

THE PHANTOM MENACE: THE F-4 IN AIR COMBAT IN VIETNAM

Michael W. Hankins

Thesis Prepared for the Degree of

MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

August 2013

APPROVED:

Robert Citino, Major Professor

Michael Leggiere, Committee Member

Christopher Fuhrmann, Committee Member

Richard McCaslin, Chair of the Department of
History

Mark Wardell, Dean of the Toulouse Graduate
School

Hankins, Michael W. The Phantom Menace: The F-4 in Air Combat in Vietnam. Master of Science (History), August 2013, 161 pp., 2 illustrations, bibliography, 84 titles.

The F-4 Phantom II was the United States' primary air superiority fighter aircraft during the Vietnam War. This airplane epitomized American airpower doctrine during the early Cold War, which diminished the role of air-to-air combat and the air superiority mission. As a result, the F-4 struggled against the Soviet MiG fighters used by the North Vietnamese Air Force. By the end of the Rolling Thunder bombing campaign in 1968, the Phantom traded kills with MiGs at a nearly one-to-one ratio, the worst air combat performance in American history. The aircraft also regularly failed to protect American bombing formations from MiG attacks. A bombing halt from 1968 to 1972 provided a chance for American planners to evaluate their performance and make changes. The Navy began training pilots specifically for air combat, creating the Navy Fighter Weapons School known as "Top Gun" for this purpose. The Air Force instead focused on technological innovation and upgrades to their equipment. The resumption of bombing and air combat in the 1972 Linebacker campaigns proved that the Navy's training practices were effective, while the Air Force's technology changes were not, with kill ratios becoming worse. However, the last three months of the campaign introduced an American ground radar system that proved more effective than Top Gun in improving air-to-air combat performance. By the end of the Vietnam War, the Air Force and Navy overcame the inherent problems with the Phantom, which were mostly of their own making.

Copyright 2013

by

Michael W. Hankins

ACKNOWLEDGEMENTS

I owe a large debt of gratitude to many people for helping to make this thesis possible. First and foremost, my major professor, Dr. Robert Citino, provided not only valuable insight and advice during the entire writing process, but an infectious enthusiasm for the work of a historian. I have leaned heavily on his guidance during our many conversations about military history, research methods, and rock and roll.

The other members of my committee, Dr. Michael Leggiere and Dr. Christopher Fuhrmann, have also been extremely encouraging and helpful throughout my graduate studies, continually making themselves available for answering my many questions about writing, research, and career building. My other professors at The University of North Texas, Dr. Guy Chet, Dr. Richard Lowe, and Dr. Richard McCaslin, have all proven incredibly supportive and valuable to my development. Dr. Peter Lane, not only a great professor but a decorated fighter pilot in Vietnam, also provided very helpful guidance in my research. The staff at the Air Force Historical Research Agency was absolutely invaluable. I cannot overstate my gratitude for their generous help and welcoming attitude.

I would like to sincerely thank the administrative staff of the University of North Texas History Department. Their diligence, combined with their tolerance of my many questions has been much appreciated. Likewise, I am extremely grateful to all my fellow graduate students at the University of North Texas for their advice, friendship, and the occasional adult beverage. Specifically, I received exceptional help in editing and proofreading as well as general guidance and inspiration from Luke Truxal, Molly Bundschuh, Megan Winkler, and Ryan English. Finally, I would like to thank my father, David Hankins, for instilling in me a fascination for history, technology, and aviation.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
CHAPTER 1 INTRODUCTION: THE DEATH AND RETURN OF AIR SUPERIORITY	1
CHAPTER 2 ORCHESTRATED CONFUSION: DESIGN AND DEVELOPMENT OF THE F-4 PHANTOM	13
Sacrificing Superiority: The Post World War II Air Force.....	15
When is a Fighter Not a Fighter? Navy Doctrine in the Cold War.....	22
A Gleam in the Customer's Eye	26
A Maelstrom of Design Changes	29
Winners and Losers.....	34
Flexible Planes for Flexible Response.....	39
Conclusion	42
CHAPTER 3 A RIFLE IN A PHONE BOOTH: AIR COMBAT DURING ROLLING THUNDER	45
Waiting To Be Hit: The Opening of Air-To-Air Combat.....	49
A Real Menace: Growing MiG Aggression.....	54
The Electric Trojan Horse: Operation Bolo.....	59
The Wheel in the Sky: Changing MiG Tactics	65
Revenge of The MiGs.....	72
Conclusion	78
CHAPTER 4 HALFTIME: REEVALUATING TRAINING AND TECHNOLOGY	82
Not a Fighter Pilot Among Them: Training in the Air Force	83

Airline Captains, Not Fighter Pilots: Training in the Navy	88
Mirror Images and the “Fly Safe” Culture.....	91
Know Your Enemy	95
A Time of Reflection	99
Rebuilding the Air Force: We Have the Technology	104
Conclusion	111
CHAPTER 5 TAKE WARNING: AIR COMBAT DURING THE LINEBACKER	
CAMPAIGNS.....	114
Nothing to Compare: New Gear, New Men, and New Strategies	118
A New Bag of Tricks: Renewed Combat	129
An Old-Fashioned Butt Kicking.....	133
The Most Effective Show We've Had: Project Teaball	135
Caught in the Apocalypse: Linebacker II	142
Conclusion	146
CHAPTER 6 CONCLUSION: THE FAILED EXPERIMENT.....	149
APPENDIX: LIST OF ABBREVIATIONS.....	154
BIBLIOGRAPHY.....	156

CHAPTER 1

INTRODUCTION: THE DEATH AND RETURN OF AIR SUPERIORITY

Many consider the F-4 Phantom II to be one of the greatest fighter planes ever built.¹ Yet by a strict definition, it was hardly a fighter plane at all. With its large size and poor maneuverability, it carries few of the traditional hallmarks of successful air superiority fighters.

¹ “It is impossible to gather enough superlatives into one book to adequately describe the McDonnell Douglas F-4 Phantom II,” states Lou Drendel in the introduction to Lou Drendel, *USAF Phantoms in Combat* (Carrollton, TX: Squadron/Signal Publications, 1987). This publisher produced a line of books that highlight the Phantom in similar terms. Other books in the same vein consist of encyclopedic works focusing on the technical aspects of the Phantom and other aircraft. The best of these include Lou Drendel, *F-4 Phantom II in Action* (Warren, MI: Squadron/Signal Publications, 1972); Lou Drendel, *The Air War in Vietnam* (New York: Arco Publishing, 1968); Lou Drendel, *Air War Over Southeast Asia: A Pictorial Record* (Carrollton, TX: Squadron/Signal Publications, 1982); Amy E. Williams, *The American Fighter Plane* (New York: Barnes and Noble Books, 2004); Peter Davies, *USN F-4 Phantom II vs VPAF MiG-17/19* (New York: Osprey, 2009); Peter Davies, *F-4 Phantom II vs MiG-21 : USAF & VPAF in the Vietnam War* (New York: Osprey Publishing, 2004); Peter Davies and Jim Laurier, *USAF F-4 Phantom II MiG Killers 1965-1968* (Oxford: Osprey Publishing, 2004); Peter Davies, *USAF F-4 Phantom II MiG Killers 1972-73* (Oxford: Osprey, 2005); Peter Davies, Adam Tooby, Henry Morshead, *USAF McDonnell Douglas F-4 Phantom II* (Long Island City, Osprey Publishing, 2013); Anthony M. Thornborough, *The Phantom Story* (New York: Arms and Armour Press, 1994); Anthony M. Thornborough, *USAF Phantoms: Tactics, Training, and Weapons* (New York: Arms and Armour Press, 1988); Walter J. Boyne, *Phantom in Combat* (Washington: Smithsonian Institution Press, 1985); Enzo Angelucci and Peter M. Bowers, *The American Fighter* (New York: Orion, 1987); Lloyd S. Jones, *U.S. Fighters* (Fallbrook: Aero Publishers, 1975); and Mick Spick, *All-Weather Warriors: The Search for the Ultimate Fighter Aircraft* (London: Arms and Armour Press, 1994). One rare example of studying the Phantom in a scholarly setting is Glenn E. Bugos, *Engineering the F-4 Phantom II: Parts Into Systems* (Annapolis: Naval Institute Press, 1996), although this work focuses on engineering and the military industrial complex. While the Phantom remains popular in these “enthusiast” works, several scholarly overviews of the period and of the air war mention the Phantom briefly in a larger context, while some neglect it completely. Important entries in this category include Robert F. Dorr, *Air War Hanoi* (New York: Blandford Press, 1988); Rene Francillon, *Vietnam: The War in the Air* (New York: Arch Cape Press, 1987); Peter B. Mersky and Normal Polmar, *The Naval Air War in Vietnam* (Annapolis, Nautical and Aviation Publishing Company of America, 1981); George W. Baer, *One Hundred Years of Sea Power: the U. S. Navy, 1890-1990* (Stanford: Stanford University Press, 1994); Robert W. Love, Jr., *History of the United States Navy, Vol. 2* (Harrisburg: Stackpole Books, 1992); Bernard C. Nalty, ed., *Winged Shield, Winged Sword: History of the United States Air Force Vol 2* (Washington, D.C.: Air Force History and Museums Program, United States Air Force, 1997); Jacob Van Staaveren, *Gradual Failure: The Air War Over North Vietnam 1965-1966* (Washington D.C.: Air Force History and Museums Program, United States Air Force, 2002); Wayne Thomspon, *To Hanoi and Back: The United States Air Force and North Vietnam, 1966-1973* (Washington D.C.: Smithsonian Institution Press, 2000); John Schlight, *The War in South Vietnam: The Years of the Offensive, 1965-1968* (Washington D.C.: Air Force History and Museums Program, United States Air Force, 1999); John Schlight, *A War Too Long: The USAF in Southeast Asia, 1961-1975* (Washington D.C.: Air Force History and Museums Program, 1996); and the official Air Force history: Carl Berger, ed., *The United States Air Force in Southeast Asia, 1961-1973* (Washington D.C.: Office of Air Force History, 1977). Several useful overviews of the Vietnam War as a whole exist, many only tangentially discussing the air war while not examining the Phantom specifically. The most useful and concise overview is George C. Herring, *America's Longest War: The United States and Vietnam, 1950-1975* (New York: McGraw-Hill, 1996). Other notable entries include Stanley Karnow, *Vietnam: A History* (New York: Viking, 1983); Guenter Lewy, *America in Vietnam* (New York: Oxford University Press, 1978); and David W. Elliott, *The Vietnamese War: Revolution and Social Change in the Mekong Delta, 1930-1975* (Armonk: M.E. Sharpe, 2003).

The F-4's design demonstrates that in the years prior to the Vietnam War, the role of air superiority transformed – redefined to serve a Cold War context that focused on intercepting potential Soviet nuclear bombers. American war planners dismissed the close-range, hard-turning dogfight as a relic of the romanticized past. The Phantom's design thus emphasized speed at the expense of agility, armed with long-range missiles and bereft of the dogfighter's weapon of choice: a gun. The F-4 was the perfect weapon for a war that never happened. Instead, the plane found itself mired in the Vietnam War, used for the roles of ground attack, bombing, and the exact type of vicious air-to-air combat that American war planners assumed was obsolete.²

Any serious discussion of airpower must confront this dominance of the strategic bombing role, and many writers have documented the development of this doctrine. The largest debate in this discussion concerns whether strategic bombing is truly decisive in war. Just as it dominates Air Force doctrine, bombing also dominates the historical study of airpower, especially after the advent of nuclear weapons.³ Examinations of air superiority and the role of air-to-air combat

² Many works critique the Air Force for failing to apply their doctrine to the context of small, limited wars. The best discussions of this idea include Donald J. Mrozek, *Air Power and the Ground War in Vietnam: Ideas and Actions* (Maxwell Air Force Base: Air University Press, 1988); James S. Corum and Wray R. Johnson, *Airpower in Small Wars: Fighting Insurgents and Terrorists* (Lawrence: The University Press of Kansas, 2003); and David J. Dean, *The Air Force Role in Low-Intensity Conflict* (Maxwell Air Force Base: Air University Press, 1986). The post-Vietnam Air Force sought to remedy this change by studying low-intensity conflict and adjust its doctrine. Two key essay collections highlighting this move are David J. Dean, ed., *Low-Intensity Conflict and Modern Technology* (Maxwell Air Force Base: Air University Press, 1986); and Stephen Blank, Lawrence E. Grinter, Karl P. Magyar, Lewis B. Ware, and Bynum E. Weathers, *Responding to Low-Intensity Conflict Challenges* (Maxwell Air Force Base: Air University Press, 1990).

³ Books regarding the proper role of airpower in warfare, especially in regards to strategic bombing are numerous. A concise overview of the literature on airpower doctrine is Phillip S. Meilinger, "The Historiography of Airpower: Theory and Doctrine" *The Journal of Military History* 64, No. 2 (Apr., 2000), 467-501. The most influential early works on airpower theory are Giulio Douhet, *The Command of the Air* (Washington D.C.: Office of Air Force History, 1983, originally published in 1921); and William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power Economic and Military* (New York: Dover Publications, 1988, originally published in 1925). Key works on the development of American air doctrine from its inception through the Vietnam period are legion. Some notable entries include Michael S. Sherry, *The Rise of American Air Power: the Creation of Armageddon* (New Haven: Yale University Press, 1987); Alexander P. de Seversky, *Victory Through Air Power* (New York: Simon and Schuster, 1942), which was adapted into an animated film by Walt Disney; Conrad C. Crane, *Bombs, Cities, and Civilians: American Airpower Strategy in World War II* (Lawrence: The University of Kansas Press, 1993); Robert F. Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force 1907-1964* (Maxwell Air Force Base: Air University Press, 1971); Lee Kennett, *A History of Strategic*

remain almost entirely absent from this discussion. While many encyclopedic books focusing on technical aspects of fighter aircraft clog the shelves, little scholarly work exists on air superiority doctrine and the role of air combat, especially as it developed through World War II and into the Vietnam era.⁴

Writing about the Vietnam War is like purposefully wading into a dense minefield, it is almost certain to cause an explosion. As historian Robert Citino has noted, “Anyone who tries to draw conclusions from the Vietnam War will almost certainly anger the legions of Americans who have already made up their minds about it.”⁵ This sentiment is certainly true of the air war as well. The bombing campaigns known as Rolling Thunder and Linebacker have generated a

Bombing (New York: Scribner, 1982); Tami Davis Biddle, *Rhetoric and Reality in Warfare: The Evolution of British and American Ideas About Strategic Bombing* (Princeton: Princeton University Press, 2002); Kenneth P. Werrell, *Death From the Heavens: A History of Strategic Bombing* (Annapolis: Naval Institute Press, 2009); Conrad C. Crane, *American Airpower Strategy in Korea, 1950-1953* (Lawrence: The University Press of Kansas, 2000); Robert F. Futrell, *Ideas, Concepts, Doctrine: Volume II: Basic Thinking in the United States Air Force 1961-1984* (Maxwell Air Force Base: Air University Press, 1989); Robert F. Futrell, *The United States Air Force in Southeast Asia: The Advisory Years to 1965* (Washington D.C.: Office of Air Force History, 1981); Gian P. Gentile, *How Effective is Strategic Bombing? Lessons Learned from World War II and Kosovo* (New York: New York University Press, 2001); Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca: Cornell University Press, 1996); Phillip S. Meilinger, *The Paths of Heaven: The Evolution of Airpower Theory* (Maxwell Air Force Base: Air University Press, 1997); Phillip S. Meilinger, *Airpower: Myths and Facts* (Maxwell Air Force Base: Air University Press, 2003); Herman L. Gilster, *The Air War in Southeast Asia: Case Studies of Selected Campaigns* (Maxwell Air Force Base, Air University Press, 1993.); Benjamin J. Lambeth, *The Transformation of American Air Power* (Ithaca, Cornell University Press, 2000); Carl H. Builder, *The Icarus Syndrome: The Role of Air Power Theory in the Evolution and Fate of the U.S. Air Force*, (New Brunswick: Transaction, 1994). The idea of gradual escalation of bombing to coerce an enemy is laid out in the influential work, Thomas C. Schelling, *Arms and Influence* (New Haven: Yale University Press, 1966), and had a large impact on bombing doctrine in Vietnam.

⁴The role of air superiority has rarely received a focused treatment in any era. Outside of non-scholarly enthusiast works or memoirs, it is usually relegated to passing mentions in books primarily about bombing or doctrine. Some examples do exist, mostly for the pre-Vietnam era. These include Denis Winter, *The First of the Few: Fighter Pilots of the First World War* (Athens: University of Georgia Press, 1983); Stephen L. McFarland and Wesley P. Newton, *To Command the Sky: The Battle for Air Superiority Over Germany, 1942-1944* (Washington D.C.: Smithsonian Institution Press, 1991); Richard H. Kohn and Joseph P. Harahan, et al., *Air Superiority in World War II and Korea: An Interview with Gen. James Ferguson, Gen. Robert M. Lee, Gen. William W. Momyer, and Lt. Gen. Elwood R. Quesada* (Washington D.C.: Office of Air Force History, 1983); William T. Y'Blood, *MiG Alley: The Fight for Air Superiority* (Washington D.C.: Air Force History and Museums Programs, 2000); Kenneth P. Werrell, *Sabres Over MiG Alley: The F-86 and the Battle for Air Superiority in Korea* (Annapolis: Naval Institute Press, 2005); Benjamin F. Cooling, ed., *Case Studies in the Achievement of Air Superiority* (Washington D.C.: Air Force History and Museums Program, 1994). Discussion of the details of fighter combat and explanations of specific maneuvers can be found in Robert L. Shaw, *Fighter Combat: Tactics and Maneuvering* (Annapolis: Naval Institute Press, 1985). The most significant study of air superiority and fighter combat in Vietnam is Marshall L. Michel III, *Clashes: Air Combat Over North Vietnam, 1965-1972* (Annapolis, Naval Institute Press, 1997).

⁵ Robert M. Citino, *Blitzkrieg to Desert Storm: The Evolution of Operational Warfare* (Lawrence: The University of Kansas Press, 2004), 254.

significant amount of controversy over several topics, such as inter-service rivalries, the role of politicians in the military, the overall efficiency of the strategic bombing concept, and the damage to civilian populations. Much of the literature on the air war is vitriolic, looking for someone or something to blame for the long years of frustration.

In a general sense, these works tend to fall into a few categories. Much of the writing produced in the 1970s and 1980s tends to claim that political leadership exerted far too great an influence on military decision-making. The limitations placed on the bombing campaigns thus rendered them ineffective. These works lament that if the Air Force had been able to cut loose from political restrictions, it could have won the war much sooner.⁶ This view seems unlikely given the small material needs of the Southern insurgency, and the fact that, when the Air Force received more latitude in bombing volume and target selection during the 1972 Linebacker campaign, its performance seemed far too timid. President Richard Nixon expressed this, saying of the Air Force,

I am disgusted with their performance. . . . If there is one more instance of whining about target restrictions we will simply blow the whistle on this whole sorry performance of our Air Force in failing for day after day after day in North Vietnam this past week [12-19 May 1972] to hit enormously important targets when they had an opportunity to do so.⁷

Many of the works that express such frustration with political restrictions are the voices of those who were there, including the many pilot memoirs, oral histories, and analytical works written

⁶ The most popular and commonly cited work expressing this view is Harry G. Summers, Jr., *On Strategy: A Critical Analysis of the Vietnam War* (Novato, CA: Presidio, 1982). Applying this to the air war is John B. Nichols and Barrett Tillman, *On Yankee Station: The Naval Air War Over Vietnam* (Annapolis: Naval Institute Press, 1987). This view is also taken by most of the memoirs from the period discussed in note 8, and is often sprinkled throughout other works on the period discussed elsewhere. Countering this perspective is Andrew F. Krepinevich, Jr., *The Army in Vietnam* (Baltimore: Johns Hopkins University Press, 1986), which argues that the Army in Vietnam was determined to use a strategy built for conventional war in Europe. This concept is applied to the air war in many of the works discussed in note 10.

