold did not replace Hansell.

However, when the time came to consolidate B-29 operations in Asia, Arnold handed over command to Maj. Gen. Curtis E. LeMay, the commander of XX Bomber Command. Arnold essentially merged two small forces into one large force and put the senior more experienced of the two previous independent commanders in charge, with the junior brigadier general as deputy. Hansell quit in a huff and declined to serve under a man who outranked him and was universally recognized as a terrific commander.

It may have made Hansell feel better to think his commitment to precision bombing was important in his losing command, and it may help Griffith create an atmosphere of moral drama around a particularly important moment in Hansell's life, but the facts simply do not support this view. However, the choice between area and precision bombing played no important role in either the decision to consolidate B-29 operations or putting LeMay in command. In fact, the choice between LeMay and Hansell was in no way a choice between area and precision bombing because both men did both types of bombing.

The real problem with Griffith's work is not that its thesis is unproven. Many valuable books reach erroneous conclusions. The problem is more his selective use of sources. He ignores material most damaging to his case. Yet, he does leave in more than enough contradictory evidence to refute himself and the critical reader will not be taken in. Moreover, Griffith ignores some of the most interesting questions. For example, believing that Hansell was fired drives Griffith toward questions about why and thus to other people's perceptions of Hansell. Recognizing that Hansell quit would have focussed attention on the general's own character and motives for quitting which Griffith ignores. Griffith also accepts at face value Hansell's self-serving rationalizations for why he chose not to serve under LeMay, and goes no further. Most interestingly, when Hansell quit in January 1945, the largest air war in the history of the world

was raging over several continents. Hansell had his pick of assignments anywhere in the world but he chose to quit, requesting a training unit in the southwestern U.S. at a time when training was being curtailed in anticipation of the end of the war. Griffith fails to explain why Hansell picked this assignment.

Griffith's thesis leads him astray in other ways as well. He is anxious to believe that the AAF did not do any area bombing in Europe, but that is simply not true. The official histories of the USAAF in World War II by Wesley Craven and James Cate acknowledge extensive area bombing in that theater. More importantly, the subsequent work of historians like Richard G. Davis and Hayes Parks have put this issue to rest by demonstrating the heavy and sustained nature of USAAF area bombing of Germany. Again, Griffith sheds no light on Hansell's understanding of this important issue.

In spite of its weaknesses, *The Quest* is well researched and the only biography we have of Haywood Hansell. It is a useful addition to the three memoirs Hansell wrote himself. Like Hansell's own work, it portrays Hansell's performance as a commander in a favorable light, but both Hansell and Griffith include enough information to allow the reader to draw conclusions different from the authors'.

Tom Searle, Airpower Research Institute, Maxwell AFB, Alabama.

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Crimson Sky: The Air Battle for Korea. By John Bruning, Jr. Dulles, Va.: Brassey's, 1999. Map. Photographs. Bibliography. Glossary. Index. Pp. 231. \$24.95 ISBN 1-57488-158-2

Crimson Sky is the latest book to hit the street in anticipation of the fiftieth anniversary of the Korean War. It is a very readable, anecdotal account of the air war in Korea and covers a wide range of subjects—U.S. Air Force and Navy, propeller and jet, fighters and bombers. Its treatment of notable missions, such as the Namsi airfield, Hwachon dam, and actions such as Tom Hudner's, that earned him the Medal of Honor, and the loss of the top American ace (at that time), George Davis, are well done. Especially interesting was the coverage of the B-26 intruders, night fighting, and the Po-2 night heckler flights. Bruning also does a good job in fleshing out the details of what happened to a number of American pilots who were shot down.

This book is intended for the general reader and enthusiast, not the student or scholar. That is, the author stresses readability above all else. There are dubious quotations, and the text implies much wider and deeper sources than indicated by either

the sparse footnotes or limited (twenty-four-item) bibliography. For example, Bruning apparently makes use of Russian materials, but provides no precise indication of their sources, in either footnote or bibliography. Certainly, this is not an analytical study and there is also a clear lack of balance. Some aspects are covered in too much detail. For example, the Namsi raid gets thirty-seven pages of coverage. There is probably too much context—the author covers the ground war too extensively. On the other hand, other aspects, such as the use of helicopters and Marine aviation, are barely mentioned.

