AIR POWER IN TRANSITION: THE KOREAN WAR 1950-1953

THESIS

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DEDICATION

THIS WORK IS DEDICATED TO THE MEMORY OF MY FATHER,
RAYMOND KARL HORKY
1932-1998
I just wish he could have seen me finally finish this

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GLOSSARY OF TERMS USED IN THIS WORK

FAC—FORWARD AIR CONTROLLER

FEAF--FAR EAST AIR FORCE

FOD—FOREIGN OBJECT DAMAGE

JBD—JET BLAST DEFLECTOR

JCS—JOINT CHIEFS OF STAFF

NKAF—NORTH KOREAN AIR FORCE

NSC—NATIONAL SECURITY COUNCIL

RATO—ROCKET ASSISTED TAKE OFF

SAC—STRATEGIC AIR COMMAND

UN—UNITED NATIONS

UNO—UNITED NATIONS ORGANIZATION

USAF—UNITED STATES AIR FORCE

USMC—UNITED STATES MARINE CORPS

USN—UNITED STATES NAVY

USS—UNITED STATES SHIP

USSR—UNION OF SOVIET SOCIALIST REPUBLICS

WOD—WIND OVER DECK

NOTES

The abbreviation "MiG," in reference to Soviet aircraft, is an abbreviation of the name of the designers, the Mikoyan i Gurevich ("Mikoyan and Gurevich") bureau. In Russian the "i" is not capitalized. In English documents, however, the terms "MiG," "MIG," and "Mig" are often interchanged. Direct quotations in this work retain the capitalization of the original text. Otherwise, the term "MiG" is used.

Other Soviet (Russian) aircraft designations referred to in this work are "La" (for Lavochkin), "Po" (for Polikarpov), "Tu" for (Tupolev), and "Yak" (for Yakovlev). All are shortened forms of the designers' names.

At the time of the Korean War the United States Air Force and United States Navy used two different systems of aircraft designations. The Air Force, which until 1947 had been part of the United States Army, retained the Army's designation system, which used a letter-and-number format to identify aircraft. The letter represented the aircraft's role ("B" for bomber, "C" for transport, "P" for pursuit, "T" for trainer, &c); numbers were assigned to aircraft in each role in sequence (the B-29, for example, was the twenty-ninth bomber project to enter development for the Army, while the F-86 was the eighty-sixth airplane in the pursuit and fighter sequence). Gaps in the sequence reflect numbers that were assigned to projects that never reached production. The P-36 and P-38 both entered service with the Army but the P-37 did not. Each numerical sequence was independent of the others, so numbers could be and were duplicated. There was, for example, a C-47 transport, a P-47 fighter, and a B-47 bomber.

When a design was modified, the new model would be identified with a letter appended to the basic designation, not by a new number. These letters were assigned in alphabetical order. Some variants did not reach production status so gaps in the sequence can occur. For example, the B-24D, B-24J, and B-24L were built in large numbers and are well known. The B-24C, B-24F, and B-24H were not.

Prefix letters were appended to an aircraft's designation to signify a change in role, mission, or status. The prototype of a particular airplane was assigned the modifier "Y," so the pre-production examples of the Boeing Superfortress were given the designation YB-29; early-series Republic Thunderjets were designated YP-84. An airplane converted into a reconnaissance platform received the prefix "R." Both bombers and fighters could be modified to carry cameras, examples being the RF-80, RF-86, and RB-45. The letter "S" identified a search-and-rescue version of an airplane. Most were modified bombers, such as the SB-29 and the SB-17.

The Navy's system was slightly more complicated than the Air Force's but it conveyed more information about the aircraft concerned. Naval aircraft designations used a letter(s)-letter or letter(s)-number-letter format. The first letter or letters identified the aircraft's role ("F" for fighter, "SB" for scout bomber, "TB" for torpedo bomber, "R" for transport, "N" for trainer, &c). The number, if used, indicated how many aircraft a particular manufacturer had produced for the Navy for that specific role (see below for example). The second letter represented the manufacturer. The Navy endeavored to assign letters that matched the company's initials but could not always do so, so while "D" indicated a Douglas product and "G" indicated a Goodyear-built machine, the letter "F" was assigned to Grumman, "U" to Vought, and "V" to Lockheed.

For example, the first naval fighter produced by the Grumman company was designated FF. Grumman's second fighter design was the F2F; its third fighter was designated F3F. The F4F was the famous Grumman Wildcat fighter of World War Two. Grumman's first airborne early warning aircraft, the Tracer, was designated WF. The WF was succeeded by the W2F Hawkeye.

It is easy to be confused by these designations, as duplications of the various components of the designations are common. There was not only an F4F, but an F4D (the Douglas Skyray), an F4H (the McDonnell Phantom), and an F4U (the Vought Corsair). Douglas produced an attack airplane designated A3D (the Skywarrior), a fighter designated F3D (the Skyknight), and a transport designated R3D (a variant of the unsuccessful DC-5 airliner).

If more than one manufacturer was involved in the production of a particular type of naval aircraft, the aircraft would receive multiple designations. The Avenger, a torpedo bomber that served in both World War Two and the Korean War, was a Grumman design but the company did not have the production capacity to fulfill all of its aircraft orders. Most Avengers were built by General Motors (designation "M"). Grumman-built Avengers received the designation TBF but the same aircraft was identified as the TBM if it came from the General Motors plant.

Naval aircraft variants were identified by a number appended to the basic designation. The first model of the Grumman Panther series was the F9F-1. It was followed by the F9F-2, F9F-3, F9F-4, &c.

Aircraft that were used by both the Army and the Navy, or the Air Force and the Navy, received two designations. These multiple designations can be confusing, as some aircraft are much better known by one designation than another. For example, the Boeing Flying Fortress heavy bomber is renowned as the B-17; its naval variant, the PB, is almost unknown. The Navy's Douglas SBD Dauntless dive bomber was the same airplane as the Army's A-24 Banshee but few people have ever heard of the latter. However, the North American Texan trainer is equally famous as the T-6 in the Army and Air Force and as the SNJ in the Navy.

In 1962 the Department of Defense created a unified aircraft identification system for use by both the Air Force and Navy. The new system used a letter-number format like the old Army/Air Force system. The numerical sequence of each sequence began anew, which is why the North American B-70 Valkyrie bomber entered service before the Rockwell B-1 Lancer and why the C-5 Galaxy succeeded the C-130 Hercules on the production lines at Lockheed. It is said that the new system was developed at the request of Robert S. McNamara, Secretary of Defense at the time, who reportedly was very confused by the differences between the Air Force's and Navy's designation systems.

Because the new system was based on the Air Force's old system, most Air Force aircraft did not change designations. The exceptions were those aircraft that were originally designed for the Navy. The F-110 Spectre was the USAF version of the USN's F4H Phantom. The type was redesignated McDonnell (later McDonnell-Douglas) F-4 Phantom, the identification by which it is best known today.

Naval aircraft generally received new identities similar to their old designations. For example, the F8U Crusader, a Vought design, became known as the F-8 and the Douglas A4D Skyhawk was redesignated A-4. However, it was not always possible to match letters and numbers. As F-4 had been assigned to the Phantom, the Douglas F4D Skyray received F-6 as its new identity.

A handful of Korean War-era aircraft were affected by the transition. The Lockheed P2V Neptune patrol bomber became the P-2 and the Douglas AD Skyraider attack aircraft was redesignated A-1. The Grumman F9F Panther/Cougar series of fighters became the F-9, while the Douglas F3D Skyknight night fighter became known as the F-10. The Douglas R5D Skymaster and Fairchild R4Q Flying Boxcar, both transports, would after 1962 be referred to exclusively by their Air Force designations, becoming the C-54 and C-119, respectively. The Lockheed TV trainer was changed to the T-1. Most references to these aircraft in this work use their pre-1962 designations. However, direct quotations referring to a particular type of airplane will retain the specific wording of the original source.

In a related note, the United States Air Force modified its aircraft designation system slightly in 1948. The most significant part of this change was the replacement of the "P-for-Pursuit" sequence with "F-for-Fighter" designations. As a result, some American fighter aircraft had different designations at various times in their service careers. For example, the Lockheed P-80 Shooting Star, the first American jet fighter, became the F-80, and the North American P-82 Twin Mustang became the F-82. The North American P-51 Mustang, the best-known American fighter of World War two, was also affected, becoming the F-51. The type was referred to by the new designation until it was retired from service. However, modern writers usually refer to it as the P-51 because it is best known for its World War Two service. The term F-51 is generally seen only in works about the Mustang in the post-World War Two era. The North American F-86 Sabre and Republic F-84 Thunderjet were originally identified as the P-86 and P-84, respectively, but these designations are not often used, as the aircraft did not enter service until after 1948. In this work, the preferred terms for these types will be P-51, F-80, F-84, and F-86. However, direct quotations referring to these machines will retain the language of the original text.

The USAF eliminated the "A-for-attack" designation at the same time it changed its fighter nomenclature. Single-engined attack aircraft were reassigned to the fighter sequence (the Douglas A-24 became the F-24, for example) while multi-engined machines were inserted into the "B-for-bomber" series. The twin-engined Douglas A-26 Invader thus became known as the B-26. However, the designation B-26 had previously been assigned to the Martin Marauder. The duplicated designations have been a source of confusion for historians and aviation enthusiasts ever since. The Marauder was the original B-26 and served only during World War Two. The Invader was the A-26 during World War Two and B-26 in Vietnam and Korea.

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CHAPTER I

INTRODUCTION

An anniversary is an opportunity to examine the past and to reflect upon how the event being commemorated has affected the present. It is also a chance to review the amount of progress made since the event in question. Of course, some anniversaries are accorded more significance than others. For example, the year 2003 will be the centenary of the Wright brothers' first successful airplane flight. No doubt the occasion will be observed with suitable ceremony. The history of the past one hundred years has been profoundly affected by the invention of the airplane. However, the year 2003 will also be the fiftieth anniversary of the armistice that ended the Korean War. This event will probably pass unremarked, save by a few. The beginning of the "air age" has had a far greater impact on the course of world events than did the end of the "forgotten war." Yet the two events are related. Much of the history of the airplane has involved its employment as a weapon. The great conflicts of the twentieth century have been some of the most destructive in human history, in part because the airplane was invented.

The Korean War is of particular interest to aviation historians because it took place at the midpoint of the air age. By examining the conduct of the Korean air war, and by comparing it to what went before and what happened after, one gains a better understanding of the history of aviation, especially its military aspects. This history involves both the technology of aerial warfare and the strategic and tactical doctrines for the employment of military air power.

The best known of the technological innovations associated with the Korean War is jet propulsion. The Korean Conflict took place during the transitional period between the propeller era and the jet age and was the first good opportunity to determine how the operation of jet aircraft would affect aerial warfare. Of course, a small handful of jets had seen action during World War Two but the conflict had ended before their effectiveness could be assessed. The Korean experience demonstrated that jet airplanes were superior to propeller-driven aircraft in almost every role.

A jet airplane can fly higher and faster than a comparable piston-engined machine, which gives the jet a considerable advantage in air-to-air combat. The air battles of the Korean War were dominated by jet aircraft; encounters between jet-powered and propeller-driven aircraft were almost always decided in favor of the jets. It quickly became obvious that a propeller-driven fighter airplane could not be expected to outperform a jet fighter. The Korean War was the last major conflict in which piston-engined aircraft were employed in the air superiority role. The jet has supplanted the propeller completely in the world's fighter forces.

The Korean War was the first war in which jet airplanes were employed in ground attack operations but was discovered that jets were not as well suited for the role as piston-engined aircraft because they lacked range and load-carrying ability and were less accurate. However, jets were more robust, having a greater capacity for battle damage, an important consideration given the intense ground fire to which attack aircraft are routinely subjected.

The primary advantage that the jet attack airplane had over its propeller-driven counterparts was that it could, if need be, defend itself against a jet fighter. This ability virtually guaranteed the demise of the piston-engined attack airplane. A handful of air forces persist in operating propeller-driven attack aircraft even today, but as the Argentines discovered in the Falklands conflict, such aircraft are always vulnerable if opposed by jet-powered fighters.

The presence of jet fighters in the Korean theatre affected the operation of strategic bombers in much the same way it affected the ground attack campaign. All of the heavy bombers employed in Korea were piston-engined types and proved so vulnerable to jet interceptors that they could not continue flying daylight missions. Forced to operate at night, their bombing accuracy and effectiveness was much reduced.

The realization that propeller-driven strategic bombers could not be reasonably expected to penetrate an area defended by jets had important repercussions, especially in the United States. The Americans had invested vast sums of money in the design and production of propeller-driven strategic bombers after World War Two and relied on those aircraft to deter aggression. Suddenly they learned that these bombers were obsolescent. As their most likely opponents already possessed jet interceptors, the Americans could only hope that they would not be drawn into a major war before their jet-powered bombers currently in development had entered service.

Other nations that maintained strategic bombing forces observed what was happening in Korea and understood the importance of the jet bomber. Accordingly, those that did not have a jet bomber program already underway quickly initiated one. The Korean War was the last conflict in which piston-engined heavy bombers were employed. Today, there are no propeller-driven bombers in service anywhere in the world.

The introduction of the jet airplane affected activities on the ground as well as in the air. Jet aircraft were found to be easier to maintain and repair than piston-engined aircraft. They required longer runways and could damage airfield pavements. They also made the task of the antiaircraft gunner more difficult. The Korean War was the first conflict in which these issues were clearly identified and they continue to be important considerations today. The advantages of the jet airplane in combat are so great that whatever problems are associated with their use are nonetheless simply accepted.

The willingness to endure the various difficulties associated with the operation of jet aircraft in order to gain the attendant advantages in combat was all that sustained the United States Navy (USN) during the Korean War. The USN's air branch had been one of the first naval air arms in the world to acquire jet aircraft and was the only one to operate jets in Korea; its leaders recognized quite early the need to obtain such weapons in order to maintain parity with the world's land-based air services. Yet the transition from propellers to jets did not go smoothly for the USN. The earliest jet airplanes were just not well suited for operations from aircraft carriers. The Korean Conflict began before naval aviators had mastered all of the skills needed to fly jets from carriers. The accelerated pace of Korean combat operations gave them much needed experience, but the conflict ended before any of the problems associated with carrier jets from could be resolved.

Most of the Navy's problems with jets carrier operations were caused by the relative smallness of its World War Two-vintage aircraft carriers. An aircraft carrier is a mobile airbase combining a runway and hangar space with fuel and ammunition storage, navigation and communication equipment, as well as living quarters for the crew and a powerplant, all in one structure. An airfield on land might have its facilities distributed over an area of several hundred acres. An aircraft carrier must contain all of its parts in a hull less than one thousand feet long and about two hundred feet wide.

Jet airplanes accelerate poorly and so need long runways from which to take off. They cannot reach flying speed in the limited distance of an aircraft carrier's flight deck without assistance. During the Korean War, the Navy used hydraulic catapults to launch airplanes from shipboard. Yet these machines used World War Two era technology and were not powerful enough to get a heavily laden jet into the air. The weapons loads carried by the jets had to be reduced, with the result that their combat effectiveness was impaired. The solution, adopted shortly after the Korean War ended, was the steam catapult, a British invention. Far more powerful than the hydraulic variety, it remains in use to this day.

Jet airplanes lose speed as poorly as they gain it, which made landing a jet on a carrier a very difficult operation. A jet pilot had to reduce speed to land on a carrier safely. However, if the aircraft lost too much speed too early it would stall and probably crash into the sea because it could not get enough power quickly enough to make up the lost speed. Yet if it did not lose enough speed, the airplane would likely stay aloft too long and miss the landing area on the aft end of the flight deck. The jet would then crash into the collision barriers erected amidships or the airplanes parked on the forward end of the flight deck. In either case, the result could be disastrous. The solution to this problem was the "angled" flight deck, also a British idea. The Americans converted all of their existing aircraft carriers to the angled configuration soon after the war in Korea ended. Every carrier they have produced since has had the angle incorporated into their designs from the beginning. While not infallible, it greatly contributes to the safety of flight operations.

The poor deceleration of the early jets also made it necessary to devise a better method of guiding airplanes into a landing on board ship. The system in use during the Korean War had been developed during the propeller era and was intended to accommodate the rather leisurely pace of piston-engined aircraft landings. It required placing a controller on a platform near the stern of the carrier. He would use signal paddles to give landing instructions to incoming aviators. The high speed of the jets reduced the amount of time in which the controller could communicate with a pilot; the poor acceleration of the jets made it imperative that the controller identify a problem early enough to tell the pilot how to correct it. The system just did not work well once jets were introduced.

The Navy had to make do with this arrangement throughout the Korean War but it was obvious that a faster, longer-ranged system of communications between ship and airplane was needed. The British finally developed one in the mid 1950s. This innovation, the mirror landing system, used lights to inform a pilot where he is in relation to the landing area. The controller now serves simply as an observer to watch that the pilot is following the light beam correctly. The mirror landing system is a feature of all aircraft carriers in service throughout the world today.

The new technology of jet propulsion was not the only feature of the Korean air war that distinguished it form earlier air campaigns. The Korean War was the first "limited" war of the air age. Earlier air wars had all been "general" wars. Most of the restrictions on the use of air power had been technological, not political. From the Korean War on, however, political considerations have played a significant role in determining how, when, and where airpower could be used in wartime.

The Korean War was limited because the various nations involved did not want it to develop into a larger conflict. The conflict had begun as a civil war between two competing Korean governments, one communist, the other pro-western. The United States and the United Nations came to the aid of South Korea soon after hostilities began. The Chinese entered the conflict on behalf of North Korea a few months later. The Soviet Union was involved as well, albeit indirectly, by supplying arms and equipment to the Chinese and North Koreans. The conflicting interests of all these world powers could easily have led to a global confrontation.[1]

Most of the nations that participated in the Korean War relied in one way or another upon air power to achieve their goals. None, however, had any previous experience with the use of air power in a limited war. Existing doctrines for the use of military air power had been formulated during the early part of the air age, a time of unrestricted or general warfare, and so did not address any of the special problems associated with the use of air power in a limited conflict. The leaders of the various air forces that fought in Korea thus had to develop their own principles for the employment of air power in a limited war. These principles were based on existing theories for the most part but were modified, sometimes considerably, to meet local conditions. Most of the air wars since Korea have also been limited in one way or another as well, so the new air power concepts introduced during the Korean Conflict have remained of value. They provide the basis for the employment of military air power to this day.

All of the early air power theorists agreed that air superiority is the key to aerial warfare.[2] Air superiority is the denial to the enemy of access to the air. A nation whose air arm cannot leave the ground is powerless to prevent an opposing nation's air force from conducting operations against its own air and surface forces.

The leaders of the Korean War air forces understood the value and necessity of establishing air superiority and never even considered conceding control of the air to their opponents; however, their political superiors imposed several significant restrictions on the means by which they might achieve air superiority. For example, American airmen were prohibited from crossing the Yalu River into China. Communist pilots were not permitted to venture across the main battle lines in central Korea. These restrictions had the effect of preventing both sides from reaching the airfields on which their opponents' air arms were based.

Forced to allow their opponents to get into the air, the Korean War air forces had to try to eliminate their enemy's air arms in aerial combat, one aircraft at a time. This method is inefficient. It is much easier to destroy an air force when it is concentrated on an airfield. An air force that cannot leave the ground cannot threaten its opponents' land, sea, and air forces. The Korean War air forces could not keep their opponents bottled up on their airbases. During the Korean War, the communists could never prevent American aircraft from attacking their ground troops and supply lines, while the Americans could never prevent communist aircraft from attacking their strategic bombers and ground attack aircraft.

The Americans' strategic bombers were affected by the political limits to the Korean War in other ways. In an unlimited war, strategic bombers are used to attack a nation's industrial base. If a nation can no longer produce arms and equipment, it cannot fight. Deep penetration bombardment missions also serve to force a nation to allocate resources to antiaircraft defenses. These resources might better be used elsewhere. The Americans, in accordance with these principles, initiated a strategic bombing campaign against North Korea soon after entering the war. Yet the North Koreans did not produce their own weapons. They received arms as aid from China and the Soviet Union. The American political authorities, committed to limiting the conflict to the Korean peninsula, would not permit attacks against Chinese and Soviet territory. As a result, the North Koreans' ability to continue fighting was never seriously impaired, despite the destruction of most of their factories. The failure of the strategic bombing campaign to achieve the effect desired in Korea led to a reexamination of the role of the strategic bomber in limited wars.

It was determined that strategic bombing just did not make sense against an enemy that relied on other nations for its arms unless the other nations were bombed as well. Yet expanding the war to those other nations might not be politically desirable. The Korean War was the last conflict in which a strategic bombing campaign, in the classical (pre-World War Two) sense, was attempted. However, the heavy bombardment aircraft that were designed for the strategic bombing role remain useful, and are in service to this day. They were used to great effect in the Falklands in 1982 and Iraq in 1991.

The early air power theorists who advocated strategic bombing have been accused of expecting too much from the heavy bomber. They believed that a single air raid could destroy a city. The strategic bombing campaigns of World War Two demonstrated otherwise. The cities of Germany and Japan were indeed devastated, but only after a number of air raids over a period of years. Yet the invention of the atomic bomb actually made it possible to destroy a city in a single attack. The early air power advocates seemed vindicated. Aerial warfare entered a new phase after Hiroshima and Nagasaki. The Korean War was the first conflict of this new era, the "atomic age." It was the first war in history in which one of the belligerents possessed atomic weapons at the beginning of the conflict. The Americans could have chosen to use the atomic bomb at any time during the war. Yet they did not. Their reasons for not using the most powerful weapon in their arsenal is worth examining, as other nations have had to make the same decision in subsequent wars. These reasons may explain why no nation has used an atomic bomb since the end of World War Two.

One of the best reasons that the United States did not use atomic weapons in Korea was that there were no appropriate military targets for them. The atomic bomb has been the described as the "absolute weapon" but it is not very effective against small or dispersed targets. These can usually be destroyed without having to use atomic weapons (a sledgehammer is not the best tool for swatting flies). The best targets for atomic weapons are large cities, military installations, industrial centers, and troop concentrations, none of which existed in North Korea.

Even if there had been targets suitable for atomic attack in North Korea, the United States probably would still not have used atomic weapons against them. The Americans would have had trouble delivering atomic weapons to targets in Korea, as they had no atomic-capable jet bombers at the time. They would have had to rely on propeller-driven aircraft not unlike those already in action in Korea. As was noted earlier, piston-engined bombers could penetrate the North Korean air defenses but would suffer heavy losses in the process. A propeller-driven atomic bomber would have had similar difficulty reaching its targets.

Also, world opinion was overwhelmingly against the use of nuclear weapons anywhere. Every time that the United States appeared to be considering the use of atomic bombs in Korea, the international community was quick to express its disapproval. The Americans would have suffered a considerable loss of prestige had they used atomic bombs during the conflict.

The allies of the United States had good reason to oppose the use of atomic weapons in Korea. They knew that the use of atomic weapons would invite retaliation from the Soviet Union, which also possessed the atomic bomb, and it would be they, not the Americans, who would suffer the most from Soviet retribution, despite the promise of American assistance. The United States was well protected behind two oceans and the vast expanse of the Arctic. Its allies in Europe and Asia were well within reach of Soviet bombers, many of which, it was assumed, were carrying atomic weapons.

Another reason that the Americans did not use atomic weapons in Korea was that their supply of such bombs was quite limited. The Americans had to consider the possibility that they might be drawn into another conflict elsewhere in the world. They were particularly concerned that the Soviet Union might invade Europe and wished to be prepared for such an eventuality.

The Americans had one other issue to consider whenever the possibility of using atomic weapons in Korea was debated. They had declared that they had entered the war expressly for the purpose of defending an ally, South Korea, against aggression. While an atomic attack would no doubt repel the invaders, it would also kill and maim countless South Koreans. It would take years to recover from the material destruction caused by an atomic attack on South Korea. The United States would be hard put to justify using atomic weapons in the territory of a friendly people.[3]

The Korean War was a time of many firsts in aerial warfare. It was the first jet war, the first limited war of the air age, and the first major war of the "atomic era." It was also the first war involving the use of helicopters on a large scale, the first war in which the aircraft carrier served more as a mobile airbase than as a seagoing vessel, and the first war in which the United States Air Force participated after achieving its independence from the Army. All of these features are characteristics of modern aerial warfare.

Yet the Korean War also had much in common with the air wars that came before it. It was the last major war in which propeller-driven fighters and bombers were employed in large numbers (the world's smaller air forces have used such aircraft in years since but even they are equipped with jets now). It was the last war in which a strategic bombing campaign in the traditional sense was attempted. It was also the last war in which aircraft were armed only with machine guns and cannon.

The Korean War took place at the middle of the air age, a period of great transition in military aviation. The introduction of two significant new technologies, combined with a radical change in the conceptual basis of armed conflict, completely transformed the nature of aerial warfare. The Korean Conflict was a revolutionary war, the end of one phase and the beginning of another in the history of air power.

CHAPTER II

"THE FIRST JET WAR:" HOW THE INTRODUCTION OF JET PROPULSION CHANGED AERIAL WARFARE

When the Korean War began in the summer of 1950, the jet airplane was still a very new weapon. Both the British and the Germans had employed jet aircraft during World War Two, but the war ended before either were able to learn how best to exploit the new technology. They did, however, determine that the jet airplane, despite its shortcomings, was superior to the piston-engined airplane[1] in almost all respects. This knowledge was sufficient to encourage the leaders of the world's larger, more affluent air forces to order the development of jet airplanes for their own air arms after the war. They believed that the jet airplane would come to dominate aerial warfare in the future.[2] The Korean war provided the first opportunity to test that belief.

The airmen who actually flew jet aircraft shared their superiors' faith in the supremacy of jets. They considered the jet airplane a vast improvement over what had come before. Jets were more pleasant to fly than propeller-driven aircraft. The constant roar of a piston engine has a debilitating effect on a flier. "The cockpit of a [Lockheed F-

80] Shooting Star [jet fighter] was far quieter than that of a [piston-engined P-51] Mustang, which made the jet easier to fly."[3] Reciprocating engines have far more moving parts than jet engines; a propeller-driven aircraft shakes and vibrates considerably. "Contributing to less crew fatigue is the comparative lack of vibration experienced while flying jet-powered aircraft."[4] The pilot's workload is greatly reduced in a jet. "Auxiliary components, instruments and controls are all reduced in number. Less attention is demanded from the pilot."[5]

Yet of all the reasons airmen gave for preferring jets to propellers, none was better, and more eloquent, then the one given by General Adolf Galland, the German flying ace in 1943. In his capacity as commander of the Luftwaffe's fighter forces during World War Two, Galland was invited to test fly the new Messerschmitt Me 262 fighter before it entered service. At the end of the flight, Galland said simply, "Es ist, als ob ein Engel schiebt (It is as if an angel pushes)." [6]

The professionals' enthusiasm for jet airplanes quickly communicated itself to the general public, especially in the United States. In the years following World War Two, the American popular press tried its best to meet the demand for information. *Time*, *Life*, and *Newsweek* all published many articles lauding the virtues of jet airplanes and the men who flew them.[7] Other general interest magazines ran articles with rather sensational titles, such as "The Marvel of Jet Propulsion" and "Flying in the Blowtorch Era."[8] The writer of a 1948 article in the *New York Times Magazine* referred to jet pilots as "superboys."[9]

Special interest publications such as *Aviation Week*, *Aero Digest*, and *Flying* provided more detailed information for their (more knowledgeable, presumably) readers.[10] A large number of these pieces focused on the role of jet airplanes in combat, for as one such article noted, "No one knows what effect [jets] will have on methods of warfare. . . . There are many things to be found out about the jet's place in the military scheme of things."[11] Most of these works were about jet fighter combat, which makes sense, given that so many of the earliest jet-powered airplanes were fighter types, airplanes designed to destroy other airplanes in air-to-air combat.