⁷ Message, Nixon/Haig to Kissinger, 19 May 1972, National Archives, Nixon National Security Council Papers, 1972, quoted in Marshall Michel III, "The Revolt of the Majors: How the Air Force Changed After Vietnam." (PhD Diss., Auburn University, 2006), 145.

by the war's participants.⁸ Closely related to this interpretation, and often presented together, is the view that inter-service rivalries created a non-cooperative environment in which the Air Force and Navy competed with one another for resources and statistical claims. The emphasis on metrics and the competition to increase performance thus led to practices that were insignificant in actually winning the war, but useful for boosting statistics that gave an illusion of combat effectiveness.⁹

More recently, in the 1990s and 2000s, more works have appeared that focus on a systematic approach to the war. While critical of the military and the politicians at times, these authors tend to view the Air Force and the military in general as large, complicated ships that cannot turn on a dime. Doctrines and attitudes evolve slowly, but are strongly rooted and

⁸ The best memoirs regarding fighter combat during Vietnam are a combination of Robin Olds, Christina Olds, and Ed Rasimus, *Fighter Pilot: The Memoirs of Legendary Ace Robin Olds* (New York: St. Martin's Press, 2010); which covers the Rolling Thunder period, and Ed Rasimus, *Palace Cobra: A Fighter Pilot in the Vietnam Air War* (New York: St. Martin's Press, 2006), which covers the Linebacker period. Other notable entries include Frederick C. Blesse, *Check Six: A Fighter Pilot Looks Back* (New York: Ivy Books, 1987); Randy Cunningham, *Fox Two: The Story of America's First Ace in Vietnam* (Mesa, AZ: Champlin Fighter Museum, 1984); John Trotti, *Phantom Over Vietnam* (New York: Berkley Books, 1985); Jerry W. Cook, *Once a Fighter Pilot* (New York: McGraw-Hill, 1996); Ed Rasimus, *Phantom Flights, Bangkok Nights: A Vietnam Pilot's Second Tour* (Washington D.C.: Smithsonian Books, 2004); Kenneth H Bell, *100 Missions North: A Fighter Pilot's Story of the Vietnam War* (Washington D.C.: Potomac Books, 2003); and Ed Rasimus, *When Thunder Rolled: An F-105 Pilot Over North Vietnam* (Washington, D.C.: Smithsonian Books, 2003). Collections of oral history from the war's participants are numerous and useful as well. The best examples include Lou Drendel, *...And Kill MiGs: Air to Air Combat in the Vietnam War* (Carrollton, TX: Squadron Signal Publications, 1984); and Robert Futrell, et al., *Aces and Aerial Victories: The United States Air Force in Southeast Asia 1965-1973* (Maxwell Air Force Base: Albert F. Simpson Historical Research Center, Air University, 1976). The latter contextualizes its oral history with useful analysis from Futrell and other prominent airpower historians. Two useful works consisting mostly of oral history with more author narration include Robert K. Wilcox, *Scream of Eagles: The Dramatic Account of the U.S. Navy's Top Gun Fighter Pilots and How They Took Back the Skies Over Vietnam* (New York: Pocket Star Books, 1990); and Zalin Grant, *Over the Beach: The Air War in Vietnam* (New York: Pocket Books, 1986). One key primary source regarding the air war is William W. Momyer, *Air Power in Three Wars: WWII, Korea, Vietnam* (Washington D.C.: Office of Air Force History, 1978), which goes far beyond a memoir's typical "I was there" perspective. During the war, Momyer served as the head of Air Training Command, Deputy Commander for Air Operations, Military Assistance Command, Vietnam, Commander, Seventh Air Force, and Commander of Tactical Air Command. His book examines the air war from mostly a doctrinal, top-down perspective while also dealing with details of the reality in the theater. Most of the books on this list to some degree fall in line with the perspective outlined in note 6, blaming the political leadership for placing severe limits on the air campaigns, thus preventing victory.

⁹ This argument is often found linked to the criticism of political restrictions, thus, many of the works in notes 6 and 8 share the view that inter-service rivalry and over-reliance on metrics produced meager results, perhaps even costing the war. For a thorough examination of the military's use of metrics, see Gregory A. Daddis, *No Sure Victory: Measuring U.S. Army Effectiveness and Progress in the Vietnam War* (New York: Oxford University Press, 2011).

difficult to change. Additionally, some of these works seek to explain, if not justify, the reasoning for these doctrines through proper contextualization.¹⁰ This is a welcome shift in the scholarship on the war, pointing the way for future research along these lines.

While the doctrine of strategic bombing dominated the Air Force and Navy aviation in the pre-Vietnam years, one undeniable fact is that it changed drastically during and after the war. Before Vietnam, Air Force leadership consisted mostly of former bomber pilots. As this thesis argues, the struggles of the F-4 Phantom in an air-to-air context during the war forced a change. Air combat, viewed by the old guard as obsolete, experienced a resurgence. Not only did the Air Force and Navy devote significant resources to developing technology, tactics, and training practices that emphasized dogfighting, but the makeup of leadership shifted. The years after Vietnam witnessed a host of new technologies, new aircraft with new design philosophies, and new air combat schools such as Top Gun and the Air Force Aggressor Squadron, all emphasizing air-to-air combat. The period also witnessed the rise of the “fighter mafia” as former fighter pilots replaced the old Air Force brass. Thus, emerging scholarship focuses on the Vietnam War as a transition point leading to a difficult but welcome period of renewal for American airpower.¹¹

¹⁰ The best book on bombing policy during the Vietnam War remains Mark Clodfelter, *The Limits of Air Power: The American Bombing of North Vietnam* (New York: The Free Press, 1989). Other notable entries that examine other aspects than strictly bombing include Earl H. Tilford, *Crosswinds: The Air Force's Setup in Vietnam* (College Station: Texas A&M University Press, 1993); Craig C. Hannah, *Striving for Air Superiority: The Tactical Air Command in Vietnam* (College Station: Texas A&M University Press, 2002); and Caroline F. Ziemke, “In The Shadow of the Giant: USAF Tactical Air Command in the Era of Strategic Bombing, 1945-1955,” (PhD. Diss, The Ohio State University, 1989). A critical analysis of the Linebacker campaign, demonstrating that the post-Vietnam Air Force can be just as stubborn as in the early Cold War is Raymond W. Leonard, “Learning from History: Linebacker II and U.S. Air Force Doctrine” *The Journal of Military History* 58, No. 2 (Apr., 1994), 267-303.

¹¹ Important works tracing the post-Vietnam changes in the Air Force include Mike Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership, 1945-1982* (Maxwell Air Force Base: Air University Press, 1998); C. R. Anderegg, *Sierra Hotel: Flying Air Force Fighters in the Decade After Vietnam* (Washington D.C.: Air Force History and Museums Program, 2001). Works on airpower in later wars often credit Vietnam with causing a major shift, such as in Richard P. Hallion, *Storm Over Iraq: Air Power and the Gulf War* (Washington D.C.: Smithsonian Institution Press, 1992). For an in-depth look at the doctrinal shift during the Vietnam period, see Marshall Michel, “The Revolt of the Majors: How the Air Force Changed After Vietnam” (PhD Diss., Auburn University, 2006). The

Despite this, the Air Force is still the victim of much criticism, particularly for its reliance on technology. Any work attempting to focus on technology, as this one does, encounters a difficult wall. Works that celebrate the role of technology in warfare tend not to be taken seriously, stacked in the corner as fodder for enthusiasts or coffee table readers.¹² Scholarly works that examine technology in any detail tend to criticize the military, especially the Air Force, for an over-reliance on invention, pointing to the fact that victory is often the result of more human factors, and that superior technology often does not even correlate with victory.¹³

The Vietnam War itself appears to be a prime example of this, as the powerful, advanced United States failed to win a war against North Vietnam, a small third world country. Yet such

work that had the most impact on Air Force doctrine in the post-Vietnam period is John A. Warden, *The Air Campaign: Planning For Combat* (Washington D.C.: National Defense University Press, 1990).

¹² For a thorough discussion of the separation between enthusiast works for “buffs” and more serious academic works, critical of technology-focused work, see James R. Hansen, “Aviation History in the Wider View” *Technology and Culture* 30, No. 3 (Jul., 1989), 643-656. A useful overview of the development of aviation technology both in the military and civilian sectors is Robin Higham, *100 Years of Airpower & Aviation* (College Station: Texas A&M University Press, 2003). Other, mostly positive studies of the Air Force fascination with technology include I. B. Holley, Jr., *Ideas and Weapons: Exploitation of the Aerial Weapon by the United States During World War I; a Study in the Relationship of Technological Advance, Military Doctrine, and the Development of Weapons* (Washington D.C.: Office of Air Force History: 1953); Michael H. Gorn, *Harnessing the Genie: Science and Technology Forecasting for the Air Force 1944-1986* (Washington D.C.: Office of Air Force History, 1988); Stephen B. Johnson, *The United States Air Force and the Culture of Innovation, 1945-1965* (Washington D.C.: Air Force History and Museums Program, 2002).

¹³ General works that illustrate an American fascination with technological achievement include Merritt Roe Smith and Leo Marx, *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge: MIT Press, 1994); Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970* (Chicago: University of Chicago Press, 2004); and Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore, Md.: Johns Hopkins University Press, 1993). Tracing the application of a technological fascination in the military is David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the U.S. Army* (Ithaca: Cornell University Press, 1998). Air Force pursuit of technology during World War II, specifically in the high degree of faith placed in the Norden bomb sight, is critiqued in Stephen L. McFarland, *America's Pursuit of Precision Bombing, 1910-1945* (Washington D.C.: Smithsonian Institution Press, 1995). For a mixed critique of the Air Force's technological development, see Jacob Neufeld, et al., *Technology and the Air Force: A Retrospective Assessment* (Washington D.C.: Air Force History and Museums Program, 1997). Harsher critiques of the Air Force's technological culture include Kenneth P. Werrell, “Did USAF Technology Fail in Vietnam? Three Case Studies” *Airpower Journal* (Spring 1998), 87-99; and James W. Gibson, *The Perfect War: Technowar in Vietnam* (Boston: Atlantic Monthly Press, 1986). The Phantom specifically is held up as a negative example of the Air Force's “technological exuberance” in a thorough study of the idea in Steven A. Fino, “Breaking the Trance: The Perils of Technological Exuberance in the U.S. Air Force Entering Vietnam” *Journal of Military History* 77 (April 2013), 625-655. For an exploration of the “cat-and-mouse” technological pendulum during the war, see Merle L. Pribbenow II, “The -Ology War: Technology and Ideology in the Vietnamese Defense of Hanoi, 1967” *Journal of Military History* 67, No. 1 (2003), 175-200.

generalizations can be deceiving, and this thesis attempts to view the technological issues of the air war in a more nuanced manner. While the United States had an unquestionable numerical superiority, its technological advantage was slight, and limited to certain areas. Equipped with Soviet and Chinese equipment including MiG fighter planes,¹⁴ plentiful surface-to-air missiles (SAMs), powerful anti-aircraft-artillery (AAA), and an expansive ground radar network, the North Vietnamese possessed one of the best air defense networks in the world. In the air-to-air arena, MiG fighters demonstrated far more proficiency at dogfighting due to their small size and high maneuverability. The ground radar system allowed pilots and ground operators to see U.S. planes and direct MiGs to attack positions long before American pilots were aware they were under attack.¹⁵

¹⁴ “MiG” is an abbreviation for “Mikoyan and Gurevich,” the Soviet design bureau that produced most of the fighter aircraft for the Soviet Union, named for its founders, Artem Mikoyan and Mikhail Gurevich. Each plane bears the acronym “MiG” followed by a design number. NATO gave its own codenames to each aircraft for reference. In 1970, upon Mikoyan’s death, “Gurevitch” was dropped from the bureau’s name, changed to “Mikoyan.” The acronym “MiG” remained in use despite this.

¹⁵ Information on “the other side” of the Vietnam War generally deals with the ground war, such as Merle L. Pribbenow, *Victory in Vietnam: The Official History of the People's Army of Vietnam, 1954-1975* (Lawrence: The University Press of Kansas, 2002); and David Chanoff and Doan Van Toai, *Vietnam' A Portrait of its People at War* (New York: I. B. Tauris, 1996). Vietnamese sources that deal specifically with the air war are almost nonexistent. Most Vietnamese memoirs and oral histories discuss the subject only tangentially, such as Truong Nhu Tang, *A Viet Cong Memoir* (New York: Vintage Books, 1985) and Xiaobing Li, *Voices From the Vietnam War: Stories From American, Asian, and Russian Veterans* (Lexington: University Press of Kentucky, 2010). The only work to deal primarily with the Vietnamese perspective of the air war is Roger Boniface, *MiGs Over North Vietnam: The Vietnam People's Air Force in Combat, 1965-1975* (Mechanicsburg: Stackpole Books, 2010), but this work is highly problematic. Boniface claims to have examined North Vietnamese records, yet cites no specific documents or sources beyond his own oral interviews with North Vietnamese pilots. The data he presents is wildly at odds with American records. In most wars, nations tend to record statistics in their favor, yet Boniface's data goes far beyond an expected level of drift. It is possible that, conducting his interviews within Vietnam, Boniface's work could be subject to censorship or alterations. The possibility of this is mentioned in Chanoff and Van Toai, *Vietnam' A Portrait*, xvi, as a reason those authors chose not to conduct interviews within Vietnam as recently as the late 1990s. Yet few, if any, other works attempt to fill this gap. Regarding the technology used by the North Vietnamese, specifically their MiG fighters, much has been written, mostly in enthusiast works and encyclopedic studies of fighter planes such as those listed in note 1. Other entries focusing on MiG aircraft include R. A. Bel'âkov and J. Marmain, *MiG: Fifty Years of Secret Aircraft Design* (Annapolis: Naval Institute Press, 1994); Robin D. S. Higham and Jacob W. Kipp, *Soviet Aviation and Air Power: A Historical View* (Boulder: Westview Press, 1978); Yefim Gordon, *Soviet Air Defence Aviation: 1945-1991* (Ottringham: Hikoki, 2012); E. Gordon and Dmitriï Komissarov, *Soviet Tactical Aviation* (Ottringham: Hikoki, 2011); Gaillard R. Peck, Jr., *America's Secret MiG Squadron: The Red Eagles of Project Constant Peg* (Long Island City: Osprey Publishing, 2012); Steve Davies, *Red Eagles: America's Secret MiGs* (New York: Osprey Publishing, 2008).

The very nature of the air war demanded a large degree of technological innovation. The realities of radar targeting, guided weapons, and high-performance aircraft led to a cat-and-mouse effect as one side developed counter-measures to technological advantages, which in turn generated counter-counter-measures. Engineers thus had as important a role in determining victory as did soldiers or pilots. Had the Air Force not held fast to its “technological exuberance” and continued to evolve new systems, its adversaries would have promptly blown it out of the sky. Certainly human factors are key contributors to victory and technological supremacy alone has rarely predicted a war's outcome. Yet we cannot dismiss the role of technology, especially in a conflict such as the Vietnam War. The Air Force clearly took its exuberance too far when it assumed missile technology would render dogfighting obsolete. Yet it corrected this mistake by reinstating the air superiority role and redesigning their missiles and planes to succeed in air combat. Most importantly, it adapted the Soviet model of ground-controlled interception (GCI) and developed an integrated radar system that allowed pilots to see MiG fighters early and engage on their own initiative. When examining air combat statistics, this last innovation proved more influential than any other factor in achieving victory against the MiGs in the skies over Vietnam.

In judging the degree of this victory, any student of the air-to-air war in Vietnam will quickly encounter a large debate that often centers on kill ratios. Most scholars view the Vietnam War as a poor showing for U.S. air superiority fighters, especially compared with other wars. The metric for this judgment is usually a ratio of enemy planes destroyed compared to American planes shot down. These numbers can often vary wildly depending on how one defines the parameters of their study. The most common statistics cite an overall ratio in the Korean War of 10:1 or as high as 15:1 in favor of American fighters against MiGs; in the Vietnam War, by

contrast, the Air Force netted only a 2.3:1 ratio, or 2.7:1 when factoring in Navy statistics, with approximately 200 kills and seventy-five planes lost.¹⁶

Unfortunately, these raw counts that look at the entire war as a block are misleading for several reasons. U.S. fighter pilots may prefer to measure their success by the number of planes they shoot down in combat, but MiGs in Vietnam measured success differently. They pursued a strategy based on a guerilla warfare model, primarily attempting interruption of bombers. While dogfights occurred with U.S. fighters regularly, the North Vietnamese did not seek primarily to shoot down fighters as much as force bombing formations to drop their ordnance before reaching their targets. Therefore, many attacks occurred against planes not equipped to fight back, and the 2.3:1 statistic includes all these types of aircraft lost to MiGs, such as bombing and transport craft. The Korean ratios cited do not include these craft, looking only at fighter-versus-fighter information. Additionally, a closer look at the air war reveals large back-and-forth swings as changes in the tactics, training, and technology of both sides had dramatic effects on fighter effectiveness. At times, U.S. forces earned kill ratios approaching those seen in Korea, while at times devolving into stalemate exchanges of nearly 1:1 or worse with the MiGs. The often-disparaged 2.3:1 statistic represents a misleading aggregate over the course of nearly a decade.

Despite occasional success in the air war, to a casual observer, it might have appeared that Phantoms continually fell from the sky. The Air Force lost 445 F-4s during the war, the Navy an

¹⁶ Tilford, *Crosswinds*, 84-5; Michel, *Clashes*, 7, 277; Nichols and Tillman, *On Yankee Station*, 168. The best source of air-to-air kills and losses in Vietnam is a series of Air Force studies known as the Red Baron Reports, which not only provide statistics, but attempt to recreate each air battle in detail from a combination of recorded flight data and pilot interviews. Some of these reports have been released to the public and some remain classified. Accurate statistics, including unconfirmed kill claims, have been compiled by the Air Combat Information Group at www.acig.org in a series of four tables, "U.S. Air-to-Air Victories, Part 1," "U.S. Air-to-Air Victories, Part 2," "Vietnamese Air-to-Air Victories, Part 1," and "Vietnamese Air-to-Air Victories, Part 2," all available online at www.acig.org [accessed 17 May 2013]. For a valuable re-evaluation and contextualization of these statistics, see William Sayers, "The Red Baron Reports: What They Really Said" *Air Power History* (Fall 2005), 4-13. These statistics along with many other useful lists of raw data can be found in John T. Correll, *The Air Force in the Vietnam War* (Arlington, VA: Aerospace Education Foundation, 2004).

additional 143, a total approaching 600 Phantoms. However, ground fire and missiles caused most of these losses, not air combat. During the entire war, MiGs claimed a single-digit percentage of U.S. losses. Depending on the sources used, MiGs claim thirty-five to fifty-three Air Force F-4s and only seven to twelve Navy Phantoms. North Vietnamese sources raise these claims substantially, adding sixty-five additional as-yet unconfirmed F-4s downed. Expanding this data to include all aircraft losses, the number reaches a shocking 2,316 American planes lost in the theater. MiGs caused only seventy-nine of these losses. Surprisingly, the largest threat by far was small arms fire, claiming 45 percent of losses – nearly 1,000 aircraft. AAA and SAMs posed the next largest threat, downing 632 and 191 planes respectively.¹⁷ Clearly, of the various components of the North Vietnamese air defense system, MiGs were the least deadly. However, the North Vietnamese Air Force (NVNAF) did not set its main goal on shooting down Phantoms.¹⁸ It focused on preventing bombing formations from attacking their targets, a goal it largely accomplished, as it forced over half of the U.S. strike groups they encountered to drop their bombs early and miss their targets.¹⁹

Although air-to-air combat was somewhat rare over North Vietnam, a study of the Phantom's struggles in this role provides a valuable glimpse into the pitfalls of the Air Force's near-sighted doctrine in the early Cold War period. To its credit, the failings of the Phantom

¹⁷ Data taken from Correll, *The Air Force in the Vietnam War*, 25-6; Nichols and Tillman, *On Yankee Station*, 163-69; Hannah, *Striving For Air Superiority*, 73; Red Baron Report Vol. I, 17-111; Air Combat Information Group, "Vietnamese Air-to-Air Victories, Part 1," http://www.acig.info/CMS/index.php?option=com_content&task=view&id=244&Itemid=47 and Air Combat Information Group, "Vietnamese Air-to-Air Victories, Part 2," http://www.acig.info/CMS/index.php?option=com_content&task=view&id=243&Itemid=47 [both accessed 17 May 2013].

¹⁸ The North Vietnamese Air Force is sometimes abbreviated NVAF, not to be confused with South Vietnam's Air Force, known as the Vietnam Air Force (VNAF), also called the Republic of Vietnam Air Force (RVNAF). The North's air arm can also be called the Vietnamese People's Air Force (VPAF). The VPAF designation usually refers to the reunited force after the fall of Saigon in 1975, but is occasionally used for the war period as well. For clarity, this thesis will refer to the Northern air forces as NVNAF throughout. No references are made to non-U.S. southern air units.

¹⁹ Michel, *Clashes*, 73.

prompted a reevaluation of this doctrine and spurred large changes in both the Air Force and Navy. The Navy instituted the Naval Fighter Weapons School, affectionately known as “Top Gun,” to train their pilots in air combat. This school proved very successful and caused a drastic increase in air-to-air effectiveness for Phantom pilots late in the war. While the Air Force resisted changes to their pilot training, they developed key technologies and began development on new aircraft designed specifically for the air superiority role. Many of its early attempts at technological innovation proved fruitless until the creation of the Teaball ground radar and surveillance system, providing early warning for fighter pilots, granting them the initiative in air combat. Teaball, when it worked, caused a much larger spike in combat effectiveness than the Navy's training changes, allowing the Phantom to menace enemy MiGs.

The F-4 Phantom II remains one of the most popular and controversial planes in the history of American aircraft, and rightly so. This oddly shaped, even ugly plane became the symbol of airpower in a war that placed it in roles its designers did not intend for it to play. Yet through technological innovation, tactical adaptation, and increases in the preparedness of its crews, the plane overcame these challenges, spawning major changes in Air Force thinking, earning the affection of its pilots and instilling fear in its enemies.

CHAPTER 2

ORCHESTRATED CONFUSION: DESIGN AND DEVELOPMENT OF THE F-4 PHANTOM

Airplanes are not born in a vacuum. Like any complex weapons system, an aircraft's intended role defines its design. Fighters require completely different design specifications than bombers. Reconnaissance craft necessitate a distinct conception from cargo transports. Design considerations stretch beyond individual aircraft, as nations build their air forces on a conceptual framework of how to utilize airpower in a potential conflict, identifying and filling niche roles dictated by that strategic plan. This plan constitutes a state's airpower doctrine. A number of factors, from data-driven analysis of previous wars to more esoteric concepts of a nation's history and value system, inform this doctrine. Geography, resources, politics, and social conceptions of power, among other components all exert their influence on military doctrine. Thus, the state usually gets the weapons it desires, whether or not they are appropriate for a given conflict.

The old maxim that militaries always prepare to fight the previous war is inaccurate; rather, a military usually prepares to fight what it thinks the next war will be. This was certainly true of the United States in the years prior to the Vietnam War. Embroiled in Cold War escalation with the Soviet Union, America based its military decisions on the assumption that the next war would pit the two superpowers against each other. When America lost its monopoly on nuclear weapons, the concept of massive retaliation took center stage, attempting to deter conflicts through the threat of atomic annihilation. For the Air Force, the delivery of nuclear weapons was the key component of doctrine. Bombers took center stage, particularly bombers that could fly higher and faster than ever before. Defending against enemy bombers, presumably operating under similar doctrine, was also extremely important. To accomplish this interception mission, the concept of the fighter plane evolved away from the agile dogfighters of the past,

instead embracing high speeds and altitudes at the expense of maneuverability, durability, and fighting power. A desire to lower costs as much as possible led to an emphasis on flexible, multi-purpose aircraft that could fulfill several types of niche missions. The byzantine bureaucracy of the military-industrial complex further fueled this emphasis. To keep options open, the military formed paternal bonds with manufacturing companies who thus had a vested interest in providing equipment that excelled in characteristics that the military valued. Designers pushed these characteristics, such as top speed and altitude, to the limit at the expense of other attributes, such as maneuverability and gunnery.