Crimson Sky is notable for its broad coverage and easy prose. It will appeal to those who desire a readable overview of the air war and the view from the cockpit. It does deliver some new material, thanks to the use of interviews. More serious readers, however, should look elsewhere for an analytical, detailed, documented study of the air war in Korea.

Kenneth P. Werrell, Airpower Research Institute, Air University, Maxwell AFB, Alabama.

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Restoring Museum Aircraft. By Robert Mikesh. Shrewsbury, England: Airlife Publishing, 1997. Illustrations. Notes. Appendices. Bibliography. Glossary. Index. Pp. 218. £39.95 ISBN: 1-85310-875-8

This beautiful volume is a treasure house of information for anyone restoring an old aircraft, for modelers, or for those who are just interested in what it takes to preserve the nation's aeronautical heritage for future generations. As former Senior Aeronautical Curator of the National Air and Space Museum (NASM), the author has many years of first-hand knowledge of the philosophy and procedures that should be followed if the technology, materials, craftsmanship, and historical attributes of these often rare and significant artifacts are to be saved. Note, however, that this book covers static museum aircraft, not ones which will again take to the air (there is a vast difference in the two approaches).

Mr. Mikesh opens with two chapters on the philosophical underpinnings of the restoration business: how does the aircraft fit in with the museum's mission, how far do you go with the work, curatorial guidelines, price versus value, and other related topics. The next chapter deals with what to do

before and during the teardown. Unquestionably, documentation is the key to the entire process, whether through photographs, log books, or marking restored parts. Much of the historical essence of an artifact can be saved through proper documentation.

The remaining chapters deal with the processes involved. Mr. Mikesh includes chapters on wood-and-fabric aircraft, metal aircraft, engines, tires, and colors and markings. Through all of these, he uses as examples a superb array of aircraft that have been restored at the Paul E. Garber Facility of NASM as well as other museums around the world. The reader will find a great deal of information on the World War I Albatross D.Va; 1912's Benoist Type XII (one of the first tractor propulsion designs in the U.S.) World War II's Arado Ar 234, Focke-Wulf Fw 190F, North American P-51C Mustang; Kawanishi "George," and Nakajima "Irving"; Roscoe Turner's Boeing 247D; and many other aircraft now on display.

Despite the amount of coverage given to some of the aircraft and the procedures used, this book is not a complete "how-to" do a restoration manual—that would take volumes of historical documents, FAA regulations and guides, manufacturer's product

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specifications, chemical handbooks, and other materials. However, what it does provide is an overview of the skills, products, and tools required, and a no-nonsense approach that must be taken to do these restorations right.

The book is printed on high-quality gloss paper. Its nearly 325 photos (most in color) and many diagrams and drawings are reproduced with exceptional clarity and detail. The casual reader could learn a substantial amount about restoration just reading the photo captions alone. In fact, for modelers, the photo collection itself is worth the price of the book. But read it in detail. The stories behind these efforts are fascinating. Mikesh has done the preservation of aeronautical history a great service through this book.

*Col. Scott A. Willey, USAF (Ret), Docent,
NASM's Garber Facility*

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A Cold War Legacy: A Tribute to Strategic Air Command, 1946-1992. By Alwyn T. Lloyd. Missoula, Mont.: Pictorial

Histories Publishing Company, Inc., 1999. Tables. Illustrations. Photographs. Maps. Appendices. Bibliography. Index. Pp. 714. \$55.00 ISBN: 1-57510-052-5.

When I received this book for review, I was impressed with its large format and length (714 pages), and its heft (some five pounds). This is definitely not a book to read holding on your lap. I was also impressed with the selection of photos, including a nice color section at the front of the book, and the quality of the paper used. A large number of appendices listing the SAC commanders, aircraft and missiles, bases, various competitions, and so on, round out this massive volume.

Unfortunately, the initial favorable impression quickly turned to frustration and disappointment because the book is so poorly organized—it gives the appearance of being a “cut and paste” job. Items have been taken from various sources and dropped into the text seemingly at random. Moreover, these items have not been edited for content, grammar, or tense. In fact, very little, if any, editing has been done. Typos abound; sentences run together or make little sense because they have been truncated; stories begin only to be abruptly halted

without any resolution to the stories; aircraft no longer in service, such as the B-50, the B-47, and the B-58 are described as if they are still operational.