The reason that most of the earliest jets were fighters was that the fighter class was the type of airplane that would benefit most readily from jet propulsion. A fighter design needs to be able to fly fast and high (maneuverability is a minor consideration).[12] Altitude is important because a pilot can convert height (potential energy) into speed (kinetic energy) by diving. Speed is significant because the pilot of a faster airplane can engage in and disengage from combat at will. He can also convert speed back into height by "zoom climbing." The jet engine is "particularly well adapted for providing the high speeds and high operating altitudes necessary in aerial warfare."[13] Little wonder, then, that aircraft designers first applied the new technology to their fighter projects.

Fighter airplanes are designed for the air superiority role. Air superiority is not easy to define but may be described as the suppression of enemy air power. The establishment of air superiority is the single most important task of an air arm in wartime, for once it has gained control of the air in the combat area, it is free to carry out its other duties at reduced risk from enemy interference. Similarly, the surface forces protected by that air arm enjoy a greater freedom of action because they are less likely to be observed or harassed by enemy air units (This topic will be discussed in greater detail in Chapter IV).

The United States Air Force (USAF) began conducting air superiority operations as soon as the United States entered the war. Although it employed both jet and propeller types on these missions, the jets quickly proved themselves better suited for the role. In the first nine weeks of the Korean Conflict, American jet pilots shot down thirty-five North Korean airplanes. American piston-engined fighter pilots were credited with but twelve victories in the same period.[14]

The North Korean air force (NKAF), which had only propeller-driven aircraft in its inventory, was simply not prepared to fight an opponent equipped with jets, as Lieutenant (j.g.) Leonard Plog, an American naval aviator, discovered on 8 July 1950. Plog was flying a Grumman F9F Panther jet fighter on an attack mission against Pyongyang, North Korea, when he was intercepted by a propeller-driven Yakovlev (Yak) fighter. His opponent had the initial advantage but could not hit Plog's airplane. "He had a perfect run on me," Plog later said, "but evidently he had never shot at anything moving that fast before."[15] The North Korean did not get a second chance. Plog used the superior performance of his Panther to get into firing position behind the Yak and destroyed it.

The USAF quickly established air superiority in Korea, leading General George E. Stratemayer, commanding officer of the American Far East Air Forces, to report in August 1950 that "the air battle was short and sweet."[16] The lack of aerial opposition permitted the ground forces of the United States and the United Nations (UN) to advance up the Korean peninsula with remarkable speed. By November of 1950, UN ground forces had reached the Yalu River, the border between North Korea and China.

The war entered a new phase shortly thereafter. Alarmed by the presence of foreign troops so near their territory, and concerned that their North Korean allies might be overwhelmed, the communist Chinese entered the conflict in late November, committing several hundred thousand men to Korea. However, because they lacked a modern air force (one equipped with jets), they knew that they could not provide their soldiers with air cover. They had to ask the Soviet Union for assistance. Josef Stalin, the Soviet dictator, quickly approved the Chinese request for aircraft and aircrews.

The transfer of Soviet aircraft to Korea meant that the USAF could no longer take air superiority in Korea for granted. The USAF would have to fight for control of the air every day. The Soviets flew the Mikoyan-Gurevich MiG-15 jet fighter, an airplane superior to any of the aircraft, propeller or jet, operated by the UN in Korea at the time. The MiG-15's primary advantage was its swept-winged layout. All of the aircraft that made up the UN's jet forces in Korea had straight wings. A swept-winged airplane enjoys a considerable performance advantage over straight-winged aircraft. It can fly faster and is more stable because the swept-back wing delays the onset of compressibility, the buildup of aerodynamic forces on an airplane's structure as it approaches the speed of sound. Even if the airplane itself is subsonic, local airflow over the wing can exceed Mach one, leading to control and stability problems.[17]

Fortunately for the United Nations forces, few of the Soviet pilots who flew the MiGs were very experienced and so were unable to take full advantage of the aircraft's superior performance. Indeed, UN pilots shot down a number of MiG-15s in the winter of 1950-1951. Among these was First Lieutenant Russell Brown of the USAF, who on 8 November 1950, shot down a MiG in what has been referred to as the world's first dogfight between two jet airplanes.[18] Yet despite their early successes, UN airmen understood that once their opponents gained experience, the UN would no longer enjoy the freedom of the skies to which they had become accustomed.

To counter the MiG threat, the Americans introduced the North American F-86 Sabre (also called the "Sabrejet") to the theatre. The Sabre, like the MiG, was a swept-winged design. The two aircraft had very similar performances. The Soviet airplane had a slight advantage in service ceiling while the F-86 had a marginally better top speed. The Sabre had been in service for some time, but USAF policy makers, believing that the UN had air superiority in Korea, had not wanted to commit them to the Far East. The presence of the MiG-15 in Korea compelled them to transfer several Sabre wings to the war zone. Once these units arrived in Korea, the other UN jet types in the theatre were relegated to ground attack duties (the usual fate of a fighter airplane that has been replaced by a better design). The struggle for air superiority in Korea became almost exclusively a contest between the MiGs and Sabres. The MiG pilots' task was to destroy UN airplanes operating in North Korea. The Sabre pilots' job was to prevent them from doing so.

The MiGs were based in China, and so had to cross into Korea to reach their targets (the UN restricted its aerial activities to North Korea proper; UN aircraft were prohibited from venturing into China). The Sabres, operating from airfields close to the front lines, would try to intercept the MiGs before they penetrated too far south. As a result, most of the encounters between the Sabres and MiGs took place in the far northwest of the Korean peninsula, in the region between the Yalu and Chong'chon rivers. This area soon became known as "MiG Alley."

The air battles between the MiGs and Sabres usually took place at fairly high altitudes. At such great heights the atmosphere takes on a different appearance than that nearer the earth. "The world around a jet, 40,000 ft. above the ground, is like a dark blue blanket."[19] It is fairly difficult to search for hostile aircraft in this environment. "There are no mountains, no clouds—nothing by which a pilot can gauge the focus of his eyes. He might think he's looking miles away for enemy planes, when actually [he is] focused on a point only a few yards ahead of him."[20] Fortunately, looking for hostile aircraft is easier in a jet than it is in a piston-engined airplane. The typical propeller-driven airplane has its engine in the front and its cockpit amidships; the nose of the airplane blocks a considerable portion of the pilot's forward view. Most jets have their engines in the rear and their cockpits in front. Pilots who had experience in both types greatly preferred jets. "The cockpit position . . . gave the pilot an excellent field of view."[21]

Jet pilots had other aids in the searches for the enemy. In the right atmospheric conditions, a high-flying airplane will produce a condensation trail (often referred to as a "contrail"), an artificial cloud, in its wake.[22] Although both propeller-driven and jet-powered aircraft can produce contrails, jets tend to do so more often. "The white contrails of the MiGs could be seen for miles against that blue background," one Sabre pilot remembers.[23] Of course, few airmen can afford to be so conspicuous. If a pilot was aware that he was leaving a contrail, he could climb or dive to find a layer of air in which the contrails would not form. "If the MiGs were not conning [leaving a contrail], we were blind. . . ."[24]

Sometimes it was possible for a pilot to spot an enemy airplane by seeing the glint of sunlight reflecting from it. To save weight and reduce drag, most MiGs and Sabres were left unpainted. The highly polished bare metal finish of the jets made them excellent reflectors. "It was just like a mirror catching the sun's rays and bouncing them back to us," another Sabre pilot recalls.[25] Most of the time, however, spotting one's enemy was simply a matter of alertness and visual acuity. John Glenn, the Mercury astronaut, served a tour of duty with an F-86 unit while a Marine aviator in Korea. He remembers that "getting an early ID [identification] was a problem. In fact—this sounds funny today—we used to carry binoculars. . . . I used to practice with them between flights."[26]

The high speed of the jets made it imperative to be the first one to see an opponent. If two jets are heading toward each other at top speed, their pilots have very little time to react. "At a closing speed of 1,200 mph, it takes only thirty seconds to close ten miles."[27] To increase their chances of spotting their opponents, American airmen always traveled in pairs, a flight leader and his wingman. "A wingman with 'good eyeballs' was our most valuable asset in MiG Alley,"[28] Winton "Bones" Marshall, an ace Sabre pilot, once noted. Even when a pilot had located his opponent, he could still lose sight of it. "We learned early on in aerial warfare that when a target was sighted, one could simply not lose that target from sight, or the chances were excellent that it would disappear from view."[29] Events take place too rapidly in the air.

The pilot who spotted an enemy airplane could not risk glancing away from it, yet if he focused too intently on one specific airplane, he could not keep watch out for his other opponents, all of whom were wanting to shoot at him. It was the wingman's responsibility to watch for threats as his leader made an attack. Coordination between a leader and wingman was of the utmost importance. One Sabre pilot recalls an incident in which he and his wingman failed to communicate properly:

> I lost a MiG once when my wingman didn't reply to my call of padlocked [a codeword meaning 'Be alert because I have chosen a target and will be concentrating exclusively on it']. He [my wingman] was there, but was so excited that he didn't hear the call. When a wingman doesn't answer, a quick chill sets in, and you're certain he's been zapped by the bad guys. A quick look—he's there. A return to target—it's gone. It's hard to believe that a target can disappear so quickly, but it's true. Milliseconds counted.[30]

The great heights at which the MiGs and Sabres operated made combat as difficult as spotting. Air density decreases with altitude, reducing lift and making aircraft less maneuverable. Frances "Gabby" Gabreski, an American fighter pilot who earned ace status in both World War Two and Korea, remembers some of the problems of high altitude combat. "I soon experienced one of the frustrations that dogged Sabre pilots. . . . The higher we went, the more unstable the aircraft became."[31] Sabre pilots had an additional concern: the MiG-15 had a better service ceiling than the F-86. Harold Fischer, an ace Sabre pilot who served under Gabreski's command, recalls a battle in which the MiGs "began to zoom up, . . . and we tried to follow. As their altitude increased, our aircraft began to mush [even] under full power, and it was impossible to raise the noses without stalling."[32] The MiG pilots were quick to attack a Sabre that had stalled out during a climb. "Once you . . . [got to,] say, 52,000 feet . . . it was almost impossible to maneuver. . . . If you lost any airspeed at all, you'd fall out of turns and be red meat for the MiGs. . . ." [33]

The high performance of the jet-powered airplane comes at great cost. A jet engine consumes fuel voraciously. "When I'm flying at full speed," a Sabre pilot told the *National Geographic*, "I burn almost a gallon every four seconds."[34] As a result, a jet airplane's endurance is much less than that of a piston-engined airplane. The difference could be quite substantial. American test pilot Donald S. Lopez, who flew all sorts of airplanes during the post-World War Two era, remembers that "with the [F-80] jet's internal fuel of 432 gallons, low altitude flying time was limited to less than one hour. A [piston-engined] Mustang, with 250 gallons of fuel internal, could fly at least four hours,"[35] The poor fuel economy of the jets caused many problems for airmen in Korea. "Bones" Marshall recalls that combat with the MiGs "took full engine power throughout, which meant maximum fuel consumption."[36] Some Sabre pilots used all of their fuel reserves returning to base. One remembers an especially close call: "When we landed . . . the crew chiefs expressed concern that I did not taxi all of the way into the revetment area. . . . They were amazed and amused [to learn] . . . that I had just run out of gas."[37]

Other pilots, running low on fuel on the way home, actually switched off their engines to conserve fuel. One pilot remembers calculating, "having 600 pounds of fuel remaining for a flight of 200 miles meant that I would have to head for maximum attainable altitude, cut the engine and glide, and restart the engine if needed."[38] Donald Lopez discovered that the "P-80 can glide almost seventy-five miles from 35,000 feet."[39] Of course, a pilot had to be extremely careful when gliding. "When you shut down your engine, you lose your radio, too. You don't want to keep your battery on, because you need all that battery power to get an air start."[40] Some pilots did not have enough fuel to start their engines again in the air. "It wasn't unusual to come back from a mission with empty tanks and make . . . a dead-stick landing. A landing without any power, where you would just glide in. We practiced those all the time."[41] Sabre pilots made unpowered landings so frequently that ace flier Douglas K. Evans of the Fourth Fighter Interceptor Wing noted in his memoirs, "We [had] a joke going . . . about changing the name of the outfit to the 4th Glider group."[42]

An American airman who was running low on fuel could try to take advantage of the jet stream that blows west to east across Korea. A jet stream is a fast moving wind current found at high altitudes. Most propeller-driven airplanes can not fly high enough to encounter a jet stream but turbine-engined aircraft can. Frances Gabreski remembers that the jet stream often reached an intensity of 150 to 175 mph, which was quite a tail wind to help us get back from MiG Alley. . . ."[43] Under normal wind conditions, it took a Sabre about twenty minutes to get from the Yalu to the American air bases in southern Korea. Flying in the jet stream cut the time almost in half.[44] Sabre ace Frederick "Boots" Blesse once flew a mission during which he spent too much time in the battle area and so had to watch his fuel consumption more carefully than usual on the way back to base. His fuel supply was so low that he would not have made it back without a tailwind. "If the winds were right,' he calculated, "I'd make it on fumes, but if they were wrong, I'd have to try to land on [an emergency airfield built on] a small island off the [Korea] coast."[45] MiG Alley was about two hundred miles from the nearest UN airfields. "Without tailwinds there wasn't a chance," he concluded. [46]

The MiG pilots, closer to their home bases than their UN opponents, did not have to worry as much about their fuel consumption. They were quick to capitalize upon the advantage. As "Bones" Marshall recalls, "Any radio calls that we were low on fuel . . .

was like throwing raw meat to a starving lion. The North Korean radio controllers continuously monitored any radio transmissions by American pilots, and, should any of us report problems, down came the MiGs to attack the lame duck fighter."[47] Communist pilots developed several tactics to exploit their opponents' need to break off from combat when their fuel was low. One of the most effective was the "box-in," which entailed sending one group of MiGs to interpose itself between the battle area and the Americans' home bases while other MiG units engaged the F-86s as usual. When the Americans withdrew due to fuel considerations, the first group of MiGs would try to intercept them. The Sabre pilots, lacking the fuel reserves to fight a second battle, would have no choice but to run the gauntlet of MiGs.[48]

The Americans did try to extend the range of their jets by fitting them with external fuel tanks. However, these tanks were heavy and created drag and thus had a detrimental effect on the aircraft's speed and maneuverability. An airplane going into combat could scarcely afford this loss of performance, so most fuel tanks designed for air superiority fighters were intended to be jettisoned just before entering battle. The high fuel demands of the early jet engines caused a number of problems for aircraft designers in the late 1940s, because they were still thinking in the terms of a piston-engined airplane's fuel needs. For example, the engineers at Lockheed had originally designed the F-80 Shooting Star to carry two 165-gallon drop tanks, the same external fuel load that had enabled the P-51 Mustang to fly from England to Berlin and back during World War Two. Yet the Shooting Star consumed fuel far more rapidly than did a Mustang.

During the first few months of the Korean War, the UN had no airfields suitable for jet aircraft operations in Korea. The F-80s that were the backbone of the USAF war effort in the summer of 1950 were stationed in Japan. "The F-80s didn't have the legs, didn't have the range"[49] to spend more than twenty minutes in the battle area after crossing the Sea of Japan. "To correct the deficiencies, some of the maintenance people altered the wing tanks . . . by putting two 50-gallon center sections in them making a 265-gallon tanks for each wing."[50] The modified tanks were called "Misawa tanks" because they were first fabricated at Misawa Air Force base in Japan. The Misawa tanks had several design flaws, however. They lacked internal baffles to prevent fuel from sloshing about within them. A number of F-80s were lost when shifting fuel caused their centers of gravity to move too far aft, resulting in a dangerous instability.[51] The additional weight of the extra four hundred gallons of fuel put great stresses on the aircraft structure as well.[52] Major General Earle E. "Pat" Partridge, the commanding officer of the USAF's Fifth Air Force during the Korean War, remembers when Clarence L. "Kelly" Johnson, the designer of the F-80, visited Korea on a fact-finding mission. He "watched [an] aircraft take off from Taegu [airfield, South Korea] with two-wing tanks full [*sic*] and a 500-pound bomb in addition. He turned away and said, 'I can't watch it.'"[53]

Other aircraft had problems with their external fuel tanks as well. Drop tanks are difficult to design properly. The Lockheed F-94, a night fighter development of the F-80, was, like its predecessor, equipped with wingtip fuel tanks. When these tanks were jettisoned, they "had a tendency to roll along the wing and bang into the fuselage. . . . In some cases, substantial damage was inflicted on the aircraft."[54] Lockheed's engineers redesigned the tanks but the new style tanks did not become available until after the war ended. "The remedy adopted [during the war] was to drop tanks when still at least half full (this [meant] throwing away some 230 gals. of fuel so precious to a jet aircraft)."[55]

Designing fuel tanks for jet aircraft is more difficult than one might expect. It is not simply a matter of attaching a fuel cell to an airplane. The tanks must be designed so that they fall away cleanly from the aircraft when jettisoned. The drop-tank designer must also make sure that the tanks' aerodynamic characteristics match those of the airplane on which they will be used. As British test pilot W. A. "Bill" Waterton observed in his memoirs, "Unless the shape of the tank and the angle at which it was attached were correct, 'lift' from the tank would produce torque in the wing structure," [56] which could cause catastrophic failure of the airframe.

The use of external fuel tanks is not the only method by which an airplane's range might be extended. It is also possible to refuel an airplane in flight. Airmen in the United States and Great Britain had experimented with aerial refueling before World War Two, but it was not until the late 1940s that they were able to develop a reliable method for transferring fuel from one airplane to another in midair. The first-ever inflight refueling of aircraft in combat occurred on 6 June 1951, when a formation of RF-80 Shooting Stars on a reconnaissance mission over North Korea received extra fuel from a KB-29 tanker, a modified version of the Boeing B-29 Superfortress bomber of World War Two.[57]

The USAF did not conduct many operations requiring inflight refueling in Korea (although the handful that were attempted were all successful).[58] This failure to take better advantage of the ability in refuel in flight was in part due to the novelty of the idea. No one in the Air Force had given much thought to the possibility of using inflight refueling for operations within a single theatre before the war. The most vocal proponent of aerial refueling, Colonel David C. Schilling, envisioned using inflight refueling as a method of deploying fighter units from one continent to another in response to a crisis.[59]

Lieutenant General Curtis E. LeMay, commanding officer of the Strategic Air Command (SAC), wanted to use inflight refueling to extend the range of his bombers.[60] (despite the advice of one of his subordinates, Lieutenant General Jack J. Catton, who once said, "I think refueling is a unique capability that we should perfect so that we can use it in very specialized circumstances. We should never plan on its broad use of it throughout the force").[61]

Although most of the operations requiring the use of inflight refueling in Korea were reconnaissance missions, the single most remarkable use of inflight refueling during the Korean Conflict was a ground attack mission. At 0510 hours on 28 September 1952, Lieutenant Colonel Harry W. Dorris, flying a Republic F-84 Thunderjet, a single-seat, single-engine fighter, took off from Yokota Air Force base in Japan. He did not return until 1925 hours that night. During the fourteen hours he was aloft, Dorris bombed, strafed, and rocketed three very widely scattered targets, including one on the west coast and one on the east coast of Korea. He had to refuel five times during the mission, the last one at night. When he landed, Col. Dorris reported that fatigue had not been a problem because the parachute pack upon which he had been sitting was so uncomfortable.[62]

The Korean War was the first war in which jet aircraft were employed in the ground attack role. There are two types of ground attack missions: close air support (CAS), air strikes targeted directly at enemy troop positions, often in close proximity to friendly ground forces, and battlefield air interdiction (BAI), attacks intended to prevent the enemy from transporting men and materiel to the battle area (the terms are modern but the concepts have been recognized since the First World War).[63] Jet airplanes were used in both capacities during the Korean War. The most obvious reason to employ jet aircraft in CAS and BAI operations is that they are fast. Ground defenses have less time to detect and react to an attacking jet airplane. "As many a North Korean can testify, the jets' speed . . . permits surprise approach which has often caught the enemy before he can take cover."[64] An Australian air force officer who observed USAF operations in Korea noted that "enemy troops described the [F-80] as the 'whoosh' plane because of its terrific speed. It was on them before they knew that they were even under attack."[65]

Even if the defenders were alerted, their opportunity to return fire was limited because the jets flew so rapidly. "Chinese and North Korean gunners invariably fired behind the jets," [66] Harold Fischer remembers. He was, of course, exaggerating. Antiaircraft fire was the single greatest cause of UN aircraft losses during the Korean War. Yet it cannot be denied that a fast airplane is difficult to shoot at from the ground. As a writer for *Air Force* magazine observed in 1952: "The jets' high speed has greatly reduced our fighter vulnerability . . . to ground fire. F-80 losses per sortie have been one-third those of the F-51."[67]

The jets' high survivability rate was in part due to their simpler construction. Jet engines "have only about one-third the number of parts required for comparable piston engines."[68] Airmen assigned to ground attack units were well aware of the ruggedness of jets. Group Captain J. E. "Johnny" Johnson, a British fighter pilot who observed USAF operations in Korea, observed that "pilots preferred to fly jets, since, having fewer moving parts than the [piston-engined] Mustangs, they could withstand more flak damage."[69]

Yet despite the many advantages that jet airplanes had over piston-engined aircraft, "there was some question, early in the war, as to the jets' suitability for close ground support."[70] Part of the problem was the poor fuel economy of the jet types used for ground attack. The fuel problems experienced by the F-86 pilots flying to and from MiG Alley were fairly minor compared to the troubles associated with low-level jet operations. Air is denser nearer the ground, which increases air resistance, which reduces fuel efficiency. Frances Gabreski was well aware of the problem confronting the ground attack pilots: "Down low, a jet really gobbles the fuel."[71] As was mentioned earlier, one method of increasing an airplane's range is to equip it with external fuel tanks. However, when the Korean War began, "the F-80 could not carry wingtip fuel tanks and bombs at the same time, because the same racks were used for both, severely limiting its range while carrying bombs or napalm."[72]

Unfortunately, the USAF had no bases on the Korean mainland suitable for jet operations during the first part of the war. The F-80s had to be based in Japan. "During these highly critical days, . . . two Shooting Stars were sent from airfields in Japan every fifteen minutes, but their long flight meant that they could only spend a short time over the battlefield."[73] The UN was able to capture a few airfields in Korea in the fall of 1950, which alleviated the problem somewhat. More significantly, the engineers at Lockheed redesigned the Shooting Star so that it could carry bombs under its wings, leaving the wingtip hardpoints free to carry fuel tanks.[74]

Limited range was not the only impediment to the effective employment of jets ground attack aircraft. Most of the early generation of jets were relatively underpowered, and thus could not carry large payloads. This problem was compounded by the high summertime temperatures in Korea. Warm air is not as dense as cold air; on a hot day, an airplane's wings do not generate much lift, which limits the amount of ordnance it can carry. During the first summer of the war, the USAF's jets rarely carried bombs. They usually carried lightweight rocket projectiles. It was not until later in the war that jets were able to carry high explosive and incendiary bombs on a more regular basis.

Throughout the Korean War, UN air attacks on communist ground forces were coordinated by an airborne observer (officially known as a Forward Air Controller, or FAC, but almost always referred to as a "mosquito"). To make the most efficient use of the resources available to them, the mosquito fliers would ask the attack pilots what ordnance they carried. When the pilot of a propeller-driven machine was asked to describe his weapons load, his "standard reply . . . was, 'you name it, we got it.' Jets carried only rockets and machine guns; [piston-engined] attack planes had, in addition, bombs and napalm."[75]

The combination of poor endurance and light weapons loads greatly degraded the effectiveness of the jet airplane in the ground attack role. Captain John S. "Jimmy" Thach, the commander of the USS *Sicily* during its one Korean cruise, remembers that

> The F-80s would come over from Fukuoka, Japan, and the front line was just near the end of their range. They'd call the controller and say, 'Give me a target, give me a target. I've only got five minutes more. Got to go back.' They would be asked 'What is your ordnance?' 'I've got two 100-pound bombs. Hurry up.' I heard that so many times and finally I heard, I think it was an Air Force controller, say, 'well, take your two little firecrackers and drop them on the road somewhere because I've got something coming in that has a load.[76]

Jet-powered ground attack aircraft had other shortcomings as well. Surprisingly, their great speed was one such. A jet pilot has less time to search for and acquire a target when he is traveling at high speed. "The jet was considered too fast for an accurate attack on targets not always easy to identify or locate."[77]

Even if the jet pilot was able to find and identify his target, the high speed of his aircraft made it difficult for him to deliver his bombs or rockets accurately. Jet pilots try to avoid diving steeply because their aircraft build up speed too quickly (piston-engined airplanes do not speed up much in dives because their propellers act as a brake). If an airplane gains too much speed in a dive, it may not be able to pull up in time to avoid smashing into the ground. The jet-powered F9F "Panther required three times the recovery altitude of a Second World War [Douglas SBD] Dauntless, since it moved well in excess of 500 mph in its dive compared to 300 mph for the older airplane."[78] Yet a pilot increases his accuracy by diving more steeply. "The steep-angle, 'dive-bomb' technique of the [piston-engined] attack planes concentrated maximum ammunition in a small area while jets, with their shallow dive and high speed, sprayed a larger area."[79] It should be noted, however, that jet aircraft enjoyed one rather significant advantage over their conventionally-powered counterparts. "In a prop-driven plane, you have torque, the twist from the propeller. [When making an attack] you have to keep jiggling the rudder."[80] A jet airplane produces very little torque, which "makes [them] wonderful gunnery platforms, particularly for rockets or strafing."[81]

This last notwithstanding, the controversy about the jets' alleged unsuitability for attack missions grew quite heated. Army officers felt that the Air Force was not doing enough to support their troops. The issue received a considerable amount of attention in the American press. An article in *Popular Science* asked, "Can Our Jets Support Our Guys on the Ground?"[82] A few months later, a writer for *Popular Mechanics* asked, "How Fast Can We Fight?"[83] Hanson W. Baldwin, military affairs writer for the *New York Times*, also addressed the issue.[84] The leaders of the USAF constantly found themselves having to defend their decisions to employ jet airplanes as ground attack aircraft in Korea. General Hoyt S. Vandenburg, Air Force Chief of Staff, and George E. Stratemayer, commander of FEAF, were among the many Air Force officers who made public statements in which they reaffirmed their confidence in the ability of jet airplanes to perform ground attack missions.[85] The debate grew so intense that even Congress took an interest. Asked to testify before the House Appropriations Committee in 1950, General Vandenburg declared his faith in jet attack aircraft by observing that "you can slow down a F-80 for a strafing run but you can't speed up a F-51 to fight a Mig."[86]

General Vandenburg believed that jet airplanes could do anything a propeller-driven aircraft could, and that they could do it better. "'Jets are superior for every conceivable job of a fighter plane, including flying at tree-top level to silence a machine gun."[87] He also recognized that there were some things that jets could do that propeller-driven aircraft could not do. Of these, the most significant was fighting enemy jets in air-to-air combat.