The years leading to the Vietnam War saw considerable confusion among air power planners. Small, “limited wars” erupted, and the policy of containment to restrict communist expansion raised questions that challenged prevailing air power doctrine. While the doctrine of strategic nuclear bombers and interceptors seemed logical, if terrifying, in a potential conflict with the Soviet Union, such a doctrine made considerably less sense over the jungles of Vietnam, which provided few relevant bombing targets, and where nuclear attacks would be absurd. The dominant air power doctrine had eroded the mission of air superiority — the role of clearing the sky of enemy fighters and interceptors to allow bombers to freely attack their targets. In the past, agile fighter craft performed this mission, protecting bomber formations by engaging in close range dogfights with other enemy fighters. In the years between World War II and Vietnam, the dominance of the strategic bombing role left the American military without an effective air-to-air weapon as U.S. high-speed interceptors designed to shoot down hypothetical Soviet bombers instead found themselves facing smaller, nimble MiG fighters.

The primary fighter for the Air Force was the F-4 Phantom II. Yet its performance record, particularly in air-to-air combat, was disappointing, especially compared to the great

success in the air superiority mission during the Korean War. Air Force Phantoms in Vietnam achieved an overall kill ratio against MiGs of about 2:1, as opposed to the F-86 Sabre's kill ratio in Korea of approximately 10:1.¹ These raw statistics hide the fact that at times the Phantom performed quite well and at other times proved disastrous. The F-4's design heavily contributed to its struggles in air combat. While its design was exactly what the American military wanted and intended for it to be, like the doctrine that spawned it, it was completely inadequate for the demands of the Vietnam War.

Sacrificing Superiority: The Post World War II Air Force

Even before manned flight was a reality, the dominant conception of air power centered on the bombing of ground targets. Science fiction writers visualized navies in the air that pummeled cities into submission. Air power theorists such as Giulio Douhet and Billy Mitchell argued that aerial bombing campaigns could win wars completely on their own by dismantling a nation's "vital centers": its war-making capability and its will to fight. By attacking production facilities, infrastructure, or people themselves, air forces could theoretically make conventional war obsolete.²

While theorists and planners held to their prevailing faith that "the bomber would always get through" despite the level of defenses against it, for bombers to be able to operate effectively and minimize losses, they required open skies, free of enemy fighters intending to shoot them

¹ Marshall L. Michel, *Clashes: Air Combat Over North Vietnam 1965-1972* (Annapolis: Naval Institute Press, 1997), 277, 7. Some estimates for the F-86 kill ratio are as high as 15:1, as in Earl H. Tilford, *Crosswinds: The Air Force's Setup in Vietnam* (College Station: Texas A&M University Press, 1993), 15.

² For early fictional takes on air war theory, see H. G. Wells, *The War in the Air* (Waiheke Island: Floating Press, 2009, originally published 1908). The most influential early expressions of air power theory are Giulio Douhet, *The Command of the Air* (Washington D.C.: Office of Air Force History, 1983, originally published 1921); and William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power, Economic and Military* (Tuscaloosa: University of Alabama Press, 2009, originally published 1925). For a fuller discussion of the development of airpower doctrine, see Michael S. Sherry, *The Rise of American Air Power: The Creation of Armageddon* (New Haven: Yale University Press, 1987).

down. Thus was born the concept of “air superiority.” Fighter planes were to clear the air of enemy forces, freeing the bombers to do the real work of air power. This doctrine seemed logical until the late 1940s. Atomic bombs delivered by a single aircraft brought a level of destruction equivalent to 1500 conventional bombers. The cataclysmic potential of atomic weapons led some planners to believe that the promises of air power theory to obviate conventional war might finally become reality. The Air Force in particular seized upon this view. In 1952, the official Air Force journal *Air University Quarterly Review* clearly expressed the doctrine that in the case of an outbreak of war, atomic retaliation must be instant, and that the intercontinental jet bomber was the most important weapon in the atomic era. War planners believed this ability to deliver atomic weapons was the sole determinant in winning a future war.³

The Air Force, newly minted as an independent service branch following World War II, founded its identity on the delivery of nuclear bombs, creating Strategic Air Command (SAC), the largest of three separate command divisions, for this exact purpose on 21 March 1946. It consisted of a large force of land-based, long-range bombers which, under the leadership of General Curtis LeMay, dominated the Air Force. Under President Dwight D. Eisenhower's “New Look” defense policy, the Air Force, led by SAC, was to provide an umbrella of atomic bombs to protect the entire free world. In the hypothetical case of a feared next war with the Soviet Union, SAC intended to “replay” an idealized version of the ending of World War II, lobbing nuclear bombs on the Soviet Union's vital centers.⁴ However, most planners hoped that SAC would simply act as a strategic deterrent, preventing war through the threat of massive retaliation. Thus, conceptual links developed, directly connecting SAC's size and reach to the prevention of World War III. For Washington decision-makers concerned with defense spending, using SAC's power

³ “Jet Strategic Bombardment,” *Air University Review Quarterly*, v. 5, Spring 1952, 19.

⁴ Tilford, *Crosswinds*, 20-22.

as a threat was also the most cost-effective defense plan for the U.S.⁵ The doctrine of massive retaliation and all its inherent assumptions took on almost religious overtones, and adhering to its tenets became necessary for the growing cult of atomic power. As one historian has stated, "Strategic bombing, independent of surface campaigns, was the one mission that air power alone could fulfill, and it was to be the foundation of the Air Force's identity... its advocates took on all the zeal, inflexibility, and myopia of the 'true believer.'"⁶

SAC completely dominated the Air Force. All other aspects of air power bent to the needs and nature of the strategic bombing mission. Tactical air concerns, such as air superiority, supply interdiction, and ground support (Close Air Support, or CAS) diminished in importance, viewed as either irrelevant, or as missions which could be easily accomplished by SAC as a matter of course. The line between tactical and strategic missions blurred. Air superiority, the realm of fighter planes, diminished, becoming almost worthless.⁷ The Air Force did not escape criticism for this approach. For example, in 1949, during the Vinson committee hearings, some Air Force commanders pointed out the deficiency of strategic bombing doctrine, noting that air superiority purchased by high performance fighters was still a necessary component of sound strategy, "yet less than six percent of Air Force research and development resources went into tactical and fighter aviation."⁸ The Air Force clung to the tenets of its doctrine and did not heed such criticism. SAC's budget continued to grow at the expense of the Army, Navy, and other specialized subdivisions of the Air Force. As a result, several tactical fighter wings (TFWs) disappeared in the late 1950s.⁹

⁵ Craig C. Hannah, *Striving for Air Superiority* (College Station: Texas A&M University Press, 2002), 28.

⁶ Caroline F. Ziemke, "In The Shadow of the Giant: USAF Tactical Air Command in the Era of Strategic Bombing, 1945-1955" (PhD diss., Ohio State University, 1989), 7.

⁷ Tilford, *Crosswinds*, 8-9.

⁸ Ziemke, "Shadow of the Giant," 99-100.

⁹ Mark Clodfelter, *The Limits of Airpower: The American Bombing of North Vietnam* (New York: The Free Press,

Secondary air missions of interdiction, ground support, and air superiority became the responsibility of a separate Air Force command: Tactical Air Command (TAC), which competed with SAC for funding. Air Force leadership regarded TAC – and the entire concept of fighter escorts to establish air superiority – as out of date, irrelevant, and “a functional and organizational anachronism.” TAC and the air superiority mission found themselves in a fight for survival.¹⁰ In order to justify itself and earn precious funding, TAC attempted to overlap with SAC's mission by focusing on two main roles: delivery of nuclear weapons in a tactical context, and the interception of enemy nuclear bombers. As one historian has noted, in an attempt to keep itself alive, “TAC had become 'SACercized' as its traditional . . . mission gradually gave way to its role as part of USAF's massive retaliatory capability.”¹¹ Essentially, TAC abandoned its traditional role of air superiority, once deemed necessary to set the stage for bombers but now regarded as irrelevant to a hypothetical next war.¹²

The Korean War from 1950 to 1953 presented an opportunity to test Air Force doctrine. However, the strategic bombing mission rested on the assumption that the target nation was a modern, industrialized country with vulnerable vital centers. This was the case when U.S. bombers had attacked Germany and Japan and made plans for attacks on the Soviet Union. North Korea was not nearly as developed. Thus, SAC found itself incredibly limited by the lack of appropriate targets. With a paucity of factories and little infrastructure to destroy, the hailed strategic mission gave way to CAS and supply interdiction. All of these missions soon encountered the serious threat of increasing numbers of MiG fighters. Air superiority proved necessary after all. In response to the MiG-15, the Air Force created the F-86 Sabre, which

1989), 28.

¹⁰ Ziemke, “Shadow of the Giant,” 10, 76-8, 114.

¹¹ Ibid, 249-50.

¹² Hannah, *Striving for Air Superiority*, 30, 22.

established a reputation as an extremely successful (and romanticized) fighter, able to get in close and dogfight with MiGs. Sabre pilots earned an esteemed reputation, some sources claiming a kill ratio of up to 15:1 against MiG fighters. Despite this impressive kill count and the flyboy romance surrounding the Sabre, air superiority was not an end unto itself, but intended simply to facilitate the missions of CAS and supply interdiction, and thus was but a small part of the overall air effort in Korea.¹³

Korea tested Air Force doctrine and found it wanting in several respects. First, massive nuclear retaliation was not the only option in a conflict. Second, not every country was vulnerable to strategic bombing to the same degree. Korea, with less industrial development than other nations and lacking modern infrastructures, was far less vulnerable to strategic bombing. Third, Korea demonstrated that the air superiority mission was still valid, especially in the context of a limited war against an unindustrialized nation. Ultimately, the Korean conflict revealed deep flaws in the American strategic bombing concept. Air Force planners, who did not intend to waver from their devotion, summarily ignored these flaws. These “true believers” argued that Korea had little relevance to doctrine, and chose not to look closely at the conflict, casting it as a unique exception. Former Air Force secretary Thomas Finletter noted, “The Korean War was a special case, and airpower can learn little from there about its future role in United States foreign policy.”¹⁴ Their devotion, however, was not blind. The decision to marginalize the Korean experience masked a reluctance to overthrow five long years of detailed planning and growth in response to events of a few isolated months.¹⁵ By this point, the Air

¹³ Tilford, *Crosswinds*, 14-15. For a full, detailed look at the Sabre's success in Korea, see Kenneth P. Werrell, *Sabres over MiG Alley* (Annapolis: Naval Institute Press, 2005), which estimates the Sabre's ratio for the entire war at a more modest 8.2:1 while acknowledging that in 1953 alone it jumped to over 13:1. Marshall L. Michel's *Clashes* rounds this out to an approximate 10:1.

¹⁴ Tilford, *Crosswinds*, 17.

¹⁵ Ziemke, “Shadow of the Giant,” 174-6.

Force was a massive vessel that could not easily alter its course. Thus, thinking continued along the same tack it had before, dominated by the all-encompassing strategic bombing mission.

TAC continued on its path of developing into a microcosm or slight translation of SAC. While TAC could not compete with the heavy bomber instruments of massive retaliation, it could focus on delivering smaller, tactical nukes with its own set of high-speed, long-range fighter/bombers. Such planes could theoretically drop nuclear bombs quickly on tactical targets while intercepting and destroying enemy bombers that threatened U.S. soil. Because war planners considered enemy bombers the biggest threat to the United States, air defense completely revolved around the creation of high-speed interceptors, designed to demolish these bombers from long range, even beyond visual range (BVR) if possible. This led to the idea that guided missiles should replace guns as the interceptor's primary weapon. The conception of the fighter plane thus mutated from an agile dogfighter to that of a fast interceptor designed to kill with a missile in one single pass without maneuvering or engaging other fighters at all.¹⁶

Through a series of shifts and redefinitions designed to reinforce the religion of strategic bombing, the very definition of air superiority changed. Air Force planners hardly detected this subtle metamorphosis. Previous conceptions of air superiority involved swarms of fighter planes that cleared the skies of enemy fighters and interceptors to clear a path for bombers. In this new context, fighters were obsolete, yet Air Force leadership still used the term “air superiority,” redefined to designate the interception of enemy bombers, whose tactics presumably resembled American bombers based on a similar, assumed doctrine. By redefining “air superiority,” the Air Force lacked a doctrinal niche for air-to-air combat against enemy fighters and interceptors, yet the continued use of the term created the illusion that these roles were still covered. This

¹⁶ Frederick H. Smith, “Current Practice in Air Defense,” *Air University Review*, v. 6, Spring 1953, 31-39.

redefinition of the mission went further, incorporating preemptive bombing strikes against enemy aircraft on the ground as part of the “air superiority” objective. Air Force Chief of Staff Hoyt S. Vandenberg testified to Congress in 1953 that, “The main defense of the United States lies in the strategic air arm's ability to destroy the bases. That is the only efficient way to knock a possible air force out of the air and get air superiority.”¹⁷ In other words, air superiority was a job for bombers.

The definition of air superiority appeared mangled beyond recognition. This re-purposing provided a pretext for the Air Force to invest further in bombers and interceptors while allowing it to claim investment in the air superiority mission. Such planes necessitated a move away from agile fighters like the Sabre in Korea, focusing instead on large, cumbersome aircraft designed for speed and altitude at the expense of maneuverability and close fighting. To these ends, in 1950, TAC requested proposals for a supersonic interceptor designed to shoot down Soviet bombers and able to carry their own tactical nuclear warheads. This led to a long line of fighters known as the “Century Series,” that included the F-100 Super Sabre, F-101 Voodoo, and F-105 Thunderchief.¹⁸ The Air Force version of the F-4 Phantom, although later re-designated, originated as a part of this series as the F-110 Specter.¹⁹

These planes, and others of the Century Series, differed from the slow, heavy bombers that populated SAC, nor did they resemble the agile fighter planes of previous wars. Instead, they excelled primarily at speed, designed to drop tactical nuclear weapons on a target and then escape immediately. Their ability to interdict enemy bombers was more important. To succeed in this defensive role, a fighter had to take off quickly, cruise at 40,000 to 60,000 feet at supersonic

¹⁷ United States. Congress. House of Representatives. “Department of Defense Appropriations for 1953.” 82nd Congress, 2nd session. (Washington D.C.: 1952), pg 2-3, 10, 1028-9, as quoted in Ziemke, “Shadow of the Giant,” 235.

¹⁸ Hannah, *Striving for Air Superiority*, 23.

¹⁹ Amy E. Williams, *The American Fighter Plane* (New York: Barnes and Noble Books, 2004), 154.

speeds, and disable an enemy bomber in a single attack pass. While previous air superiority craft in TACs arsenal of fighters emphasized the maneuverability and agility essential to dogfighting, these characteristics disappeared in favor of speed, altitude and climb rate.²⁰ TAC's transformation over these years left it hardly capable of performing some of its traditional key roles, especially that of air-to-air combat, creating a system that was unprepared for what it found over the jungles of Vietnam in terms of both material and doctrine. Historian Caroline Ziemke summarized the problem:

Like Dorian Grey, TAC had sold its soul in exchange for vitality, and in Vietnam, the world got a look at its aged and decrepit conventional structure. . . . The Air Force seemed to have dismissed nearly three years of combat experience in Korea – not to mention the three years of World War II operations in Europe and the Pacific – as irrelevant to its present needs and had done little to incorporate them into its institutional memory.²¹

The Air Force sacrificed TAC and the air superiority mission on the altar of strategic bombing doctrine.

These developments informed the Air Force's approach to aircraft design, yet the Phantom was not originally an Air Force project. The USAF did eventually purchase the vast majority of manufactured F-4s,²² which thus clearly reflected its doctrinal approach, yet the aircraft originated in the Navy. Thus, the strategies and doctrines of Naval Aviation exerted the largest influence on the inception of the Phantom.

When is a Fighter Not a Fighter? Navy Doctrine in the Cold War

Just as TAC's budget or even its survival seemed dependent on how well it could emulate or incorporate SAC's massive retaliation role, the Navy also bowed to this concept. The Air

²⁰ Hannah, *Striving for Air Superiority*, 46.

²¹ Ziemke, "Shadow of the Giant," 303.

²² Amy E. Williams, *The American Fighter Plane*, 154.

Force shouldered most of the responsibility for nuclear delivery, thus the Navy's role in that mission consisted primarily of submarine launches. As the defense budget shrank in the late 1940s, so did the size of the aircraft carrier fleet. The Navy cancelled construction of the supercarrier USS *United States* in 1949 along with other carriers. However, the Korean War revealed that the Air Force's strategy of long range, heavy nuclear bombers was not ideal for smaller, localized conflicts. This led to a resurgence of the carrier as a means of projecting power. In 1955, the Navy commissioned four new *Forrestal* class supercarriers with additional carriers planned for the following years.²³ By 1962, the Navy was the proud owner of twenty-six aircraft carriers, including USS *Enterprise*, the first nuclear-powered carrier.²⁴

The doctrine of massive retaliation as a deterrent formed the conceptual underpinning for this large carrier force, capable of employing a large number of nuclear-ready planes. Unlike the Air Force's long-range intercontinental bombers, Navy aircraft possessed a limited range, forcing Navy planners to think in local terms. Thus in the 1950s the Navy developed what became known as a “swing strategy” dictating that the carrier fleet be split between Pacific and Atlantic theaters, prepared to protect U.S. interests in the Pacific, or to engage in the European theater in case of Soviet aggression. This strategy required the Navy to prepare for quick nuclear strikes necessitated by the doctrine of massive retaliation, but also to be ready to fight a conventional war.²⁵ The legacy of World War II naval strategy remained intact, focused on over-the-shore air strikes and control of the sea. This outlook, viewing a long, phased war as more advantageous to America, was more balanced than the Air Force's approach.

²³ Peter Davies, *USN F-4 Phantom II vs VPAF MiG-17/19* (New York: Osprey, 2009), 36-7.

²⁴ George W. Baer, *One Hundred Years of Sea Power: the U. S. Navy, 1890-1990* (Stanford: Stanford University Press, 1994), 334.

²⁵ Robert W. Love, Jr., *History of the United States Navy, Vol. 2* (Harrisburg: Stackpole Books, 1992), 375-6.

Aviation was key to the Navy's objectives. Naval aviation was ideal for striking enemy ground installations such as ports, airfields, and naval production facilities. This was especially important for suppressing enemy submarines through attacks on docking facilities. While these attacks were “conventional” when compared to massive atomic retaliation, they did include a nuclear component in the form of smaller, tactical nuclear weapons. Advances in nuclear technology made this possible. As early as 1952, the weight of atomic bombs had shrunk from 10,000 pounds to only 3,600 pounds. Navy planes, by necessity smaller and incapable of carrying the massive weight that Air Force bombers typically hauled, could enter the nuclear game.²⁶

Both roles – either over-the-shore strikes or control of the seas – required airplanes of a similar design to those TAC sought: long-range, high-speed bombers. The Navy owned no such craft before the Korean War. This dearth prompted a new design focus and eventually produced planes along these lines, such as the A3-D Skywarrior in 1952, and the A-5 Vigilante in 1955. The Navy also extended this design philosophy to include all-weather²⁷ medium bombers to focus on interdiction of supply lines, carrying more ordinance and radar equipment for increased accuracy. This project eventually became the A-6 Intruder, which budgetary delays kept from entering service until 1960.²⁸

One of the main problems that surfaced in Korea and affected the Navy's design philosophy was the carrier fleet's vulnerability. The Air Force's F-86 Sabre saw significant success in the air-to-air role, but the Navy owned no aircraft designed for air superiority against enemy fighters. The Navy determined that carriers were vulnerable to fighter attacks and, by

²⁶ Baer, *One Hundred Years of Sea Power*, 334-8.

²⁷ The term “all-weather” simply refers to radar-equipped planes, as radar allows targeting and navigation even when weather conditions limit visibility.

²⁸ Love, *History of the United States Navy*, 382.

extension, to tactical nuclear strikes, thus it sought to increase defenses against airborne threats via two main strategies. The first was the development of surface vessels armed with missiles to shoot down enemy fighters. The second was the development of jet fighter-interceptors. The goal of these craft was similar to the TAC interceptors and other Navy interceptor projects, and thus required high-speed, high-altitude, and long-range attack capabilities. Yet these craft included requirements for maneuverability and effectiveness in the air-to-air combat role that the Air Force marginalized or ignored. The first of these Navy-designed supersonic jet fighters was the F9F-6 Cougar (a modified F9F Panther) which first joined the fleet in 1952. Later, in 1956, McDonnell's F3H Demon filled this role. To increase their attack range, the AIM-9 Sidewinder heat-seeking missile replaced the unguided air-to-air rockets these planes originally carried. The Demons also made use of the radar-guided AIM-7 Sparrow. The most exemplary of these new fighters was the F-8U Crusader, which first flew on 25 March 1955.²⁹

Though the design of these craft placed an emphasis on air-to-air combat and maneuverability that the Air Force lacked, the Navy still downplayed other key aspects of the traditional air-to-air role. For example, the Fleet Air gunner Unit (FAGU), which trained weapons officers on Navy planes, closed in 1960. The role of gunners seemed increasingly obsolete in the burgeoning age of long-range missiles. Navy planners assumed that the capability of these missiles rendered visual encounters with enemy planes a rare, if non-existent possibility, thus gunnery was a wasted skill. As a result, new training syllabi excised air-to-air combat.³⁰ These assumptions later became ludicrously contradictory during the Vietnam War, when planners specified rules of engagement that required visual identification of enemy planes before firing missiles. In the conception of Naval and Air Force planners, they had not removed the air-

²⁹ Love, *History of the United States Navy*, 382-3.