Although covering all aspects of SAC, from aircraft and units assigned, to exercises, to combat operations, to more esoteric subjects, like the RBS trains, the overall effect is of jumble and disorganization. Wings and groups and squadrons come and go, described at length but breaking up any narrative flow. The author also recounts numerous accidents throughout the book. While some are described in detail, most are not. Nor does the author offer a rationale for choosing the ones he did. SAC had far more accidents than are found here, including some of far more interest. The lack of editing is also evident in many of these descriptions. For example, a B-58 accident is related (page 475) in which a crew member dies while ejecting. Two paragraphs later, the same accident is retold. This time all of the crew escapes! Which account is correct?

There are other errors or evidence that the manuscript was not closely edited before publication. For example, in the SAC commanders appendix (page 671), Gen. Larry D. Welch somehow retires in 1986, instead of going on to become the Air Force chief of

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staff. Finally, far too much minutiae is included in the book. The times of day, having nothing to do with an accident or an exercise, are routinely mentioned as xxxx Hours. Two films concerning SAC, "Bombers B-52" and "A Gathering of Eagles," are mentioned prominently, including their running times. The latter even receives a critical review by the author. Included is a long description of a symposium held at Offutt AFB and an even longer piece on SAC's relations with civic leaders, neither event merits the space devoted to it. Sadly, despite the size of this book, it is not the tribute that SAC's memory deserves.

William T. Y'Blood, *Air Force History Support Office*

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Innovation and the Development of Flight. Ed. by Roger D. Lanius. College Station: Texas A & M University, 1999. Photographs. Illustrations. Index. Pp. 400. \$44.95 ISBN 0-89096-876-4

Innovation and the Development of Flight is a collection of twelve essays on various aspects of aviation history. Written by several well-known aviation historians, including Tom Crouch, Robin Higham, William Leary, and Stephen McFarland, and clearly some other very capable scholars, each selection provides a detailed look at a narrow and neglected element of aviation history. These subjects are quite diverse, covering both civilian and military, airliners and aerospace planes, engines and fuel, avionics and airfields. With one exception, they are all extensively documented.

Due to the broad range of the topics, even more than is usually found in most collected works, the appeal of these essays will largely depend on the reader's interests and background. Regardless, the book's two strongest points are its high order of scholarship and the novelty of its subjects—most of these topics have been neglected. This collection also has a lofty goal. The editor, NASA historian Roger Lanius, writes that *Innovation and the Development of Flight* attempts to present a "new" type of aviation history, one that is not dominated by the aircraft, but that relates "the subject to the larger issues of society, politics, and culture...." In his words: "This 'New Aviation History' moves beyond a fetish for the artifact to emphasize the broader role of the airplane and, more importantly, the whole technological system...."

While this objective is a welcome initiative, its execution is flawed. As a group these essays lack focus. Although the individual pieces are in general interesting and in some cases stimulating, there is no overall cohesion. Second, despite the editor's assertion that these pieces are on twelve

major topics, certainly there are a number of equally and more important topics that are not included in this collection. It appears the editor gave the contributors no more direction than to write scholarly studies on aviation subjects that either have not been covered or to approach them in a different manner. And that is what he got. Third, all but two of the twelve essays are on topics that occurred in the thirty-year period following the end of World War I. Admittedly this is an interesting and important era, yet it covers only three of aviation's almost ten decades of powered flight. Finally, only two essays are on strictly non-American topics. On its face, such a narrow chronological and geographic view is suspect. The result is a diverse collection of detailed explorations of heretofore little known aspects of aviation history. While most are well done, many could have been shorter; some are quite technical, several are very narrow, and a few certainly could have been written more clearly. At least one was previously published.

This valiant effort to break the domination of aircraft studies in the field of aviation history reveals more the pitfalls than the promise of this approach. Some in fact may contend that what this collection requires is some unifying theme, and suggest that the "artifact" itself—the aircraft—could effectively provide that. Another possible organizing tool would have been a shorter chronological period. Clearly there is a lot more to aviation than the aircraft, but it should not be forgotten that these other aspects are only useful in their contribution toward making aviation more effective. That being said, hopefully these essays will provide the raw material that will allow others to synthesize and write such an effort. In short, for all its flaws, *Innovation and the Development of Flight* is a worthy initial step to exploit the power and potential of the "new aviation history."