Although a number of American, British, and other allied airmen flying piston-engined aircraft shot down jets during World War Two,[88] their victories were due primarily to their numerical advantages and the unfamiliarity of their opponents with the new technology (considering that they were learning how to fight in jets at the same time they were learning how to fly them).[89] After the war, however, most pilots realized that a jet-versus-propeller dogfight would be a rather one-sided affair. "It wouldn't be a fight. The jets would make one pass. If they nailed you, you'd be through. If they missed, you'd never catch them."[90]

Most of the dogfights between jets and propeller-driven aircraft in Korea ended, as was expected, in the destruction of the piston-engined machine. The official list of USAF victories for the Korean Conflict includes forty-seven entries for propeller-driven aircraft destroyed by jets.[91] American naval jets accounted for seven more.[92] The total number of airmen flying reciprocating-engined aircraft who were credited with victories over a jet airplane in Korea was two (and a half).[93] Of these, one was himself shot down by a jet shortly after scoring his improbable victory.[94]

An additional twenty-three jet aircraft were credited to the gunners of the (piston-engined) B-29 Superfortress heavy bombers that the USAF operated in Korea.[95] It is very likely that this number is somewhat inflated. Bomber crews tend to overclaim. A single B-29 carries five gunners, and heavy bombers do not operate alone, but in groups of six or eight airplanes. Thus any fighter approaching a formation of B-29s would be fired at by a good number of gunners. If that fighter were to be destroyed, all of the gunners who fired at it might submit a claim for its destruction. The USAF lost seventeen B-29s in combat in Korea (although some of these fell to flak),[96] so even if all of the victories credited to B-29 gunners were indeed valid, the exchange ratio of jets for bombers was not very favorable. Also, the USAF considered only those bombers shot down in Korea combat as combat losses. A large number of B-29s were so badly damaged by flak and fighters that they had to ditch into the sea around Korea or make crash landings at friendly airbases. The USAF wrote off nearly one hundred B-29s during the three years the war lasted.[97]

The communist air forces were particularly interested in repelling the B-29s. The Superfortress was the backbone of the American strategic bombing campaign in Korea. It was also used for tactical bombing. Each one could carry up to 20,000 pounds of bombs. Little wonder, then, that the communist ground-controlled intercept (GCI) operators would order the MiG pilots they controlled to "get the big guys! Get the big guys! Disregard the Sabres! Get the big guys!"[98] The MiGs usually outnumbered the Sabres, so it was not uncommon for some MiGs to evade the Sabres patrolling the Chinese-Korean border. Once past the Sabres, the MiGs would make quick work of the B-29s. "It was almost impossible to prevent a determined MiG pilot from getting a shot at a B-29, usually with bad results for the bomber."[99] Just how bad those results could be was demonstrated on "Black Thursday," 23 October 1951. On that day a force of eight 9a ninth aircraft aborted the mission) B-29s flew into North Korea to bomb communist airfields under construction. They were escorted by fifty-five F-84 Thunderjets. An additional thirty-four F-86 Sabres ranged ahead of the bombers to provide a barrier patrol at the Chinese-Korean border.

As the bombers were approaching their targets, a force of some one hundred MiG-15s crossed the Yalu to engage the Sabres. While the F-86s were thus occupied, fifty more MiGs attacked the bombers. The straight-winged Thunderjet escorts were no match for the swept-winged MiGs. The communist interceptors easily avoided the F-84s and began mauling the bombers. Three of the B-29s were shot down over the primary target, the airfield at Namsi. Of the remaining bombers, four were damaged so badly that they were struck off charge after returning to their bases.[100]

The heavy loses suffered by the B-29 units at Namsi had many repercussions. One immediate result of the debacle of "Black Thursday" was that the USAF suspended its daylight B-29 bombing campaign in Korea. From December 1951 until the end of the war, the B-29s operated only at night. The decision to do so was quite difficult for the leaders of the USAF. American airmen had long been committed to the doctrine of daylight precision bombing. The German air force had destroyed thousands of American bombers during World War Two but these losses were accepted as the price paid for accuracy (the Americans did bomb Japan at night during the last part of the war, but only because Japanese industry was so decentralized that precision bombing was not necessary). "The [communists] had now done what the Luftwaffe had been unable to do; they had called a halt to USAF daylight precision bombing."[101]

Another result of the slaughter over Namsi was that it forced the leaders of the USAF to reevaluate their ability to defend the United States. General Vandenburg visited Korea shortly after "Black Thursday" to investigate the heavy B-29 losses. "He left fearing that the [Air Force] might not be able to fulfill its atom-bomb retaliation mission, if and when Russia strikes."[102] The USAF's atomic striking force, the Strategic Air Command, relied exclusively on propeller-driven bombers in the early 1950s.

The American press was quick to report the controversy. "The harrowing story of the American bomber losses was spread all over the U. S. [*sic*] media. It reflected adversely on the survivability of our bomber forces on daylight operations. . . . "[103] *Aviation Week* was rather blunt: "MiG-15 Dims USAF's A-Bomb Hope."[104]

Newsweek's military affairs writer, retired General Carl A. "Tooey" Spaatz, who had commanded the American strategic bombing forces in Europe during World War two, used his column to wonder, "Is the B-36 Obsolete?"[105] The Convair B-36, a huge and ponderous propeller-driven intercontinental bomber, was the mainstay of the Strategic Air Command at the time. Although, as Spaatz observed, "the bomber has always been vulnerable to the faster fighter,"[106] the speed difference between jets and fighters was just too great to overcome. "Propeller-driven planes [are] vulnerable to jets because of the higher speed of the jets,"[107] Spaatz concluded.

The American fighter arm did not escape blame for the disaster at Namsi, either. Harold Fischer was at the battle in his Sabre. He remembers that "there was no air fighting as far as the F-86s were concerned. Instead, we were helpless observers to a complete disaster as the MiGs attacked the B-29 formation with little interference from us."[108] The press looked into this issue as well, wondering why the Thunderjets and Sabres did not shoot down more MiGs than they did. They claimed but four that day, just two more than the bombers claimed.[109] The Sabre pilots' inability to defend their charges greatly damaged "the credibility of the fighter forces that had been glorified for their ever-increasing victories over the MiGs (resulting in new jet fighter aces every other week)."[110]

The American fighter pilots were able to redeem themselves, however. On 30 November 1951, just five weeks after Namsi, the North Korean Air Force, which did not undertake offensive air operations very often during the war, attempted to bomb the South Korean ground forces holding the island of Taehwa-Do at the mouth at the Yalu river. The attacking aircraft were some thirty Tupolev Tu-2 medium bombers, Soviet-built propeller-driven aircraft. They were escorted by a mixed lot of propeller and jet aircraft. "Bones" Marshall scored the fourth of his six-and-a-half victories during the battle. As he recalls,

> The North Korean Air Force's bomber formations [were] devastated when they attempted their only daylight operation of the war, although the thirty Tu-2 medium bombers [were] escorted by many MiGs and [propeller-driven Lavochkin] La-9 fighters. Our F-86s so decimated the Communist bomber

> formation that they aborted their bomb runs just prior to reaching their target. To add insult to injury, more of the bombers [were] destroyed before they reached the safety of China. In addition, a large number of La-9s and MiGs [were] lost.[111]

The heavy losses suffered by the propeller-driven bomber forces of both sides in the Korean War served notice that the piston-engined bomber could not long survive in an environment in which jet-powered aircraft were operating. Alpheus W. Jessup, *Aviation Week*'s Korean War correspondent, wrote in 1952 that "today, the only safe assumption is that any bomber rated below mach .98 [98 percent of the speed of sound] is well on its way to obsolescence."[112] General Spaatz declared, "We must . . . replace our prop bombers with jets as rapidly as possible."[113] The USAF had several such bombers in development at the time. "But," as General Spaatz observed, "the change-over will take several years at best."[114] Until the new jet bombers became available, SAC continued to rely on the B-36. To better its chances of surviving an encounter with Soviet jet interceptors, the designers at Convair added four jet engines to the B-36, raising its top speed by twenty mph and increasing its service ceiling by almost 5,000 feet.[115]

Although most of the battles between jet fighters and propeller-driven aircraft were won by the jets, there was one type of combat in which the piston-engined aircraft not only held their own against the jets but actually bested them more often than not--night fighting. As was noted earlier, the North Korean Air Force lost air superiority early in the campaign. Driven from the daytime skies over the Korean peninsula, the NKAF, like the American B-29 force, retreated to the safety of darkness. From the summer of 1951 until the end of the war, the NKAF conducted a small-scale campaign of night harassment and nuisance missions against airfields and other UN installations in South Korea. Most of these raids involved but a single airplane. Nonetheless, they were surprisingly effective. Although they caused very little material damage,[116] their psychological effect was enormous. The United Nations response was far out of proportion to the threat.

Frederick Blesse remembers how annoying it was to be awakened by one of these nuisance raiders. "One of the maddening aspects [of the war] was 'Bedcheck Charlie,' a Russian-designed Po-2 biplane which kept us awake."[117] The Polikarpov Po-2 was a frail wood-and-fabric biplane that had first flown in 1935. It had a top speed of some eighty or ninety mph. The USAF was not prepared to fight "Bedcheck Charlie." It had gotten rid of the last of its propeller-driven night fighters shortly before the war began. The jet that had replaced them, the Lockheed F-94, was much faster than the Po-2. Indeed, the F-94's stall speed was greater than the Polikarpov's best speed (an airplane's stall speed is the minimum speed at which it can fly). Yet because it lacked any other night fighting aircraft, the USAF was compelled to use the F-94 against the night intruders. The results were disastrous. "Boots" Blesse remembers that "it was a long time before anyone got that guy [Bedcheck Charlie]. We heard an F-94 did the job but it was a midair collision. The controllers tracked him on radar and saw the interceptor accidentally fly into him. That was the end of Bedcheck Charlie but at the high price of two damned good fighter pilots and an expensive airplane."[118] A second F-94 was lost when its pilot slowed down to fire at another Po-2. Although he destroyed the intruder, his jet stalled and spun into the ground.[119]

When Admiral J. J. "Jocko" Clark , the commander of the Navy's Seventh Fleet, learned that the Air Force was having trouble with the night intruders and that the cause of the problem was "the inability of high performance jets to maneuver at the low altitudes and low airspeeds of [the] enemy aircraft, he immediately volunteered the services of 'our Navy planes which fly low and slow on every night mission.'"[120] Unlike the USAF, the Navy and Marine Corps still operated piston-engined night fighters at the time. These machines were very successful against the night intruders. Lieutenant Guy Pierre Bordelon, the navy's only ace of the Korean war, scored all five of his victories at night. Flying a Vought F4U Corsair, the night fighter variant of the famous gull-winged day fighter of World War Two, Bordelon was the last American airman ever to become an ace in a propeller-driven aircraft.[121]

The only Air Force jet pilots who had any luck at all against "Bedcheck Charlie" were the fliers who destroyed a couple of intruder aircraft parked at the Pyongyang main airfield on 16 July 1952. [122] The two aircraft had been left on the field after an American bombing raid earlier in the month had left the runway unusable. This attack had been part of an ongoing American campaign to neutralize North Korean airfields to prevent their use as MiG bases (the disastrous Namsi raid had been part this effort). The Americans would bomb an airfield, allow the communists to rebuild it, then bomb it again. The campaign was fairly successful. Unable to use the airfields in North Korea, the communists were forced to operate from the sanctuaries of China, far from the front lines.[123] In order to know when the repair work on the North Korean airfields were nearing completion, the Americans kept the bases under constant surveillance. American reconnaissance aircraft photographed the airfields in North Korea on a regular basis. Of course, the reconnaissance aircraft provided other useful intelligence as well.[124]

In the early days of the conflict, the USAF employed propeller-driven reconnaissance aircraft but these were soon supplanted by jet types. Jet airplanes could transit a hostile area far more quickly than piston-engined aircraft could, thus reducing their exposure to the enemy defenses. However, the high speed of the jets proved to be a liability as well as an asset. The technology of photography had not kept up with advances in aeronautics. The cameras installed in the jets had been designed for propeller-driven aircraft and had relatively slow shutter speeds. As a result, the photographs taken from jet aircraft often turned out blurred.[125] The solution was to have the reconnaissance aircraft fly over their targets at low speed, which negated their main advantage.[126] "RF-80s [the most common type of USAF reconnaissance aircraft] besides being . . . slower than the MiGs. [had] to slow down below 200 mph. when making photo runs because the camera equipment designed for use in the P-38 [was] too slow."[127] The Lockheed P-38 Lightning was a World War Two fighter airplane also used for reconnaissance.

The transition from propellers to jets brought about changes on the ground as well as in the air. The development of jet propulsion affected aircraft maintenance procedures and airfield construction techniques. It also made affected the task of shooting at an airplane from the ground.

Jet airplanes are much easier to maintain than propeller-driven aircraft, and "in the field, ease of inspection and maintenance are major factors. . . ."[128] A turbojet engine, having fewer moving parts than a reciprocating engine, is easier to repair when damaged, which "made it possible for jet units to constantly maintain a higher rate of [aircraft] availability than the conventional squadrons."[129] A jet airplane, lacking a propeller, has no need for a tall undercarriage, so most of them sit fairly low to the ground. Most of the parts of a jet airplane are within easy reach of a person standing on the ground, which reduced the need for workstands and ladders in most circumstances. "Generally speaking, [the jet engine's] accessories are more accessible. . . ."[130] Unlike a piston engine, a turbojet engine is relatively simple to install and remove. "Some [turbojet] units can be removed in less than half an hour."[131] Installation is similarly brief. "Approximately 150 man-hours are spent in the change of a conventional fighter engine; less than five man-hours are necessary to change a jet engine."[132] A jet engine requires fewer auxiliary components than a reciprocating engine. "The ignition system of a jet engine is required only to start the engine. . . . Once started, [it] has no further use, as the engine operates by continuous combustion."[133] A jet engine has no need of an elaborate cooling system (often the most vulnerable component of a piston engine). "They are self-cooled by the air flow and require no radiators or projecting air scoops."[134] Lubrication is similarly simple. "No oil is required in the combustion process, and very little is required in the few moving parts of the engine"[135]

As anyone who has ever attempted to start an automobile engine on a cold morning can attest to, a piston engine must be warmed up before it can be used, else it might be damaged. Turbojets do not have this problem. "They require no . . . warming-up, and will develop full power for takeoff in two or three minutes."[136] Test pilot Donald S. Lopez recalls his first flight in a jet: "It seemed odd to eliminate the engine run-up and magneto check that I had performed on every flight until this one."[137]

A jet engine is also easier to start than a piston engine. "You just pressed the button. . . ."[138] and an electric motor started spinning the turbine. Once the tachometer indicated a certain number of engine revolutions, fuel was introduced to the engine's combustion chambers and ignited. The engine could then sustain combustion on its own.

The electric motor that started the turbine was generally powered by an external source to conserve power in the aircraft's batteries. If a battery cart or other external power source was not available, it was possible to start the turbine spinning by directing the exhaust blast of another jet into the intake of the one needing the start.[139]

One of the few maintenance problems associated with the early jets was their constant need of brake repair and replacement. "Early on, jets' wheel brakes gave a lot of trouble, for the jets' clean lines, tricycle undercarriage, and lack of propeller drag, encouraged them to keep on moving."[140] Wheel fires were a fairly common occurrence until aircraft designers developed better, more powerful brakes for their aircraft projects.

The introduction of jet propulsion may have eased the work of maintenance personnel but it added to the concerns of the airfield engineer. The poor endurance of the jet airplanes employed in Korea made it necessary to build airstrips as close to the front lines as possible. However, during the first nine months of the war, the front lines moved frequently. "The number of strips needed was considerably increased by the short range of the jets."[141] The USAF operated some fifty airbases in Korea over the course of the war. It was also necessary to construct these airfields near waterways, when possible, "so as to permit fuel to be brought in by boat. It was impracticable to . . . keep a jet fighter group supplied with fuel by land transport."[142] A jet air group could consume as much as 125,000 gallons of fuel in a single day of combat operations.[143]

Jet airplanes need fairly long runways because they accelerate so very poorly compared to piston-engined aircraft. In a postwar analysis of airfield construction activities, a pair of Air Force engineers observed that "Modern runways for fighter aircraft approximately doubled in length over World War II models. . . ."[144] Yet even these longer runways were not always sufficient. Aviation Week's war correspondent noted in 1952 that "the [F-84] Thunderjet is still a '9,000-ft.' airplane and it is apparent that tactical aviation must operate from runways less than 6,000 ft. long."[145] Most of the forward airfields in Korea had relatively short runways. To allow the F-84s to operate from the short runways, they were often equipped with RATO (Rocket Assisted Take Off) units, small rocket tubes attached to the underside of the airplane. Ignited during takeoff, RATO provides additional thrust, allowing the airplane to become airborne in a shorter distance than would be usual. After takeoff, the RATO "bottles" are jettisoned.

The disposable RATO tubes were fairly expensive. The high command of the FEAF commissioned a study during the war to determine whether it would be better to build longer airfields in Korea or just continue to use RATO. The engineers who conducted the research concluded that "logistically and from a cost standpoint the extension of the runways to 9,000 feet would be far more economical than to employ [R]ATO."[146] When fired, RATO produces a thick and heavy cloud of smoke that does not dissipate quickly. A war correspondent who observed a squadron of F-84s taking off told his readers that "the first ships to take off held their bottles to the last second to leave the smoke as far down the runway as possible. Each succeeding pilot discharged his [RATO] just a little ahead of his predecessor."[147] The smoke cloud grew larger and larger, slowly advancing down the runway until "the last F-84s were barreling through the dense fog at a 150 mph. clip, taking off blind."[148]

The use of RATO can cause severe damage to an airport runway. "One of the most destructive forces which man can turn loose on an airfield pavement is the blast of a modern rocket."[149] The heat and pressure of the rocket exhaust is not the sole source of the damage. RATO rockets also leave a residue of nitric acid that can damage pavement where they are used.[150] Of course, most of the airbases in Korea did not have paved runways. To expedite airfield construction, Air Force engineers originally built airstrips in Korea out of pierced steel planking (PSP), also known as "Marston matting," which can be laid down quickly and easily. However, "the terrific blasts from the jet tailpipes dispersed the dirt foundation . . . under the landing mats,"[151] which made it difficult for the engineers to keep the runways smooth and level.

The rock and dirt displaced by jet exhaust blasts could be ingested by a jet engine, which is surprisingly fragile. "Any small particle—a bolt, screw, or cotter pin—that can be sucked down the intake of a jet aircraft will cause severe damage or catastrophic failure for a turning engine."[152] There is a record of a jet engine being destroyed after ingesting an overcoat.[153] Foreign Object Damage (referred to as "FOD" by almost everyone associated with aviation) is a constant concern to pilots and maintenance crews. The low profile of most early jet aircraft contributed to the problem because it put the airplane's engine intake so close to the ground. A jet engine is like huge vacuum cleaner, taking in huge volumes of air all the time. One early-model turbojet processed sixty pounds of air—960 cubic feet—every second.[154] The force of the suction was tremendous. The engine of the prototype F-80 actually sucked part of the airplane's intake duct into its own compressor during a test run.[155]

Also, the low profile of the first generation of jet airplanes provided very little ground clearance for underwing stores such as bombs or droptanks. Most aircraft wings are designed to flex under heavy loads. As the jets taxied over the uneven PSP surfaces of the Korean airfields, their wings would flex considerably. One pilot described the situation as "exciting. The armament cleared the taxiway by only a few inches and as you bounced along, the bombs would scrape the mat causing a flurry of sparks."[156]

One solution to this problem was to adjust the pressure in the jets' shock absorbers to its maximum level. This measure prevented the heavily laden jets from bouncing so much as they taxied and took off. However, when the airplanes landed, they would be much lighter, having dropped their ordnance, expended their ammunition, and burned off most of their fuel. "The shock struts, now stiff and unyielding, impose[d] severe loads on the [aircraft structure],"[157] which shortened the life of the airframe and made landing quite uncomfortable for the pilot. The airfield engineers would, when possible, put a layer of asphalt under the Marston matting. However, jet fuel acts as a solvent on petroleum-based paving surfaces. Dripping jet fuel greatly weakened the pavement, which was then blasted apart by jet exhausts, adding to the FOD hazard.[158] The engineers charged with maintaining the airfields in Korea eventually gave up trying to keep the PSP runways in good condition. Airbase engineers soon found it necessary to install hard-surfaced runways . . . as a matter of economy."[159] They addressed the problem of fuel spills and drips by insisting that aircraft parked only in certain areas.

The last group of ground personnel affected by the introduction of jet aircraft were the antiaircraft gun crews. In a speech given in 1948, the President of the Sperry Gyroscope Company, which made precision instruments for antiaircraft guns, noted that "shell velocity far exceeded airplane velocity when airplanes flew at speeds less than 200 miles an hour. The ratio was over seven to one."[160] Jet-propelled aircraft flew just under the speed of sound while antiaircraft rounds traveled at Mach 2 or so. "With the advent of targets [aircraft] of significantly increased speeds . . . the ratio has fallen to 2 ½ to 1."[161]

The antiaircraft gunner thus had much less time to react to, aim at, and fire upon an approaching jet airplane.

As a result, "jets suffered less [from flak] than did propeller-powered aircraft. The jets took fewer hits because they operated at higher speeds and altitudes than did the propeller aircraft."[162] Even if the flak did hit the jet, the jets could take "a phenomenal amount of punishment and still come home."[163] *Aviation Week* amazed its readers with photographs and descriptions of jet airplanes that had suffered tremendous flak damage yet had still been able to fly back to base.[164] "'It takes almost a direct hit by heavy antiaircraft,' said one pilot, 'to bring down an F-80.'"[165]

One reason that jets were so hard to knock down was their rugged and simple construction, as was noted earlier. Another reason was that jet fuel is much less flammable than regular gasoline. The JP-series of fuels are more like kerosene and have a relatively high flashpoint. The jets also had the advantage of flying and fighting at high altitudes where the air is thinner. There is much less oxygen available to sustain combustion should a fuel line, fuel tank, or engine component be damaged and fuel spilled onto hot engine parts.[166]

The Korean War is often referred to as "the first jet war."[167] It was not the first war in which jet airplanes were employed but it was the first in which jet aircraft were able to play a significant role. The experience of the various air arms that operated jet airplanes in Korea demonstrated that jets, despite their shortcomings, were very effective weapons. The deficiencies could be systematically addressed and corrected; the jet airplane was well worth developing. That the vast majority of the military airplanes in service today are powered by jet engines is a testament to the superiority of the jet, first established in the skies over Korea between 1950 and 1953.

CHAPTER III

THE PROBLEMS ENCOUNTERED BY THE UNITED STATES NAVY DURING THE TRANSITION FROM PROPELLER-DRIVEN AIRCRAFT TO JETS AND HOW THOSE PROBLEMS AFFECTED NAVAL AIR OPERATIONS DURING THE KOREAN WAR

Despite the problems described in the preceding chapter, the USAF was able to make the transition from propellers to jets with relative ease. The United States Navy (USN) was not so fortunate. The Navy experienced great difficulty during the early days of the jet era. American naval leaders were aware that the Navy needed to adopt the new technology as quickly as possible to maintain parity with the air arms of the potential enemies of the United States. They also had to consider that the operational requirements of their service called for the acquisition of airplanes capable of operating from aircraft carriers. Carrier-based aircraft must be designed to meet performance specifications far more demanding than those for comparable land-based airplanes because the flight deck of an aircraft carrier is so much smaller than a conventional airfield and because aircraft carriers have very limited repair and storage facilities. Unfortunately, the jets available to the Navy in the late 1940s, the early years of the jet era, were poorly suited for carrier operations. The aviators who would fly them needed time to learn how to do so; however, the Korean War began before they were completely ready. Naval aviators fought the war while still in the process of learning how best to operate jet airplanes from shipboard.

A number of factors contributed to the problems the Navy had trying to adapt jet airplanes for carrier use. "Modern carrier aircraft are heavier and larger in size than their predecessors,"[1] observed Admiral William M. Fechteler in 1952, the midpoint of his three-year tenure as Chief of Naval Operations. "Being jets, they consume more fuel. Their landing speeds are greater."[2] He might also have mentioned that jet aircraft accelerate and decelerate less quickly than piston-engined airplanes, and that jet engine intakes and exhausts created shipboard hazards unknown in the days of propellers. He did note, however, that the World War Two-vintage aircraft carriers then in service were inadequate for the needs of the jet age. Because jets were bigger, heavier, faster, and less economical than reciprocating-engined aircraft, "they require[d] a bigger ship to service and operate them."[3] Such larger ships, however, were not to appear for several years. In the five years between 1945 and 1950, Congress had been steadily decreasing the American military budget. Given the choice between funding a fleet of heavy bombers or a single "super aircraft carrier," Congress elected to buy the bombers. As a result, the Navy had to fight in Korea with aircraft carriers designed and built for piston-engined airplanes. Writing almost twenty years after the Korean War, Admiral Sir Arthur Hezlet wrote that during the Korean War, "the use of jet aircraft, even from the larger Second World War carriers, was a marginal operation."[4]

The most significant reason that jet aircraft were considered unfit for carrier operations was that they responded very slowly to changes in power. As late as 1958, sixteen years after the first flight of an American jet airplane,[5] a Navy Department publication warned that "in a turbojet plane, the pilot just doesn't have the speed control—whether in slowing down or speeding up—that he does in a reciprocating-engine plane."[6] For reasons that will discussed later, good acceleration and deceleration are highly desirable traits in a carrier-based airplane. Early jet airplanes had neither characteristic. Naval aviators found that "whether the throttle is pushed forward or pulled back, there's a short time lag before anything happens."[7]

Direct comparisons between the acceleration of propeller airplanes and jets always favored the former. One of the Navy's last propeller-driven fighters, the Grumman F8F Bearcat, "reacted to the application of power almost instantaneously; there was no discernable lag between opening the throttle and the R-28000 engine pushing you back in your seat"[8] In contrast, the powerplant of Grumman's first jet design, the F9F Panther, was not quite as responsive. "In the Panther, the J42's windup was leisurely at best."[9] Another early jet type, the Lockheed TO-1, received similar comments from fliers. A navalized version of the F-80 Shooting Star, the first American jet to enter service, the TO-1 "wouldn't take power as fast [*sic*] as a Corsair,"[10] one airman noted. The Vought F4U Corsair was one of the best piston-engined naval fighters of World War Two.