³⁰ Davies, *F-4 vs MiG 17/19*, 4.

to-air role but simply altered it. By designing craft designed to intercept and fire missiles from long range, they considered the air-to-air role covered. In reality, the abandonment of previous requirements for the role such as maneuverability, gunnery, and close-range dogfighting marked the end of the air superiority concept.

A Gleam in the Customer's Eye

Eisenhower's famous use of the term “military-industrial complex” was particularly apt for the period. Few defense contractors existed, and the large sums involved in contract awards and losses could make or break companies quickly. To keep options open, the military had a strong incentive to keep their contractors afloat, sometimes making purchases regardless of actual needs. The military also encouraged these companies to push the envelope of cutting-edge technology, sometimes guided by strict mission parameters, at other times without many guidelines at all. Thus, a strong paternal bond developed between the military and its industrial suppliers, creating an environment that encouraged companies to experiment and take risks without fear of a total company failure.³¹ This was the strange situation faced by the aircraft manufacturer McDonnell in the early 1950s.

In September 1952, the Navy Bureau of Aeronautics (BuAer) invited proposals for a new fighter plane, essentially creating a competition among aircraft designers. The requirements stipulated that the new fighter be dedicated to the (redefined) air superiority and interception missions. It had to fly at supersonic speeds but be able to approach and land at speeds below 115 miles per hour, a requirement for carrier landings. After reviewing several proposals, the Navy eventually awarded the contract to McDonnell's rival firm Chance-Vought's design, which

³¹ Glenn E. Bugos, *Engineering the F-4 Phantom II: Parts Into Systems* (Annapolis: Naval Institute Press, 1996), 23.

became the F-8U Crusader. McDonnell's design in this competition was a version of the F3H Demon upgraded with a dual-engine and a missile armament.³² McDonnell lost this contract after its defeat in a flyoff competition with Vought's F-8U, resulting in a devastating loss of the resources McDonnell had poured into the development of the Demon upgrade. The Demon's Westinghouse engines took the blame for its failure, incapable of producing the amount of power their manufacturers promised. This debacle was not a total loss for McDonnell, as a modified version of the F3H joined the fleet in 1956 when the Navy bought 500. However, in 1954, losses from this project nearly destroyed the company. Two key lessons from this failure informed the development of the F-4. First, the fact that the Navy did indeed buy some F3Hs taught the company that the Navy was a loyal customer, committed in its paternal relationship to keep McDonnell alive. This paternal bond formed a key component of the Navy's standard procurement procedure, which encouraged unsolicited proposals from creative companies, judged solely on technical merit with no regard to cost. Because these proposals included proprietary information, legal considerations prevented the Navy from sharing design specifications with competitors for either design improvements or price competition, leading to expensive sole-source contracts that competing firms could not challenge. Second, the Demon's engine failure led McDonnell to assume a much more involved stance regarding the development of their aircraft's components.³³

McDonnell engineer Herman Barkley took the upgraded F3H Demon's rejection as a personal challenge and immediately began designing an unsolicited new aircraft. This plane, which eventually became the F-4 Phantom II, thus began life as a significant risk – a company-

³² Enzo Angelucci and Peter M. Bowers, *The American Fighter* (New York: Orion, 1987), 451, 310; Larry Davis, *F-4 Phantom II's in Action* (Carrollton: Squadron/Signal Publications, 1984), 4.

³³ Bugos, *Engineering the F-4*, 15-17.

funded project in response to the rejection of McDonnell's previous design.³⁴ Original sketches for the new craft essentially consisted of yet another version of the Demon, similar to the design that had already failed against Vought's F-8U. At the time the Navy reviewed these sketches, it gave no stated mission requirements for the plane, but the Navy had a vested interest in allowing McDonnell to experiment with the design. The Navy could push the technological envelope while keeping McDonnell afloat, allowing it to remain a valuable supplier, and more specifically, allowing both the Navy and McDonnell to perhaps reap some return on the initial investment they had both placed in the failed F3H. The paternal bond was strong. The Navy made no specific requirements of the design, simply allowing McDonnell to experiment on the drawing board and see what came of it. According to J. S. McDonnell himself, "All we had to work with in the beginning [of F-4 Phantom II Development] was a gleam in the customer's eye. . . . What followed was two years. . . of orchestrated confusion." The Navy, because of their doctrinal assumptions, wanted to focus on high-speed interceptors, but was purposefully vague about communicating this, hoping McDonnell would reach in new and unexpected directions. This, combined with McDonnell's desire to produce something the Navy would indeed want to purchase, led to the development of a multi-role aircraft not optimized for the air-to-air role. McDonnell's earlier success with the F2H Banshee, adapted to a variety of roles in Korea, also encouraged the company to focus on multi-role craft. This taught McDonnell that long and profitable production runs were much more likely to occur from an adaptable, flexible craft than one focused to a single mission.³⁵

³⁴ Angelucci and Bowers, *The American Fighter*, 451, 310. Davis, *F-4 Phantom II's in Action*, 4.

³⁵ Bugos, *Engineering the F-4*, 23, 9, 13-14.

A Maelstrom of Design Changes

The first step in any aircraft design is solidifying the airframe itself. While the requirements of carrier operations placed certain limits on Navy planes, these constrictions decreased as technology improved. Newer supercarriers replaced the smaller *Essex* class carriers, allowing Navy aircraft to increase in size and power while growing less specialized.³⁶ Airpower doctrine dictated a focus on multi-role craft, which received reinforcement from the inherent incentives of the military-industrial complex and by technological advances. Flexibility soon became the watchword of the F-4 program.

The earliest F-4 design, coded as the AH-1³⁷, was a twin-engine craft with a single pilot and four twenty-millimeter cannons.³⁸ These early designs impressed the Navy, which promptly ordered two prototypes, referred to as the YAH-1.³⁹ In December 1954, the Navy transferred the plane, originally slated for a ground attack role, to its fighter branch because of its size, placing Commander Francis X. Timmes as the officer in charge of the project. Timmes was purposefully vague and delayed making any specific requirements until the spring of 1955. At this time, he specified some exact conditions for the plane, all of which emphasized the high-speed interceptor role and stressed adaptability. The aircraft needed to run Combat Air Patrol (CAP, or escort) missions, circling a fleet for up to three hours and fending off intruders, a role that necessitated high speeds. The Navy also wanted the plane to feature two seats, two engines, and an armament exclusively of missiles. The additional engine, which McDonnell had already worked into the design, allowed for higher speeds and larger amounts of heavy ordnance conducive to

³⁶ Bugos, *Engineering the F-4*, 23.

³⁷ Before Defense Secretary Robert McNamara instituted a standardized notation system for all aircraft in 1962, each military branch used a unique numbering system. In this case, the naval system was used: 'A' indicating a ground attack role, 'H' indicating McDonnell as the designer. Thus, it is the first attack aircraft provided to the Navy by McDonnell.

³⁸ Lloyd S. Jones, *U.S. Fighters* (Fallbrook: Aero Publishers, 1975), 310.

³⁹ Angelucci and Bowers, *The American Fighter*, 310.

interception missions. To meet this requirement, the plane featured eleven hardpoints for carrying bombs or missiles, the most ever designed on an airframe. The two-seat cockpit reduced pilot workload and allowed for the operation of increasingly complex radar equipment, increasing the plane's adaptability. The insistence on a missile-only approach theoretically made the plane more versatile as well. Since pilots would ideally fire missiles from long range, before acquiring visual identification, the aircraft did not need to maneuver, further reducing pilot workload and theoretically keeping valuable crews from risky close combat situations. Missiles weighed much less than guns, increasing the plane's performance. The process of replacing the cannons and rockets completely with missiles evolved over several designs and was not complete until April 1957, but the impetus was evident as early as 1955. In June of that year, the Navy legitimized its unofficial encouragement of McDonnell's efforts with a stated requirement for a two-seat, all-weather craft for the interceptor role. The next month, the plane's designation changed to F4H-1 with a contract for the production of seven prototypes.⁴⁰

To optimize the airframe's design, engineers performed extensive wind tunnel tests on scale models, in addition to other tests such as dropping scale models from airplanes to observe their flight characteristics, or strapping scale models to the front of rockets to gather high-speed flight data. Over 5300 hours of such tests led to thinner wingtips and the noticeably high tail position. Out of seventy-five tested wing shapes, only one proved resistant to a tendency to pitch up at high speeds. Supersonic flight introduced a host of new problems since shockwaves could affect maneuverability and jet intake. Turning at supersonic speeds often caused "roll coupling," which made a craft uncontrollable, a condition from which training dictated pilots instantly eject. Designers were aware that roll coupling risked the expensive aircraft and posed a danger to the

⁴⁰ Bugos, *Engineering the F-4*, 20, 25-28.

lives of pilots and made efforts to prevent it, leading to the two most characteristic visual elements of the Phantom. The first was the pitched up wingtips set at a 12-degree dihedral, which solved some problems but created others that necessitated the second: a large, high tail, pitched down with an unusual negative 23-degree dihedral.⁴¹

Technological advances in building materials also influenced these designs. A new honeycomb material enhanced the structural stability of the plane, especially in the tail, without a corresponding increase in weight. A final guard against losing control through roll coupling was the “Stab Aug” automatic stability system that automatically corrected an unstable flight path quicker than a pilot could react. To deal with intake problems, the F-4 featured another innovation: variable intake ramps. Two small ramps just in front of and inside the large, boxy jet intakes guided airflow. The inside ramp, controlled by an onboard computer, could sweep from a zero-to-fourteen degree incline to better guide airflow into the jet engines as necessitated by changes in speed and temperature. This system increased the top speed of the plane significantly.⁴² To increase the plane's versatility, and allow for carrier landings, McDonnell introduced another innovation to increase low-speed performance characteristics: Boundary Layer Control. In this system, excess air from the engines blew out across the wings. This seemingly cheated the laws of physics, generating more lift by superficially mimicking high-speed conditions. The final shape of the plane resulting from these tests and design changes was bizarre by any standards of the time. It became a joke to claim that the F-4 performed better flying backwards.⁴³ These design choices, emphasizing high speed and lack of maneuverability – the latter so much so that tight maneuvering risked the pilot's life via roll coupling – all reflected

⁴¹ Bugos, *Engineering the F-4*, 37-40.

⁴² *Ibid.*, 51-2.

⁴³ Lou Drendel, *F-4 Phantom II's in Action* (Warren: Squadron/Signal Publications, 1972), 6.

the doctrinal and systematic influences which exalted the interceptor role at the expense of the air superiority mission.

A new policy prompted by the earlier failure of the F3H, called “concurrency testing,” guided development of the F-4. This process attempted to compress development time by initiating large production runs before the aircraft's design was complete. This rendered more planes available for testing purposes, and production lines were up and running earlier in the process so that production could scale quickly upon finalization of the design. However, this meant that McDonnell was now committed to large-scale production of an aircraft before its design was complete. Problems expanded as McDonnell experienced great difficulty in the development of parts and subsystems for the various prototypes in what one historian labeled, “a maelstrom of constant design changes.”⁴⁴

McDonnell had less control over the Phantom's internal subsystems, and tension soon developed between the F-4's overall airframe design and the components meant to fill it. Due to advances in technological complexity, these systems required a deeper level of integration with the plane's structure than earlier generations of aircraft. Constant subsystem design changes, initiated by the Navy, often necessitated alterations to the entire aircraft. As was common for most defense companies, McDonnell subcontracted many of these systems to various developers, who designed them for specific roles the Navy had in mind for the F-4. Yet these systems often created new, unique problems.

One of the key systems was the Central Air Data Computer (CADC) developed by AiResearch Manufacturing in Tucson, Arizona. High-speed flight can often have a detrimental effect on an airplane's instruments – shockwaves, air pressure, temperature, and other factors can

⁴⁴ Bugos, *Engineering the F-4*, 93, 49.

cause the display of misleading or incorrect data. The CADC was an analog computer placed behind the backseat of the cockpit that continuously monitored information from outboard sensors, recalculating correcting data to ensure pilots received accurate information on their instruments. The CADC integrated with other key equipment, such as the intake ramps, bombing and navigation systems, missile fire controls, and the autopilot system.

The F-4 also relied on large radar systems. Westinghouse won the contract for the design of the Phantom's primary radar. Their APQ-72 model featured a 32-inch dish, the largest ever used on a fighter plane. This large radar tied into the smaller (Raytheon designed) radars inside the AIM-7 Sparrow missiles. Westinghouse continually upgraded their radars with subsequent models of the F-4, culminating in 1963, when Westinghouse finally wrested control of the missile firing systems from Raytheon. This led to the APG-59 Pulse Doppler radar, which integrated smoothly into their AWG-10 missile control system, replacing the previous Raytheon systems. This Pulse Doppler radar had a number of important advantages over earlier models, the most important of which was ground visualization—the ability to “see” targets on the ground via radar.

Balancing all of the plane's complex equipment caused severe problems with electromagnetic interference. Sensors and other devices used competing radio signals to communicate and often interfered with each other. In one extreme example, one pilot's plane lost control every time he spoke certain words into his headset. His particularly low voice happened to resonate at the same frequency as the radio signal involved in the autopilot system sensors, thus his voice would activate the system and cause the plane to veer out of control as its autopilot engaged. Because designers regarded the production process as too advanced to correct this flaw,

they were content simply to place a warning against this in the manual.⁴⁵

These subsystems each increased the Phantom's performance in particular roles. Separately, they all worked well, but in combination, the plane buckled under the weight of “mission creep,” the tendency to add functionality to multi-mission craft. These additions came at the price of air-to-air combat performance, as none of the subsystems focused on close-range fighting or maneuverability. The F-4's internal systems, like its airframe design, proved to be successful in the areas the military deemed important for the hypothetical next war with the Soviet Union, but they created severe problems felt by many pilots in the unique environment of Vietnam.

Winners and Losers

Though the paternal bond between the Navy and its developers was strong, the military was also loathe to place all its eggs in one basket. It was still smarting from the earlier fiasco of McDonnell's F3H Demon. While The Navy could not legally release design specifications for the developing F-4 to competing firms, they could solicit proposals for other planes in the same mission roles, primarily that of interception. Timmes did exactly that in August 1955. The company that stepped up to the plate was none other than McDonnell's old nemesis: Chance-Vought. Vought had developed an upgraded version of their successful F-8U Crusader, the very plane that had beaten McDonnell's F3H Demon. Vought developed its new offering, simply dubbed the F8U-3, concurrently to McDonnell's F-4. The firms were aware of each other's designs, and some exchange of ideas had occurred. The idea for the F-4's Boundary Layer Control system originated with Vought, as did the F-4's power-boosting engine cooling system.

⁴⁵Bugos, *Engineering the F-4*, 61-2, 64-5, 85-6, 92, 68-9.

Vought was not innocent of borrowing ideas either.⁴⁶ The F8U-3 was a single-engine, single-seat plane, however, with an emphasis on speed. Like the F-4, it overflowed with cutting-edge electronics and relied primarily on missiles.⁴⁷

Both planes impressed BuAer, which wanted both to enter production, but the Chief of Naval Operations deemed this too costly and demanded that the Navy would only produce one, fueling the already intense rivalry between the companies and culminating in an unofficial flyoff. On 15 September 1958, a series of competitive tests began between the Phantom and the upgraded Crusader. The tests emphasized the interceptor role, focusing on maximum speed at various altitudes and climbing rates. The assessments did not include maneuverability, gunnery, and other metrics pertinent to air-to-air combat, as doctrinal assumptions had almost completely erased their relevance.

In every tested category, the F8U-3 Crusader proved superior. It even had better fuel mileage. Its only drawbacks were a lower payload and difficult, time-consuming maintenance requirements. Despite this, George Spandenberg, then the director of BuAer's Evaluation Division, considered single-seat, single-engine planes inherently unreliable (data suggested the two-seat design to be approximately twenty percent more reliable) and that a two-seat plane would boost morale, boldly asserting, "The single-seat fighter era is dead." Thus, advocates of the F-4 often claim the Phantom "won" the contest while a close look at the flyoff reveals the upgraded Crusader had clear performance advantages in every category. Yet the Navy chose the F-4 due to a pre-determined bias for two-seat planes, and in February 1959 McDonnell received a contract for the production of twenty-four Phantom IIs. By September, the number increased to

⁴⁶Bugos, *Engineering the F-4*, 95.

⁴⁷Drendel, *F-4 Phantom II's in Action*, 6.

133.⁴⁸ In addition to the focus on interceptor roles at the expense of air combat, the decision to rely on two-seat, two-engine aircraft necessitated larger planes. This size differential between the F-4 and the enemies it later faced in Vietnam further limited its effectiveness in air combat.

The F-4 finally received its official name on 3 July 1959, as a literal last-minute decision by J.S. McDonnell himself, who changed his mind just before christening the plane. Navy and McDonnell employees had voted on potential names from a list of reserved paranormal titles such as Sprite, Ghost, Goblin, Satan, and Phantom. Satan and Ghost tied among voters, but the company's owner overrode the ballot, preferring the Phantom II, a callback to the original Phantom, a World War II era fighter built in 1946 that had first propelled McDonnell to the forefront of their field.⁴⁹

Despite the Phantom's lackluster performance at the flyoff, it was still an impressive aircraft and quickly set an incredible number of flight records, most of these during carrier trials – a crucial series of tests to determine if a new plane was suitable for aircraft carrier operations. Between December 1959 and April 1962, the F-4 set over a dozen world records, including absolute altitude of 98,557 feet, a sustained altitude of 66,443.8 feet, and a range of climbing rate records such as the ability to reach 50,000 feet (nearly double the cruising altitude of a modern passenger 747) in less than two minutes. The most coveted record, and the one most revealing of the doctrinal design focus of the Phantom, was that of absolute top speed: 1,606.3 miles per hour.⁵⁰ While observing these trials, the Air Force grew interested as the F-4 went on to set a wider range of records than any other aircraft to that time, a confirmation of its versatility. One of these was the fastest trans-American flight, speeding from Los Angeles to New York City in

⁴⁸ Davies, *F-4 Phantom II vs MiG 17/19*, 16; Drendel, *F-4 Phantom II's in Action*, 6; Bugos, *Engineering the F-4*, 95-9.

⁴⁹ Drendel, *F-4 Phantom II's in Action*, 6; Bugos, *Engineering the F-4*, 53-4.

⁵⁰ Mick Spick, *All-Weather Warriors: The Search for the Ultimate Fighter Aircraft* (London: Arms and Armour Press, 1994), 131; Angelucci and Bowers, *The American Fighter*, 310-1.

under three hours. The Air Force interpreted this feat as evidence for the plane's usefulness as a strategic bomber, able to deliver nuclear warheads quickly over vast distances.⁵¹

These tests indeed revealed a powerful and versatile aircraft, but they did not evaluate the Phantom's performance in typical air-to-air combat roles. While the plane was a complex engineering marvel, it was not without serious flaws, some of which represented grave danger to the lives of pilots. McDonnell's assumptions about the changing nature of air combat grew further, influenced by Navy and Air Force doctrine and by their faith in new technology, primarily that of missiles, which had yet to prove themselves in a real combat situation.

The F-4 possessed many problems that came back to haunt the military over the jungles of Vietnam, and that appear almost negligent in retrospect. One gaping flaw was its horrid visibility. Pilots had an extremely limited range of vision, mostly to the rear, especially dangerous since most air-to-air threats originated from behind. The engines, while powerful and capable of producing great speed, also produced gigantic streams of thick black smoke that gave away the locations and heading of all Phantoms in the air. Engineers had developed a makeshift solution to the smoke problem, at the cost of a few thousand dollars per plane. Pressured to limit expenses, military planners found it cheaper to allow this black, smoky bull's-eye to hover over their pilots. The F-4 utilized external fuel tanks to increase its range, but the coupling devices were unreliable. Not only did the tank itself limit the maneuverability of an already ungainly craft, but they severely limited the plane's chief advantage – speed – and ejecting the tanks often caused damage to the plane due to the problematic couplings. The F-4's radio – vital in combat situations – was notoriously unreliable and the plane was extremely vulnerable to ground fire, mostly because of its hydraulic systems. This was a particularly potent flaw as ground fire was

⁵¹ Bugos, *Engineering the F-4*, 104.

one of the largest threats faced in Vietnam, causing more aircraft losses than anti-aircraft artillery (AAA), surface-to-air missiles (SAMs), MiG fighters, and friendly fire combined.⁵² The F-4 was also the first plane bereft of an internal gun, which caused the loss of several kill opportunities and sparked heated discussion among pilots and engineers until a later Air Force model added a cannon.

By far the worst and most dangerous problem of the F-4 was that of “departure,” also known as the “Adverse Yaw Effect.” This is the tendency during certain conditions – usually high angles of attack or hard turns – to lose control and stall. During this phenomenon, airflow over the plane was disturbed, and many control surfaces became ineffective, rendering the pilot completely incapable of guiding the aircraft. Pilots could sometimes regain control by attempting to reduce the attack angle or releasing the drag chute. Departure is somewhat preventable through a very complex, conscious effort on behalf of a pilot that has truly mastered the unique controls of the Phantom. Unfortunately, pilots rarely received training in correcting and preventing departure. The conditions creating this hazardous situation were more likely to occur in air-to-air combat, where agility and maneuverability are required. To claim that pilots found it extremely taxing to prevent or correct departure while engaged in a dogfight is an extreme understatement.⁵³ An F-4 experiencing departure during combat not only loses the chance to defeat the target, but places the pilot's life at risk both from an advantaged enemy and from the his own plane. Preventing or correcting this phenomenon potentially made the situation even more hazardous.