Kenneth P. Werrell, *Airpower Research Institute, Air University, Maxwell AFB, Alabama.*

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Over Lord: General Pete Quesada and the Triumph of Tactical Air Power in World War II. By Thomas Alexander Hughes. New York: The Free Press, 1995. Maps. Photographs. Notes. Bibliography. Index. Pp. ix, 380. \$28.00. ISBN: 0-02-915351-4

Dr. Hughes has done air power history a great service in providing an overdue and detailed look into one of the lesser studied areas of World War II, tactical air power. His exhaustive research into primarily original material produced an excellent portrayal of one of the architects of air power, General

Elwood R. Quesada—a truly interesting air pioneer. Hughes avoids long digressions into the general's upbringing and personal life to concentrate on his professional development and wartime role. Unfortunately, the effort suffers from several flaws.

Sloppy writing and an apparent lack of technical knowledge are evident throughout: "To facilitate [D-Day] identification, ground crews painted white stripes on P-38, P-47, and P-51 fighters." Actually, they were white and black stripes and were on all Allied aircraft except heavy bombers. "Radar operators, their eyes glued to a bank of oscilloscopes..." Unless they were testing their equipment, they were not looking at oscilloscopes. "...the fuselage was merely a canvas tarp tacked tautly to a wooden frame." Canvas was never used on aircraft, and fabric was not tacked. "*Sopwith SE-5*"; P-47s firing 50mm ammunition; "mastering the Army's first all-steel monoplanes;" a Curtiss Condor complete with...*pressurized* fuselage"; "Operation QUEEN in November 1994;" "poor aerial-combat characteristics of the P-47s" (try explaining this to members of the 4th and 56th Fighter Groups); "When he arrived in France in October 1943..." and many more. A random typo *may* be forgivable, but such plentiful and basic errors as these throw into question the accuracy of other material despite the interminable use of footnotes at the end of nearly every paragraph.

The second shortcoming is the author's forays into analysis. In his preface he says he attempts to recover the lost memory of "Quesada's tactical innovations" and add insight to modern-day debates on air policy in the Department of Defense. He accomplishes the former by reporting expertly from his vast research. But, in the latter, he falls short. First, IX TAC was not the only command working tactical air, nor was Europe the only theater in which these problems had to be addressed. Second, Dr. Hughes himself seems confused over the differences between tactical air power, close air support, and interdiction, often using the terms interchangeably. And, while he pontificates on the Army Air Forces's leanings toward strategic missions at the expense of the ground troops, he shows a lack of fundamental understanding of the roles of air superiority and strategic bombing in keeping enemy air power off the backs of army forward and support forces and in reducing availability of enemy military power in general.

For a great—and balanced—biography of General Quesada and history of IX Tactical Air Command, this is the book to read; but, for insight into the development of the Air Force and tactical air power, other sources will serve the reader better.

Col. Scott A. Willey, *USAF (Ret) Docent, NASM's Garber Facility.*

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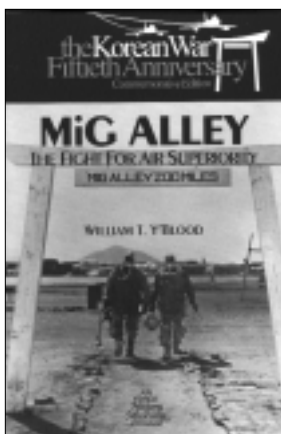
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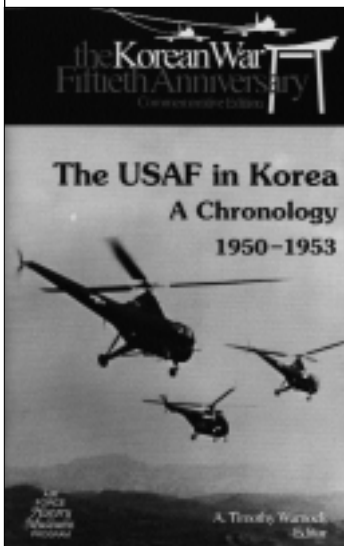
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