The poor acceleration of the early jets made it difficult for them to gain speed without diving, which meant that at low altitudes pilots needed to be particularly careful to maintain flying speed because they would not have sufficient height to recover from a stall safely. Jet "landing speeds were 30 to 35 knots faster than [those of] the speediest props"[11] and fliers unfamiliar with the differences between jet and propeller aircraft would often get too low and too slow, particularly while landing. Naval aviation accident rates reached a peacetime high in the years between 1945 and 1955.[12]

Although it involved an airplane belonging to the United States Marine Corps (USMC), the crash of an F9F in 1949 was typical of the sort of accident that could occur when a pilot failed to appreciate the special characteristics of jet airplanes. The airplane lost was one of the first jets delivered to the marines; its pilot was the Operations Officer of VMF-115, the first Marine squadron to convert to jets. Approaching the runway, he dropped below safe flying speed and attempted to recover by accelerating. Having never flown jets, Major [Herbert] Gomes . . . [was] not aware of the time required to get power on a jet engine after the throttle was advanced."[13] Gomes has committed a classic error. As one of his squadron mates observed, "Most of us thought power would be instantaneous as it was with reciprocating engines."[14] They were wrong. "If [while flying a jet] you tried to stretch a glide into a [landing] field and then overcome that by advancing the throttle," another Marine aviator cautioned, "you'd wind up in the boondocks. . . ."[15]

Baseball great Ted Williams nearly had a similar mishap in 1952. He had been recalled to the Marines that year and was taking a refresher course on flying, having flown piston-engined airplanes during World War Two). Like Gomes, he did not realize just how slowly a jet airplane responded to changes in power. Fortunately, the "Splendid Splinter" had enough altitude and airspeed to recover without crashing.[16]

Because jet aircraft accelerated so slowly, and because they were larger and had higher stall speeds than most piston-engined airplanes, the early jets required much more room than a propeller-driven aircraft to get airborne. One naval aviator, a fighter pilot with over a thousand hours experience flying propeller aircraft, remarked after his first flight in a jet airplane that "the ground takeoff run seemed excessively long"[17] Later, after transferring to a jet unit, he noted that "six thousand feet of runway was considered a workable minimum"[18] for jet operations. At the Naval Air Station at El Centro, California, which had runways 7,000 feet long, he "observed pilots routinely use every inch of the runaway on takeoff."[19]

Of course, an aircraft carrier is nowhere near six thousand feet long. The flight decks of the largest American carriers in service at the time, the *Essex*-class vessels, measured but 820 feet from bow to stern.[20] Of that length, just over half was used for launching aircraft. During launch operations, the aft portion of the flight deck was reserved for parking the airplanes waiting to take off. Propeller-driven aircraft could attain takeoff velocity in the short space of a carrier's forward deck without assistance.[21] Jets, however, could not, at least not under their own power. As Admiral Fechteler noted, "The effectiveness of jet aircraft depends on their being catapulted rather than flown from the flight deck."[22]

The aircraft carrier deck catapult had been developed during the 1920s as a means to assist heavily-laden airplanes get into the air from a carrier's deck. Early designs had relied on compressed air as their source of motive power; later models used gunpowder charges like those used in the main gun batteries of battleships.[23] Neither approach, however, proved very satisfactory, and in the late 1930s a hydraulically-powered catapult was developed. By the end of World War Two most American and British aircraft carriers were equipped with hydraulic catapults.[24] The hydraulic catapult "made catapulting a very common, practical thing for a ship" in the waning days of the propeller era.[25] Yet even hydraulic catapults were insufficient at times to meet the demands of launching jet airplanes. "The H-8 hydraulic catapult was a Frankenstein of complexities, all designed to squeeze the last possible ounce of push from the system,"[26] a Navy night fighter pilot would recall. "The [Douglas F3D] Skyknight, at its higher gross weights, often needed every one of those ounces and then some."[27] Hydraulic catapults were so badly underpowered that they could not launch heavily loaded jets unless the proper wind conditions existed. Wind was a factor because it directly affects the amount of weight an airplane can carry. Aircraft take off into the wind whenever possible to increase the volume of air passing over their wings, which creates lift. The more lift that is produced, the heavier the load that the airplane can lift into the air.

In keeping with this principle, aircraft carriers steer into the wind when launching aircraft. This maneuver creates a headwind over the deck equal to the force of the wind plus the speed of the ship. If the airplane being launched was particularly heavy, however, sometimes even this artificially augmented headwind was insufficient. The following remarks by retired Rear Admiral Paul T. Gillchrist illustrate the problem:

> The original H-8 catapult could accelerate a 25,000-pound airplane to an end speed of 35 knots. If the takeoff speed of that airplane were 135 knots, the carrier would have to generate 40 knots of wind over the deck [WOD] for a successful launch. Since the maximum speed of the Essex-class [*sic*] carriers was slightly over 30 knots, there would have to be at least 10 knots of natural wind to steam into to be able to operate. . . .[28]

The slim operating margins of the available hydraulic catapults greatly limited the effectiveness of the Navy's air campaign in Korea, particularly during the first year. Although the only jet airplanes the Navy operated in Korea were designed as fighters, they did have a secondary ground attack capability and naval mission planners wanted to be able to use them in the strike role as needed. In the early months of the war, however, the only external ordnance that could be carried by jets operating from shipboard were unguided air-to-ground rockets, which are relatively light weapons. The number of rockets each airplane could carry depended on the wind conditions at the time of launch. If the WOD was thirty-three or more knots, the airplane's full load of six rockets could be lifted. Every one-knot reduction in wind speed necessitated the removal of one pair of rockets, so that if the wind dropped below thirty knots, the jets had to take off without any external stores at all, relying only on their internal guns.[29]

It was not until April, 1951, eleven months after the beginning of hostilities in Korea, that the Navy was able to conduct a mission with carrier-based jet aircraft carrying bombs.[30] As was the case with the rockets, the bombload each airplane could lift was determined by the wind available at takeoff. Delays occurred frequently as the result of changing winds. As one veteran remembers:

> Many times we'd start off with 400 pounds of bombs. Before we got [launched] off the catapult, they [any of a number of officers with the authority to decide on weapons loads] decided we'd better unload a couple [of bombs] and we'd launch with maybe 200 pounds and a full load of ammunition because [a carrier-launched jet airplane] just didn't have the thrust . . . to get off the carrier unless you had a lot of wind.[31]

Even under the best wind conditions, launching jet aircraft from catapults could be a very hazardous exercise. An airplane was linked to the catapult by means of a cable "bridle," and it was not unknown for a bridle to fall off or break. The result was usually the loss of the airplane. With engines running at full power for takeoff, "most [jet] fighters have enough thrust . . . to get moving pretty fast [even] without a catapult."[32]

Traveling too quickly to slow down safely, yet lacking sufficient speed to get airborne, an airplane involved in a catapult "runaway" usually went "skidding off the bow with brakes locked."[33]

Early jet aircraft had trouble slowing down in the air as well as on deck. Jets decelerate very poorly compared to propeller-driven airplanes. "One of the advantages of the conventional airplane . . . is that when power is reduced, the prop acts as a brake—an effect which is absent in the turbojet airlane."[34] Another reason that turbine-powered airplanes lost speed so slowly was that they were designed to be very efficient aerodynamically. Early jet engines delivered relatively small amounts of power, so aircraft designers strove to create airframes that would generate as little drag as possible. Compared to most propeller-driven airplanes, which usually have all sorts of drag-producing bumps and bulges on the wings and fuselages, early jet types had remarkably "clean," smooth contours, and so "were inherently faster than props, and because of lower total drag, they would also decelerate slower [*sic*]."[35]

The poor deceleration of early jet aircraft, combined with their slow acceleration, greatly impaired the efforts of the Navy to adapt jet airplanes for carrier service. The most significant problems associated with the inadequate throttle response of the early jets occurred during carrier landings, by far the most critical portion of naval aircraft operations. An indication of the seriousness of the problem can be found in *Naval Aviation in Review*, an informal history produced in 1958 by the Department of the Navy for popular audiences, which noted, "In carrier landings, the absence of quickly available power is somewhat troublesome until the pilot gains some experience in carrier-jet operations."[36] If the situation was still being described as "troublesome" by an official source a full ten years after the Navy had begun deploying jets to its carriers,[37] the problem was undoubtedly much worse in the early days of the jet age when no naval aviator had much experience flying jets from carriers.

The navy's first jet pilots discovered very quickly that the poor throttle response and other handling deficiencies of early jet airplanes made carrier landings far more difficult and dangerous than they had been during the propeller era. The standard procedure for landing airplanes on carriers in the late 1940s and early 1950s had been developed during the propeller era specifically for piston-engined airplanes and entailed evolutions much better suited for reciprocating-engined airplanes than for jets. It was not until the late 1950s, when the mirror landing system and the angled flight deck were introduced, that a jet carrier technique tailored to the flight characteristics of jet aircraft were devised, so throughout the Korean War all carrier landings, by both propeller aircraft and jets, "were made in the classic military pattern: overhead pass at low altitude, break, dirty up, short turn to final, and almost immediate landing."[38] Unfortunately, the performance deficiencies of early jet airplanes caused problems at almost every step of this process.

Of course, before the recovery procedure could begin, the carrier had to be prepared to receive aircraft. If there were aircraft parked on the aft end of the flight deck when the order to recover aircraft was given, they had to be "respotted forward," moved to the front of the ship to clear the landing area. At the same time, the carrier began heading into the wind.[39] Aircraft land into the wind for the same reasons that they take off in that direction; additionally, the increased flow of air over their control surfaces make them more responsive and easy to handle.

While the carrier was being made ready, the aircraft waiting to land would enter a holding pattern, called the "orbit," above the vessel. Piston-engined airplanes usually made their circuits at an altitude of about two or three hundred feet. However, "the [high] rate of fuel consumption of jet aircraft at low altitudes require[d] that they . . . hold altitude above 20,000 feet until a few minutes before . . . landing."[40] Except in extreme emergencies, both piston-engined and jet airplanes circled the ship in a counterclockwise direction, and usually flew the orbit stepped to the right in echelon formation, with the airplane scheduled to land first in the lead position.[41]

Most naval air operations during the Korean War were conducted with a mix of jet and propeller aircraft, the typical mission force being a unit of piston-engined attack aircraft escorted by a small number of jet fighters. These aircraft would remain together until they reached the vicinity of the carrier. The jets were usually given priority to land because their fuel reserves were so much smaller than those of the propeller-driven aircraft. "If . . . both jet and prop planes [were] on a mission, the prop planes usually [took] off first and land[ed] last because of their greater endurance."[42]

If all was in order, the ship's Landing Signals Officer (LSO), stationed on a platform on the port side of the carrier's stern, gave the waiting pilots permission to land by transmitting either the Morse code letter "C" or the word "Charlie" over the radio. The ship's signal crew would also hoist the "C" pennant on the mast to communicate the LSO's instructions to aircraft without radios and to alert other ships in the area that aircraft recovery operations were underway.[43] The "Charlie," as the LSO's signal was called, informed the pilots in the holding circuit that they could lower their tailhooks, "let down into the [landing] pattern and start making passes."[44]

Each section of aircraft was cleared to land by the LSO separately. "Jets and prop aircraft [were] seldom mixed in the landing pattern because of their different speeds and turning radii."[45] After their section had received permission to land, individual aircraft would "break" from the orbit, waiting until after they had passed the ship on an upwind leg before doing so. Each aircraft would initiate a wide descending turn, lowering its flaps and landing gear and dropping to masthead height. "When it was done right [*sic*], the first pilot after 180 degrees of turn would be directly opposite the LSO's platform, headed downwind and ready to start his first approach. . . ."[46] The other aircraft in the flight would follow, "stretching out behind [the leader] in trail in what would become an oval, racetrack-like pattern."[47] Propeller aircraft usually maintained a thirty-second interval while in the landing pattern; the higher speeds of jet types warranted a forty-second separation between aircraft."[48]

Coming abeam of the ship's stern, the aircraft would then "get into the groove," as carrier personnel used to refer to making a landing approach. The airplane, slowed to near stall speed, would make a "continuous, almost flat turn"[49] towards the carrier. Ideally, at the completion of this maneuver, the aircraft would be just above the ship's fantail, ready to set down on the landing ramp.[50] Before he could land, however, the pilot would have to negotiate the "burble," an area of turbulence just aft of the ship like the draft behind a tractor-trailer rig moving at high speed. His task was further complicated by the need to compensate for the movement of the ship. Even in calm seas, a carrier will pitch and roll enough to cause the flight deck to rise and fall several feet and to tilt considerably from side to side.[51]

Very few airmen have the skill to make a carrier landing unaided, so at the midpoint of the turn to final the pilot began watching the LSO for guidance. Using a pair of large red signal paddles, the LSO would indicate to the pilot the proper airspeed, altitude, and angle of bank needed to land safely.[52] The pilot depended utterly on "Paddles," as the LSO invariably nicknamed, to get his airplane onto the deck. Indeed, the final decision to land or not land was made by the LSO, not the pilot.[53] If, at anytime during the landing pass, the LSO determined that the aircraft would not be able to land safely, he would give the pilot the "wave-off" by raising his paddles over his head and waving them emphatically. The pilot's response to this signal depended upon the type of airplane he was flying. If he were in a piston-engined aircraft, he would simply add power and go around or above the carrier. Once clear, he would reenter the landing pattern and make another attempt.[54]

The pilot of a jet airplane would also try to go around again but could not be sure that his engine would respond quickly enough to the sudden power demand. With "no immediate power at his disposal with which to regain positive flying speed,"[55] the pilot would need plenty of warning should he need to be waved off. This requirement "created a time constraint for the LSO. He had to anticipate that a pilot was getting into trouble before it happened, while there was still room [and time] for the pilot to respond successfully."[56]

The pilot also needed to react quickly. From the moment he came under the LSO's guidance, "the . . . approaching pilot could count on seeing, processing and responding to only one or two signals before either getting waved off or being committed to a landing."[57] The margin of error was small. "The alternatives [to landing safely] were not pleasant. Flying into the water was not desirable; flying into the blunt end of the boat was disaster."[58]

If the airplane was not waved off, the LSO would instruct the pilot to land by "giving the cut," dropping his left paddle to his side and bringing the other smartly across his chest. The time at which this order was given depended upon the type of airplane that was landing. A propeller-driven aircraft was not given the cut until it was over the flight deck. "In a prop airplane, when the Landing Signal Officer [gave] a cut, the pilot [took] off power, and his airplane [hit] the deck in a landing attitude."[59] However, because "chopping the throttle [had] no immediate effect upon [an early jet] airplane's speed,"[60] the cut would have to be given earlier so that the airplane could decelerate sufficiently. "Therefore, the cut [was] given [to a jet pilot] when the airplane in the groove [was] a good distance astern of the ship; and during the relatively long slowing-down process the pilot [kept] flying the plane until I land[ed]."[61]

If all went well at touchdown, the airplane's tailhook would engage one of nine arresting "wires," actually heavy cables, running across the aft end of the flight deck. These cables were under considerable tension and would bring the airplane to a complete halt very quickly. "You don't land on a carrier, you get snatched out of the air,"[62] one pilot described the experience, which could be quite violent. Another naval aviator, amplifying the previous sentiment, noted that the common expression "'Carrier landings are controlled crashes' is only part euphemism."[63]

Occasionally, however, the tailhook would miss all nine wires and the airplane would roll or fly into one of a series of special emergency barriers just forward of the landing area. "The most common accident on axial-deck [pre-1955] carriers involve[d] planes running into the barrier because of missing the wires of the arresting gear."[64] These barriers consisted of two stanchions, each about four feet high, on either side of the flight deck, with a number of heavy cables strung between them. Hydraulically operated, the barriers were raised before each landing, then folded back down to permit each airplane that touched down to be taken forward to the parking area at the bow of the ship.[65]

A piston-engined airplane would usually engage the barrier with its propeller or landing gear, and although these components might be badly damaged by their contact with the barrier cables, the rest of the airframe generally avoided damage. The pilot, too, stood a very good chance of escaping serious injury, as the cockpits of most propeller airplanes were located well back on the fuselage. When a piston-engined aircraft struck the barrier, its "nose, propeller, and engine block provided . . . protection for the pilot."[66] On the other hand, jet airplanes and jet pilots usually did not fare so well in collisions with the barrier. "The cables proved dangerous to the jet pilot and caused great damage to jet aircraft."[67] As was noted above, most early turbine-powered aircraft were very highly streamlined. Lacking propellers and long undercarriage legs (the primary purpose of which was to provide adequate ground clearance for an airscrew), they tended to slide almost entirely through the barriers, not halting until the vertical tail assembly became entangled in the wires. The heavy steel cables would thus come into contact with much of the airplane's structure, most of which was lightweight aluminum and could be damaged quite easily. The heavy cables also endangered the pilot. Most early jet airplanes had their cockpits located fairly far forward, near the nose, the first part of the airplane to strike the barrier. The pilot's only protection came from the cockpit canopy, a fragile bubble of

Plexiglas. It does not take much imagination to picture the carnage that could result when a jet airplane smashed through the heavy barrier cables at high speed.[68]

A second type of accident also involved the barriers albeit indirectly. Up until the mid 1950s, American aircraft carriers were designed with "straight" or "axial" flight decks, meaning that aircraft both landed and took off on a single axis, parallel to the centerline of the ship. Aircraft parked on the bow of the ship were directly in the path of those that were landing. If the landing airplane was not arrested by the landing wires or the barrier, it would crash into the airplanes forward. As has been noted earlier, early jet airplanes decelerated slowly and so could maintain flying speed for some time after the throttle was closed. As a result, they tended to "float" over the flight deck before touching down. It was entirely possible for an airplane to remain airborne long enough to fly over both the arresting cables *and* the barrier. Unable to accelerate to safe flying speed, the jet would continue along the length of the flight deck, descending steadily until it went "plowing into parked aircraft at the bow and causing fire and damage."[69] Such collisions could be disastrous if fuel or ordnance ignited. On 17 September 1951, while on station off of the coast of Korea, the USS *Essex* experienced a spectacular accident of this sort that killed seven seamen, wounded nearly thirty, and destroyed four aircraft.[70]

Similar mishaps occurred on American aircraft carriers throughout the early jet era, during both training and combat operations.[71] Walter Schirra, a naval aviator who who flew over ninety combat missions in Korea before becoming a Mercury astronaut, once wrote, "On straight-deck carriers, there were . . . [either] arrested landings or there were major accidents. There was nothing in between."[72]

Because barrier accidents involving jets were so frequent and so dangerous, a new type of arresting gear was developed in the early 1950s. Called a barricade, this new device was like the barrier except that it consisted of vertical strips of nylon fabric instead of horizontal steel cables. "The barricade was higher than the barriers and was much more effective at stopping the newer airplanes."[73] The arrangement of the nylon strips allowed an airplane's nose to pass through but not its wings. Because the fabric went around the sides of the airplane and was not dragged over its upper surfaces, the risk of injury to the pilot was reduced. Use of the barricade also decreased the chances of damaging the airframe. As the barricade was designed to engage the entire wing, it distributed its braking force more evenly across the aircraft's structure. The first American carrier to be equipped with the new device was the USS *Antietam*, which had barricades installed in time for her 1951-1952 Korean War cruise. Other carriers soon followed.[74] The barricade remains in use to this day, although the introduction of the angled flight deck (on which airplanes do not land parallel to the ship's keel) has greatly reduced its necessity.

Of course, the barrier and barricade were emergency equipment and the majority of carrier landings occurred without incident, despite the performance shortcomings of the early jets. Yet even when it had landed and was securely aboard the carrier, a jet airplane created problems for carrier crews. Some were merely inconveniences, while others were very real hazards to life and limb.

The safety hazards associated with carrier operations in the jet age were very different from those of the propeller era. In the days of piston engines, the most significant danger on the flight deck or hangar deck was the propeller. Although "propwash," the air blown back behind a spinning propeller, could sometimes knock a man off his feet,[75] the propeller itself can be deadly. The 1950 edition of *The Bluejackets' Manual*, a handbook for sailors, warned seamen that "the moving propeller of a plane can kill or seriously maim a man who gets too near to it. A rapidly moving propeller is not visible and you may be closer to it than you think."[76] Fortunately for carrier personnel, the risk was limited to the immediate area of the propeller. The majority of propeller-related injuries and fatalities have involved actual contact with the whirling blades."[77]

A jet, on the other hand, could endanger people at long range. Powerful enough to propel an airplane at speeds sufficient to sustain flight, "the exhaust blast [of a jet engine], even at considerable distance, can burn a man or throw him over with force enough to cause bruises or lacerations."[78] Sailors working anywhere near a jet airplane had to exercise constant vigilance to avoid the invisible peril. Inattention could have tragic consequences. The November, 1951, issue of *All Hands*, an information and entertainment magazine for naval personnel, contained the following eyewitness account of an incident that could easily have had a much less happy ending:

> Seeb [Aviation Bosun's Mate Johny Seebold] was running this chock from under an F9F to the catwalk. . . . This jet starts taxiing up to the catapult and just as Seeb gets this chock to the catwalk the plane swings its tail around and—wingo!—the blast picks Seeb up by the seat of his pants and drapes him across the rail. A couple of feet more and he would have gone over the side.[79]

Little wonder, then, that *The Bluejackets' Manual* cautioned its readers that they should "never get within 100 feet of the rear of a jet aircraft that is about to take off or to taxi; nor within 100 feet in any direction if it is possible that the jet plane may turn. . . ."[80] A carrier crewman of the early jet age might have had a little difficulty obeying that last directive. The beam of the *Essex*-class carriers was only about one hundred fifty feet.[81]

So strong was the blast of a jet that it could damage equipment and knock over other airplanes.[82] The problem became so acute that the Navy had to install jet blast deflectors (JBDs) aft of each catapult on its carriers to protect the aircraft, men, and machinery behind the "cats." The JBDs were hydraulically extended during launches and retracted to permit aircraft to be taken to the catapult.[83] Another precaution involved the way that jet airplanes were moved about on the flight deck. A photograph in the 1951-1952 cruise book of the *Antietam* shows a line of F9F Panthers waiting to be launched for a mission over Korea. Their engines already running, the Panthers are arranged so that their tails hang over the edge of the flight deck. Their noses were "angled in so [the] tail blast [went] harmlessly outboard."[84]

Jet exhausts also posed fire hazards. The pilot's handbook for the F9F-6 Cougar, an advanced variant of the Panther, notes that its exhaust plume could reach a temperature of over one thousand degrees Farenheit.[85] The F3D Skyknight had the exhaust pipes of its two engines canted downward to protect its tail surfaces from heat and blast damage. However, this feature caused problems when the airplane was operated from shipboard. "Even at idle engine speeds, the heat gushing onto the deck was formidable. At full power, such as when waiting for a catapult shot, the exhausts were like twin blowtorches. . . ."[86] Most of the American carriers used in Korea still had wooden flight decks. "The heat [from the engines] would bake the wood, which had . . . been previously saturated with oil and fuel spills. Eventually, a minor conflagration would start."[87] A fire on board ship is a very serious matter, but most of the flight deck fires started by jet exhausts were small enough to be put out by a deck hand with a hand fire extinguisher. There was only one major fire on an American aircraft carrier during the Korean War, and it was caused by the explosion of an airplane's fuel tank.[88]

A jet engine's intake is also dangerous, though not as much as its exhaust. A jet engine must ingest great quantities of air to sustain combustion, particularly when it is idling on the ground. The current of air thus produced is strong enough to sweep a man off his feet. "Serious injury can result from the suction at the front of a jet plane. If a man ventures too close, he may be sucked against the intake scoops and held there . . . until the engine can be shut down."[89] It is even possible, if the intake opening is large enough, for a man to be pulled into the jet engine's gullet entirely. [90] Such accidents occur with distressing frequency. "That is why there are all those big yellow signs aboard ship, the ones that say 'Beware of Jet Intakes.'"[91]

Yet for all of its power, a jet engine is surprisingly fragile, as was noted earlier. A small piece of metal or other debris sucked into an engine can wreck a turbine blade and cause the engine to tear itself apart. Foreign object damage ("FOD") has been taken very seriously from the start of the jet age,[92] and as a preventative measure, carrier crews conduct frequent "FOD walkdowns." A line of men walking shoulder to shoulder inspect the flight deck from bow to stern looking for trash and other loose material that might get drawn into a jet intake and turn a multimillion dollar engine into a useless pile of junk.[93] Such litter was not simply a hazard to aircraft. "Flight decks were carefully swept of all debris which, if hard and solid and then picked up by a jet's efflux, could act as a rifle bullet and kill someone."[94]

Of course, not all of the difficulties associated with handling jet aircraft on shipboard were potentially lethal. Some were merely nuisances. The storage problems created by jet aircraft were generally of this nature. As was observed earlier, an airplane that has to be launched from shipboard was connected to the catapult by a heavy cable bridle. The bridle was not permanently attached to either the airplane or the catapult and so would be flung out to sea and lost.[95] "Strange as it may seem, the limiting factor to how long a carrier could operate at sea was not its supply of food, drinking water, fuel, etc. It was how many . . . bridles it could carry!"[96] The expense associated with this method of launching led the Navy to investigate ways to recover the bridles. A solution was found, but not until after the Korean War had ended.[97]

The aircraft themselves were difficult to store as well. Because space is so limited on board a ship, carrier-based airplanes are usually designed with folding wings. This arrangement permits more aircraft to fit into a given area. However, jet aircraft tend to be larger than piston-engined airplanes, and so need more room. Aircraft designers also have to take the height of an airplane with folded wings into consideration, because the airplane has to fit into the carrier's hangars below decks.

The *Essex*-class carriers had a hangar deck clearance of seventeen feet, six inches. The F9F Panther, one of the Navy's first jets, and the most common naval jet employed in Korea, was designed with this figure in mind. "The Grumman engineers optimized this one; the airplane fit, but just barely."[98] However, the F9F, like most early jets, consumed fuel at a prodigious rate and the Navy soon decided that all Panthers were to have external fuel tanks bolted permanently onto their wingtips (the Panther was used primarily for ground attack duties so there was no need to use jettisonable fuel tanks). The tanks installed on the Panthers were large enough that the F9Fs could no longer fit into the hangar deck when their wings were folded. Grumman's designers had to adjust the wing folding mechanism. "As modified, the wings when folded leaned about 35 degrees away from the vertical—outboard, that is, not inboard."[99] As a result, the F9Fs took up more floor space. They had to be parked farther apart from each other, or arranged so that they alternated facing, the nose of one plane next to the tail of another, packed so tightly that it was difficult to take a specific airplane out of the line to be serviced. As one former naval aviator wryly observed, "A whole generation of aircraft-handling officers on *Essex*-class carriers went gray or simply tore their hair out over [the problem]."[100]

The poor fuel economy of the early jet aircraft also created other storage problems on the carriers. It was noted earlier that the Navy employed both jet and propeller-driven aircraft in Korea. Each carrier had squadrons of both types on board. However, piston-engined aircraft ran on AvGas, grade 115/145, while jets used either JP-4 or JP-5, similar to kereosene.[101] "Since there wasn't the capacity aboard [the *Essex*-class carriers] to store two kinds of fuel, at sea the jets burned 115/145 too."[102] The use of AvGas in jet aircraft caused a number of problems. AvGas is more flammable than jet fuel and so had to be stored in the ship's armored fuel compartments.[103] Also, AvGas is more dense than jet fuel. "Every time we switched from one kind of fuel to the other . . . we had to reset all the fuel controls [in the aircraft],"[104] one Navy plot recalled in his memoirs. He also noted that the high levels of lead in the AvGas left thick, gooey deposits on turbine parts, which degraded engine performance. Although the residue would burn off when the airplane reverted to jet-grade fuel, such fuels were available only at shore installations. "Aboard ship we just put up with the mess."[105]

The insatiable appetites of jet airplanes for fuel, armament, and other support had a profound effect on naval operations during the Korean War. The carriers constantly needed to resupply. The Navy's official history of the Korean Conflict notes that "each jet sortie cost the parent ship a minute in replenishment alongside a tanker."[106] A carrier had to withdraw from combat to take on fresh supplies. "Our usual routine on the line was to fly three days and replenish on the fourth,"[107] a flier recalled. "High-intensity flight operations could empty [a carrier] of 'beans, bombs, and bullets' in a couple of days."[108] The Navy's logistical organization, which had been able to sustain a huge fleet of aircraft carriers in the Pacific theatre during World War Two, was severely tested during the first of the so-called limited wars. The high "fuel consumption of jets strained the capacity, not only of the parent carriers, but of ammunition ships and oilers as well."[109]

The Korean War experience revealed a number of problems associated with the operation of jet airplanes from aircraft carriers. Eventually, though, the Navy was able to find solutions to most of these problems. Some were brought about by advances in aviation technology. Today's jet engines are much more powerful than those of the 1950s, enabling modern jet airplanes to accelerate much more quickly than their predecessors. Air speed brakes and lift dumpers (spoilers) permit jets to slow down without reducing power, making carrier landings more safe. Jet engines still consume vast amounts of fuel, but inflight refueling more than compensates for this shortcoming, and ejection seats make it possible for an airplane's crew to abandon a crippled aircraft rapidly with a minimum of danger.[110]

The carriers, too, have changed. The Korean War experience demonstrated to Congress the need to fund new aircraft carriers and modernize the old ones. Modern carriers have steam-powered catapults that can launch a heavily laden airplane to flying speed in zero-wind conditions. The catapult has been redesigned to attach directly to an airplane's nosewheel strut, eliminating the need for a bridle. The angled flight deck permits an airplane that misses the arresting wires to go around again without endangering other aircraft parked on the deck. The mirror landing system enables airplanes to fly a straight descending approach for landing instead of the flat turning "groove" approach. And the ships themselves are larger, with more capacity for bigger airplanes and the fuel, crews, ordnance, and spare parts they need.[111]

Yet these advances were not available to the Navy during the Korean War (Indeed, most of them were developed as a direct result of experiences in that conflict). Three years of combat operations demonstrated very effectively the problems inherent in operating ships and aircraft that were not compatible with each other. Nevertheless, American naval aviators managed to overcome the problems of jet carrier operations during the conflict through hard work and perseverance. For the first eighteen months of the war (July, 1950 to December, 1951), the ratio of sorties flown by jet aircraft to sorties flown by piston-engined aircraft was one to two. The ratio rose to two to three over the next six months. Between June 1952 and February 1953, the ratio of jet to prop sorties was one to one. Finally, during the last five months of the war, naval aviators actually flew more jet sorties than they did propeller sorties. The ratio during the final part of the war was four to three.[112] This progress demonstrated that it was possible to operate jet airplanes from carriers during wartime. The Navy continues to do so to this day.