⁵² Hannah, *Striving for Air Superiority*, 70, 73. Across the Air Force, Navy, and Marines combined, from January 1962-January 1973, 930 planes were lost to small arms ground fire, or, 45% of losses by known causes. AAA claimed 632, SAMs shot down 191, MiGs destroyed 79, and friendly fire claimed 25.

⁵³ Hannah, *Striving for Air Superiority*, 54-57, 63-4; Marshall Michel, *Clashes*, 85-6; Clodfelter, *Limits of Airpower*, 133.

Flexible Planes for Flexible Response

Once rooted in the strict and terrifying concept of massive retaliation, the early 1960s saw a slight doctrinal shift in Air Force policy that affected the F-4's burgeoning development. The election of John F. Kennedy brought a change in military policy, focused on three main concepts: the use of budget as a way to further national aims, the centralization of power in the office of Secretary of Defense, and most importantly, the strategy of “flexible response” as opposed to the Eisenhower concept of massive retaliation. Rather than focusing on the ability to annihilate the Soviet Union at a moment's notice (which was not abandoned, but shifted to a reliance on Inter-Continental Ballistic Missiles instead of SAC's bomber fleets, which received no funding for construction in 1962) the Air Force, now working on a reduced budget, took on a variety of new roles. Airlifts, rapid deployment, counterinsurgency, and the training of native air forces became important missions. Flexible response doctrine dictated that the Air Force be able to handle varying levels of conflict and conventional war, not just a hypothetical nuclear war. This increased the role of TAC significantly, and further fostered an emphasis on versatility in its aircraft.⁵⁴

The new Secretary of Defense, Robert McNamara, was keen to save as many dollars as possible, accomplished through an increased emphasis on versatile, multi-mission planes and an insistence on the new concept of “commonality.” The key tenet of commonality was for the different service branches (especially the Air Force and Navy) to share the same aircraft. Ideally, this would streamline the design process and allow for greater economy of scale in production, as well as easing battlefield logistics.⁵⁵ An earlier plane attempted this for both Air Force and Naval operations, the controversial TFX: Tactical Fighter Experimental. This plane endured a sordid

⁵⁴ Bernard C. Nalty, ed., *Winged Shield, Winged Sword: History of the United States Air Force Vol 2* (Washington, D.C.: Air Force History and Museums Program, United States Air Force, 1997), 173, 209-10.

⁵⁵ Bugos, *Engineering the F-4*, 117-8.

design process and eventually became the F-111 Aardvark, which the Navy refused to purchase. Designers of the TFX hoped that it could fulfill the role of fighter, reconnaissance, and bomber for both services, but technical problems and political infighting essentially killed the potential of dual-service adoption.⁵⁶

Despite the TFX's failure, the F-4 epitomized the concept of flexible response. Its design emphasized flexibility and a multi-mission role, and with the modifications proposed for the Air Force's C model, it could function as a ground attack craft. McNamara was convinced that the F-4, originally designed for bomber interception and tactical nuclear delivery, would be equally effective in a smaller conventional war in the varying levels of aggression dictated by flexible response doctrine.

The Air Force assumed the Phantom was effective in the air-to-air combat role against Soviet fighters because in a flight test, it outmaneuvered another Air Force interceptor, the F-105 Thunderchief.⁵⁷ This however is an unfair comparison. The F-4 was indeed more maneuverable than the F-105, but the Thunderchief was a high-speed interceptor that either delivered nuclear weapons quickly or intercepted enemy bombers with incredible speed. The F-105 was purposely lacking in maneuverability, and did not compare to the agile, small soviet fighters that the F-4 later faced in the skies of Vietnam. Convinced that air-to-air roles were covered, McNamara proposed a “tactical strike fighter” version of the F-4, able to “dogfight, dive-bomb and strafe.” Designers took for granted that the Phantom could handle the first two of these capabilities and arranged another flyoff against the F-105 Thunderchief in November 1961, testing low-speed ground support maneuvers. The planes essentially tied, but the Phantom's wide versatility

⁵⁶ Dennis R. Jenkins, “General Dynamics F-111 Aardvark,” in *Air Warfare: An International Encyclopedia, Vol. 1*, Walter J. Boyne, ed. (Santa Barbara: ABC-CLIO, 2002), 251-2.

⁵⁷ Nalty, *Winged Shield, Winged Sword*, 186, 199.

convinced the Air Force of its value.⁵⁸

Already favoring heavy adoption of the Phantom, partly because of its record-breaking performance and partly due to pressure from McNamara to embrace commonality, in 1962 the Air Force decided to put the F-4 aircraft in yet another flyoff against its other star interceptor: the F-106 Delta Dart. In a series of tests at Edwards Air Force Base in California, the Phantom proved to have 25 percent greater radar range and to require about one third less maintenance time. The plane was less effective than the F-106 in the ground attack role, including nuclear delivery, still a key component of Air Force doctrine. However, the Air Force was sufficiently impressed enough with the Phantom that it placed large orders, with a few design changes stipulated. The Air Force eventually ordered more than triple the number of Phantoms as the Navy, lending considerable weight to their modification requests. In August 1962, the Air Force released Specific Operational Requirements (SOR) 200, asking for a larger ground-attack capability, dual flight controls for the backseat, and forward air base capability. McDonnell eventually created four new models of the Phantom to Air Force specifications, the first and most significant of which was the F-4C.⁵⁹

While Navy designs conceived of the plane as part of the fleet, and thus tied to the carrier itself, the Air Force desired a more autonomous aircraft. The first change was new power plants enabling the engines to start with less support equipment, allowing operations at distant forward air bases. Unhampered by carrier landing requirements, USAF Phantoms could carry more ordnance, fuel, and on-board equipment than their Navy counterparts, but the additional weight and the thinner paved runways used by the Air Force necessitated changes to the Phantoms tires

⁵⁸ Bugos, *Engineering the F-4*, 116-120.

⁵⁹ Anthony M. Thornborough, *USAF Phantoms: Tactics, Training, and Weapons* (New York: Arms & Armour Press, 1988), 11-12; Bugos, *Engineering the F-4*, 115. In Navy designs, the backseat pilot was a radar operator and weapons officer with no access to flight controls.

and braking systems. Designers attempted to lower instrument panels to improve cockpit visibility. The plane's instrumentation received significant revisions. The C model placed flight controls in the backseat and improved the computers to allow for vastly improved autopilot and navigation systems. These navigation systems integrated with the bombing targeting system, increasing the Phantom's effectiveness in ground attack roles. However, bombing was still a complex, manual system that relied on crew expertise and required pilots to memorize tedious charts detailing proper bomb release points for various altitudes and angles of attack.⁶⁰

Conclusion

The F-4 Phantom II's design process was the epitome of both the dominance of the strategic bombing mission and flexible response doctrine. Originally conceived as an interceptor and soon burdened by “mission creep” that insisted it handle multiple roles, the plane revealed the redefinition and abandonment of the traditional air-to-air role of true fighter planes. Its designers placed no importance on the ability to perform tight, agile maneuvers and close-range combat in dogfighting scenarios. Instead, planners assumed that advanced technology rendered the air combat role fundamentally changed and irrelevant. Speed, missiles, and interception were the only factors that mattered in the air superiority role according to Air Force and Navy Aviation doctrine. The Phantom excelled at these characteristics at the expense of maneuverability, gunnery, visibility, size, durability, and other factors necessary for success in air combat. By modifying the definition of air superiority to include interception of bombers, reliance on long-range missiles, and even preemptive bombing of airfields, planners assumed

⁶⁰ Thornborough, *USAF Phantoms*, 11-12; Bugos, *Engineering the F-4*, 115.

that their new aircraft adequately covered the role, an assumption the Vietnam War later proved false.

These doctrinal influences combined with the inherent systematic tendencies of the military-industrial complex to create a plane that emphasized versatility. When paired with the doctrine of flexible response, modifications to the Phantom allowed it to handle other roles of ground attack and ground support. Yet the design of these fighters was not ideal for bombing roles either. The harsh weather patterns of Vietnam did not facilitate standard bombing tactics that ensured some degree of accuracy, and bombing drops were often wildly inaccurate.⁶¹

Ultimately, the F-4 Phantom II was a jack-of-all-trades and master of none. Upon closer inspection, it was actually a jack of only some trades, sacrificing specified excellence for versatility. While strategic bombing, although controversial, made sense when warring against fully industrialized modern nations, the concept was highly flawed in limited wars against nonindustrial societies. The Korean War proved this, but war planners ignored its implications, and the United States thus entered war in Vietnam with an airpower doctrine completely unsuited for the type of warfare it found there. The F-4 Phantom II was the child of this doctrine. The plane itself was not inherently deficient. Its design accentuated particular characteristics, in which the plane excelled. However, similar to the doctrine that spawned it, the F-4 was the right plane for the wrong war.

⁶¹ Tilford, *Crosswinds*, 75.

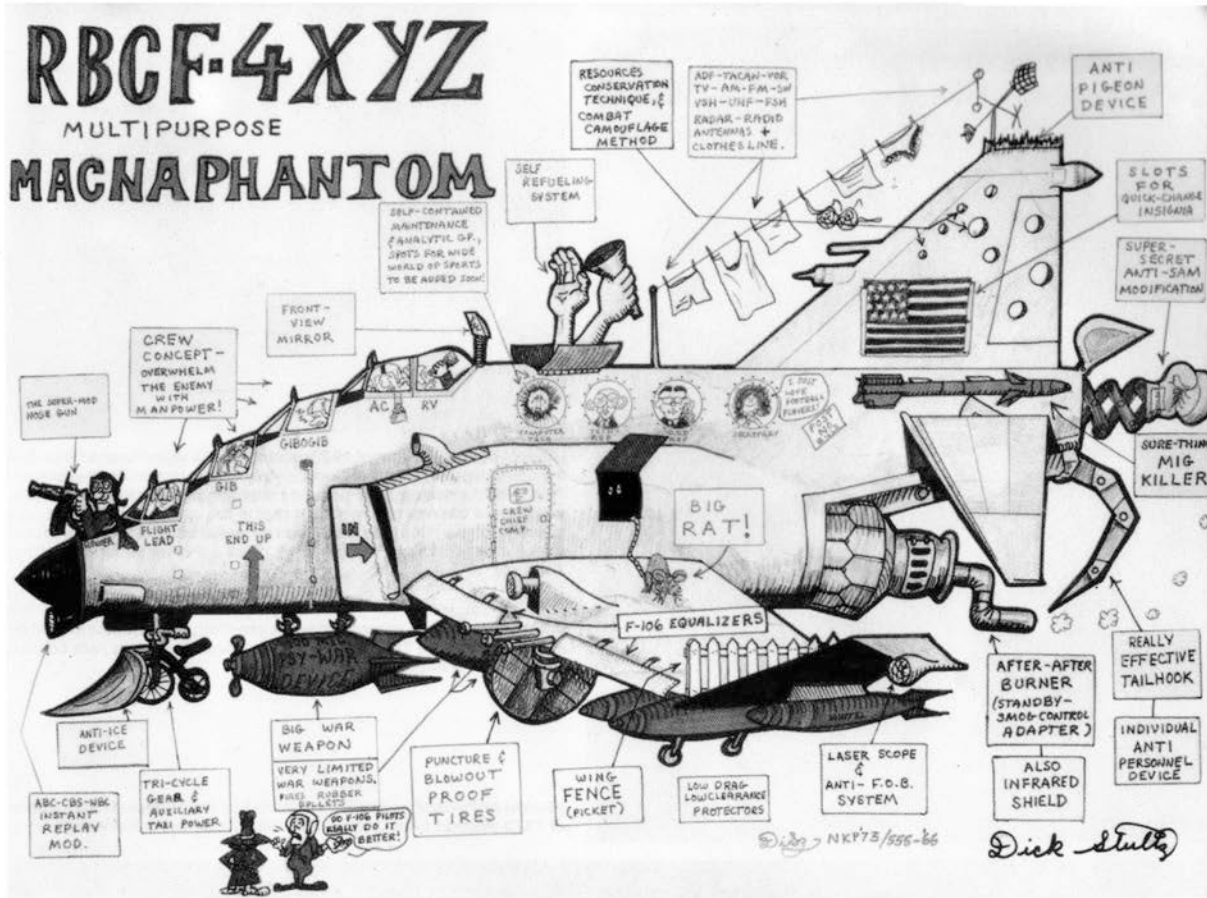


Figure 1 This cartoon, drawn by pilot Richard Stultz, mocks the multi-role nature of the F-4 Phantom. Taken from Lou Drendel, *USAF Phantoms in Combat* (Carrollton, TX: Squadron/Signal Publishing, 1987), 53.

CHAPTER 3

A RIFLE IN A PHONE BOOTH: AIR COMBAT DURING ROLLING THUNDER

In the spring of 1965, President Lyndon Johnson initiated Operation Rolling Thunder, a large scale bombing campaign designed to deter North Vietnamese aggression and support of the insurgency in the South. With the commencement of this operation, the air war began in earnest, and U.S. forces quickly found themselves tangled in the type of air combat that Air Force doctrine claimed was obsolete. Enemy MiG fighters, first the small, nimble MiG-17 and later the advanced MiG-21, accosted American bombing strikes. Against this threat, the United States Air Force (USAF) and Navy primarily employed the F-4 Phantom II to escort bombing missions and engage MiGs when they attacked. While the first few years of the war saw the Phantom largely successful in the fighter escort role – despite a lack of design emphasis in this area – advancements in MiG tactics soon unleashed havoc on the F-4s. The North Vietnamese Air Force (NVNAF) did not attempt to directly establish or maintain air superiority. Severely outnumbered, it instead pursued a strategy of harassment to force American attack flights to drop their bombs before reaching their targets. This strategy defied the type of conventional warfare that the USAF assumed would take place in future wars – an assumption that had informed and directed its policy development and procurement procedures. Thus, the USAF and the Navy found themselves unprepared for the type of warfare encountered in Vietnam in terms of aircraft, missile technology, tactics, and doctrine. Combat statistics show a sharp drop in the effectiveness of the F-4 over the course of the Rolling Thunder Campaign. American escort flights proved ineffective against MiG attacks that increasingly interrupted bombing strikes and forced the U.S. to devote more airborne resources to the growing MiG threat.

McDonnell designed the F-4 primarily for the role of intercepting enemy bombers and

shooting them down in one quick strike. While the airplane was adequate in multiple roles, including ground attack, the fact that it filled the fighter function revealed the lack of emphasis on, or even transformation of the traditional air superiority mission. This change in attitude was also evident in the Air Force's belief that ground attacks on enemy airfields could achieve air superiority, traditionally the domain of nimble fighters and hard-turning dogfights. Historian Robert Futrell has noted,

It was ironic that the importance of air-to-air, eyeball-to-eyeball combat in aerial maneuvering as a primary function of gaining and maintaining air superiority was so soon discounted after both World War II and the Korean conflict. In the mid-1950s, maneuver experience simulating the employment of tactical nuclear weapons clearly demonstrated that the way to gain aerial superiority was to destroy hostile air forces by attacks against enemy air bases. . . . In Tactical Air Command the idea that enemy aircraft would be destroyed on the ground worked against any development of an air-to-air fighter while the idea of flexibility of airpower mitigated against the idea of single-purpose fighters.¹

The Air Force, dominated by Strategic Air Command (SAC) and guided by strategic bombing doctrine, now regarded the gaining and maintaining of air superiority as a task for bombers.

As America's involvement in Southeast Asia increased in the early 1960s, many airpower planners urged such attacks against North Vietnamese airfields despite the reluctance of Washington leadership. On 20 February 1964, President Lyndon Johnson requested detailed contingency plans for possible operations against North Vietnam. The primary purpose of these plans was limiting North Vietnamese support for the insurgency in the South and had little to do with gaining or maintaining air superiority, although Washington leaders and the JCS failed to define the goals of a potential bombing campaign clearly. In April, the Joint Chiefs of Staff (JCS) produced Operations Plan (OPLAN) 37-64, a bombing campaign of increasing intensity that focused on airfields, bridges, supply depots, POL (petroleum, oil, and lubricants) storage, and other industrial targets. The President's advisers did not support the JCS plan, preferring less

¹ Robert F. Futrell, *Ideas, Concepts, Doctrine: Volume II: Basic Thinking in the United States Air Force, 1961-1984* (Maxwell Air Force Base, Air University Press, 1989), 287.

intense strikes to persuade the North to cease supporting the Southern insurgency gradually. At a conference in summer 1964 to discuss these questions, advisers could not clearly define the objectives for a proposed air campaign and thus neglected discussion of its political goals. Various planners each had individual reasons for beginning a bombing campaign that corresponded with their interests.² For the Air Force, this included gaining air superiority by attacking airfields and destroying the enemy planes on the ground. Yet, as the early stages of the war unfolded, Washington forbade such attacks.

On 5 August 1964, in response to the Gulf of Tonkin incident, the U.S. Navy launched an attack against North Vietnamese torpedo bases and oil storage facilities in sixty-four sorties under the code name “Pierce Arrow.” These strikes drew considerable reaction from the Soviet Union and prompted China to send approximately thirty MiG-15 and MiG-17 fighters to Phuc Yen airfield in North Vietnam. General Hunter Harris Jr., then the Commander in Chief of Pacific Air Forces (CINPACAF) strongly urged Washington to attack the field and destroy these fighters on the ground to maintain air superiority. Johnson ignored this urging, instead seeking to diminish follow-up attacks and avoid escalating the war.³

On 1 November, a successful Viet Cong attack against Bien Hoa Air Base killed four Americans, wounded seventy-two others and destroyed or damaged fifteen American and South Vietnamese aircraft. This incident galvanized many in Washington who had previously disagreed about air strikes or urged against the bombing of North Vietnam. The various service chiefs now proposed using SAC's B-52 bombers to attack Phuc Yen airfield, which housed most of the NVNAF's planes. Such an attack would have undoubtedly been a huge blow to the NVNAF and

² Mark Clodfelter, *The Limits of Airpower: The American Bombing of North Vietnam* (New York: The Free Press, 1989), 45-8.

³ Jacob Van Staaveren, *Gradual Failure: The Air War Over North Vietnam* (Washington, D.C., Air Force History and Museums Program, 2002), 49-52.

established American air superiority before the air war had even begun. However, the combination of Defense Secretary Robert McNamara's opposition to retaliatory strikes and the fact that the Bien Hoa attack occurred only two days before the Presidential election prompted Johnson to forgo such strikes.⁴ Additionally, it remained unclear whether China intended to resupply North Vietnam with additional MiG fighters if attacks destroyed the existing force.

More attacks triggered further retaliation by both sides. A Viet Cong attack against an American base at Pleiku prompted an air strike code named "Flaming Dart" launched on 7 February 1965. A second attack against American Army barracks at Qui Nhon led to Flaming Dart II four days later. Both of these attacks primarily targeted North Vietnamese barracks and some anti-aircraft sites and excluded airfields. In fact, on the same day, the JCS proposed an eight-week bombing program against North Vietnam that excluded any attacks on MiG bases unless Chinese or NVNAF pilots attacked first.⁵

To leaders in Washington, the Flaming Dart strikes indicated a willingness to undergo sustained bombing operations in the North. As National Security Advisor McGeorge Bundy remembered, "I think that most of us assumed that this was bound to mean . . . that we had to set it [bombing] up as a policy and do it."⁶ This proved accurate when only two days after Flaming Dart II, President Johnson ordered project "Rolling Thunder," a sustained bombing campaign against North Vietnam. The goals of this campaign remained murky. Presidential advisers each had differing conceptions of the bombing's purpose, both politically and militarily, and Johnson expressed continuing uncertainty and second thoughts about the campaign.⁷ The target choices for Rolling Thunder did not include MiG airfields. Harris again urged for a strike against Phuc

⁴ Staaveren, *Gradual Failure*, 59-60.

⁵ Ibid, 14-15, 22, 78-9.

⁶ Quoted in Clodfelter, *The Limits of Air Power*, 58.

⁷ Clodfelter, *The Limits of Air Power*, 59-60.

Yen, the primary base for MiG fighters. SAC went as far as to arm thirty B-52 bombers for a night strike against the airfield to be included as part of the initial Rolling Thunder strike, yet planners quickly cancelled this attack, intending to limit the campaign strictly to targets below 20 degrees North latitude. Phuc Yen, north of Hanoi, was far outside the range of this restriction.⁸ Air war planners grew increasingly concerned about the inability to attack targets in the North, especially airfields, as the defenses around these areas expanded quickly, and attacking them later could prove incredibly difficult. Additionally, there was evidence that the NVNAF had obtained a small number of Il-28 bombing aircraft that could conceivably attack American strategic targets, spurring the JCS to continue pressing their agenda of bombing airfields.⁹

Waiting To Be Hit: The Opening of Air-To-Air Combat

In early 1965, the United States possessed unquestionable numerical superiority. In February, the USAF maintained 200 aircraft in South Vietnam, mostly the propeller-driven attack A-1 Skyraider. Bases in Thailand housed eighty-three more modern jets, and three aircraft carriers of the Seventh Fleet guarded the Gulf of Tonkin with approximately 200 Navy aircraft at their disposal. During Flaming Dart II, four and a half additional attack squadrons deployed to Southeast Asia along with two squadrons each of B-52s and KC-135 tankers.¹⁰ Against this, the NVNAF owned approximately 120 aircraft, mostly transport craft, trainers, or helicopters. Only thirty to forty of these were fighters, mostly MiG-17s, which NATO code-named “Fresco.” While the North maintained between twenty and forty working airfields, only Phuc Yen could

⁸ Robert Futrell, et. al., *Aces and Aerial Victories: The United States Air Force in Southeast Asia 1965 – 1973* (Maxwell Air Force Base, The Albert F. Simpson Historical Research Center, Air University, 1976), 3-4.

⁹ William W. Momyer, *Airpower in Three Wars* (Maxwell Air Force Base: Air University Press, 1985), 19-21.

¹⁰ Staaveren, *Gradual Failure*, 69.

handle modern jets in early 1965.¹¹

With attacks on airfields forbidden, the only option for obtaining and maintaining American air superiority was engaging enemy fighters in the air. The USAF requested a squadron of F-4 Phantoms to provide escort for Rolling Thunder missions that McNamara approved on 1 April 1965. Six days later the fighters arrived and immediately began flying escort missions, commonly referred to as Combat Air Patrol (CAP).¹² The arrival of F-4s in Southeast Asia proved unfortunately late, as MiG forces attacked Rolling Thunder strikes on the third and fourth of April resulting in two lost F-105s.¹³ The first encounter between Phantoms and MiGs occurred on 9 April when a flight of four Navy F-4s engaged four MiG-17s while flying CAP for a Rolling Thunder strike. The battle resulted in one MiG shot down and one Phantom lost. The engagement revealed one key issue that continued to plague air-to-air combat during the remainder of the war: the malfunction of guided missiles. Of the two AIM-9 Sidewinders and eight AIM-7 Sparrow missiles fired during the encounter, only one produced a hit and most of them malfunctioned. Identification problems and the necessity of visual confirmation also created issues and revealed the danger of previous assumptions regarding the irrelevancy of close range air combat. The report noted, “There is a need for a close-in weapon as a backup on any missile system. If an ID pass has to be made, aircraft should have a weapon to give him an immediate attack capability if the target proved hostile.”¹⁴

¹¹ Staaveren, *Gradual Failure*, 70; see also, Roger Boniface, *MiGs Over North Vietnam: The Vietnam People's Air Force in Combat, 1965 – 75* (Mechanicsburg: Stackpole Books, 2008), xvii-xviii. Boniface claims to have consulted North Vietnamese sources, and naturally reports higher numbers for NVNAF forces, yet his research is inadequately documented and relies almost exclusively on recent oral history rather than documentation.

¹² Staaveren, *Gradual Failure*, 96.

¹³ “Air-To-Air Encounters in SEA (U),” Volume II: F-105 Events Prior to 1 March 1967 (U), Institute for Defense Analyses Systems Evaluation Division, WSEG Report 116, September 1968, 17, 35-38; hereafter cited as “Red Baron Report Vol. II.”

¹⁴ “Air-To-Air Encounters in SEA (U),” Volume I: Account of F-4 and F-8 Events Prior to March 1967 (U), Institute for Defense Analyses Systems Evaluation Division, WSEG Report 116, October 1967, 35-41; hereafter cited as “Red Baron Report Vol. I.”

The air-to-air war had clearly begun, but the North Vietnamese MiG forces seemed hesitant at the opening of the conflict. Until spring of 1966, air-to-air engagements were rare, and MiG fighters did not conform to any identifiable strategy. F-4 Phantoms only engaged MiGs fourteen times during this period, and many of these incidents were simply sightings or radar contacts that did not lead to combat. However, U.S. forces claimed four MiGs and two more probable kills with only one loss.¹⁵ These early engagements revealed several issues that became commonplace over the course of the war. As with the 9 April engagement, missile problems were frequent and not limited to malfunction. The Phantom suffered from problematic “switchology,” a term describing the complex control system these missiles required.¹⁶ The F-4’s weapons systems utilized a complicated series of switches and controls and an unintuitive layout. One analyst described this system as “undoubtedly laid out by a left-handed, cross-eyed, pigmy engineer with a demented sense of humor.”¹⁷ Furthermore, pilots often fired these missiles outside their ideal environment. Influenced by the set of assumptions that guided the design of the Phantom, designers of the Sidewinder and Sparrow missiles intended them as long-range weapons against non-maneuvering targets such as large enemy bombers. However, the requirement of visually confirming MiGs before firing missiles forced planes to get close before engaging, virtually guaranteeing the missiles would be ineffective. The visual identification requirement was necessary, evidenced in an engagement with MiGs on 10 July that experienced multiple occasions where USAF planes accidentally targeted friendly Navy aircraft. Many pilots

¹⁵ These figures are based on Red Baron Report Vol. I, 17-111. North Vietnamese sources naturally differ substantially. According to Boniface, *MiGs Over North Vietnam*, 11-13, the NVNAF claimed to shoot down nine Phantoms for Fourteen lost MiGs over a course of 156 dogfights. These figures seem almost ludicrous when it is considered that this would require more than one dogfight per day, when American sources show that such engagements were quite rare during this period. Given such inconsistencies, and the lack of specific citations outside of oral history conducted by himself, much of Boniface's data seems dubious at best.

¹⁶ Red Baron Report, Vol. 1, 48.

¹⁷ Captain M. O. Beck, “The New Phantom Switchology,” *USAF Fighter Weapons Review* (Summer 1973), 26.

indicated a need for a new missile designed to operate at short range, some calling for the addition of a gun to the Phantom, yet disagreement emerged on the latter point. Some claimed a gun would lead to more kills, that they lost many opportunities for shooting down MiGs without one. However, others thought such a weapon would tempt pilots into dangerous situations and would simply “get people into trouble.”¹⁸

Complaints from aircrews regarding the capabilities of their Phantoms grew commonplace after combat with the agile MiG-17s. Some pilots criticized the plane's poor rear visibility, and many others pointed out the fighter's lack of maneuverability, to the point of requesting the military design an entirely new aircraft specifically for the purpose of air combat. Some went as far as to blame the design philosophy behind the F-4 itself, claiming that multi-mission craft were not feasible for air-to-air combat and that expecting planes and pilots to perform multiple roles “degrades pilot capabilities as well as weapon system performance for any given mission.”¹⁹ Another significant problem area identified by many pilots was the lack of training they received for combat. Some crews expressed that they did not know how to maneuver the F-4 effectively in a close combat situation because they lacked adequate Air Combat Training (ACT). This problem emanated from the F-4's nature as a multi-role fighter, as aircrews identified that, “The requirements demanded of pilots flying multi-mission aircraft meant that some aspects (e.g. ACM [Air Combat Maneuvering]) would not receive sufficient training.”²⁰

During these opening battles, the MiG-17 was the only fighter available to the NVNAF. This plane in many respects was simply a modified and slightly upgraded version of the MiG-15

¹⁸ Red Baron Report, Vol. 1, 17-111, quote from 57.

¹⁹ Ibid, quote from 84.

²⁰ Red Baron Report, Vol. 1, 57.

“Fagot,” the primary fighter during the Korean War over a decade earlier. Thus, the Fresco seemed inferior in almost all respects to the newer American planes, but its smaller, lighter design rendered it far superior in turning ability. This agility advantage allowed the MiGs to engage F-4s at a close distance and perform gun attacks with its two twenty-three millimeter guns and one thirty-seven millimeter cannon. While the rate of fire from these weapons was slow, the gun’s larger power and greater size rendered them more deadly than the twenty-millimeter cannon on the F-8 Crusader, the other American fighter in Southeast Asia. The Phantom, which possessed no gun, was extremely vulnerable to such fire. Airpower historian Peter Davies noted, “A single strike by 37mm shell that weighed in at 750 grams could easily disable a US fighter.”²¹ Test pilot Ronald McKeown summed up the differences between the two aircraft, explaining that fighting a MiG-17 in an F-4 “was like being a giant with a long rifle trapped in a phone booth with a midget using a knife.”²²

The NVNAF relied on ground-based radar to control their flights, a system known as Ground Controlled Interception (GCI). The system eventually grew to over 200 radar stations routed through three main GCI sites at Bac Mai, Phuc Yen, and Kep airfields. These sites used radar information to coordinate air defense and direct MiGs to attack positions. The system contained a high level of redundancy, so much that American forces found it impossible to jam the system. GCI could thus track American planes at any time, and essentially controlled MiG flights, dictating their headings, vectoring them into attack positions and directing individual pilots to make attacks on U.S. aircraft.²³

American forces experienced an additional disadvantage because all parts of a strike

²¹ Peter Davies, *USN F-4 Phantom II vs. VPAF MiG-17/19: Vietnam, 1965-73* (New York: Osprey, 2009), 28-30.

²² Quoted in Robert K. Wilcox, *Scream of Eagles: The Dramatic Account of the U.S. Navy's Top Gun Fighter Pilots and How They Took Back the Skies Over Vietnam* (New York: Pocket Star Books, 1990), 138.

²³ Momyer, *Air Power in Three Wars*, 118-9, 141.

mission, even those flying escort or CAP missions, carried air-to-ground bombs. American planes did not fly in pure escort roles at this early stage in the war because the MiG threat was less dangerous than other air defense elements. The number of available fighters was not sufficient to fulfill separate bombing and escort roles, and planners desired to maximize the amount of ordinance dropped on a target. If MiGs attacked a strike formation, designated fighters would immediately drop their bombs (since carrying bombs under an airplane significantly reduced its speed and already low maneuverability) and engage the MiGs. However, as General William W. Momyer, then head of Air Training Command (ATC) and later commander, Seventh Air Force, noted, “Many of the F-4 pilots weren't happy with these tactics – the tactics were defensive in nature and cast them in the unpleasant role of targets waiting to be hit.”²⁴

A Real Menace: Growing MiG Aggression

While the MiG-17 possessed a few advantages over American fighters, overall it did not perform well in air-to-air combat, as evidenced by the poor kill ratio of at least 4:1 in favor of the F-4 Phantom in the opening months of the war. However, beginning in spring 1966, the NVNAF adopted several changes, growing more aggressive and dramatically increasing the number of air-to-air engagements in the theater. Most significantly, it introduced the MiG-21 “Fishbed.” The first sighting of the MiG-21 occurred on 6 February 1966, when one of the new North Vietnamese fighters attempted to intercept a U-2 spy plane on a photo-reconnaissance mission. Not until 23 April did F-4s face a MiG-21 in combat. At this first encounter, the MiG attacked a pair of Phantoms from behind and followed one into a hard turn. The first F-4's wingman slipped in behind the MiG, but all six of the plane's missiles failed and the MiG escaped. By the end of

²⁴ Momyer, *Air Power in Three Wars*, 144.

April, the Fishbed regularly engaged F-4 Phantoms, primarily those of the USAF.²⁵

Whereas the MiG-17 was essentially a slightly upgraded holdover from the Korean War, the MiG-21 was a true next-generation fighter. In some ways, it appeared “as equal to – and in some aspects superior to – the F-4 and F-8 in maneuverability and acceleration and was vastly superior to the F-105 in every performance area except maximum speed at low altitude.”²⁶ The new plane featured a large, thirty-millimeter cannon and wielded a new Soviet weapon: two K-13 (referred to in the U.S. as 'Atoll') air-to-air missiles. The Atoll was a heat-seeking missile roughly equivalent to the AIM-9 Sidewinder the American planes carried. The Fishbed, while not as maneuverable as the nimble MiG-17, could still out turn the Phantom, yet this agility advantage disappeared at higher speeds. The new Soviet fighter also had extremely poor visibility. The simplicity of its design and the armor plating protecting its pilot rendered the plane more durable and likely to survive attacks. However, its largest advantage was the fighter's extremely small size, roughly half that of the bulky Phantom. This, combined with the lack of an engine smoke trail, made the plane incredibly difficult to acquire visually.²⁷

By late March 1966, the NVNAF possessed approximately sixty MiG-17s and 15s and about fifteen of the new MiG-21s at Phuc Yen airfield. Additionally, American reconnaissance photographed more than fifty large aircraft crates believed to contain around thirty more MiGs.²⁸ The NVNAF often targeted EB-66 flights, used primarily for jamming enemy radar.²⁹ On many occasions, the MiG forces, guided by GCI, followed coordinated attack patterns using MiG-17s

²⁵ Red Baron Report, Vol. 1, 17, 110, 133-5.

²⁶ Marshall Michel III, *Clashes: Air Combat Over North Vietnam, 1965 – 1972* (Annapolis, Naval Institute Press, 1997), 41.

²⁷ Richard S. Ritchie, United States Air Force Oral History Program, Interview #K239.0512-630, 11 Oct 72 and 30 Oct 72, 2-3. See Also, Wayne Thompson, *To Hanoi and Back: The United States Air Force and North Vietnam, 1966 – 1973* (Washington, D.C.: Smithsonian Institution Press, 2000), 34-5; Michel, *Clashes*, 75-83.

²⁸ Staaveren, *Gradual Failure*, 241.

²⁹ Red Baron Report, Vol. 1, 103-413; see also Michel, *Clashes*, 41-2.

approaching from low altitude while MiG-21s approached from higher up to take advantage of their dive capability.³⁰

From March until the end of the year, fifty-five engagements with F-4s occurred in North Vietnam, and many more with other U.S. aircraft. During this period, U.S. records show twelve MiG kills and two more probable, compared to only two F-4s lost to MiGs and two more lost to uncertain causes.³¹ Therefore, the ratio was 3:1 in the Phantom's favor at its most conservative, and could be as high as 7:1. However, when factoring in the multiple engagements with other aircraft, the ratio moves closer to 2:1, still in the favor of the U.S.³²

Focusing simply on the raw kill counts can be misleading. For many aggressive American fighter pilots, shooting down MiGs was a concrete goal. Yet the NVNAF did not view the air war through the same lens. Heavily influenced by the ideas of guerrilla warfare proposed by Mao Zedong, the North Vietnamese had observed the annihilation of the North Korean Air Force when it engaged in traditional dogfighting tactics during the Korean War. The North Vietnamese also realized they were incapable of obtaining numerical parity with the United States. Thus, they did not attempt to achieve any of these goals but rather sought to frustrate and demoralize American forces through hit-and-run attacks only when they possessed a clear advantage. As historian William Sayers noted,

They [the NVNAF] would seek a decisive fight only when they believed the conditions were so absolutely aligned in their favor that victory was almost inevitable. In effect, the VPAF [Vietnamese People's Air Force] ceded air superiority to the U.S. in order to wage a guerrilla war of the air. . . . This strategy allowed the VPAF the flexibility to engage only on its own terms.³³

³⁰ Boniface, *MiGs Over North Vietnam*, 18; see also, Futrell, *Aces and Aerial Victories*, 10.

³¹ Red Baron Report, Vol. 1, 17.

³² Ibid, 17-18; Red Baron Report Vol. 2, 17-19; "Air-To-Air Encounters in SEA (U)," Volume III: Events from 1 March 1967 to 1 August 1967 and Miscellaneous Events, Institute for Defense Analyses Systems Evaluation Division, WSEG Report 116, February 1969, 15-18; hereafter cited as "Red Baron Report Vol. 3."

³³ William Sayers, "The Red Baron Reports: What They Really Said," *Air Power History* 52 (Fall 2005), 7-8.

Additionally, the goal of North Vietnamese interceptors was not to engage with U.S. fighters for the sake of winning in air-to-air combat. Their main objective was to prevent bombers from dropping ordnance on their targets. Thus, while MiG kill ratios may be a somewhat useful metric, a truer measure of CAP missions and of the NVNAF's success is whether U.S. bomb strikes could freely attack their targets. In preventing this, the North Vietnamese proved quite successful, given their small numbers. From September through December of 1966, MiG interference forced 107 strike sorties to jettison their bombs. This represented less than 3 percent of the total number of strikes flown during this period, but this was a function of the small number of available MiGs, not indicative of their effectiveness. What does indicate the efficacy of MiG tactics is the fact that of all the American flights that encountered them at all, MiGs prevented over 55 percent of them from striking their targets.³⁴ Viewed another way, in December alone, MiGs forced 20 percent of all U.S. strikes in the Hanoi area to drop their ordnance before reaching their targets.³⁵ Thus, while the MiGs were not numerous enough to threaten a significant percentage of the many U.S. strike formations, they were quite effective against what strikes they did engage.

As the end of 1966 approached the MiG threat grew significantly, yet neither the Air Force nor the Navy took action to address the growing concerns. As the commander of the 8th Tactical Fighter Wing, ace pilot Robin Olds, described it,

The MiGs started becoming a real menace. . . . By then, about the end of November of '66, . . . the MIGS, as I said, became a factor that we really had to reckon with. And we started losing aircraft to MiGs. . . . This was having an impact on our accuracy, such as it was, and on our ability to operate. . . . But there was no concerted effort really to do anything about the MIGS.³⁶

³⁴ Futrell, *Aces and Aerial Victories*, 10.

³⁵ Michel, *Clashes*, 73.

³⁶ Robin Olds, United States Air Force Oral History Program, Briefing, K239.0512-222, 29 Sept 1969, 6-8, hereafter cited as Olds, "Bolo Briefing."

Destroying the enemy fighters on the ground by bombing known airfields was the preferred method of establishing air superiority. However, Washington held firm in its resistance to attacking these targets. Before March 1966, the JCS had made eleven requests to McNamara to authorize the bombing of North Vietnamese Airfields. Civilian leadership refused these requests, fearing Chinese or Soviet intervention. After March, as MiG air attacks drastically increased. Admiral U. S. Grant Sharp, then Commander in Chief, United States Pacific Command (CINCPAC) worked with SAC and other USAF and Navy commanders on a proposal detailing options for a major strike against Phuc Yen and Kep airfields, the main bases for NVNAF jet fighters. Despite the increase in MiG activity, the Johnson administration again refused any of the proposed options. Washington leaders reasoned that the airfields were politically sensitive targets that could deal a harsh propaganda blow to the U.S. cause or prompt Chinese intervention. The State Department determined China was in the initial stages of a cultural revolution and was not necessarily a rational actor. Additionally, Hanoi appeared resolved to continue the war in earnest, regardless of whether or not the U.S. bombed its airfields. Thus, the civilian administration essentially argued that the bombing of airfields was simultaneously too effective and not effective enough.³⁷ Some planners also argued that aircraft losses in the event of an attack on North Vietnamese airfields would be disproportionate to the level of damage inflicted on the NVNAF. Momyer rejected this reasoning, claiming that strike forces regularly penetrated these areas without significant losses. Despite this, authorization for strikes against airfields did not occur until later in 1967.³⁸ To put a dent in the growing MiG threat, the only option for U.S. forces was a dangerous direct air-to-air confrontation.

³⁷ Staaveren, *Gradual Failure*, 241, 272-3, 300.

³⁸ Momyer, *Airpower in Three Wars*, 140.

The Electric Trojan Horse: Operation Bolo

As early as April 1965, American air planners showed interest in a plan to send a large decoy strike force to lure MiGs into a decisive air-to-air battle. By the end of 1966, MiG activity was aggressive enough to prompt the execution of such a plan.³⁹ As Momyer recalls,

We began planning in mid-December 1966 for a large fighter sweep which would take place immediately after the expected Christmas and New Year standdown. Previous experience showed that the MIGs would put up a substantial effort after a standdown; their in-commission rate would be high, their tactics refined, and their skills polished by training sorties accomplished with little fear of attack.⁴⁰

On 22 December 1966, the 8th Tactical Fighter Wing (TFW), led by Robin Olds, planned the sweep, designated “Operation Bolo.” Olds intended to disguise a large group of F-4s as a typical F-105 strike force. Historian Walter J. Boyne described the operation as an “electronic Trojan Horse concealing the hard-hitting F-4 Phantoms of USAF's 8th Tactical Fighter Wing within a radiated image that simulated bomb-laden F-105 Thunderchiefs.”⁴¹ The plan called for fifty-six F-4 Phantoms, eight F-104 Starfighter interceptors, and twenty-eight F-105s on a typical bombing strike along with their typical CAP escort flights. Two additional waves of F-4 fighters joined these forces to target vulnerable positions. Working with U.S. intelligence sources, Bolo planners predicted that MiG forces tended to orbit two particular areas near Phuc Yen airfield, awaiting vulnerable Rolling Thunder bombing strikes. U.S. fighters took off in intervals timed to correspond with the MiG's predicted fuel capacity. These fighters would orbit enemy airfields, placing them in a prime position to attack MiG forces precisely when they attempted to land due to low fuel. To prepare the pilots and crews that were involved in the plan, the USAF launched Operation Charging Sparrow, which gave pilots the valuable opportunity to practice launching

³⁹ Michel, *Clashes*, 73.

⁴⁰ Momyer, *Airpower in Three Wars*, 145.

⁴¹ Walter J. Boyne, “MiG Sweep” *Air Force Magazine* 81 No. 11 (November 1998), 46.

Sparrow missiles against drone targets.⁴²

The plan for Bolo contained an extremely high degree of risk and assumption, as well as some inherent problems. At the time planning began, the 8th TFW was in the midst of a massive operation called “Rapid Roger,” an attempt by the USAF to gauge the highest possible sortie rate that could be generated by a particular wing, given a lack of resource limitations. This operation had the crews and aircraft of Olds' wing working extraordinarily long shifts, exhausting both manpower and equipment. Another key concern was effectively convincing North Vietnamese radar operators that the F-4s were actually vulnerable F-105s. To appear convincing, the plan employed similar flight paths, call signs, and timing as typical Thunderchief strikes, but these were insufficient without the QRC-160 jamming pod routinely carried by the F-105. North Vietnamese radar operators would expect to see the pod’s telltale electronic effects. To mimic the bombers effectively, Phantoms would have to carry these pods, for which they were not properly equipped. Not only was the F-4 incapable of carrying the QRC-160, but there was a shortage of them in the theater. The number of available pods, which numbered at fifty-seven in all of Southeast Asia, thus dictated the size of the strike force. Regularly scheduled F-105 strikes required the pods, limiting access to them until two days before Bolo launched, forcing maintenance crews to remove them during the night and fit them to the F-4s through an improvised rewiring of the Phantom’s right outboard pylon. The timing window for completing this work was short and quite risky. Additionally, the placement of the pod rendered the F-4 out of balance and difficult to fly, making takeoff and landings extremely difficult. As Olds described, when landing with the pod attached, “You just had to come in with full rudder and

⁴² Red Baron Report, Vol. 1, 415.

hope.”⁴³

Bolo carried other inherent risks as well. The plan hinged on the large assumption that MiG forces would continue to operate as they had in the previous months, orbiting in precisely the same places with the same timing as before. Some planners considered this a safe assumption, but any changes in the NVNAF's strategy would place the plan in extreme danger. Successfully deceiving the enemy forces was also a risk. While U.S. forces undertook extreme measures to convince North Vietnamese radar operators that the F-4s were actually a typical F-105 strike, U.S. forces would also need to fool North Vietnamese ground observers, who could easily see the differences between an F-4 and an F-105. Clearly, no actual measures existed to disguise the aircraft visually for spotters on the ground, so the highly detailed and carefully orchestrated plan ultimately “depended on luck and the cloud cover.”⁴⁴ Pilot experience was also a factor. Most of the pilots assigned to the operation had not experienced air-to-air combat before. As Olds recalls, “In this particular mission, I think there were only two of us on it that had ever seen an enemy airplane in the air.”⁴⁵

To counter this reliance on luck, the plan employed staggering numerical superiority. At the time, the NVNAF consisted of approximately sixty-five fighter airplanes, fifty of which were the older MiG-17s.⁴⁶ The plans for Operation Bolo called for ninety-two attack aircraft, fifty-six of which were F-4 Phantoms prepared for a dogfight. Had the NVNAF launched every available fighter in their inventory, they would have barely possessed a numerical advantage, with a ratio slightly over 1.4:1. However, when the operation launched on 2 January 1967, a combination of weather, refueling issues and technical problems prevented some of the planned forces from

⁴³ Olds, “Bolo Briefing,” 11-17, quote on 17; Olds, *Fighter Pilot*, 272-6.