CHAPTER IV

THE LIMITS OF AIR POWER:
THE KOREAN WAR CAMPAIGN EXAMINED IN THE CONTEXT OF THE AIR POWER THEORIES OF WILLIAM MITCHELL AND GIULIO DOUHET

By the time the Korean War began in June of 1950, the United States of America was firmly committed to the use of military air power as its primary instrument of national policy. Air power had played a significant, perhaps decisive, role in the Allied victories over Nazi Germany and Imperial Japan during World War Two, and American military planners were confident that air power would prove to be equally important in any future conflict.[1] Thus, when it was determined that the United States would go to war in Korea on behalf of the United Nations, there was little doubt that it would do much of its fighting in the air. The United States was the most powerful nation on earth at the time, due primarily to the strength of its air arm, the United States Air Force, which had no equal in either reach or power anywhere in the world.

The prevailing American air power doctrine at the time of the Korean War was based to a large extent on the writings of two important and influential air power theorists, of the early twentieth century, Giulio Douhet and William ("Billy") Mitchell. Both men were early advocates of air power, and their works were instrumental in defining the role of air power in war. Their books provided the theoretical basis of the American air campaigns against the Axis powers during World War Two, the success of which had much to do with the acceptance of the USAF as the primary expression of national military power projection and the emergence of the United States as the world's preeminent military power in the years following World War Two.

Because the American air campaigns of World War Two had been so successful, it was only natural that USAF planners believed that they could conduct the Korean air campaign in much the same way that they had conducted their 1942-1945 operations. Thus, the Korean air war, like the air campaigns of the Second World War, was originally intended to be fought according to the precepts of Douhet and Mitchell. As it turned out, however, Korea was a limited war, limited in scope and objective; and Mitchell and Douhet had written about unlimited, or general wars. As a result, the air campaigns in Korea departed from as well as confirmed with the model air war scenarios created by Mitchell and Douhet. To understand better how and why air power practice departed from theory in Korea, it is important to know that the concept of "limited war" as it is understood today did not exist at the time that Mitchell and Douhet were writing. Both men were veterans of World War One and had only their experiences in that conflict upon which to base their theories. Although their books predicted quite accurately the course of future wars (because they so profoundly influenced future warfare), neither

Mitchell nor Douhet could have foreseen the vast changes in the world's sociopolitical order that brought about the need to wage "limited" wars. The wars with which Douhet and Mitchell were familiar were generally unrestricted, bordering on "total" wars, in which the warring powers mobilize their entire populations and their entire economies, "The wars of the future will once more involve all nations and all their resources, with no exceptions,"[2] Douhet predicted.

Total wars tend to be wars of technology. Fought by highly industrializes powers relying on machines as well as men. World war One, in which three significant new military technologies were employed for the first time, was no exception. Two of these technologies, the tank and the submarine, were simply new developments in the traditional milieux of land and naval warfare. However, the third innovation, the airplane, made it possible to take war into an entirely new realm, the earth's atmosphere, adding, literally, another dimension to warfare.

The airplane was a relatively new creation, having been invented but eleven years before the outbreak of hostilities. "The European war was only the kindergarten of aviation,"[3] Mitchell would recall. At the beginning of the war, none of the belligerent powers fully appreciated the potential military applications of aircraft. As the war progressed, however, more and more uses had been found for aircraft. By the time of the armistice, a multitude of roles had been found for airplanes, including tactical and strategic bombing, ground attack, dogfighting, and reconnaissance. Yet the evolution of aerial strategy and tactics during World War One was a rather haphazard affair, a matter of opportunity and trial-and-error rather than planning. No coherent all-encompassing doctrine for the employment of air power had appeared either before or during the war. It remained for Mitchell and Douhet to devise such doctrines; synthesizing their ideas from observations made during the 1914-1918 conflict.

Douhet and Mitchell recognized that the airplane's unique abilities gave it the potential to become the single most valuable weapon in any nation's arsenal. Douhet, commander of the Italian air service in the latter part of the war, first published *Il Dominio Dell'Aria* (*The Command of the Air*) in1921. Revised and enlarged versions appeared in 1928, 1929, and 1930, the last posthumously. Although an authorized English-language edition did not appear until 1942, translations of his works were circulating among U. S. Army Air Service personnel as early as 1932.[4] Mitchell, who had commanded the air arm of the American Expeditionary Forces under General Pershing during World War One, wrote *Winged Defense* in 1924. A second edition was released a year later.

Despite the differences in their authors' backgrounds, *Winged Defense and The Command of the Air* were remarkably similar works. Both share as a central thesis the ability of air power to transform the nature of war. No longer would armies and navies be the dominant military arms. "An aerial bombardment . . . will certainly have more influence on the realization of victory than a battle of the kind fought during the last war without appreciable results,"[5] wrote Douhet. Air forces could reach any point on earth, unimpeded by considerations of terrain. "The frontiers in the old sense—the coastlines or borders—are no longer applicable,"[6] Mitchell claimed. Able to bypass hostile surface forces by flying over them, aircraft could strike directly at the vital centers of the enemy's heartland. Any country "subjected to incessant aerial attacks . . . whatever its surface forces may be able to do, must arrive at the conviction that . . . all hope is dead.

This conviction spells defeat."[7] Wars in the future would be won or lost in the air, Mitchell concluded. "The influence of air power on the ability of one nation to impose its will on another in an armed contest will be decisive."[8]

Not only did Mitchell and Douhet agree that air power would be the decisive factor in future conflicts, they also held similar ideas regarding how military air power should be applied. Both men devoted substantial portions of their works to descriptions of a model air campaign. These models address the basic methods by which air power can be used to strike at a hostile nation, and although they have been modified somewhat in the intervening years (primarily as a result of experienced gained in World War Two and later conflicts), they still provide the basic format for the conduct of military air campaigns to this day.

According to both Douhet and Mitchell, the first task to be undertaken in any air campaign is the elimination of the opposing air arm. Activities directed against an enemy air force are today identified as "counterair" operations." These operations are important for two reasons. Deprived of his air force, the enemy can no longer threaten one's own land, sea, or air forces; and one's own air arm can range at will over the enemy's territory, attacking whatever targets present themselves. Mitchell, in a passage reminiscent of Alfred Thayer Mahan's *The Influence of Sea Power on History*, noted that "once an air force has been destroyed it is almost impossible to build it up after hostilities commence, because the places capable of building aircraft will be bombed. . . ."[9] To this statement can be added Douhet's observation that "after we have destroyed the enemy [air force], we would be free to choose targets at our own convenience, because our country would be safe from attacks."[10] The essence of aerial warfare, then, is aerial superiority, the control of the air. Both Mitchell and Douhet understood the importance of establishing air superiority, mentioning it often in their writings. The concept of air supremacy was, of course, the central thesis of Douhet's work, hence its title.

How does one go about defeating an enemy air arm and obtaining air supremacy? Mitchell felt that the answer was "to whip the enemy's air force in aerial battles. . . . [by] menacing his airplanes on the ground, in the hangars, on the airdromes and in the factories. . . ."[11] The enemy would have no choice but to take to the air and defend these targets. However, Douhet cautioned that "destroying an enemy's airplanes by seeking them out in the air is, while not entirely useless, the least effective method." [12] He felt that it would be "much better . . . to destroy his airports, supply bases, and centers of production."[13]

It was during World War Two that Mitchell's and Douhet's theories concerning air superiority were first tested in actual warfare. By the time hostilities broke out in 1939, the need to control the skies in a war zone was acknowledged by most of the belligerent nations' military establishments (no doubt because of the influence of Douhet and Mitchell). Many of the aerial operations of World War Two might be identified as counterair. The Battle of Britain, for example, took place because the German High Command recognized that an invasion across the English Channel could not succeed unless Britain's Royal Air Force was eliminated or at least neutralized..

American air planners also understood the need to establish and maintain air superiority. War Department Field Manual FM 100-20, *Command and Employment of Air Power*, issued during the summer of 1943, the midpoint of American involvement in World War Two, identifies six basic tasks for military air power. The first, and most important, of these tasks is the destruction of the enemy's air force, which is "accomplished by attacks against aircraft in the air and on the ground, for the application of air power."[14] Once control of the air was established, the air force would then be free to carry out its other responsibilities.

American military planners continued to stress the importance of establishing air superiority in the years after World War Two. General Robert M. Lee remembers that "we [in the Air Force] still maintained the philosophy of a requirement for control of the air. . . . "[15] after World War Two. The USAF went into Korea with this philosophy. As it turned out, it was impossible for the USAF to conform to the precepts espoused in Douhet, Mitchell, and FM 100-20 for much of the Korean War. The political leadership of the United States feared that the Soviet Union or the People's Republic of China might become more involved in the war (by striking at Taiwan or Japan instead of limiting their activities to the Korean peninsula). As a result, "the Joint Chiefs recommended that the Far East Command's air offensive not be extended beyond the Yalu into Manchuria [China] itself. . . ."[16] Unfortunately, this directive had the effect of putting most of the enemy's air assets out of reach of the USAF. The North Korean Air Force had never been much of a threat; most of the opposition to UN air activities came from Chinese and Soviet aircraft. These aircraft were based in China on the wrong side of the Yalu. The only place that the Americans could meet the Chinese Air Force was in the air over the two Koreas. "The enemy's sanctuary in China greatly compounded our problems in maintaining air superiority. . . ."[17] Communist aircraft could venture across the Yalu, make a quick pass against an Allied aircraft, and then dash back to safety across the river. American bombers striking at targets near the border of China were especially vulnerable to these hit-and-run tactics. "It's too late to fight the air battle in and around the bombers," one frustrated fighter pilot charged. "The enemy has to be engaged . . . a minimum of a hundred miles in advance of the bombers' target,"[18] which, of course, would not have been possible unless the Americans' self-imposed prohibition against crossing the Yalu was lifted.

Brigadier General James Ferguson, commander of the Fifth Air Force in Korea for much of the conflict, shared his men's concerns. "Although our B-29s and fighters came within a few miles of the Yalu," he said later, "we were denied the opportunity of wiping them out. . . . ."[19] He did, however, abide by his orders. There were, however, incidents in which American aircraft overflew the Yalu, usually in pursuit of an enemy airplane originally engaged over Korea. "We were forbidden to cross the Yalu river but we did it anyway,"[20] ace pilot "Boots" Blesse would confide in his autobiography. Yet even the pilots who violated Manchurian airspace observed certain restrictions: attacking enemy aircraft on the ground was always prohibited. "If he was flying, okay, shoot him down, but if he was even rolling down the runway, no dice because that's really ground attack,"[21] which, of course, could be construed as an attack against Chinese sovereign territory and might lead to an escalation of hostilities.

Curiously, the communists seem to have imposed some restrictions on themselves. Communist aircraft rarely approached the main battle area along the 38th parallel. "In the Korean war there wasn't a single [air] attack that I was able to identify that was put against our ground forces,"[22] observed General William Momyer.[23] Communists pilots were hesitant to fly over the sea as well, which enabled American and UN naval forces to operate freely in the waters around the Korean peninsula. The reluctance of communist pilots to fly over open water also gave some measure of relief to UN aircrews, who could evade pursuing hostile aircraft by heading out to sea.

Generals Momyer and Ferguson have speculated that the communists' apparent timidity might have been occasioned by the need to protect their identities.[24] The presence of Russian airmen in Korea was long suspected but has not been confirmed until recently. American pilots frequently reported seeing enemy fliers with European features and blond hair.[25] The presence of non-Asian airmen in Korea would have indicated that the Soviets were more extensively involved in the conflict than they had been willing to admit at the time. Until the fall of the Soviet Union, the official Soviet position was that they were only supplying military equipment to the Chinese and North Koreans.

The communists' refusal to fly into the main battle area or open water may have also been motivated by a desire to protect Soviet technological secrets. Among the equipment provided by the Soviets to the Chinese and North Korean armed forces was a new type of fighter, the Mikoyan-Gurevich MiG-15. Comparable to the best fighters produced in the West, the MiG-15 came as a great surprise to western intelligence because the Soviets were believed to be at least five years behind the United States in jet engine technology. The Americans were so concerned about the new Soviet fighter that they made several attempts to recover the wreckage of downed MiG-15.[26] They could learn little from these badly damaged machines and consequently decided that an intact MiG-15 was needed. To this end, Operation "Moolah" was launched. The USAF dropped thousands of pamphlets over North Korea offering a reward of $100,000 to the first communist pilot to deliver a flyable MiG-15 to UN forces. On 16 September 1953 (several months after the peace accords were signed at Panmunjon) a North Korean pilot, Lieutenant Kum-Suk No, flew his MiG-15 to an American air base in South Korea. Although he claimed not to be aware of the reward, he was paid anyway.[27]

Thus, the "limiting" of the Korean War air superiority battle came about because of decisions made by both sides. The Americans refused to actively pursue the elimination of the communist air forces; the communists stayed away from areas in which UN land or sea forces operated. Both powers had valid reasons for their decisions, based on the political considerations of the times, but by imposing restraints on themselves, neither side was able to realize fully the advantages of air superiority that Mitchell and Douhet described in their works.

Even without the security afforded by establishing complete air superiority, the USAF was still able to conduct a wide variety of operations in Korea. American tactical aircraft maintained a constant presence over the battle lines, flying support and interdiction missions in support of American and UN ground forces throughout the campaign. Combat Cargo Command kept the units at the front supplied with the vast amounts of men and materiel needed to fight a modern war. Aerial reconnaissance provided valuable and timely intelligence to allied commanders, and medical and rescue aircraft saved the lives of thousands of American and allied servicemen. The USAF also attempted to carry out a large-scale strategic bombing campaign against industrial and other targets in North Korea for most of the conflict.

Strategic bombing is the cornerstone of the air power theories of Douhet and Mitchell. Both men recognized that modern wars are economic as well as military contests and understood that strategic bombing provides a new and unique opportunity to strike directly at the economic strength of a hostile nation. "An attack from an air force using explosive bombs and gas may cause the complete evacuation of and cessation of industry. . . . "[28] No longer would wars have to be decided on the battlefield. "Once one had to be content with destroying a battery with shells;" Douhet wrote, "today it is possible to destroy the factory where the guns for the battery are being built."[29] All facilities that contribute to the enemy's war effort, including "manufacturing and food centers, railways, bridges, canals and harbors,"[30] are appropriate targets for strategic bombing, because their destruction impairs the enemy's ability to wage war. It is easier to cripple an army by cutting off its supplies at their source than it is to defeat that army in the field. Navies are similarly vulnerable. "In terms of military results, it is much more important to destroy a railroad station, . . . a war plant, or any other behind-the-lines objective, than to strafe or bomb a trench."[31]

Mitchell and Douhet both also believed that strategic bombing was an effective psychological weapon. Experiments with strategic bombing during World War One indicated that noncombatants in communities that had been bombed grew fearful and anxious far out of proportion to the material damage inflicted. Recognizing that modern warfare is a struggle of national wills, Mitchell and Douhet argued that strategic bombing could be used to demoralize the civilian population of a hostile nation, thus hastening its capitulation. By combining physical destruction with psychological pressure, "bombing units spread terror and havoc, . . . and break down the moral and physical resistance of [the enemy] people."[32] No modern industrial nation could withstand attacks against both its military economy and the morale of its people, Douhet believed, leading him to write, "Such offensive actions can . . . bomb the interior of the enemy's country so devastatingly that the physical and moral resistance of the people would also collapse,"[33] And so certain was Mitchell that strategic bombing could paralyze a nation by demoralizing its population that he ventured to predict that "in the future the mere threat of bombing a town . . . will cause it to be evacuated, and all work in munitions and supply factories to be stopped."[34]

Neither Mitchell nor Douhet lived to see their theories about strategic bombing put into practice, the first real opportunity to implement their ideas not occurring until World War Two. In that conflict, both the United States and Great Britain conducted strategic bombing operations against the Axis powers. The test of combat revealed both strengths and weaknesses in the concept of strategic bombing. The validity of "offensive air warfare [directed] against the sources of strength, military and economic, of [one's] enemies. . . ."[35] was demonstrated quite convincingly. As one historian has observed, "Complex industrial societies *can* be hamstrung by a judicious pattern of destruction."[36] Yet that same historian has noted that the bombing of civilians with the intention of lowering their morale was shown to be a waste of resources. "Almost universally, morale bombing was a diappointment."[37] On the whole, however, the strategic bombing campaigns could be considered to have been successful.

Strategic bombing continued to be a central part of American military policy after the war. A textbook published by the Air Tactical School of the USAF's Air University in 1949 identifies one of the wartime missions of the Air Force as the "destruction of the economic capacity and will to wage war [of the enemy]."[38] This task is accomplished "through the systematic application of force to a selected series of vital targets. . . ."[39] Although the text cites a number of examples from World War Two that demonstrate that strategic bombing can reduce a nation's "war-making capacity to a point where [it] no longer retains the ability to . . . wage war,"[40] how the destruction of "vital targets" can adversely affect a country's will to continue fighting is not explained.[41]

Nevertheless, the United States committed itself totally to strategic bombing in the late 1940s. The limited American defense budgets of the immediate post-World War Two era forced defense planners to choose between a new fleet of heavy long-range bombers or a single new aircraft carrier. The nation could afford one of the other but not both. Congress, understanding that as an emerging "superpower," the United States needed to be able to project its military power globally, chose to fund the bomber program.

The new bombers had not yet entered service in 1950, so when the Korean war most USAF bomber units still were equipped with World War Two-vintage B-29aircraft. These machines were immediately available and began flying combat missions three days after the beginning of hostilities. The B-29 had been instrumental in the American victory over Imperial Japan five years earlier—Japan had not been invaded but, as some argued, had been bombed into submission—and Allied commanders were confident that the Superfortress would be equally successful in Korea. However, the Korean War was fought under very different conditions than those existing during world War Two, limiting the effectiveness of the B-29 and the American strategic bombing effort.

For one thing, North Korea was not a particularly appropriate subject for a strategic bombing campaign. Although more industrialized than South Korea, North Korea was in the early 1950s primarily an agricultural nation. What little industry existed north of the 38th parallel was identified and attacked early on in the conflict. "The targets in North Korea were fewer and required less force to destroy or neutraliaze,"[42] General

Momyer has written. Although there were few worthwhile targets in North Korea that remained unbombed at the end of August 1950,[43] the B-29s were kept in action for the rest of the conflict. The bombers were simply assigned to other missions against different target types. "The FEAF commander used the B-29s in Korea against airfields along the Yalu, against interdiction targets, against industrial facilities, and at times for close air support,"[44] this last an activity for which the B-29 was not very well suited.

The problems faced by the USAF mission planners in finding targets in North Korea was anticipated by Douhet, who had foreseen that strategic bombing was best employed against nations with highly concentrated wealth and a dependence on technology. A large scale bombing campaign would not be very effective against a preindustrial country such as an agrarian society or "a nomad people living in the desert; but . . . would be very effective . . . against a highly civilized people living in large centers of population."[45] An agricultural economy such as that of North Korea offered few conspicuous targets for strategic aerial bombardment.

It should not be assumed, however, that strategic bombing is completely unable to inflict economic damage against a primarily agricultural nation. Mitchell himself noted several times in *Winged Defense* that farms, ranches, and other-food-producing areas are valid targets for strategic bombardment. "Air forces will attack centers of production of all kinds, means of transportation, *agricultural areas*, ports and shipping, . . ." (italics supplied)[46] he wrote. His logic seems sound: a food shortage will certainly have an adverse effect on the ability of a nation to fight effectively. Yet surely Mitchell was not suggesting sending vast fleets of aircraft to rain down bombs upon open fields and gardens. It would be much easier to target a nation's food distribution network. The

Allies never attempted a systematic destruction of German or Japanese farmlands during World War Two. North Korea is much smaller than either of the two major Axis powers but the task of destroying the millions of acres of cultivated land in North Korea would seem impossible. Was Mitchell simply exaggerating the capabilities of air power, as he has often been accused of doing?

He was not. In Korea, the United Nations air forces did indeed strike at the farms and agricultural economy of North Korea. However, this campaign was not targeted directly against the farms, fields, and pastures of the country. Instead, the bombs fell upon the system of dams upon which North Korean agriculture relied. "In a traditional war strategy . . . dams represent a target system of limited value."[47] But Korea was not a traditional war. Lacking other, more obvious targets, USAF mission planners had to be willing to consider any and all parts of the North Korean economy as possible targets. The dams were identified as potential targets in the middle of 1952, but UN and USAF commanders were originally reluctant to order strikes against them, fearing that air strikes against North Korea's food supply would be used in anti-American propaganda by the Chinese, Soviets, and North Koreans. By the summer of 1953, however, it was decided to proceed with attacks on the dams. Mission planners hoped that the attacks would break the military stalemate and encourage the communists to speed up the armistice negotiations then in progress. It was known that the dams supplied three-quarters of the water needed for North Korea's rice production, so the air strikes not only raised the possibility of famine in North Korea, but "also raised the likelihood that China would have to supply rice from her own strained economy"[48] to support the communist war effort. Food production was the only part of the North Korean economy that had not suffered greatly during the war. Air Force planners also hoped that the water released from the dams when they burst would damage roads ands rail lines in downstream areas.

Five dams were attacked between 13 May and 14 June 1953. Two of the dams were breached, resulting in floods that caused massive damage for miles downstream. The other three dams were also destroyed but not until after the North Koreans had drained their reservoirs. Although this action prevented flooding, it did deny the North Koreans a significant source of irrigation water. Another result of the dams raids was the destruction of some 90 percent of North Korea's hydroelectric system.[49] General Mark W. Clark, commander of UN forces in Korea for the last fourteen months of the war, was quite pleased. "The breaching of the Toksan dam has been as effective as weeks of rail interdiction,"[50] he wrote in a command report in May of 1953.

Yet despite the occasional spectacular success, the American bombing campaign against North Korea failed to achieve its purpose. The nation's ability to wage war was never seriously impaired. The factories producing the guns, tanks, and aircraft used by the North Korean armed forces were located in China and the Soviet Union, and thus could not be bombed. Some Americans, among them General Douglas MacArthur, the first commander of UN forces in Korea, wanted to bomb targets in Chinese Manchuria, but American President Harry S. Truman and other UN leaders, attempting to contain the war within the Korean peninsula, forbade such actions (see Chapter V). Attacks against China or the Soviet Union could easily have caused the limited Korean conflict to escalate into a world war. So the strategic bombing offensive in Korea was affected by political consideration in much the same way that the air superiority was.

The air war in Korea, for the most part, was fought according to the precepts of Giulio Douhet and William Mitchell. Air superiority and strategic bombing remained the most important tasks of air forces, but with modifications occasioned by the political realities of limited war. Nevertheless, although Mitchell and Douhet had created their theories to apply to total, or unlimited, war involving industrial nations, both Mitchell and Douhet would have recognized what was going on in the air over Korea between 1950 and 1953. The underlying principles of aerial warfare, which they themselves had established, have changed little since the days of World War One.

CHAPTER V

THE ULTIMATE MANIFESTATION OF AIR POWER: THE IMPACT OF ATOMIC WEAPONS UPON THE CONDUCT OF THE KOREAN AIR WAR

As was recounted in the preceding chapter, two of the most influential early advocates of air power were William Mitchell and Giulio Douhet, who in the 1920s argued that the development of the military airplane had forever changed the nature of warfare. Both men were avid proponents of strategic bombing and predicted that aerial bombardment would play a decisive role in any armed conflict in the future. Both Douhet and Mitchell recognized that bomber aircraft could strike directly at the economic sources of a nation's military strength and thus destroy its ability to wage war. They also observed that strategic bombing had a demoralizing effect upon civilians and thus could be used to destroy the will of a nation to continue fighting.

The first opportunities to put the theories of Douhet and Mitchell into practice occurred during World War Two (which neither man lived to see). The strategic bombing campaigns against Germany and Japan during World War Two were generally considered to have been successful although they did not produce the spectacular results Mitchell and Douhet had described in their works. Strategic bombing failed to bring about the collapse of civilian morale that Mitchell and Douhet both expected to happen. Most civilian populations subjected to aerial bombardment during the war actually grew more resolute and willing to continue fighting. Douhet and Mitchell also predicted that strategic bombing could shatter a nation's economy and paralyze its ability to wage war within weeks, if not days, of the onset of hostilities. The experience of World War Two indicated that although bombing raids could indeed physically destroy a nation's warmaking ability, this process could take several years. Additionally, Mitchell and Douhet had written that armies and navies would no longer be needed in the future, as air power would be the decisive factor in warfare. Certainly, air power contributed to the Allied victories over the Axis powers in World War Two, not by replacing land and sea power, but by heavily supplementing them.

Ironically, however, a new weapon had been introduced during World War Two that appeared to give the strategic bomber all of the abilities that Douhet and Mitchell had originally attributed to it. Possessed of enormous destructive power, this new weapon could indeed annihilate an entire city. Used in quantity, this new weapon could quickly and easily destroy a nation's capacity to wage war. This new weapon also inspired great fear and awe; the mere threat of its use created a climate of terror throughout the world immediately after World War Two. Combined with this new weapon, strategic bombing would finally become the decisive force Douhet and Mitchell had thought it could be.

This new weapon was the atomic bomb, of course. An American invention, developed during World War Two, the atomic bomb was not successfully tested until after the fighting in Europe had ended. Japan, however, had not yet capitulated, and American President Harry S. Truman quickly authorized its use against Japan. On 6 august 1945, an atomic bomb was dropped on the city of Hiroshima. A second bomb was used against Nagasaki three days later. The Japanese surrendered shortly thereafter, ending World War Two.

The Korean War began five years later. Korea, like Germany, was a divided nation in1950, partitioned after World War Two into a communist north and a democratic south. Neither Korean government could tolerate the existence of the other, so on 25 June 1950, North Korea invaded South Korea, almost completely overwhelming it. The United States quickly intervened, committing land, sea, and air forces to the defense of South Korea as part of an international coalition fighting under the auspices of the United Nations organization (UN). Although almost twenty other countries would eventually take part in UN operations in Korea, the American contribution to the UN war effort was by far the largest and the United States provided most of the UN's military leadership. Accordingly, most policy decisions regarding the conduct of the Korea War were made in Washington, not at UN headquarters.

The Korean War was thus the first major world conflict involving a nation already in possession of atomic weapons when it entered into hostilities. The United States had the option to employ atomic weapons at any time during the Korean War. This ability had a profound effect on the conduct of the war. It affected nearly every decision the Americans made about the policy, strategy, and tactics of the Korean conflict.

The civil and military leadership of the United States did consider the use of atomic weapons in Korea. President Truman's office admitted as much publicly in November, 1950, in a press release noting "consideration of the use of any weapon is always implicit in the very possession of that weapon."[1] Yet atomic weapons were never used in Korea. The United States deliberately refrained from employing the single most powerful weapon in its arsenal. Why did it not?.

One of the most compelling reasons that atomic weapons were not used in Korea was that the theatre offered so few appropriate targets. It was observed in Chapter IV that North Korea contained very few targets for strategic bombing of any sort. Indeed, the USAF was hard pressed to find gainful employment for its B-29 bombers carrying conventional weapons. "Within eight days after the outbreak of war in Korea, B-29s . . . were dropping bombs in North Korea. Within a matter of weeks they had destroyed the few strategic targets in North Korea."[2] If there was not enough military and economic activity in North Korea to warrant a full-scale strategic bombing campaign with conventional weapons, there certainly was not enough such activity to make atomic bombing worthwhile. As air power theorist Alexander deSeversky, a disciple of Douhet and Mitchell, noted shortly after the fighting in Korea began, "There are no genuine strategic targets in Korea."[3]

Because there were so few strategic targets in North Korea, the heavy bombers[4] of the USAF were often assigned to tactical targets instead. Tactical missions are those generally performed in support of friendly ground forces. The B-29, designed for the role of strategic bombing, was "not considered the ideal aircraft for the job, but it [was] available in large numbers. . . ."[5] and made to do.

Of course, like the B-29, atomic weapons could be used tactically. In November, 1950, Paul Nitze, Director of the Policy Planning staff, discussed the possible uses of atomic weapons with a representative of the Army, General Herbert Loper. After their meeting, Nitze circulated a memorandum in which he observed that "if the [atomic] bomb were used in Korea it would be for tactical purposes."[6] Yet Nitze recognized that there would be very few opportunities for such usage, noting that "such targets would . . . have to be created. . . ."[7] How such targets were to be created was not explained. A considerable number of the enemy would have to be concentrated in a relatively small area to make the use of tactical nuclear weapons worthwhile. It seems unlikely, however, that either the Chinese or the North Koreans would allow themselves to get into such a situation. "Very few atomic bombs could be used as few targets could be created,"[8] Nitze concluded.

Of course, such situations could develop spontaneously. American military intelligence identified four occasions during the course of the war in which suitable conditions existed for the use of tactical atomic weapons.[9] All four took place in the six weeks between 24 November 1950, shortly after the communist Chinese entered the conflict, and 8 January 1951, after which the Chinese had distributed themselves more evenly throughout the theatre. Of course, "intelligence did not establish the existence of the [first two] hostile concentrations . . . until they were breaking up"[10] and the third and fourth masses of communist troops were located too near American and UN positions for atomic bombs to have been employed without risking serious casualties to friendly forces.[11] Also, "there was some reason to believe that the United Nations Command forces would not have been well enough prepared to use such weapons effectively."[12]

Never again would such opportunities present themselves. President Dwight D. Eisenhower, who succeeded Truman in 1953, noted that during his administration, "the Joint Chiefs of Staff were pessimistic about the feasibility of using tactical atomic weapons, in view of the extensive underground fortifications which the Chinese Communists have been able to construct."[13]

Although North Korea was an unsuitable environment for the employment of nuclear weapons, China and the Soviet Union most certainly were not, each full of potential targets. That the United States might attack either nation was discussed many times during the conflict. General Douglas MacArthur, the first Supreme Commander of UN forces in Korea, wanted to use atomic bombs against targets in both North Korea and China in December, 1950.[14] Two years later, MacArthur, who had since been relieved by Truman for insubordination, submitted to President-elect Eisenhower a plan to end the Korean Conflict by threatening to attack the Soviet Union with atomic weapons if need be.[15] However, Truman and Eisenhower were both committed to limiting the conflict to the Korean peninsula, and neither indulged MacArthur. There was too large a risk of precipitating a worldwide war.

The possibility of a nuclear war between the United States and the Soviet Union provided ample opportunities for sabre-rattling in both countries. Truman's Secretary of State, Dean Acheson, recalled that "General Orville Anderson, Commandant of the Air War College, announced that the Air Force . . . only awaited orders to drop its bombs on Moscow. The resulting furor led to Anderson's early retirement"[16] The Soviets were equally bellicose. *Pravda* warned that 'in the event of a United States attack on our country, the ruling circles will use the atomic bomb."[17] The Soviets had exploded their first atomic device in 1949.

The Chinese were less sanguine. Sardar K. Panikkar, the Indian ambassador to Peking (as Beijing was known at the time), spoke to General Nieh Yen-Jung, acting Chief of Staff of the Chinese army, shortly after the UN landing at Inchon. Nieh, talking about the possibility of Chinese intervention in the war and the risks of conflict with the United States, said, "The Americans can bomb us, they can destroy our industries. . . . They may even drop atomic bombs on us. What then? They may kill a few million people."[18] Panikkar asked if the Chinese could truly withstand the widespread destruction caused by atomic warfare. Nieh's reply was, "China lives on the farms. What can atom bombs do there?"[19]

Of course, had the decision been made to use atomic weapons against the Koreans, Chinese, or Soviets, the USAF could not guarantee delivery. The only American bombers capable of carrying atomic weapons in the early 1950s were the Boeing B-29 Superfortress, the aircraft that had bombed Hiroshima and Nagasaki; the Boeing B-50, an advanced version of the B-29; and the Convair B-36, a ten-engined intercontinental bomber.[20] Only the older B-29s were deployed to the Far East. The B-50s and B-36s remained in North America as a deterrent to possible Soviet aggression. "The U. S. A. F. just didn't want to waste its first-line equipment in Korea," nor would it necessarily help.[21]The B-36, B-29, and B-50 were all propeller-driven aircraft (although the B-36 had four jet engines to augment its piston engines) and were no match for jet-propelled interceptors such as the Mikoyan-Gurevich MiG-15 (see previous chapters). Even with jet fighter escorts, B-29 losses in Korea were so heavy after the MiG-15 debuted that the USAF restricted the Superfortress to night missions. The MiG-15 served in the Soviet, Chinese, and North Korean air forces, raising serious doubts about the USAF's ability to deliver atomic weapons against any nation equipped with jet interceptors (see Chapter II).[22] Until the B-29, B-50, and B-36 could be replaced, the USAF had to be very careful with its bombers, as the chances of them surviving a long-range penetration mission were greatly reduced by the existence of hostile jet fighters. "Certainly, the capability of continuous atomic-bombing [*sic*] is . . . much less than it was prior to the Korean War. Perhaps the best that can be hoped for is a successful, one-time atomic attack."[23]

In addition to the military factors discussed above, there were also a number of political considerations that contribute to the American decision not to employ atomic weapons in Korea. The American civil authorities knew that world opinion would be overwhelmingly against such employment. It must be recalled that the Americans were in Korea as part of the United Nations, and although the United States for the most part directed UN operations in Korea, neither Truman nor Eisenhower wanted to act unilaterally on a matter of such import. The opinions of the other members of the world community had to be taken into account.

President Truman, in his memoirs, acknowledged the concern of America's allies about the possibility of using nuclear weapons in Korea or Manchuria. "Just how sensitive and on edge the world had become was demonstrated when the words 'atomic bomb' were mentioned at my press conference on 30 November [1950]."[24] The incident, which had worldwide repercussions, had begun innocently enough. The conference had been called so that the President could discuss the military situation in Korea. The UN had suffered a serious setback when China entered the conflict earlier in the month. The President was discussing the various possible responses to the Chinese intervention, and remarked that the United States "will take whatever steps are necessary to meet the military situation [in Korea][25]. Responding to that statement, one of the reporters in attendance asked the President if those steps included the use of atomic weapons.

"That includes every weapon that we have,"[26] replied the President.

The reporter repeated Truman's words, confirming that the President had indeed used the phrase "every weapon we have." Following up his own question, he asked, "Does that mean that there is active consideration of the use of the atomic bomb?"[27] "There has always been active consideration of its use," said Truman. "I don't want to see it used. It is a terrible weapon. . . ."[28]

Truman could not have anticipated the reaction his extemporaneous exchange with the reporter would generate. Within the day, however, it became apparent he the President's statements were being interpreted to mean that the Unites States was planning to employ atomic weapons in Korea or Manchuria. Charlie Ross, the President's press secretary, issued a press release after the conference to clarify Truman's remarks. "The replies to the questions at today's conference do not represent any change in this situation."[29] Intended to allay fears that Truman had threatened to use nuclear weapons in Korea, the statement stressed that, "by law, only the President can authorize the use of the atomic bomb, and no such authorization has been givem."[30] The damage to American credibility had already been done, however.

The reaction from overseas was immediate. The American representative to the United Nations, Warren R. Austin, spent much of the day speaking to foreign diplomats and assessing their reactions. Reporting to Secretary of State Acheson, the next day, Austin noted that 'if [the atomic] bomb [is] used, [the] effect on US relations would be disastrous for years to come."[31] A number of Europeans expressed their concern that Truman had blundered greatly.[32] "Federer, [a] German observer, felt [that the] threat or even [the] use of [the] A-Bomb would solve nothing."[33]

Truman recognized that America's European allies had genuine cause for concern. "The possibility of general war . . . was much more frightening to the inhabitants of Paris and London—barely recovered as they were from the ravages of the last war. . . . "[34] Most Europeans felt that their continent would be the primary battleground in any future conflict between the United States and the Soviet Union. Without careful management, Korea could escalate into such a conflict. "Europeans generally assumed that a new war would be a battle of atomic weapons, and the slightest mention of atomic bombs was enough to make them jittery." [35]

Even after the clarification was issued, America's allies were still concerned about the Korean situation. Truman recalled that "news reports persisted that I had threatened to use the A-bomb in Korea,."[36] Acheson noted that "in London the House of Commons, engaged in a five-day foreign policy debate, received an erroneous report that General MacArthur might be given discretion to use the atomic weapon."[37] Unhappy that Truman appeared to have made a unilateral decision about the use of atomic weapons in the Far East, "one hundred labor MP's [Members of Parliament] signed a letter to Prime Minister [Clement] Atlee to protest the possibility of the use of the atomic bomb."[38]

Atlee himself was so perturbed by the press conference that he flew to Washington to speak to Truman personally. Although other matters were discussed, Atlee's primary concern was the possible use of nuclear weapons in Korea. Truman's memoirs contains the following account of their meeting: "He asked me if my recent press-conference statement had been intended to be a hint of some sort that perhaps we were giving more active thought to using the bomb. I assured him that nothing of the sort was intended and told him in detail how the statement came to be made."[39]

However, the Prime Minister sought more than reassurance from the President. Acheson recalled that "he wished Britain to be admitted to some participation with us in any future decision to use nuclear weapons."[40] All that came from the meeting was a vague promise that the United States would "consult" Great Britain before using atomic bombs. No formal and binding agreement was ever produced.

The Truman administration also was concerned about the racial and ethnic issues raised by the possible use of atomic weapons in Korea or China. The United States was founded by Europeans, and most of its population was of European heritage. China and Korea were Asian nations and a good many Asian national leaders thought that it was no coincidence that Germany had been spared atomic bombing during World War Two while Japan had suffered not one but two atomic attacks during the conflict. In early November, 1950, before President Truman's unfortunate press conference, John Emmerson, the planning advisor of the State Department's' Bureau of Far Eastern Affairs, informed Dean Rusk, the Assistant Secretary of State for Far Eastern Affairs, that the feeling in Asia was that "the A-bomb has the status of a peculiar monster conceived by American cunning and its use by us, in whatever circumstances, would be exploited to our serious detriment."[41] He went on to observe that if nuclear bombs were used in Korea or Chinese Manchuria, "fears that we reserve atomic weapons exclusively for Japanese and Chinese would be confirmed, [and] our own efforts to win the Asiatics to our side would be cancelled. . . . "[42]

After Truman's press conference of 30 November 1950, reaction from Asian leaders and diplomats was quite strong. The next day, Warren Austin at the UN informed his superiors that "several Arab delegates went out if their way to convey [the] fear, as expressed to them by Asian delegates, that [the] A-bomb might be dropped again on [an] Asian people."[43] Ironically, the Israelis agreed with the Arabs that Ross' clarification had done little to dispel the impression that the United States was preparing to employ nuclear weapons in Korea. Two days later, the Assistant Secretary of State for UN Affairs, John Hickeson, reported that "[Indian premier Jawaharlal] Nehru believes that it is a matter of absolute necessity to avoid use of the atomic bomb."[44]

Interestingly, Indian Ambassador Panikkar noted that in China itself the only apparent response to Truman's words were an increase in anti-American propaganda and the construction of bomb shelters along the city walls of Beijing. His diary offers insight into the attitude of the Chinese. He observed that "they know that they have but few industries to be destroyed and equally they know the bombs the Americans may make for a hundred years will not be sufficient to destroy the manpower of China."[45]

The Chinese "would have been able to do little"[46] in the event of a nuclear attack, but the Soviets could have launched a nuclear strike of their own, another reason why the Unite States did not want to employ atomic weapons in Korea. The American "nuclear monopoly" had lasted but five years. The Soviet Union had tested its first atomic device in September, 1949, a mere eight months before the outbreak of hostilities in Korea, but was believed to have built up its atomic stockpile quickly. Carlton Savage, a member of the Policy Planning Staff of the Joint Chiefs of Staff, observed in early 1951 that "with atomic weapons in the possession of the Soviets, if we use them, they will almost certainly be used against us."[47] American and UN forces in the Far East, at the end of a long logistics trail extending across the Pacific, would be inviting targets for Soviet retaliatory strikes, far more vulnerable than communist forces operating in their home territories. "UN forces and installations are, in general, better targets for atomic weapons than those of the enemy. . . . "[48] The Joint Chiefs of Staff estimated that some 1,1000 soviet bombers were based in eastern Asia, and "expected that at least some of these bombers are capable of delivering atomic weapons."[49]

There was also concern that, if provoked by the use of atomic weapons in Korea, the Soviets might choose to widen the conflict by attacking nations not directly involved in the Korean War. "Our allies would be likely targets for atomic attack, particularly those in whose territory we have air base rights."[50] Even though the Soviets were probably unable to deliver nuclear weapons to the United States itself, American allies in Asia and western Europe were within easy reach of Soviet bombers. The United States had too many commitments to adequately defend its many allies against nuclear attack in the early 1950s. President Eisenhower recalled in his memoirs, "Of all the Asian targets which might be subjected to Soviet bombing, I was most concerned about the unprotected cities of Japan."[51]

Another factor contributing to the decision not to use atomic weapons in Korea was the feeling in American political and military circles that the Korean War was a

Soviet diversion intended to distract American and world attention from Europe. The United States and the Soviet Union had both emerged from the Second World War as "superpowers," and both considered Europe to be a key component of their national security needs. Between 1945 and 1950, the two nations concentrated on building up their respective spheres of influence in Europe, the Soviets in the east and the Americans in the west, with both sharing Germany. The Berlin crisis of 1948, which precipitated the year-long Berlin airlift, greatly increased tensions between the superpowers. These tensions had not been significantly reduced by 1950. Two months before the Korean War began, Tracy Voorhees, Undersecretary of the Army, reported to Secretary of State Acheson that "probably our greatest military danger is that the Russian Army will overrun western Europe."[52]

The Truman administration committed American forces to Korea despite some serious reservations. "The North Korean attack was a limited operation designed to . . . commit western forces to relatively non-vital areas."[53] A memorandum circulated by the National Security Council (NSC) written on 29 June 1950, shortly after the war began, cautioned the American military establishment to be alert to the possibility of Soviet aggression in other theatres.[54] Two days later, a draft report prepared by the NSC warned that the United States did not have the resources to fight in both Korea and another region.[55] By November, when China entered the conflict, it was recognized that the use of atomic bombs in Asia would "make it difficult, if not impossible to withdraw in order to fight in another theatre of war"[56] such as Europe. Well into 1951, the Americans were concerned that the Korean War was a sort of "sideshow." In April of that year, Secretary of Defense George C. Marshall received a message from the Joint Chiefs of Staff (JSC) that observed, "if the immediate objectives of the USSR . . . are in Western Europe, it would be to the advantage of that nation for the maximum number of United Nations forces to remain in Korea."[57]

The United States did not have very large supply of atomic weapons on hand in1950.[58] If, as the JCS believed, the Korean War was diversionary action on the part of the USSR, "there was a strong motivation for saving for the main show our then relatively limited nuclear stockpile."[59] The National Security Council (NSC) concurred with the JCS. In early 1953, the NSC issued a policy paper in which were discussed possible options for prosecuting the conflict in Korea. This document, NS-147, contains a number of references to atomic weapons but concludes that the disadvantages associated with their use against North Korea or Manchuria outweighed the advantages. Among the reasons given for drawing this conclusion is the observation that the "use of substantial [of bombs] will reduce the U. S. stockpile and global atomic capabilities."[60]

Another reason that the United States did not employ atomic weapons in Korea was that the war took place in the territory of an ally. The United States was fighting to protect the freedom and independence of South Korea. Would it make sense "to destroy communist-occupied Seoul, the capital of the South Korean republic, whose freedom and independence we [the United States] are defending?"[61] asked the editor of *The Bulletin of the Atomic Scientists* in 1950. He concluded that it would not. "We would be facing the question of how to protect a country from subjugation, or liberate a country already subjugated . . . without decimating its people and destroying their wealth, their homes, and their beloved ancient cities and monuments."[62] War is destructive enough without atomic weapons. Europe had been so devastated by World War Two that the United States had instituted the Marshall plan in 1948 to help its allies there recover.

In hindsight, it is easy to see why the United States did not use atomic weapons in Korea. The reasons for limiting the conflict to conventional weapons were overwhelmingly compelling. As discussed above, there were no targets suitable for atomic bombs in North Korea. The United States still might not have wanted to employ atomic weapons there, for fear of alienating its allies by putting them at risk. Of course, the United States, too, perhaps would be subject to Soviet retaliation as well if it abrogated the tacit understanding that nuclear weapons were not to be used in the Korean theatre. Such retaliation could very well have escalated into third world war for which the United States was woefully unprepared, unable to rely on its obsolescent nuclear bombers to deliver what few atomic bombs the Americans actually had stockpiled. Truman and Eisenhower made the correct decisions, knowing that the use of atomic weapons in Korea would have had disastrous political and military consequences.

CHAPTER VI

CONCLUDING REMARKS

The history of aerial warfare, which coincides roughly with the twentieth century, may be divided into two almost equal parts. Each is characterized by weapons and concepts quite unlike those of the other half. Yet it is almost impossible to identify a single event that separates the one from the other. The introduction of jet propulsion might be considered to have been the decisive moment, but it took nearly twenty years for the jet to supplant the propeller. The invention of the atomic bomb was another significant development, but it should be remembered that no atomic weapon has ever been used in combat save for the two dropped on Hiroshima and Nagasaki in 1945. The change from general warfare to limited or regional conflicts might also be seen as a watershed, but this transition was evolutionary, not revolutionary.

Yet all of these innovations combined serve to distinguish the early part of the history of aerial warfare from the later part. Military aviation in the first half of the century involved piston-engined airplanes carrying conventional weapons in an environment of total warfare. Military aviation in the second half of the century has been characterized by jet-powered airplanes fighting in conflicts limited in part by the fear of atomic destruction.

The Korean War should be considered to have been the transitional event that divides the two halves of the history of aerial warfare. It is not a coincidence that the conflict took place almost exactly at the midpoint of the air age. The introduction of the jet engine and the atomic bomb, combined with the new concept of limited warfare, changed forever the conduct of war in the air. The Korean air war is well worth studying, for by examining its nature, and by comparing it to air wars before and since, one will understand better the history of military aviation.

NOTES TO CHAPTER I

1. The following works provide a good overview of the Korean Conflict, its origins, and the strategies and policies of the major participants:

Clay Blair, *The Forgotten War: America in Korea 1950-1953* (New York: Times Books, 1987); Jay Allen Cassino, ed., *Pictorial History of the Korean war: The Graphic Record of the United Nations Forces in Action throughout every Phase of the Korean Conflict: MacArthur Reports*, Veterans of Foreign Wars memorial edition ([Washington]: 1951, Veterans Historical Book Service, 1951); George Forty, *At War in Korea* (New York: Bonanza Books, 1982); D. M. Giangreco, War in Korea 1950-1953 (Novato CA: Presidio, 1990); Joseph C. Goulden, *Korea, the Untold Story of the War* (New York: Times Books, 1982); Max Hastings, *The Korean War* (Simon and Schuster, 1988); James I. Matray, ed., *Historical Dictionary of the Korean War* (New York: Greenwood Press, 1991); Harry J. Middleton, *The Compact History of the Korean War* (New York: Hawthorn Books, 1965); David Rees, ed., *The Korean War: History and Tactics* (London, Orbis, 1984); Stanley Sandler, ed., *The Korean War: an Encyclopedia* (New York: Garland, 1995); James L. Stokesbury, *A Short History of the Korean War* (New York, Morrow, 1988); Harry G. Summers Jr., *Korean War Almanac* (New York: Facts on File, 1990); John Toland, *In Mortal Combat* (New York, Morrow, 1991).

2. The introduction of a new type of weapon invariably leads to the development of new tactics as those who possess it strive to learn how best to exploit its capabilities. The airplane was no exception. The airmen of World War One had identified most of the basic principles of tactical aerial combat by 1916. The majority of these concepts remain valid today.

However, a small handful of military theorists realised the airplane could also transform *strategy*. The airplane could fly above and past an army or a navy and strike directly at the political and industrial centers of a hostile nation. The ability to fight in three dimensions promised to transform the nature of warfare (see chapter IV).

Among the early advocates of air were Giulio Douhet, William Mitchell, Hugh "Boom" Trenchard, and Alexander deSeversky. All were veterans of World War One. Douhet, an Italian, and Mitchell, an American, both wrote books about the military applications of air power (Giulio Douhet, *The Command of the Air*, trans. Dino Ferrari [New York: Coward-McCann, 1942]; William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power--Economic and Military*, [New York: G. P. Putnam's Sons, 1925]). These works profoundly influenced the thinking of airmen in the years after their publication (see chapter IV). Trenchard was an early commander of Great Britain's Royal Air Force and is considered to have been "the father of the RAF" (Andrew Boyle, *Trenchard* [New York: Norton, 1962]). deSeversky was a desciple of Douhet and Mitchell and wrote popular books about air power (Alexander deSeversky, *Victory Through Air Power* [New York: Simon and Schuster, 1942]).

3. It should be observed that the Americans would have had a similar problem had the Soviets invaded Europe at any time during the last fifty years. The United States and its allies might not have been able to defeat the Soviets without resorting to atomic weapons. The citizens of Europe would suffer more hardship from an atomic attack on their homelands than from a Soviet conquest and occupation.

NOTES TO CHAPTER II

1. The terms "piston-engined," "propeller-driven," "reciprocating-engined," and "conventionally-powered," in reference to aircraft, are used interchangeably in this work, as they were during the Korean War era. The terms "conventional" and "conventionally-powered" in this context are used sparingly, as the terms have less meaning today than they did during the early days of the jet age.

There are engines that combine pistons, propellers, and jets (turbines). The turboprop engine, in development during the late 1940s and early 1950s, uses a gas turbine to power a propeller. The rarely used mechano-jet, a dead-end technology, uses a piston engine to drive the compressor of a gas turbine.

Other jet engines include the ramjet (athodyd), pulsejet, and turbojet. The turbojet is the most common type of jet engine. Air enters the engine and is compressed, after which fuel is injected into the compressed air and ignited. The resulting combustion creates gases that expand rapidly and are exhausted rearwards to provide propulsion. The exhaust jet also spins a turbine that provides power to the engine's air compression mechanism (hence "turbojet").

There are two classes of turbojet engines, identified by the flow of air through their compressors. The centrifugal-flow turbojet forces air from the center outward during compression. In the axial-flow turbojet, air passes straight through the compressor. A turbofan is an axial-flow turbojet with an oversized compressor that passes air both into the combustion chamber and around it.

An afterburner, or reheat, is a mechanism for augmenting a jet engine's "dry" thrust. It works by injecting raw fuel into the hot exhaust plume, where it ignites, producing extra thrust. Afterburners use great amounts of fuel and are generally used only for short bursts of speed. Because they are so uneconomical they are used primarily on military aircraft. The Concorde is the only civilian airplane with afterburning engines. The afterburner was a relatively new invention in 1950; the only Korean War airplane that had an afterburner was the Lockheed F-94 Starfire.

Jets and rockets are both reaction engines. A jet is distinguished from a rocket in that it is "air-breathing." A jet engine must take in air to sustain combustion; rocket fuel contains its own oxygen. As a result, jets must remain in the atmosphere while rockets may venture into space.

2. Henry H. Arnold, *Second Report of the Commanding General of the Army Air Forces to the Secretary of War* (Washington: USGPO, 27 February 1945), 75-76; Henry H. Arnold, *Third Report of the Commanding General of the Army Air Forces to the Secretary of War*, (Baltimore: Schneidereth & Sons, 12 November 1945), 68.

The Russians produced several types of rocket engines but no jet engines during World War Two. They went to great lengths to acquire jet technology from the Germans after the war, raiding every research station in their zone of occupation between 1945 and 1948. The first Russian jet airplanes flew in 1947 (William Green, "The Development of Jet Fighters and Fighter Bombers," *in The Soviet Air and Rocket Forces*, ed. Archer Lee [New York: Frederick A. Praeger, Publishers, 1959], 134-141; Russell Miller, *The Soviet Air Forces at War* [Alexandria, VA:Time-Life, 1983], 162-163; Richard E. Stockwell, "The German Legacy," in *The Soviet Air and Rocket Forces*, ed. Archer Lee [New York: Frederick A. Praeger, Publishers, 1959], 232-233, 236-237).

3. J. E. Johnson, *Full Circle: The Tactics of Air Fighting*, (New York: Ballantine Books, 1964), 260.

4. Air University AFROTC, *Elements of Aerial Warfare: Aircraft*, Air Science 2, volume IV, (Montgomery, Ala.: Air Force Reserve Officers' Training Corps, 1953), 65 (hereafter referred to as AFROTC, *Aircraft*).