⁴⁴ Olds, *Fighter Pilot*, 272.

⁴⁵ Olds, “Bolo Briefing,” 23.

⁴⁶ Momyer, *Airpower in Three Wars*, 143.

participating. Only thirty-two F-4s participated in the operation, along with four F-104s and twenty F-105s, against fourteen to twenty MiGs.⁴⁷ Even when considering only the combat-prepared Phantoms, U.S. forces still possessed nearly a 2:1 advantage. However, the raw ratio can be misleading. These forces consisted of several smaller flights spread over a large area. Amidst all of these aircraft, three distinct combat engagements occurred. Each action pitted four F-4s against a group of five to seven MiG-21s.⁴⁸ However, these numbers, if correct, would account for every single MiG-21 possessed by the NVNAF at the time. While this is certainly possible, it is also possible that these numbers are exaggerated or that some were mistaken MiG-17s. In any case, U.S. forces possessed a clear numerical superiority in terms of the operation, but in the individual engagements, were at a slight disadvantage.

During Operation Bolo, the USAF claimed seven MiG kills and two other unconfirmed probable kills and no losses – likely as successful an operation as its planners hoped. Yet these engagements revealed and reinforced many of the same problems that were inherent in earlier conflicts. A large number of the pilots involved expressed a need for a more maneuverable, close-range weapon, either a gun or a missile designed for the dogfight environment. The performance of the Phantom also frustrated many pilots, who called for a more maneuverable airplane, specifically citing the F-4's poor turn radius and roll rate. The “heads-down” controls also caused problems, forcing pilots to take their eyes off the sky to operate the complex switches necessary for missile launches. The missile systems themselves were quite problematic. Over all three encounters, U.S. planes fired eighteen AIM-7 Falcons, claiming four kills and one unconfirmed. The AIM-9 Sidewinder performed only slightly better, causing three kills and one probable over twelve firings. This seemingly poor success rate of 20-25 percent was actually

⁴⁷ Red Baron Report, Vol. 1, 415.

⁴⁸ Red Baron Report, Vol. 1, 417-37.

much higher than the overall rates for these missiles over the course of the war, especially considering that U.S. aircrews often fired Sidewinders purposefully out of envelope as a “scare tactic” to intimidate the enemy. While the American pilots involved in these engagements were extremely inexperienced, several of them noted a similar lack of expertise among their North Vietnamese counterparts. The Phantom crews reported that some MiG fighters seemed completely unaware they were under attack, and those that actively engaged made many maneuvering mistakes, or demonstrated a lack of familiarity with their own weapons systems.⁴⁹

Despite these issues, Bolo was clearly an overall success and showed that these problems were solvable given certain conditions. As Olds described, “you can hassle with a MIG-21 with an F-4 at this altitude – this ranged from about 8,000 feet up to 12,000. And you can hack it. You've got a good fight on your hands, but you can hack a MiG-21.”⁵⁰ Although Bolo pointed to future improvements on Air Force equipment, the plan was devastating to the NVNAF, destroying nearly half of its MiG-21 force. As Olds recalls, “The mission took a huge toll on the small fleet of new MiG-21s. It also proved the ability of the F-4 and its missile armament to effectively engage the enemy aircraft. A gun would still be a priority for future models, but we could accomplish the mission with what we had.”⁵¹ Despite the heavy damage inflicted on North Vietnamese forces, the NVNAF could replace destroyed fighters quickly and indeed already had many more MiG-21s in crates, awaiting assembly at Phuc Yen airfield.⁵² However, this fact does not diminish the severity of the blow to the small fleet. Operation Bolo also demonstrated that air-to-air combat, while a key component of maintaining air superiority and protecting the lives of bomber crews, was not a defining characteristic of the air war over North Vietnam, where the

⁴⁹ Red Baron Report, Vol. 1, 417-37.

⁵⁰ Olds, “Bolo Briefing,” 51.

⁵¹ Olds, *Fighter Pilot*, 281. For his full narrative account of the battle, see 279-282.

⁵² Futrell, *Aces and Aerial Victories*, 41.

larger threat came in the form of SAMs (surface-to-air missiles) and AAA (anti-aircraft artillery). Bolo was the largest single battle against MiGs during the war, but it was very small compared to previous conflicts. In comparison, the largest air battle during the Korean War witnessed thirty-nine F-86 Sabres against seventy-three MiG-15s in over seventeen separate engagements on one day.⁵³

The success of Operation Bolo led USAF planners to try the ruse tactic again on a smaller scale only a few days later. On 6 January 1967, two USAF F-4s attempted to pose as a weather reconnaissance mission in an attempt to lure more MiGs into battle. This was not a large-scale operation in the sense of Bolo, nor did it attempt to establish numerical superiority. The Phantoms aggressively pursued four radar contacts and quickly identified them as MiG-21s. When the MiGs realized the ruse, they attempted to escape, but the F-4s pursued and claimed two kills despite the typical problems with missile systems.⁵⁴ This further success spawned the planning of a larger operation for later that month, simply called Bolo II. However, Olds expressed doubts that these tactics were likely to deceive the NVNAF again, especially because Bolo II mimicked the first Operation in almost all of its details. As he described,

It was virtually the same. The timing was very little changed, very little change in any of the aspects of the mission. . . . Intuitively I felt the timing was all wrong, it was bad. Because I felt if we tried to do this thing again and the weather was bad, all we were going to get for our pains were SAMs. They weren't going to be sucke[re]d twice the same way.⁵⁵

His hesitancy proved prophetic, as the Bolo II operation failed to lure any MiGs into action, but found itself accosted by SAMs. Olds summarized the failed mission, saying, “We lost one bird to

⁵³ Momyer, *Air Power in Three Wars*, 146-7.

⁵⁴ Red Baron Report, Vol. 1, 451-54.

⁵⁵ Olds, Bolo Briefing, 64-5.

a SAM and had another couple of birds very badly battered; and that's all it turned out to be.”⁵⁶ Nonetheless, the massive losses sustained by the NVNAF, combined with heavy monsoon weather caused a drop in MiG attacks during the next two months. In response to these heavy losses, the Vietnamese force stood down and began another heavy training cycle to develop new tactics – a response that became a pattern during the Rolling Thunder period.⁵⁷

The Wheel in the Sky: Changing MiG Tactics

Relatively few air-to-air engagements occurred during early 1967, although U.S. forces reported several MiG sightings, and F-105 fighter-bombers shot down three North Vietnamese fighters with no losses. This situation took a dramatic turn in March, as MiG forces attacked in large numbers. By mid-April, the weather cleared dramatically over North Vietnam and the number of air combat engagements skyrocketed. Dogfights occurred almost daily, and in many cases, several times on the same day. North Vietnamese pilot Nguyen Nhat Chieu recalled that, “May 1967 was a time I flew combat missions up to two or three times a day.”⁵⁸ The NVNAF during this period largely targeted F-105 strikes, claiming many American losses and forcing several sorties to drop their ordnance long before reaching their targets.⁵⁹ Robin Olds summarized the situation, noting,

During April [1967] the MIGs got more aggressive and more aggressive, and they were beginning to attack the 105's on ingress to the target and more and more were forcing them to jettison their ordnance in order to evade these attacks. Then came a rather bleak week when a number of 105's were lost to MIGs. . . . On one day one of the wings lost three F-105's in one afternoon.⁶⁰

⁵⁶ Ibid, 66.

⁵⁷ Futrell, *Aces and Aerial Victories*, 44.

⁵⁸ Boniface, *MiGs Over North Vietnam*, 49.

⁵⁹ Red Baron Report, Vol. 3, 16-20.

⁶⁰ “Interview of Col Robin Olds,” United States Air Force Oral History Program, K239.0512-160, 12 July 1967, 20-1.

This explosion of activity also revealed a dramatic shift in NVNAF tactics. Until this time, U.S. forces realized that the F-4 was not effective in close turning engagements, nor were the Sparrow or Sidewinder missile systems. Experienced American pilots knew that successful combat tactics against MiG fighters relied heavily on moving in a vertical pattern, taking advantage of the F-4s speed and power while negating the MiG's maneuverability advantage. However, in 1967, North Vietnamese pilots demonstrated that they understood these concepts as well and had developed effective defenses against them. They forced the fights to a lower altitude, where their plane's performance increased. They refused to engage in vertical maneuvers where they did not possess the advantage. Perhaps most significantly, MiG forces began using a tactic known as the "wagon wheel."⁶¹ In this formation, several NVNAF fighters followed each other, flying in a large, flat circle in orbit over specific points, usually airfields or known targets of U.S. bomb strikes. Using this formation rendered the MiGs incredibly difficult to attack. If an F-4 attempted to engage a MiG, another MiG located across the circle would automatically gain an attack position on that F-4. The tight turns also "effectively negated the missile attacks."⁶² In some cases, MiGs set themselves into two wheels, one operating at low altitude and the other at high altitude. These wheels were mutually supportive – if a U.S. fighter attacked either wheel, the other could break and engage. Often these dual wheels alternated their positions, forming a strong defensive pattern that was difficult for American pilots to break. This formation was primarily defensive, and meant that MiG forces often did not initiate combat with F-4 fighters, but remained in orbit over strike areas in order to attack F-105 bombers, forcing them to drop their ordnance before completing their strike missions. However, when F-4s did engage with these MiGs, many pilots noted a marked increase in North Vietnamese pilot

⁶¹ Michel, *Clashes*, 89.

⁶² Red Baron Report, Vol. 3, 234. For other examples of the wagon wheel tactic, see 212, 269; see also, "Interview of Col Robin Olds," 26-7.

aggression and capability. These new tactics highlighted and took advantage of the weaknesses of the Phantom. As one pilot noted during spring of 1967, “MiG pilots were very aggressive and made no mistakes. . . . Missiles and F-4s would be no good in this 'on deck hassle.’”⁶³

However, while these new tactics caused a large degree of frustration for many U.S. pilots, they did not necessarily correspond to an increase in the NVNAF's effectiveness. From mid-March until the end of July of 1967, the vast majority of air-to-air engagements ended in stalemate, with the new North Vietnamese tactics effectively countering U.S. efforts but not leading to more kills. During this period, the NVNAF shot down only five F-4 Phantoms and the same number of F-105 Thunderchiefs. By comparison, Phantoms claimed twenty-six MiG kills, and this figure does not include kills made by the F-105, which separately possessed a positive kill ratio against MiG fighters. Thus, examining only engagements against the Phantom, the F-4 achieved a kill ratio of over 5:1. It is also notable that all but two of these kills involved USAF fighters, as the Navy took part in very few engagements during this time.⁶⁴ However, kill ratios, while a useful metric, rarely tell the whole story. MiG fighters did not necessarily look to shoot down U.S. fighters as much as they attempted to disrupt strike formations and force them to drop their ordnance before reaching their intended targets. Thus, a poor kill ratio for the NVNAF does not necessarily indicate a lack of success.

The spike in MiG activity also spawned a number of changes in U.S. tactics. These changes indeed reveal that the NVNAF's primary mission of disrupting bomber forces was succeeding, despite the unfavorable kill ratio. The first major change was the dedication of planes to a purely CAP role, which rendered bombing formations smaller and less effective. Previously, even fighters used as screens against MiG attacks often carried bombs, in order to

⁶³ Red Baron Report, Vol. 3, 128. for an example of the two wheels working together, see 269.

⁶⁴ Red Baron Report, Vol. 3, 16-20.

increase the amount of ordnance a strike could drop on any particular target. However, an F-4 fully loaded with bombs was far less maneuverable due to the higher weight loads. Additionally, strike formations often flew much slower than the high speeds of which the powerful Phantom was capable. These two factors proved severely limiting in the case of a MiG attack. F-4s had to drop their bombs first and then attempt to accelerate to engage the MiG fighters, who often escaped before the Phantoms could engage them effectively.⁶⁵ The USAF thus began to devote resources specifically to the CAP mission. As Momyer explains,

After January 1967 we had to stop giving F-4s the dual mission of carrying bombs as part of the strike force and providing fighter cover if a MiG attack developed. With the increased MiG activity. . . our F-4s couldn't jettison bombs and get in position quickly enough to defeat all of their attacks. . . . We had to protect our strike forces by assigning an increasing proportion as escorts throughout the year.⁶⁶

Additionally, a proportion of F-105 Thunderchiefs, the primary bombing aircraft of the Rolling Thunder missions, began to be assigned to a purely CAP role as well.⁶⁷ Although the single-seat F-105 was primarily a ground attack and interceptor aircraft, it did possess an internal gun and, similar to the F-4, could function as a multi-role fighter/bomber. While it could not perform as well in an air-to-air context as the Phantom, it was nevertheless effective in this CAP role, shooting down fourteen MiGs, more than half as many as their F-4 counterparts claimed. However, these kills were primarily against the older MiG-17s. The MiG-21 vastly outmatched the Thunderchiefs, which suffered significant losses when facing them in combat.⁶⁸

American forces also attempted to form sound tactics to defeat the effective wagon wheel formations. In many respects, these resembled a similar tactic dating back to the First World War known as the “Lufberry circle.” To counter this tactic, American aircrews began employing hit-

⁶⁵ For one example, see Red Baron Report, Vol. 3, 262; see also, Futrell, *Ideas, Concepts, Doctrine*, 291-2.

⁶⁶ Momyer, *Air Power in Three Wars*, 147.

⁶⁷ Michel, *Clashes*, 91-2.

⁶⁸ Red Baron Report, Vol. 3, 16-20; see also, Michel, *Clashes*, 95-9.

and-run attacks, avoiding entering a dogfight by staying to a single high-speed pass to attempt to force a single MiG out of the wheel formation.⁶⁹ The 8th TFW attempted other strategies against the wheel formations, one of which was to split the F-4 element into two groups, with one group first engaging the wheel and attempting to force the entire wheel to climb to a higher altitude, allowing a second group of F-4s to attack from underneath. The NVNAF attempted to counter this by placing their wheels over AAA-defended areas, eliminating the possibility for F-4s to approach from low altitude. American forces then attempted a difficult maneuver, using a group of F-4s to attempt to engage the MiGs and separate them from the wheel while another group of Phantoms approached from another angle and attempted to get behind the MiGs – essentially using the first group of American pilots as bait. These maneuvers relied heavily on group coordination and a large degree of luck, yet they did produce some kills.⁷⁰

Another significant change was the beginning of what became a long process of reevaluating standard USAF fighter formations. Since World War II, the Air Force held their fighters to a formation known as “fluid four,” also called “finger four,” a grouping of four airplanes fairly close together to provide mutual support. This contrasted the Navy's preferred formation of “Loose Deuce,” consisting of two fighters, widely spaced, each which could attack or cover the other as necessary. The fluid four formation worked well in the 1940s and saw extensive use with considerable success in the Korean War. However, the advent of missile technology and the higher performance envelopes of next-generation aircraft such as the Phantom and the Fishbed rendered this formation problematic. In a finger four grouping, the small distance between planes forced wingmen to focus on keeping the formation's integrity rather than watching the sky for enemy planes. While the tighter formation was useful in an age

⁶⁹ Futrell, *Aces and Aerial Victories*, 45. Pilot Randy Cunningham also noted the similarity to the Lufberry circle in M. F. Porter, “Linebacker: Overview of the First 120 Days,” Project CHECO Report, 27 Sept 1973, 47.

⁷⁰ Michel, *Clashes*, 112.

where guns were the only weapons, the use of long-range missiles discounted the support that wingmen could provide. Additionally, fluid four used a “single shooter” policy that exclusively allowed only flight leaders to engage an enemy plane, with wingmen merely providing support. This fostered a sense of elitism that was unpopular with wingmen, who rarely received clearance to fire on MiGs, and it created a sense of tradition that made many USAF fighter pilots reluctant to change these tactics. The fluid four formation became in some ways a matter of pride, and many wing leaders were reluctant to use other formations, such as loose deuce, that originated in naval aviation. The firepower of a fluid four group was also quite small. The “single-shooter” policy meant that a typical USAF fighter group was only using 25 percent of its potential offensive capability. Additionally, MiG fighters noticed that a single plane could effectively cause a group of four USAF fighters to give chase, leaving other MiGs free to attack a strike formation. The USAF was aware of the issues with this formation as early as 1965, yet took no immediate steps to correct the problems.⁷¹

The Air Force did not officially change its approach to fighter formations until 1971, yet some pilots were aware of these issues, and some took steps to remedy the problems.⁷² In some cases, Air Force pilots recognized through trial and error that the loose deuce formation proved more effective for handling MiG attacks, and assumed this formation upon identifying approaching MiGs.⁷³ The Air Force did not institutionalize these changes in any way, but particular fighter wings, often given significant leeway to develop their own tactics, employed them on their own initiative and discretion. For example, after a particularly difficult dogfight in May of 1967, Robin Olds decided to abandon fluid four and change his tactics to feature more

⁷¹ Michel, *Clashes*, 170-2.

⁷² On the official Air Force adoption of “Double Attack,” essentially a copy of the Navy’s “Loose Deuce” formation, see Vincent P. Roy, “Double Attack Revisited” *USAF Fighter Weapons Review* (Spring 1971), 26-32.

⁷³ For one example, see Red Baron Report, Vol. 1, 58.

flexible groups of two planes, telling his pilots, “OK, we don't fight as flights of four any more. We're going [to] fight in coordination as pairs. As a matter of fact we're going to fight as four pairs of a total of eight aircraft and all in coordination.”⁷⁴ These tactics more closely resembled the Navy's loose deuce formation, which proved highly adaptable. While USAF leadership held firm on fluid four as a doctrine, individual wing commanders received leeway to change their tactics to fit the realities of combat as they evolved during the war. The success of these changes is evident in the high kill ratio American forces earned during this period.

Perhaps the most significant response to the dramatic increase in MiG activity during the spring of 1967 was the decision to bomb North Vietnamese airfields. Air war planners had been advocating for the bombing of airfields as a method of establishing air superiority since the beginning of the war. Washington, in response to the increasing MiG threat, approved these requests, and on 23 April 1967, U.S. bombers struck Hoa Lac and Kep airfields, claiming nine destroyed MiGs on the ground and three more probable kills. More strikes followed against the same targets on 28 April, 1 May, and 3 May, claiming twenty more MiGs destroyed, although some of these were unconfirmed.⁷⁵ North Vietnamese forces often transferred their MiGs to Chinese bases to protect them from destruction on the ground or hid the aircraft in nearby shelters while using bamboo mock-ups to deceive U.S. strikes.⁷⁶ In any case, the decision to release North Vietnamese airfields as bombing targets marked a significant shift for U.S. policy makers, demonstrating an increasing commitment to the conflict and an escalation of hostility. However, U.S. leadership did not approve strikes against Phuc Yen, the main fighter base for the NVNAF, until much later in the year in response to major setbacks in the air-to-air war.

⁷⁴ “Interview with Col Robin Olds,” 29.

⁷⁵ Arthur P. Geesey, “Air to Air Engagements in SEA, 1968-72” unpublished CHECO manuscript, 5; Futrell, *Aces and Aerial Victories*, 48.

⁷⁶ Boniface, *MiGs Over North Vietnam*, 56, 118.

Revenge of The MiGs

In August 1967, General Momyer confidently reported to the U.S. Senate that, “We have driven the MiGs out of the sky for all practical purposes.”⁷⁷ This was true at the beginning of August, but the MiGs soon struck back in earnest. During the summer months, the NVNAF had slowed their activity, focusing on developing and perfecting new tactics that took advantage of the capabilities and characteristics of the MiG-21. The main method that emerged was to perform quick hit-and-run attacks at supersonic speeds under strict GCI control, attacking only when controllers were certain the MiG-21 possessed a clear advantage. The attacks were selective, disciplined, and effective. In September alone, MiGs forced forty-seven strike groups to jettison their ordnance before reaching their targets. This was approximately double the number of such interruptions than occurred in any previous month. As one squadron history noted, “The MiG pilots grew more skillful and aggressive overnight.”⁷⁸ American forces attempted to counter these tactics by increasing the number of CAP flights, changing the distance between those flights and the main strike flights, and making improvements to the radar systems, yet none of these improvements truly countered the effect of these hit-and-run offensives. Another key problem was that American intelligence was aware of the MiG’s new tactics, having observed the NVNAF’s training flights, but had not communicated this information. Some squadron commanders, such as Robin Olds, expressed disgust at this lack of communication, claiming that sharing this information could have saved lives.⁷⁹ His sense of betrayal is understandable, but his assertion that losses were preventable is arguable since U.S. forces were unable to counter the new MiG tactics long after they became well known.