5. G. Geoffrey Smith, *Gas Turbines and Jet Propulsion*, fifth edition (New York: Aircraft Books, Inc., 1951), 22.

6. Adolf Galland, statement made 15 May 1943, quoted in J. Richard Smith and Eddie J. Creek, *Jet Planes of the Third Reich*, (Boylston, MA: Monogram Aviation Publications, 1982), 67.

7. "Faster and Faster," *Newsweek*, 28 May 1945, 74-76; "Faster, Faster," *Time*, 19 November 1945, 50-52; "Faster, Faster!," *Time*, 4 February 1946, 25; "Faster & Faster," *Time*, 21 June 1948, 82; "P-80s: The U. S. Army Uses Fast-flying Jet Planes to Develop a Spectacular New Air Force," *Life*, 9 December 1946, 99; James Felton, "Shooting Star: Jet-Propelled P-80, the World's Fastest Plane, May Soon Come Close to the Speed of Sound," *Life*, 13 August 1945, 43.

8. Frederick G. Vosburgh, "Flying in the Blowtorch Era," *National Geographic*, September 1950, 281; Hall L. Hibbard, "The Marvel of Jet Propulsion," *Reader's Digest*, September 1945, 112.

9. Sam Boal, "Pilots of the Jet Planes—the Superboys," *The New York Times Magazine*, 28 September 1948, 7.

10. J. E. Barfoot, "Design of Sweptback Wings," *Aero Digest*, June 1947, 55; "Jets in Combat," *Flying*, September 1948, 26; "F-94 Innards Revealed," *Aviation Week*, 26 June 1950, 13; Gaither Laitrell, "F-86—World's Fastest Fighter," *Flying,* November 1948, 15; Ben Robin, "You Can Fly It!," *Flying*, November 1949, 38; Nathaniel F. Silsbee, "Jet Fighter Base," *Aero Digest*, June 1948, 54.

11. Boal, "Superboys," 7.

12. Mike Spick, *The Ace Factor* (New York: Avon Books, 1988) 89; Mike Spick, *Fighter Pilot Tactics: The Techniques of Daylight Air Combat* (New York: Stein and day, 1983), 160; Mike Spick, *Jet Fighter Performance: Korea to Vietnam* (London: Ian Allen, 1986), 22-26.

13. AFROTC, *Aircraft*, 51.

14. Warrren Thompson, "Kills List—1950" in "Fighter Combat Over Korea Part 1: First Kills," *Wings of Fame*, volume 1, 33.

15. Leonard Plog, quoted in Warren Thompson, "3 July 1950:Carrier Strikes begin" in "Fighter Combat Over Korea part 1: First Kills," *Wings of Fame*, volume 1, 14 .

16. George E. Stratemeyer, quoted in Robert F. Futrell, *The United States Air Force in Korea* (New York: Duell, Sloan and Pierce, 1961), 96.

17. Bill Gunston, *Jane's Aerospace Dictionary* (London: Jane's, 1980), s. v. "compressibility," "compressibility effects;" Barfoot, "Sweptback Wings," 55.

18. Futrell, *USAF in Korea*, 211-212; David C. Isby, *Fighter Combat in the Jet Age* (London: HarperCollins, 1997), 28-29; "Jet Against Jet," in "Fighter Combat Over Korea part 1: First Kills," *Wings of Fame*, volume 1, 26-27; Bryce Walker, *Fighting Jets* (Alexandria, VA: Time-Life Books, 1983), 51-53.

This battle was claimed to be the world's first dogfight between two jet-powered aircraft almost as soon as it happened (Charles Grutzner, "U. S. Airmen View Battle of Jets as a Lure to Cross over Border," *The New York Times*, 9 November 1950, 1, 6; "U. S. Pilot Shoots Down MiG in First Fight between Jets," in "Air War at the Boundary," *Life*, 27 November 1950, 34). It was not, however. It was the first *air-to-air* combat between two *manned* jet aircraft. Although it is not well known, there were a number of combats between jet aircraft during World War Two.

The earliest of these battles took place on 4 August 1944, when Flying Officer T. D. "Dixie" Dean of the Royal Air Force used the wing of his jet-powered Gloster Meteor to push a German V-1 "buzz bomb" out of control. The V-1, an unmanned aircraft, got its nickname from the sound produced by its pulse-jet engine (Jeffrey Ethell and Alfred Price, *World War Two Fighting Jets* [Shrewsbury, England: Airlife, 1994], 97; Walker, *Fighting Jets*, 38). "Later that day Flying Officer J. Roger shot down a flying bomb using his cannon" (Ethell and Price, *WWII Fighting Jets*, 97). Meteor pilots accounted for some thirteen V-1s during the war (Isby, *Fighter Combat*, 18).

Near the end of the war in Europe, a squadron of Meteors was transferred from England to the Netherlands. On 19 March 1945, a pair of Arado Ar 234s, German jet-powered bombers, attacked the airfield at which the Meteors were based. One Meteor was struck by bomb fragments. This damage, inflicted by enemy action, would have been described as "combat damage" in the squadron's records, so the incident can and should be considered as being "a combat between two jets" (Bryan Philpott, *Meteor* [Wellingborough, England: Patrick Stephens, 1986], 153).

19. "How U. S. Air Power looked in Korea," *Business Week*, 29 August 1953, 68-70.

20. *Ibid.*, 70.

21. Frances Gabreski, *Gabby: A Fighter Pilot's Life* (New York: Orion Books, 1991), 213.

22. Robert McLarren, "Jet Engines Accent Vapor Trails," *Aviation Week*, 3 January 1949, 24-25.

23. W[inton] W. Marshall, "MiG Alley," in *Top Guns,* eds. Joe Foss and Matthew Brennan (New York: Pocket Star Books, 1991), 363.

24. *Ibid.*

25. George L. Jones, "Air War in Korea—the Early Days," in *Top Guns,* eds. Joe Foss and Matthew Brennan (New York: Pocket Star Books, 1991), 310.

26. John H. Glenn, "Glenn,"interview with John H. Glenn, *Approach,* April/May 1990, 19.

27. Jones, "Air War," 312.

28. Marshall, "MiG Alley," 369.

29. Leonard W. Lilley, "Kimpo (K-14)," in *Top Guns,* eds. Joe Foss and Matthew Brennan (New York: Pocket Star Books, 1991), 399.

30. Lilley, "Kimpo," 400.

31. Lilley, "Kimpo," 400.

32. Harold Fischer, "Kismet and the Paper Tiger," in *Top Guns,* eds. Joe Foss and Matthew Brennan (New York: Pocket Star Books, 1991), 336.

33. Robert Baldwin, quoted in David Knox, *The Korean War: Uncertain Victory: The Concluding Volume of an Oral History* (New York: Harcourt Brace Jovanovich, 1988), 237.

34. Vosburgh, "Blowtorch Era," 307.

35. Donald S. Lopez, *Fighter Pilot's Heaven* (Washington: Smithsonian Institution Press, 1995), 52.

36. Marshall, "MiG Alley," 367.

37. Fischer, "Kismet," 330.

38. William Wescott, "Gunnery," in *Top Guns,* eds. Joe Foss and Matthew Brennan (New York: Pocket Star Books, 1991), 395.

39. Lopez, *Heaven*, 111.

40. Doug Carter, "MiG Alley," in *No Bugles, No Drums: an Oral History of the Korean War*, ed. Rudy Tomedi (New York: John Wiley & Sons, 1993), 172.

41. *Ibid.*

42. Douglas K. Evans, *Sabre Jets Over Korea: a Firsthand Account* (Blue Ridge Summit, Penn: tab Books, 1984), 98.

43. Gabreski, *Gabby*, 232.

44. *Ibid.*

45. Frederick C. Blesse, *Check Six: a Fighter Pilot Looks Back* (New York: Ivy Books, 1987), 96.

46. *Ibid.*

47. Marshall, "MiG Alley," 367.

48. Larry Davis, *MiG Alley: Air to Air Combat Over Korea* (Carrollton, Tex: Squadron/Signal Publications, 1978), 50.

The poor fuel economy of the jet airplane has been a problem since the first jets were introduced during World War Two. American and Allied fighter pilots were quick to recognize and take advantage of the German jets' poor endurance. Instead of fighting the jets in the air, they would loiter in the vicinity of a German airfield and wait for the jets to return home when low on fuel. The early jets did not accelerate very quickly (see Chapter III), so when they slowed down to land, they could not speed up to escape the Allied fighters, who would attack them as they approached their runways. The pilot of the jet under attack could not make many evasive maneuvers because he had to conserve fuel. As one German pilot explained, "It was a petrifying experience to be low on fuel, preparing to land, and find that Allied fighters had followed you home" (Heinz Bar, quoted in Isby, *Fighter Combat*, 20.)

This tactic, called "rat catching" by Allied fighter pilots, proved very effective. Charles "Chuck" Yeager, the first man to exceed the speed of sound in level fight, shot down a German jet by this method (William N. Hess, *German Jets versus the U. S. Army Air Force* [North Branch, Minn: Specialty Press, 1996], 44-460). The Germans eventually had to assign propeller-driven fighter units to protect the jet airfields during landing operations.

49. Earle E. Partridge, quoted in *Air Interdiction in World War II, Korea, and Vietnam: an Interview with Gen. Earle E. Partridge, Gen. Jacob E. Smart, and Gen. John W. Vogt, Jr.*, eds. Richard H. Kohn and Joseph P. Harahan (Washington: Office of Air Force History, United States Air Force, 1986), 43.

50. *Ibid*

51. James D. Kelly, "Loitering," in *Test Flying at Old Wright Field,* eds. Ken Chilstrom and Penn Leary (Omaha: Westchester House, 1993), 102-103.

52. Marcelle Size Knaack, *Post World War Two Fighters 1945-1973* (Washington: Office of Air Force History, United States Air Force, 1986), 9.

53. Partridge, quoted in *Air Interdiction,* 45

54. George L. Christian, "Far East Pilots Praise F-94's Durability," *Aviation Week*, 7 July 1952, 63.

55. *Ibid.*

56. W. A. Waterton, *The Quick and the Dead* (London: Frederick Muller, 1956), 67.

57. Vernon B. Byrd, *Passing Gas· the Story of Inflight Refueling* (Chaco, Cal.: Byrd Publishing, 1994), 8-89.

58. *Ibid*

59. Byrd, *Passing Gas*, 85-89; John C. McClure and Charlotte S. McClure, *Follow Me the Life and Times of David C Schilling* (Dallas, Taylor Publishing, 1995), 87-117.

60. Byrd, *Passing Gas*, 112; Billy R. Gibson, "Casey Lowers the Boom," *Aerospace Historian*, Summer 1968, 14.

61. Jack J. Catton, quoted in *Strategic Air Warfare: an Interview with Generals Curtis E. LeMay, Leon W Johnson, David A Burchinal, and Jack J. Catton* (Washington: Office of Air Force History, United States Air Force, 1988), 104.

62 Byrd, *Passing Gas*, 89.

63. Richard P. Hallion, *Strike from the Sky* (Washington: Smithsonian Institution Press, 1989), 1-2.

64. "What about the Jets?," in "The Air to Ground Operation in Korea," *Air Force*, March 1943, 43.

65. George Odgers, *Across the Parallel: the Australian 77th Squadron with the United States Air Force in the Korean War* (Melbourne, Australia: William Heinemann, 1952), 155.

66. Fischer, "Kismet," 322.

67. "What about the Jets?," 43.

68. Smith, *Gas Turbines*, 22.

69. Johnson, *Full Circle*, 260.

70. Bureau of Naval Personnel (BuPers), *Navy Wings* (Washington: USGPO, 1955), 86.

71. Gabreski, *Gabby*, 211.

72. Lopez, *Heaven,* 21

73. Johnson, *Full Circle*, 257.

74. Knaack, *Fighters,* 8-9; Lopez, *Heaven,* 215.

75. R. C. Robson, "Cockpit Viewpoint: Liaison Pilot Sounds Off on Ground Support," *Aviation Week*, 1 October 1951, 56.

76. John S. Thach, "The Black Sheep in Korea," in *Into the Jet Age,* ed. E. T. Wooldridge, (Annapolis: Naval Institute Press, 1995), 174.

77. BuPers, *Navy Wings*, 86.

78. Richard P. Hallion, *The Naval Air War in Korea*, (New York: Zebra Books, 1986) 193.

79. Robson, "Cockpit Viewpoint," 56.

80. Vosburgh, "Blowtorch Era," 305.

81. *Ibid*

82. John F. Loosbrock, "Can Our Jets Support Our Guys on the Ground?," *Popular Science*, September 1950, 112.

83. James H. L. Peck, "How Fast Can We Fight?," *Popular Mechanics,* December 1950, 125.

84. Hanson W. Baldwin, "Air Issue Being Resolved in Korea," *New York Times*, 14 August 1950, 4.

85. "Air Head Sees Jets Justified in Korea," *New York Times*, 15 October 1950, 7; "Air Officer Asserts Jets 'Are Here to Stay' in War," *New York Times*, 2 November 1950, 9; "Value of Jets Held Proved in Korea War," *New York Times*, 15 July 1950, 6.

86. Hoyt S. Vandenburg, testimony before the United States Congress, House, Hearings before the Appropriations Committee, The Supplemental Appropriations Bill For 1951, 81st Congress, 2nd session, (Washington: United States Government Printing Office), 1950), 235; quoted in Phillip S, Meilinger, *Hoyt S. Vandenburg: the Life of a General* (Indianapolis: Indiana UP, 1989), 172.

87. "What about the Jets?," 43.

88. Manfred Boehme, *JG 7: the World's First Jet Fighter Unit 1944/1945* (Atglen, Penn: Schiffer Publishing, 1992), 158-165; B. Michael Gladych, "How to Shoot Down a Jet," *Flying*, August 1949, 26-27; Hess, *German Jets*, 164-173; "Jets in Combat," 54.

89. Boehme, *JG 7*, 45-69, 86-91, 95-96; Ethell and Price, *WWII Fighting Jets*, 20-23, 30-32; Smith and Creek, *Jet Planes,* 134-135, 122, 200, 310.

90. Edwin Simmons, "The Reserves Fly High," *The Marine Corps Gazette*, September 1948, 11.

91. *USAF Credits for the Destruction of Enemy Aircraft Korean War*, USAF Historical Study no. 81 (n. p., Office of Air Force History, 1975), 3-37.

92. Warren Thompson, "Kills List—1950," in "Fighter Combat Over Korea part 1," *Wings of Fame,* volume 1, 33; Warren Thompson, "Kills List—1950/1951" in "Fighter Combat Over Korea part 2: Jet Aces," *Wings of Fame*, volume 2, 22-23; Warren Thompson, "Kills List 1952" in "Fighter Combat Over Korea part 3: Year of MiGs," *Wings of Fame*, volume 3, 108-113; Warren Thompson, "Kills List 1953," in "Fighter Combat Over Korea part 4; the Final Year," *Wings of Fame*, volume 4, 94-95.

93. On 9 August 1952, a pilot from HMS Ocean, Lieutenant Peter C. "Hoagy" Carmichael, shot down a MiG-15 while flying a Hawker Sea Fury piston-engined attack aircraft (John R. P. Lansdown, *With the Carriers in Korea: the Fleet Air Arm Story 1950-1953* [Wilmslow, England: Crecy, 1997), 273-275). The half kill noted in the text was brought down by the collective effort of Carmichael's squadron; Carmichael and 802 Squadron were credited with a half victory each (Thompson, "Kills List 1952," 111).

See also note 94 below.

94. On 10 September 1952 Marine Captain Jesse Folmar shot down a MiG-15 while flying a Vought F4U Corsair. He was shot down by another MiG a short time later but survived. Folmar and Carmichael were lucky; the MiGs they shot down had flown right in front of their guns (Jesse G. Folmar, "The Corsair's First MiG Kill," *Air Trails*, Febraury 1953, 26-27, 56; Warren Thompson, "MiG 1, Corsair 1," in "Fighter Combat Over Korea part 3: Year of MiGs," *Wings of Fame*, volume 3, 106-107.

It is interesting to note that although the majority of the American airmen who shot down jets during World War Two were flying the North American P-51 Mustang, the best piston-engined fighter of the war, few Mustang pilots fared well in combat with the MiG-15 in Korea. A number of P-51s were shot down by MiG-15s, while Mustang pilots were officially credited with just seven MiGs damaged and two probably destroyed. One P-51 pilot, Major Kendall Carlson, claimed a MiG-15 on 7 November 1950, but this victory has never been confirmed (David R. McLaren, *Mustangs Over Korea: the North American F-51 at War 1950-1953* [Atglen, PA: 1999], 98-99, 182).

95. *USAF credits Korean* War, 3-37.

96. Larry Davis, *Air War Over Korea: a Pictorial Record* (Carrollton, TX: 1982), 30.

97. *Ibid*

98. Jones, "Air War," 308.

99. *Ibid*

100. Davis, *Air War*, 30.

101. M. J. Armitage and R.A. Mason, *Air Power in the Nuclear Age*, second edition (Chicago: University of Illinois Press, 1985), 35.

102. A W. Jessup, "MiG-15 Dims USAF's A-bomb Hopes," *Aviation Week*, 4 February 1952, 16.

103. Fischer, "Kismet," 379.

104. Jessup, "MiG-15 Dims Hopes," 16.

105. Carl A. Spaatz, "Is the B-36 Obsolete?," *Newsweek*, 11 February 1952, 31.

106. *Ibid.*

107. *Ibid.*

108. Fischer, "Kismet," 378-379.

109. One of the MiGs was shot down by Walter "Wally" Schirra, later a Mercury astronaut. It was the only air-to-air victory of his career. Schirra was a naval aviator but had been seconded to a F-84 unit.

110. Fischer, "Kismet," 379.

111. *Ibid,* 377-378

112. Jessup, "MiG-15 Dims Hopes," 16.

113. Spaatz, "Is B-36 Obsolete?," 31.

114. *Ibid*

115. Marcelle Size Knaack, *Post World War II Bombers*, Encyclopedia of U. S. Air Force Aircraft and Missiles Systems, volume II (Washington: USGPO, 1988), 54-55.

116. Most of the "Bedcheck Charlie" night heckler aircraft did not carry bombs. Instead, the crew would throw hand grenades and mortar shells out of the cockpit by hand. Every once in a while they got lucky. On 17 June 1951, a night intruder attacked the air base at Suwon. A grenade scored a direct hit on a parked F-86, destroying it. Eight others were damaged, four "seriously." The most spectacular "Charlie" raid took place on 16 June 1953, when a night intruder bombed a fuel dump at Inchon. "Nearly 98,000 drums and 48,000 five-gallon cans of POL (petroleum, oil, lubricants) were lost" (Mike O'Connor, "Coping with Charlie," *American Aviation Historical Society Journal*, Spring 1985, 4, 9).

117. Blesse, *Check Six,* 52.

118. *Ibid.*, 53.

119. O'Connor, "Coping with Charlie," 9.

120. Guy Pierre Bordelon, "Corsair Ace," in *Top Guns,* eds. Joe Foss and Matthew Brennan (New York: Pocket Star Books, 1991), 355.

121. Hallion, *Naval Air* War, 282; O'Connor, "Coping with Charlie," 10-11.

122. W. M. Cleveland, *Mosquitoes in Korea* (Portsmouth, NH: Peter E. Randall, 1991), 255; Futrell, *USAF in Korea*, 623.

123. *Air University Quarterly Review* Staff, "Powerful Communist Air Forces are Poised on the 38th Parallel," in *Airpower: the Decisive Force in Korea*, ed. James T. Stewart (Princeton: D. Van Nostrand, 1957), 53-59.

124. James T. Stewart, ed., *Airpower: the Decisive Force in Korea*, (Princeton: D. Van Nostrand, 1957), 216-228.

125. Glenn B. Infield, *Unarmed and Unafraid* (London: Macmillan, 1970), 143-144; Futrell, *USAF in Korea*, 513.

126. Futrell and Jessup are both fairly reliable sources, so their descriptions of the "slow camera, fast jet" problem (see notes 125, above, and 127, below) should be fairly accurate. Futrell was the USAF's official historian of the Korean War and cites as his

source a document produced by the 67th Tactical Reconnaissance Wing during the war. Jessup, of course, was *Aviation Week*'s correspondent in Korea during the conflict there and presumably got his information directly from the personnel it most affected.

However, other equally reliable sources indicate that the "slow camera, fast jet" problem was a nonissue. An article about aerial photography in the May, 1947, issue of *Flying* is illustrated by "razor-sharp" photographs taken at "fantastically high speeds" by a camera in a jet airplane. The remarkable clarity of the pictures was attributed to the smooth, vibration-free flight common to all jet aircraft, which permitted the cameras to "be mounted solidly, without the ordinary vibration-proof mountings" needed in a piston-engined camera plane ("Photo Jet: Jet Camera Planes take Amazing Aerial Photos at 500-plus m. p. h.," *Flying,* May 1947, 25).

Later that same year, a researcher at the Photographic Laboratory, Engineering Division, of the USAF's Air Material Command (AMC) described a camera "peculiarly [*sic*] suitable for aerial reconnaissance photography at supersonic speeds" in the AMC's professional journal. Accompanying the text were photographs taken by one jet in flight of another jet in flight. The two aircraft were both flying at top speed but in opposite directions from one another so their combined speed was some 1,000 mph. The airplane in the pictures is remarkably sharp and clear but the background is, as could be expected, just a blur (A. D. Keogh, "An Experiment in Supersonic Aerial Photography," *Technical Data Digest*, 15 November 1947, 11-12).

It is possible that the Keogh and *Flying* pieces, both of which were published before the Korean War began, were describing experimental procedures and equipment that were either not adopted at all or not adopted in time to be used in Korea. However, Colonel George W. Goddard, the chief of the USAF's photography laboratory, published a couple of articles in 1951 in which it is implied that the techniques and equipment described in Keogh's work were indeed in use in Korea. He makes no mention of any problems associated specifically with the use of jet airplanes as camera platforms. Of course, the United States was fighting a war at the time and it is possible that the problems really did exist but Goddard was not allowed to mention them (George W. Goddard, "Our Eyes Aloft Spy Out the Enemy, part I," *Popular Mechanics*, October 1951, 98; George W. Goddard, "Our Eyes Aloft Spy Out the Enemy, part II," *Popular Mechanics*, November 1951, 250-252).

127. A. W. Jessup, "Korea: Field Test for Tactical Air Power," *Aviation Week,* 10 March 1952, 26.

128. AFROTC, *Aircraft*, 65.

129. "What About the Jets?," 43.

130. Christian, "Pilots Praise Durability," 64.

131. Smith, *Gas Turbines*, 22.

132. Donald H. Stuck, "Jet Fighter Maintenance," *Aero Digest*, July 1949, 101.

133. AFROTC, *Aircraft*, 59.

134. Smith, *Gas Turbines*, 22.

135. AFROTC, *Aircraft*, 59.

136. Smith, *Gas Turbines*, 22.

137. Lopez, *Heaven,* 8.

138. *Ibid*

139. "Industry Observer, *Aviation Week*, 11 June 1951, 9; "Starting Jet Fighters by Artificial Respiration," *Mill & Factory*, July 1952, 132.

140. Waterton, *Quick and the Dead*, 119.

141. Joseph W. Albert and Billy C. Wylie, "Problems of Airfield Construction in Korea," in *Airpower the Decisive Force in Korea*, ed. James T. Stewart, (Princeton: D. Van Nostrand, 1957), 236.

142. Robert W. Lockridge, "Jet Planes Spell Trouble for Aviation Engineers Building Korean Airfields," *Civil Engineering,* July 1951, 36.

143. Futrell, *USAF in Korea*, 364.

144. Albert and Wylie, "Problems of Airfield Construction," 235.

145. Alpheus W. Jessup, "Better Planes Needed to Match MiGs," *Aviation Week*, 19 November 1951, 16.

146. Memorandum from Lieutenant Colonel U. S. Nero to Brigadier General Darr H. Alkire, Far East Air Forces Deputy for Materiel, Subject: Effects of Inadequate Runways on Korean Operations, circa April 1951, quoted in Futrell, *USAF in Korea*, 363.

147. George L. Christian, "Tactical Jets Prove Ruggedness in Battle," Aviation Week, 14 July 1952, 62.

148. *Ibid*

149. "Navy Holds Seminar on Jet Airfield Pavements," *Roads and Steets*, May 1952, 66.

150. *Ibid.*

151. Lockridge, "Jet Planes Spell Trouble," 36.

152. Richard L. Zeke Cormier, Walter M. "Wally" Schirra, and Phillip R. "Rat" Wood, *Wildcats to Tomcats: the Tailhook Navy* (St. Paul, MN: Phalanx Publishing, 1995), 198.

153. Steven J. Bond, *Meteor: Gloster's First Jet Fighter* (Leicester, England: Midland Counties Publications, 1985), 10.

154.Paul H. Wilkinson, *Aircraft Engines of the World 1946* (New York: Paul H. Wilkinson, 1946), 287.

155. Clarence L. "Kelly" Johnson, *Kelly: More Than My Share of it All* (Washington: Smithsonian Institution Press, 1985), 99; E. T. Wooldridge, Jr., *The P-80 Shooting Star: Evolution of a Jet Fighter* (Washington: Smithsonian Institution Press, 1979), 20.

156. Edward Fernandes, quoted in Robert F. Dorr and Warren Thompson, *The Korean Air War* (Osceola, WI: Motorbooks International, 1994, 84.

157. Christian, "Jets Prove Ruggedness," 62.

158. Lockridge, "Jet Planes Spell trouble," 36.

159. Albert and Wylie, "Problems of Airfield Construction," 234.

160. Preston R. Bassett, address given at the Ordnance Technology Round Table at the Thirtieth Annual Meeting of the American Ordnance Association, Detroit, Michigan, 9 June 1948, reprinted as "Ground to Air Defense: Antiaircraft Artillery has an Assured Place in America's Forces," *Ordnance*, September/October 1948, 101.

161. *Ibid.*

162. Kenneth P. Worrell, *Archie, Flak AAA, and SAM: a Short Operational History of Ground-Based Air Defense* (Maxwell Air Force Base, Ala.: Air UP, 1988), 75.

163. A. W. Jessup, "Combat Reports Prove F-80 Can Take It, *Aviation Week*, 31 July 1950, 12.

164. Christian, "Jets Prove Ruggedness," 63; "How Jet Planes Survive Battle Damage," *Aviation Week*, 7 August 1950, 16; "How Thunderjets Fare Under Fire," *Aviation Week*, 18 June 1951, 9; Jessup, "Combat Reports," 12; Jessup, "Korea: Field Test," 21.

165. "Tough Jets," *Time*, 18 December 1950, 72.

166. "Aviation Flashes," *Newsweek*, 25 June 1951, 11; Gabreski, *Gabby*, 243; Bob Hoover, "Gas or Kerosene?," in *Test Flying at Old Wright Field*, eds. Ken Chilstrom and Penn Leary (Omaha: Westchester House, 1993), 101-102.

167. Dennis E. Showalter, "The First Jet War," *MHQ: the Quarterly Journal of Military History*, Spring 1996, 66; "Part VI: First Jet War—Korea," in *Fighter Pilot*, ed. Stanley M. Ulanoff (New York: Doubleday & Company, 1962), 395; "Part Five: Korea: First Jet War," in Edward H. Sims, *The Aces Talk* (New York: Ballantine Books, 1972), 241.

NOTES TO CHAPTER III

1. William M. Fechteler, speech made in New York City (date not given), quoted in "Mobile Air bases: At Home at Sea," *All Hands*, July 1952, 14.

2. *Ibid.*

3. *Ibid*

4. Arthur Hezlet, *Aircraft and Sea Power* (New York: Stein and Day, 1970), 327.

5. Enzo Angelucci and Peter Bowers, *The American Fighter* (New York: Orion Books, 1985), 48.

6. Office of the Chief of Naval Operations, *Naval Aviation in Review* (Washington: USGPO, 1958), 94.

7. *Ibid.*

8. Richard Linnekin, *Eighty Knots to Mach 2: Forty-Five Years in the Cockpit* (Annapolis, Naval Institute Press, 1991), 183.

9. *Ibid.*

10. John P. Condon, interview quoted in William J. Sambito, *A History of Marine Attack Squadron 311* (Washington: History and Museum Division, HQ, USMC, 1978), 13.

11. Linnekin, *Eighty Knots*, 171.

12. E. T. Wooldridge, editor, *Into the Jet Age: Conflict and Change in Naval Aviation 1945-1975* (Annapolis, Naval Institute Press, 1995) xix.

13. John B. Maas (name also spelled "Mass" elsewhere in text cited), draft manuscript dated 22 September 1986, Comment File, Marine Corps History Center, Washington DC, quoted in John C. Chapin, *A History of Marine Fighter Attack Squadron 115* (Washington: History and Museums Division, HQ, USMC, 19880, 17

14. *Ibid.*

15. Condon, interview quoted in Sambito, *History of VMA-311*, 13.

16. Ted Williams with John Underwood, *My Turn at Bat· the Story of My Life* (New York: Simon and Schuster, 1988), 177.

17. Lınnekin, *Eıghty Knots*, 157.

18. *Ibıd.*

19. *Ibıd.*

20. Roger Chesnau, editor, *Conway's All the Worlds Fıghtıng Shıps 1922-1945* (London: Conway Maritime Press, Ltd., 1980), 104.

21. Deputy Chief of Naval Operations (Air), and Commander, Naval Air Systems Command, *Unıted States Naval Avıatıon 1910-1970* (Washington: USGPO, 1970), 162 (hereafter cıted as *Naval Avıatıon 1910-1970*); Linnekin, *Eıghty Knots*, 384.

In late November, 1946, a Grumman F8F Bearcat, a sıngle-engined carrıer-based propeller-drıven fighter, was able to take off ın a distance of 115 feet from a standing start. Also note that the sixteen North American B-25 Mitchell twin-engined medium bombers that took part in the "Doolittle Raid" of 18 April 1942 were able to take off from the flight deck of the USS *Hornet* wıthout assistance despite their overloaded condition. The *Hornet's* flight deck was 809 feet long but the B-25s were able to make use of less than half that distance because the aft portion of the flight deck was used to park the bombers (they were too large to be stored below in the hangar deck).

22. Fechteler speech quoted in "Mobile Air Bases," 14.

23. James S. Russell, "Carriers for the Jet Age--Angled Decks, Steam Cats, and Mirrors," in *Into the Jet Age: Conflıct and Change ın Naval Aviation 1945-1975*, ed. E. T. Wooldridge (Annapolis: Naval Institute Press, 1995), 56-57; *Naval Avıatıon 1910-1970*, 6, 12, 56, 90.

24. Chesnau, *Conway's Fıghtıng Shıps*, 101; Norman Polmar, *The Postwar Naval Revolutıon* (Annapolıs: Naval Institute Press, 1995), 188.

25. Russell, "Carriers for the Jet Age," 57.

26. Gerald G. O'Rourke, "Korean Knights," in *Into the Jet Age: Conflıct and Change ın Naval Avıatıon 1945-1975*, ed. E. T. Wooldridge (Annapolis: Naval Institute Press, 1995188.

27. *Ibid.*

28. Paul T Gillchrist, *Feet Wet: Reflections of a Carrıer Pılot* (New York: Pocket Books, 1990), 160-161.

Based on the weights and speeds to which Admıral Gıllchrist refers, he appears to be describing the naval aircraft that entered service in the mıd and late 1950s. However, his remarks still serve to illustrate the problems of the underpowered catapult and low wind overe deck (WOD).

29. Richard P. Hallion, *The Naval Air War ın Korea* (New York: Zebra Books, 1986), 190; Richard E. Brown, quoted in Robert F. Dorr and Warren Thompson, *The Korean Air War* (Osceola: WI: Motorbooks Internatıonal, 1994), 129.

30. *Naval Avıatıon 1910-1970*, 185.

31. Gerald E. Miller, "Korea--the Carrıer War," in *Into the Jet Age: Conflıct and Change ın Naval Avaıtıon 1945-1975*, ed., E. T. Wooldridge (Annapolıs: Naval Institute Press, 1995), 157.

32. O'Rourke, "Korean Knights," 189.

33. *Ibıd*

34. *Naval Avıation ın Review*, 94.

35. Linnekin, *Eıghty Knots*, 168.

36. *Naval Avıatıon ın Review*, 94.

It is interesting to note that this book, an official publication of the Navy Department, refers to the person flying the airplane as a "pılot." Many current and veteran naval personnel will go out of their way to point out that a "pilot" is one who guides ships into harbor and that those who fly airplanes are "avıators." As the reader has no doubt noticed, this text uses both terms interchangeably, simply for variety.

37. *Naval Avıatıon 1910-1970.*

38. Peter Garrison, *CV: Carrıer Avıation*, The Presidio Airpower serıes (Novato, CA: Presidıo Press, 1987), 75.

39. *Antıetam* Cruise Book, *Photo-Narratıve of the Aırcraft carrıer USS Antıetam (CV-36) ın Actıon agaınst the Communıst Aggressors ın North Korea; September 8, 1951-May 2, 1951* (Berkeley, CA: Lederer, Street, & Zeus Co., 1952), 32; USS Princeton, *USS Princeton CV 37: Korea 50-51* (Berkeley, CA: Lederer, Street, & Zeus Co., 1951), Bill Mauldin, *Bill Mauldin ın Korea* (New York: W. W. Norton, & Company, 1952), 147-149; Eric Melrose "Winkle" Brown, *Wıngs on my Sleeve* (Shrewsbury, England: Airlife, 1978), 10; Gillchrist, *Feet Wet*, 13.

40. *Naval Avıatıon ın Revıew*, 332.

41. Linnekin, *Eıghty Knots*, 92; Gillchrist, *Feet Wet*, 11-42.

42. *Naval Aviation in Review*, 332.

43. Linnekin, *Eighty Knots*, 92.

44. *Ibid.*

45. *Naval Aviation in Review*, 332.

46. Linnekin, *Eighty Knots*, 92.

47. *Ibid.*

48. *Ibid.*

49. *Ibid.*

50. *Ibid*; Gillchrist *Feet Wet*, 11, 13.

51. Douglas Keeney and William Butler, *No Easy Days: The Incredible Drama of Naval Aviation* (Louisville, KY: Butler+Keeney+Farmer, 1995), 10; Gilchrist, *Feet Wet*, 213; Brown, *Wings*, 21.

52. Linnekin, *Eighty Knots*, 92-93;; Gillchrist, *Feet Wet*, 6; *Second Hitch: USS Bon Homme Richard, CV-3,* (Seattle: Naval Publishing Co., n.d.), 44.

53. Linnekin, *Eighty Knots*, 92-93, 385.

54. Brown, *Wings*, 106; Keeney and Butler, *No Easy Days*, 64.

55. *Naval Aviation in Review*, 94.

56. Linnekin, *Eighty Knots*, 183.

57. *Ibid.*

58. *Naval Aviation in Review*, 94.

60. *Ibid.*

61. *Ibid.*

62. Jim Barker, quoted in Carl Mills, *Banshees in the Royal Canadian Navy* (Willowdale, Canada: Banshee Publications, 1991), 144.

63. Linnekin, *Eighty Knots*, 93.

64. *Naval Aviation in Review*, 333.

65. Gillchrist, *Feet Wet*, 8; Linnekin, *Eighty Knots*, 108.

66. Paul Beaver, *Encyclopedia of the Fleet Air Arm since 1945*, (Wellingborough, England: Patrick Stephens Limited, 1987), 232.

67. Bureau of Naval Personnel (BuPers), *Navy Wings*, (Washington, USGPO: 1955), 93.

68. Secretary of the Air Force and Chief of the Bureau of Aeronautics, *Flight Handbook: Navy Models F9F-6, -6P Aircraft*, (n.p., 1956; reprint, Atglen, PA: Schiffer Military/Aviation History, 1995), 92 (page numbers same in both original and reprint; hereafter referred to as *F9F-6 Flight Handbook*); Beaver, *Fleet Air Arm*, 323.

69. "New Angle in Flight Decks," *All Hands*, March 1953, 38.

70. James A. Field, Jr., *History of United States* Naval *Operations: Korea*, (Washington, DC: USGPO, 1962), 417; Hallion, *Naval Air War*, 172.

71. USS Princeton, *USS Princeton*, 38; Keeney and Butler, *No Easy Days*, 34-35, 68-87; Gerald E. Miller, "Transition to the Jet Age," in *Into the Jet Age: Conflict and Change in Naval Aviation 1945-1975*, ed., E. T. Wooldridge (Annapolis: Naval Institute Press, 1995), 12; Field, *Naval Operations*, 417; *Naval Aviation*, 94.

72. Richard L. "Zeke" Cormier, Walter M. "Wally" Schirra, and Phillip R. "Rat" Wood, *Wildcats to Tomcats: TheTailhook Navy*, (St. Paul, MN: Phalanx Publishing, 1995), 89.

73. Linnekin, *Eighty Knots*, 186.

74. Hallion, *Naval Air War*, 173; Antietam Cruise Book, *Photo-Narrative*, 33-35; Gillchrist, *Feet Wet*, 8; Linnekin, *Eighty Knots*, 186.

75. R. M. "Mike" Crosley, *Up in Harm's Way Flying with the Fleet Air Arm*, (Shrewsbury, England: Airlife, 1995), 161.

76. The United States Navy, *The Bluejackets' Manual*, 14th ed., (Annapolis: Naval Institute Press, 1950), 590-591 (hereafter cited as *1950 Bluejackets Manual*).

77. The evidence for this assertion is indirect but fairly compelling. Since the late 1950s, all of the USN's multi-engined propeller-driven aircraft have been marked with conspicuous red stripes, bearing the legend "propeller," that indicate the plane of the propeller discs. The word "DANGER" (all capitalized) appears on either side of the stripe, each with arrows pointing to the stripe, which would seem to indicate that the risk

is limited to the immediate area of the propeller disc itself. In contrast, the engine intakes of naval jet aircraft are marked with large red triangles. The word "DANGER" (again, capitalized) appears in the middle of the triangle with an arrow pointing forward, even on those aircraft that have their intakes at the extreme front. This arrangement suggests that the danger extends to a very large area in front of the airplane.

Additionally, it should be mentioned that since before World War Two, most piston-engined aircraft have had the tips of their propellers painted a bright color. When the propeller is spinning, the color blends into a circle that identifies the outer edge of the propeller disc. Most military organizations use yellow for this purpose but the USN uses white prop tips with red stripes. This pattern provides further evidence that the danger associated with the propellers comes from the blades themselves, not the area in front of or behind them.

Further support for this conclusion can be found on the warning signs posted conspicuously on board aircraft carriers. Before the jet age, these signs said simply, "BEWARE OF PROPELLERS." During the 1950s and '60s, however, the signs were amended to say, "BEWARE OF PROPELLERS AND JET BLAST" (today, the warning is usually, "BEWARE OF PROPELLERS, JET BLAST AND ROTORS," because modern carriers will often have large numbers of helicopters on board). The choice of words in each case would indicate that while propeller and rotor blades are hazardous only in their immediate areas, jet engines are hazardous even at a distance.

78. *1950 Bluejackets' Manual*, 591.

79. Pat Casey, quoted in "Carrier Crewmen Have Rugged Vital Job," *All Hands*, November 1951, 5.

80. 1950 *Bluejackets' Manual*, 591.

81. Chesnau, *Conway's Fighting Ships*, 104.

82. Larry Davis, *Air War Over Korea*, (Carrollton, TX: Squadron/Signal Publication, 1982), 90.

83. James Michener, *The Bridges at Toko-Ri*, (New York: Bantam Books, 1953), 6; USS Princeton, *USS Princeton*, 82; Antietam cruise Book, *Photo-Narrative*, 18-19; Keeney and Butler, *No Easy Days*, 66.

The two cruise book references are to pages that have photographs of the jet blast deflector, a small square panel about eight feet high, in its extended position; the Kenney and Butler book reproduces a photograph of the baffle in its retracted position. All that can be seen is a series of warning stripes on the deck to indicate its location.

84. Antietam Cruise Book, *Photo-Narrative*, 18.

85. *F9F-6 Flight Handbook*, 70.

86. O'Rourke, "Korean Knights," 85.

87. *Ibid.*

88. Hallion, *Naval Air War*, 173, Field, *Naval Operations Korea*, 381.

89. *1950 Bluejackets' Manual*, 591.

90. "Marine Saved from Jaws of Jet," *All Hands*, April 1953, 38-39; George C. Wilson, *Super Carrier: An Inside Account of Life Aboard the World's Most Powerful Ship, the USS John F. Kennedy* (New York: MacMillan Publishing, 1986), 21; Garrison, CV, 14-15; Linnekin, *Eighty Knots*, 181.

91. Linnekin, *Eighty Knots*, 181.

92. J. Richard Smith and Eddie J. Creek, *Jet Planes of the Third Reich*, (Boylston, MA: Monogram Aviations Publications, 1982), 125; William Green, *Warplanes of the Third Reich*, (New York, Galahad Books, 1970), 638.

93. Garrison, *CV*, 28-29; Wilson, *Super Carrier*, 16-17.

94. Crosley, *Harm's Way*, 26.

95. D. N. Ahnstrom, *The Complete Book of Jets and Rockets*, revised edition (New York: World Publishing, 1959), 94; Crosley, *Harm's Way*, 193; Paul Ellis, *Aircraft of the Royal Navy* (London: Jane's, 1982), 139; Ken Moore, quoted in Mills, *Banshees*, 146; *Naval Aviation 1910-1970*, 197; Rosario Rausa, editor, *Pistons to Jets* (Washington: the Deputy Chief of Naval Operations [Air Warfare] and the Commander, Naval Air Systems Command, 1987), 114.

The pages cited in the Ellis and Rausa works have photographs of airplanes being launched from carriers. In both pictures, the bridle can be seen suspended in midair, quite obviously not attached to either the airplane or the catapult shuttle.

96. Ahnstrom, *Jets and Rockets*, 94.

97. *Ibid.*, Gillchrist, *Feet Wet*, 200; Moore, in Wills, *Banshees*, 146.

The whole problem of lost catapult bridles was obviated in late 1962 when the Navy began experiments with the nose-tow catapult shuttle, which attaches directly to the nosewheel strut of the airplane and eliminates entirely the need for a bridle. Aircraft designed before this innovation was introduced still required bridles, but most of these types had been retired by the mid 1970s. Today, all US Navy carrier aircraft have nosewheel struts incorporating a t-bar to engage the catapult shuttle.

98. Linnekin, *Eighty Knots*, 160.

99. *Ibid.*, 161.

100. *Ibid.*

101. *Ibid.,* 197.

102. *Ibid.*

103. Friedman, *Postwar Naval Revolution*, 90-91.

104. Linnekin, *Eighty Knots*, 197,

105. *Ibid.*

1-06. Field, *Naval Operations Korea*, 369.

107. Linnekin, *Eighty Knots*, 197.

108. *Ibid.*

109. Field, *Naval Operations Korea*, 380.

110. Gordon Swanborough and Peter M. Bowers, *United States Navy Aircraft since 1911,* (Annapolis: Naval Institute Press, 1990), 249-279, 321-346, 454-463; Angelucci and Bowers, *American Fighter*, 242-254, 297-301, 304-306, 310-317, 320-323, 446-456; Beaver, *Fleet Air Arm*, 56-152; Crosley, *Harm's Way*, 134-154, 212-223; Linnekin, *Eighty Knots*, 155-229, 254-244; *Naval Aviation 1910-1970*, 201-274.

The pages cited in the two books co-authored by Bowers are those about the post-World War Two products of Vought, McDonnell (later McDonnell-Douglas), and Grumman, three American aircraft manufacturers that specialize in naval designs.

The works by Angelucci and Bowers, Swanborough and Bowers, and Beaver are encyclopedic in nature; new technologies are mentioned in passing in the entries about individual aircraft types.

The works by Crosley and Linnekin are pilots' memoirs but both authors often discuss the new technologies in some detail. The pages cited are for the years after the Korean War and the aircraft that entered service in that era.

Naval Aviation 1910-1970 is a chronology of the USN's aviation activities, organized on an almost day-by-day basis. Most innovations in aircraft technology are included, but take some searching for, as they are often buried in the text. Fortunately, the work is well indexed. The pages cited pertain to the post-Korean war period.

111. Gino Galuppini, *Warships of the World: An illustrated Encyclopedia* (New York: Times Books, 1986) 118, 121-125; Beaver, *Fleet Air Arm*, 228-237; Friedman, *Postwar Naval Revolution*, 84-109; Russell, "Carriers in the Jet Age," 54-63; Gillchrist, *Feet Wet*, 153-164; Crosley, *Harms's Way*, 120-133; Hallion, *Naval Air War*, 294-295; *Naval Aviation 1910-1970*, 201-274.

The Beaver and Friedman books are particularly useful.

Russell, Gillchrist, and Crosley are pilots but the works cited include much valuable material about the evolution of aircraft carrier design in the period after the post-Korean War.

The Hallion book is a secondary history but its last chapter discusses the legacy of the Korean War to the Navy,

As observed in note 109 above, *Naval Aviation 1910-1970* contains a large amount of material about technological innovations but it can be difficult at times to find specific entries.

112. Malcolm W. Cagle and Frank A. Mason, *The Sea War in Korea* (Annapolis: Naval Institute Press, 1957), 523.

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1. The President's Air Policy Commission, *Survival in the Air Age: A Report by the President's Air Policy Commission* (Washington, DC: USGPO, 1948), 8.

2. Douhet, *Command of the Air*, 175.

3. Mitchell, *Winged Defense*, 29.

4. James L. Cate, "Development of United States Air Doctrine, 1917-41," in *The Impact of Air Power: National Security*, ed. Eugene M. Emme, (Princeton: D. Van Nostrand, 1959), 189; Lee Kennett, *A History of Strategic Bombing*, (New York: Charles Scribner's Sons, 1982, 56).

5. Douhet, *Command of the Air*, 140.

6. Mitchell, *Winged Defense*, xiv.

7. Douhet, *Command of the Air*, 140.

8. Mitchell, *Winged Defense*, 214.

9. *Ibid*, 10.

10. Douhet, *Command of the Air*, 201.

11. Mitchell, *Winged Defense*, 199.

12. Douhet, *Command of the Air*, 34.

13. *Ibid.*

14. United States Department of War, *War Department Field Manual FM 100-20: Command and Employment of Air Power*, (Washington: USGPO, 1944), 6.

15. Richard H. Kohn and Joseph P. Harahan, eds., *Air Superiority in World War II and Korea: An Interview with Gen. James Ferguson, Gen. Robert M. Lee, Gen. William Momyer, and Lt. Gen. Elwood P. Quesada* (Washington: Office of Air Force History, 1983), 61.

16. William W. Momyer, *Air Power in Three Wars* (WWII, Korea, Vietnam) (Washington: USGPO, 1978), 5.

17. Momyer, *Air Power*, 115.

18. Ferguson, quoted in Kohn and Harahan, *Air Superiority*, ??????

19. Kohn and Harahan, *Air Superiority*, 76.

20. Frederick C. Blesse, *"Check Six:" A Fighter Pilot Looks Back* (New York: Ivy Books, 1987), 87.

21 *Ibid.*

22. William W. Momyer, quoted in Kohn and Harahan, *Air Superiority*, 74-75.

23. General Momyer did not serve in Korea but is an authority on air power theory. During the Korean Conflict he was assigned to various command and staff schools, both as student and as an instructor.

24. Ferguson and Momyer, quoted in Kohn and Harahan, *Air Superiority*, 76-77.

25. Harold Fischer, "Kismet and the Paper Tiger," in *Top Guns*, eds. Joe Foss and Matthew Brennan (New York: Pocket Books, 1991), 334; Bill Lilley, "Kimpo (K-14), " in *Top Guns*, 403; Frances Gabreski, *Gabby: A Fighter Pilot's Life* (New York: Orion Books, 1991), 220; Futrell, *USAF in Korea 1950-1953*, 92; Larry Davis, *Air War Over Korea*, 3; Larry Davis, *MiG Alley: Air to Air Combat Over Korea* (Carrollton, TX: Squadron/Signal, 1978), 71.

26. Davis, *Air War Over Korea*, 51; Futrell, *USAF in Korea*, 650.

27. Futrell, *USAF in Korea*, 610-611; Davis, *MiG Alley*, 70-71.

28. Mitchell, *Winged Defense*, 5-6.

29. Douhet, *Command of the Air*, 188.

30. Mitchell, *Winged Defense*, xvi.

31. Douhet, *Command of the Air*, 126.

32. *Ibid.*, 35.

33. *Ibid.*, 25.

34. Mitchell, *Winged Defense*, 6.

35. War Department, *FM 100-20: Command and Employment*, 6.

36. Kennett, *Strategic Bombing*, 183.

37. *Ibid.*, 185.

38. Air University Tactical School, *Air Power, Warfare, and Principles of War* (Montgomery, AL: Air University USAF Extension Course Institute, 1949), 11.

39. *Ibid.*, 7.

40. *Ibid.*

41. *Ibid.*, 14-15.

42. Momyer, *Air Power*, 56.

43. Robert Jackson, *Air War Over Korea*, (New York: Charles Scribner's Sons, 1973) 56; Davis, *Air War Over Korea*, 25.

44. Momyer, *Air Power*, 56.

45. Douhet, *Command of the Air*, 259.

46. Mitchell, *Winged Defense*, 16.

47. Air University Quarterly Review Staff, "The Attack on the Irrigation Dams in North Korea," in *Airpower: the Decisive Force in Korea*, ed. James T. Stewart, (Princeton: D. Van Nostrand , 1957), 169.

48. M. J. Armitage and R. A. Mason, *Air Power in the Nuclear Age*, (Urbana, IL: U of Illinois Press, 1985), 42.

49. AUQR Staff, "Attack on Dams," in *Airpower*, ed. Stewart, 167.

50. Mark C. Clark, FEC (Far East Command) Report, May 1953, 3; quoted in Futrell, *USAF in Korea*, 626-627.

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1. Harry S. Truman, *Memoirs by Harry S. Truman: Volume Two: Years of Trial and Hope* (Garden City, NY: Doubleday, 1956), 395.

2. "Air Policy Still Rests on Strategic Bomber," *Aviation Week*, 25 February 1952, 25.

3. Alexander deSeversky, *Air Power: Key to Survival* (New York: Simon & Schuster, 1950), 2.

4. The term "heavy bomber" is used loosely in this context. During World War Two, the B-29 was classified as a "very heavy bomber," a reference to its weight-carrying ability. By 1950, however, the B-29 had been redesignated as a "medium bomber." The change in nomenclature came about in 1947 and was actually based on the aircraft's range, not it size (although the B-29 was indeed dwarfed by the Consolidated B-36, which entered service in 1948 as a "heavy" [long range] bomber).

See Marcelle Size Knaack, *Post-World War II Bombers*, Encyclopedia of US Air Force Aircraft and Missile Systems, volume II (Washington: USGPO, 1988), 21.

5. Alpheus W. Jessup, "Flexibility Seen as Air Power Key," Aviation Week, 10 September 1951, 18.

6. *Foreign Relations of the United States 1950: Volume VII Korea* (Washington: USGPO, 1976), 1041. Subsequent references to works in this series will use format *FRUS*, giving year and volume.

7. *Ibid.*

8. *Ibid.*

9. Futrell, *USAF in Korea*, 655-656.

10. *Ibid.*, 656.

11. *Ibid.*

12. *Ibid.*

13. Dwight David Eisenhower, *Mandate for Change 1953-1956* (Garden City NY: Doubleday, 1963) 180.

14. Max Hastings, *The Korean War* (New York: Simon & Schuster, 1987), 183-184.

15. Douglas MacArthur, *Reminiscences* (New York: McGraw-Hill, 1964), 411.

16. Dean Acheson, *Present at the Creation: My Years in the State Department* (New York: W. W. Norton, 1969), 478.

17. *Pravda*, 6 October 1951, page number and translator not identified in citation in Carl B. Feldman and Ronald. J. Bee, *Looking the Tiger in the Eye: Confronting the Nuclear Threat* (New York: Harper & Row), 1988.

18. K. M. Panikkar, *In Two Chinas: Memoirs of a Diplomat* (London: George Allen & Unwin, 1955), 108.

19. *Ibid.*

20. Knaack, *Bombers*, 161-202, 479-494.

21. Unidentified aviator, quoted in Hastings, *Korean War*, 263.

22. A. W. Jessup, "MiG-15 Dims A-Bomb Hopes," *Aviation Week*, 4 February 1952, 16.

23. *Ibid.*

24. Truman, *Memoirs*, 395.

25. *Ibid.*

26. *Ibid.*

27. *Ibid*

28. *Ibid.*

29. *Ibid.*

30 *Ibid*

31. *FRUS*, 1950, vol. VII, 1300.

32. *Ibid.*

33. *Ibid.* This writer has been unable to find another reference that would identify positively the Federer to whom Austin refers.

34. Truman, *Memoirs*, 395.

35. *Ibid.*

36. *Ibid.*

37. Acheson, *Present at the Creation*, 478.

38. Truman, *Memoirs,* 396.

39. Truman, *Memoirs*, 410.

40. Acheson, *Present at the Creation*, 481.

41. *FRUS*, 1950, vol. VII, 1098.

42. *Ibid.*, 1100.

43. *Ibid.*, 1300.

44. *Ibid.* 1334.

45. Panikkar, *Two Chinas*, 119.

46. Eisenhower, *Mandate for Change*, 180.

47. *FRUS*, 1951, vol. VII, 834.

48. *FRUS*, 1952-54, vol. XV, 841.

49. Joint Chiefs of Staff, "Fighter-Borne Atomic Capability," Document 1102, Reel X, on *Joint Chiefs of Staff Part 2. 1946-54 The Far East* (Washington: University Publications of America), microfilm.

50. *FRUS*, 1951, vol. VII, 834.

51. Eisenhower, *Mandate*, 180.

52. *FRUS*, 1950, vol. III, 45.

53. *Ibid.*, 1135.

54. *FRUS*, 1950, vol. I, 327-330.

55. *Ibid.*, 331-341.

56. *FRUS*, 1950, vol. VII, 1100.

57. *FRUS*, 1951, vol. VII, 295.

58. Thomas B. Cochran, "U. S. Nuclear Weapons Production: An Overview," *Bulletin of the Atomic Scientists*, January/February 1988, 14.

59. Bernard Brodie, *Strategy in the Missile Age*, (Princeton: Princeton UP, 1959), 319.

Brodie, credited with defining the concept of nuclear deterrence, is to atomic war theory what Mitchell and Douhet are to air power theory. In 1946, he edited *The Absolute Weapon*, the first book to address the impact the atomic bomb would have on international security and diplomatic issues. He was briefly a consultant to the USAF target selection staff during the Korean War years.

60. *FRUS*, 1952-54, vol. XV, 841.

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