⁷⁷ Quoted in Michel, *Clashes*, 118.

⁷⁸ “Squadron History,” 497th TFS, 8th TFW, January-March 1968, 4, quoted in Michel, *Clashes*, 130.

⁷⁹ Futrell, *Aces and Aerial Victories*, 65-66; Michel, *Clashes*, 128-33.

MiG attacks at this time were so effective that they force Washington to reconsider its targeting restrictions. John P. McConnell, then Chief of Staff of the USAF, supported by other Air Force leaders, argued vigorously that MiG attacks represented a massive threat to the bombing campaign and that control of the air was in danger of being lost. On 24 October 1967, President Johnson approved the bombing of Phuc Yen airfield, although he also placed significant restrictions on the timing of the operation and the number of aircraft that could participate in the mission.⁸⁰ Formerly, a strike against Phuc Yen seemed likely to spur Chinese intervention. Targeting the airfield thus revealed a certain amount of frustration among U.S. planners caused by the effective tactics of the NVNAF. The strike claimed to destroy four MiG-21s and as many MiG-17s. These losses were not significant, and the NVNAF continued pressing attacks against American strike flights. Bombing strikes continued against all North Vietnamese airfields with the exception of Gia Lam, which functioned as the country's international airport. However, North Vietnamese forces quickly repaired airfields, sheltered many valuable MiGs in China, and promptly received replacements for lost fighters.⁸¹ With the ability to overcome such attacks rapidly, the NVNAF proved it could cling to life despite heavy opposition from the numerically superior U.S. forces. However, its grip was slipping. From the beginning the war in 1964 until 1968, the North Vietnamese had replaced 90 percent of their aircraft and 80 percent of their pilots. Such heavy turnover was likely unsustainable in the long run.⁸²

The renewed aggression of MiG forces proved successful in disrupting a large number of flights, and showed a marked increase in their air-to-air combat abilities. From the beginning of

⁸⁰ Momyer, *Air Power in Three Wars*, 25-6.

⁸¹ Futrell, *Aces and Aerial Victories*, 67-71.

⁸² Boniface, *MiGs Over North Vietnam*, 67.

August 1967 until the remainder of the year, F-4 Phantoms claimed twelve MiGs shot down while losing nine, very nearly a 1:1 ratio, a shocking drop from the 5:1 rate in spring and summer. North Vietnamese sources claim eleven more F-4s shot down during this period, although these claims remain unconfirmed. In any case, the fall of 1967 represented a sharp downward swing in U.S. air-to-air effectiveness. The USAF experienced the bulk of these kills and losses, with Navy F-4s netting four of those kills for two losses. The statistics also show that the MiG force's main target was the F-105 bombers. The USAF lost eight of these, although the Thunderchiefs did manage to shoot down five MiG-17s.⁸³ The U.S. still maintained a positive kill ratio, although the margin was almost nonexistent. Air superiority was not lost according to technical definition, yet at this point in the war it was truly in contest. F-4 Phantoms proved incapable of defending bombing forces from interruption by the hit-and-run tactics of MiG-21s. This success prompted the NVNAF to further aggression, and the trends seen at the end of the year persisted into 1968.

MiG tactics continued to evolve. In December 1967 and into 1968, the two types of MiGs coordinated their attacks effectively. MiG-21s and 17s often made alternating attack passes against U.S. bombing strikes with precise timing. Often, MiG-17s acted as bait or cover for MiG-21s, which made the bulk of real attacks. At times, 17s attempted to disrupt an American flight formation, allowing 21s to take advantage of the distracted craft. The wagon wheel tactic persisted and proved effective, especially when MiG-17s used it to provide a screen for MiG-21s at vulnerable points. Previously, MiGs had often fled into Chinese airspace quickly after an attack, but from the start of the new year this pattern decreased as confident MiG pilots returned

⁸³ These statistics are from the Air Combat Information Group (www.acig.org). Their data from the first years of the war is verified by the data in the Red Baron Report, Vol. 1. The remainder of the data is likely accurate, as later Red Baron Reports remain classified. For these statistics, see "U.S. Air-to-Air Victories during the Vietnam War, Part 1," http://www.acig.org/artman/publish/article_243.shtml [accessed 11 April, 2013]; and "Vietnamese Air-to-Air Victories, Part 1," http://www.acig.org/artman/publish/article_245.shtml [accessed 11 April 2013].

for second passes.⁸⁴ MiGs extended their threat area further from Hanoi than usual with increased aggression. The number of air combat engagements remained high as both sides traded losses in a nearly one-to-one ratio. In the last three months of 1967, the 8th TFW alone engaged in over 100 dogfights. Aggressive MiG pilots initiated seventy of these. These attacks often came from the six o'clock position, where the F-4 was extremely vulnerable due to the plane's complete lack of rearward visibility. During these battles, an increasing number of MiGs appeared to be operating without CGI control.⁸⁵ While most NVNAF pilots relied on the precise instructions of their GCI controllers, experienced pilots often received freedom to operate independently, which proved successful in many cases.⁸⁶

In early 1968, MiGs continued similar tactics, although the overall number of encounters against Air Force strikes dropped significantly. To counter these tactics, the USAF increased the number of aircraft devoted to MiGCAP and screen actions, literally doubling the CAP forces, and shrinking the size of bombing formations, which proved somewhat effective in deterring MiG attacks. An increase in the use of airborne and ground-based radar systems also improved U.S. fighter effectiveness by providing advance warning of approaching MiGs.⁸⁷ However, while these changes rendered MiGs statistically less deadly to the USAF during the opening of 1968, the NVNAF was accomplishing its objective. They forced the U.S. to shift more resources from bombing operations to MiG protection. Strike formations became smaller and less efficient, which was the true measure of success for the NVNAF.

Amidst this flurry of aggressive MiG activity, in January 1968, the Tet offensive shook the American public and put immense pressure on the Johnson administration. The President and

⁸⁴ Futrell, *Aces and Aerial Victories*, 73-4; Michel *Clashes*, 141-2.

⁸⁵ "History of the 8th Tactical Fighter Wing," 1 October – 31 December 1967, 16, 22-3, 27.

⁸⁶ Boniface, *MiGs Over North Vietnam*, 21.

⁸⁷ "History of the 8th Tactical Fighter Wing," 1 January – 31 March 1968, 34-7; "Squadron History: 433rd Tactical Fighter Squadron," 1 Oct. 67 – 31 Dec. 67, 11.

many Washington policy makers considered that a bombing halt might serve to deescalate hostility and provide a chance for serious negotiations with North Vietnam. However, Air Force leadership, including General William Momyer (then Commander, Seventh air Force) and General John D. Ryan (CINCPACAF) had no faith that a bombing halt would produce any progress towards a settlement but advocated it for an altogether different reason: the approaching monsoon season. As Momyer explained, “I supported the proposal for a bombing halt because I realized that the weather alone would probably cause us to cancel all but a few hundred sorties and because we were not being permitted to strike the most valuable targets in any case.”⁸⁸ Thus, on 31 March 1968, President Johnson announced a halt on the bombing of targets above the 20th parallel. However, bombing, and the air-to-air war that accompanied it, still raged in the southern areas of North Vietnam.

During this time, MiG forces began venturing further south than before, bringing them into greater contact with Navy aircraft. During most of the activity of the previous years, the USAF bore the vast majority of engagements with the NVNAF. While Navy strikes did encounter MiGs, the number of engagements was a small fraction of those seen by the Air Force. After the bombing limitation in spring of 1968, MiGs increasingly engaged Navy fighters as they pushed farther South. However, in this arena, Navy aircraft often had the advantage. Operating far from their bases, North Vietnamese GCI control was limited, if it existed at all. USAF strikes repeatedly bombed attempts to create GCI facilities in the southern regions of the country. Additionally, Navy aircraft possessed their own GCI from naval vessels on the coast, which provided a significant advantage in identifying and tracking MiG movements.⁸⁹

Despite these advantages, Navy fighters did not perform as well as they might have

⁸⁸ Momyer, *Air Power in Three Wars*, 27.

⁸⁹ Michel, *Clashes*, 146-7.

expected, although the number of engagements was so small that it is difficult to determine statistically significant information. From the time of the bombing restriction until 1 November 1968, the Navy lost two F-4s and claimed four MiG-21s shot down. The Navy's F-8 Crusaders claimed four MiGs destroyed for no losses. North Vietnamese sources claim four more unconfirmed kills each of the F-4 and F-8. Interestingly, during this period, the USAF incurred no losses and no kills. Many engagements resulted in stalemate. Looking at the entire period of increased MiG activity from August 1967 until November 1968, all American F-4 Phantoms scored twenty-four kills and thirteen losses, an overall ratio of 1.8:1. Air Force F-4s earned a 2:1 ratio with sixteen kills for eight losses. Navy Phantoms shot down eight MiGs while losing five planes, a ratio of 1.6:1.⁹⁰ In some respects, this shows a drastic decrease in combat effectiveness for both branches compared to all the earlier periods in the war, particularly the successful period in the beginning of 1967. Two important points are clear. First, that the latter portion of this period, particularly after the bombing restriction in March, contained a small number of engagements mostly ending in stalemate, thus a purely statistical interpretation might not truly represent the situation. Secondly, at no point did the NVNAF possess a positive ratio. In this sense, North Vietnam never approached the attainment of true air superiority.

However, attaining superiority was never the goal of the small force of MiG fighters. Their focus instead was the interruption of U.S. bombing formations, in order to force them to drop their ordnance before reaching their targets or otherwise render their strikes less efficient. Because this forced the U.S. to devote an increasing number of resources to CAP missions while shrinking the size of bomber forces, the NVNAF could claim to have succeeded brilliantly in their goals, even when suffering heavy losses. By 1 November 1968, they were so successful that

⁹⁰ "U.S. Air-to-Air Victories during the Vietnam War, Part 1," "Vietnamese Air-to-Air Victories, Part 1."

American air superiority, despite an immense numerical advantage, seemed almost nonexistent. While many analysts point to the poor performance ratios as evidence of this, the true definition of air superiority is whether strike forces are free to attack their targets. By the fall of 1968, they clearly were not.

Under heavy domestic pressure, President Johnson met with the Joint Chiefs and other military leaders, including Momyer, who advocated against further bombing restrictions in spite of such strong negative trends in the air war. However, they admitted that a brief bombing halt could determine whether the North Vietnamese earnestly sought a settlement. Thus, the President announced a cessation of all bombing of North Vietnam on 31 October 1968.⁹¹ From that November until the resumption of bombing activities in 1972, the air-to-air war against MiG fighters virtually ceased.

Conclusion

The quest for air superiority in Vietnam began with many severe problems. The USAF had initially intended to avoid an air-to-air conflict and gain air superiority through bombing North Vietnamese airfields. Politicians blocked this strategy for several years, fearing reprisals from other Communist regimes. When American bombers did finally receive clearance to attack airfields, they did not achieve the results that early planners anticipated. MiGs remained a viable threat to Rolling Thunder strikes. In fact, evidence shows that after the airstrikes against MiG bases, the NVNAF became much more effective, given their small size. However, the bombing of airfields did not directly cause this increase in effectiveness, but neither did these bombings have any ramification on the balance of air superiority in Southeast Asia, despite destroying

⁹¹ Momyer, *Airpower in Three Wars*, 28-9.

several aircraft. The NVNAF kept their fighter force viable by sheltering MiGs in Chinese air bases, using decoys, and replenishing losses with MiGs from supporting Communist states. North Vietnamese air strategy did not necessitate a large number of aircraft, and a reduction of their forces, while likely unsustainable in the long run, did not change the situation in the short term. Thus, the only option for U.S. forces was to face the MiGs directly in air-to-air combat.

Unfortunately, the intended role for the aircraft used by both the USAF and Navy was not such combat. The F-4 Phantom's design focused on the interception of bombers presumably attacking from the Soviet Union in a large conventional conflict. War planners assumed that traditional air superiority fighters were irrelevant to this type of conflict, and designed their aircraft accordingly. The Air Force, influencing the Navy, assumed that if America could handle this hypothetical large-scale conventional war, it could handle a smaller war by default.⁹² However, these assumptions neglected the fact that not only could the size of the conflict be different, but the type. North Vietnam did not follow the predicted model of conventional war with a large industrial power. The NVNAF, with such a vastly outnumbered force of MiG fighters, did not attempt to wrest air superiority from U.S. forces, but instead pursued guerrilla-like tactics that focused on harassment and interruption while avoiding direct combat when possible.

In the first three years of the war, the NVNAF suffered sound defeat when facing American planes in direct combat, as seen in Operation Bolo and in the overall kill statistics and ratios. However, the MiGs proved largely successful in stopping many bombing raids, or simply rendering U.S. strikes less effective by forcing the USAF to devote more resources to CAP missions at the expense of bombing capacity. The NVNAF refined these tactics over the course

⁹² Earl H. Tilford, *Crosswinds: The Air Force's Setup in Vietnam* (College Station: Texas A&M University Press, 1993), 24.

the Rolling Thunder period, employing defensive wagon wheel formations combined with hit-and-run tactics that took advantage of the specific performance envelopes of their aircraft. By the time of the bombing halt in November 1968, the U.S. had not developed effective countermeasures to these tactics, causing a drastic upswing in the number of interrupted bombing sorties and severely limiting the efficacy of ground strikes.

American successes in air-to-air combat saw a sharp decline at this time, demonstrating their struggle to overcome the MiG's refined tactics. After earning a 5:1 kill ratio against MiGs early in 1967, USAF F-4s suddenly dropped to a 2:1 rate by the time of the bombing halt, with the Navy performing even worse. The overall MiG threat also increased relative to other North Vietnamese defenses. SAMs and AAA were still the largest threats to U.S. aircraft. In 1965, MiGs had been responsible for only 1 percent of aircraft losses. By the end of March 1968, they claimed 22 percent of all downed U.S. aircraft.⁹³

Judging the nature of American success or failure in the air war requires a sense of nuance, and differing interpretations arose even at the time. In a statistical sense, the U.S. never lost air superiority, and when viewed from the reverse perspective, the NVNAF never came close to achieving it, as they still lost two MiGs for every F-4 shot down. Through this lens, we can view the Air Force as successful in the air-to-air war despite the downturn, and some USAF leaders viewed the situation in just this light. If air superiority is the ability to bomb targets at discretion, then the U.S. had not lost superiority by a strict technical definition. Nevertheless, its cost was much higher than many were comfortable with. Some planners and pilots found this cost unacceptable, pointing to the declining combat statistics and the decreasing efficiency of bombing strikes. Those espousing this critical view lobbied for changes to USAF technology,

⁹³ Geesey, "Air-to-Air Engagements in SEA," 6.

policies, and tactics. The period from 1968 until 1972, when air-to-air combat resumed, thus became a period of reflection and change for both the Air Force and Navy as they attempted to remedy the situation through a variety of changes to technology and policy. The Linebacker campaigns put these changes to the test in 1972, when F-4s again faced MiGs in aerial combat.

CHAPTER 4

HALFTIME: REEVALUATING TRAINING AND TECHNOLOGY

American forces during the opening two years of the Vietnam War experienced massive success against North Vietnamese MiG fighters. Through numerical superiority and sound tactics, Air Force and Navy pilots achieved unquestionable air superiority. In the last months of 1967 that changed. The North Vietnamese Air Force (NVNAF) adopted highly effective hit-and-run tactics and wheel formations that frustrated American aircrews. Kill ratios dropped from over 5:1 in favor of the United States to a brutal stalemate, trading F-4 Phantoms and MiGs nearly one for one. More importantly, the efficiency of Rolling Thunder bombing strikes steadily dropped as MiGs frequently interrupted formations and prevented them from attacking their targets. The formations themselves shrank as more and more resources shifted to the role of protection from the growing MiG threat. The small, third world country of Vietnam contested American air superiority in a way not experienced in World War II or Korea.

During the halt of bombing against North Vietnamese targets that lasted from late 1968 until 1972, the Air Force and Navy turned inward and reevaluated their approach, seeking to reverse the situation. The issues of pilot training and technological modifications to both aircraft and weapons became the focus of intense debate as both branches reconsidered their previous doctrine that de-emphasized the air superiority mission. The Air Force did not view its performance problem during Rolling Thunder as drastic, nor as one that could be improved by changes to training procedures. Thus, it emphasized technological improvements to give pilots an edge in air-to-air combat. For the Navy, Rolling Thunder was a crisis demanding action. With a heavy influence from a proud community of F-8 fighter pilots, the Navy emphasized changes to its training practices, primarily by forming the Navy Fighter Weapons School, later known as

“Top Gun.” This school’s mission was to train pilots in advanced air combat maneuvers against planes that simulated the enemy MiGs. In his 1984 memoir, Navy fighter ace and Top Gun trainee Randy Cunningham boldly stated, “My training is the reason I’m alive today.”¹ Effective training can often make the difference between success and failure in a mission, and in the case of aerial combat, the difference between life and death. The Air Force, while often maligned for its lack of foresight in changing its training practices and its over-reliance on technology, simply sought to protect the lives of aircrews and create effective weapons systems.

Not a Fighter Pilot Among Them: Training in the Air Force

The early insistence on multi-role functionality in aircraft design influenced pilot training practices. In the Navy, as well as most air forces of other nations, pilot trainees usually followed divergent various training tracks depending on their specialization. The best performing pilots often focused on fighter and attack aircraft² while others trained specifically for large multi-engine planes such as bombers, fuel tankers, or transport crafts. However, the USAF eschewed this approach. As historian Marshall Michel notes,

This idea of splitting pilots by flying skill in pilot training was anathema to the bomber-dominated Air Force, because . . . the Air Force refused to accept the idea that fighter pilots were more skillful than bomber pilots. The result was an Air Force personnel policy that said that any pilot who graduated from pilot training was a 'universal pilot' who could be trained to fly any type of aircraft.³

This policy conceivably granted USAF pilots greater versatility in several roles, at the expense of true expertise. These “universal pilots,” like the F-4 itself, were jacks-of-all-trades, yet masters

¹ Randy Cunningham, *Fox Two: The Story of America's First Ace in Vietnam* (Mesa, Arizona: Champlin Fighter Museum, 1984), 96.

² Aircraft are created with several designations to indicate their primary role. “Fighter” refers to primarily air-to-air combat, while “attack” generally means the attacking of ground targets, usually for supply interdiction or Combat Air Support (CAS, supporting ground troops), either through bombing or strafing.

³ Marshall Michel III, “The Revolt of the Majors: How the Air Force Changed After Vietnam” (PhD Diss., Auburn University, 2006), 58-9.

of none.

Training was often the victim of cuts and pressures due to manpower shortages. In 1965, pressure to produce students at a quicker rate led to considerable reductions in pilot training. New “universal pilots” had only 240 hours spread over four and a half months to progress from flying a Cessna to a T-38, an aircraft that supposedly “closely duplicate the handling and control characteristics of most modern, high performance, jet aircraft.”⁴ The accuracy of this duplication seems dubious given the variety and complexity of contemporary aircraft. Qualified instructors were also in short supply. The Air Force reassigned many of the few quality teachers to service in Southeast Asia just as training requirements increased. By 1968, enough pilot instructors filled these positions although other key roles such as navigation and electronic warfare instructors still dragged behind.⁵

Air Force personnel policies contributed to an emphasis on breadth rather than depth of new pilots. A “tour” in Vietnam meant flying either for one year over South Vietnam, or for one hundred missions over the more dangerous North Vietnam, which usually took approximately six months. The USAF instituted a rule barring an aircrew from flying a second tour (non-voluntarily) until every pilot had flown his first tour. This effectively meant the replacement, every six-to-twelve months, of every single aircrew. This immense need for manpower increased pressure to create “universal pilots” and induced a reduction in training time and quality. The USAF did not require its pilots to meet any specific skill levels, and often lowered its training standards as personnel needs mounted. Recent graduates, who in earlier times would likely have

⁴ Graham P. Crow, “Toward Better Flying Training” in *USAF Instructor's Journal* (Summer 1968), 31. A Cessna is a small, single engine propeller plane which serves as an entry point for many private pilots.

⁵ Thomas A. Manning, *History of Air Training Command, 1943-1993* (Randolph Air Force Base, Office of History and Research, Headquarters, Air Education and Training Command, 1993), 164, 175.

failed out of their training courses, increasingly replaced experienced pilots.⁶

These policies also led to the reassignment of former bomber and transport pilots to fighters, where they often experienced difficulty adapting. Their experience favored a “by the book” approach, contrasting the flexibility and quick reflexes necessary in air combat. The controls and flight characteristics of their new fighters were drastically different from the bombers to which they were accustomed.⁷ Air Force pilots also lacked consistent partners – they usually flew with a different man in the back seat (sometimes called RIO for “radio intercept officer,” WSO for “weapons system operator” or simply GIB for “guy in back”), making it difficult to maintain the synergistic relationship required of a successful aircrew.⁸ Thus, many pilots beginning fresh tours arrived at their wings with little to no background in F-4s or in fighter aircraft in general. Ace pilot Robin Olds, commander of the 8th Tactical Fighter Wing (TFW) recalled meeting many of these new trainees:

I had learned to doubt the thoroughness of the combat training given to pilots being sent to SEA [Southeast Asia]. . . . Practically no one sent over had ever dropped real bombs, had made a max weight takeoff, or had fired his guns on an air target. The first time most of the replacement pilots ever saw a fighter loaded with live ordinance was when they arrived in Thailand. They hadn't a clue what they were looking at. . . I looked at them and said, 'Dear God, don't tell me there isn't a fighter pilot among you! . . . This is the big league and you guys are not qualified. Goddamn it, why don't they send me some fighter pilots?'⁹

To familiarize these men with their new planes, the Air Force used a system of Replacement Training Units (RTUs). While the first few classes of RTUs saw pilots with some background in other fighters, by 1966, nearly all new pilots came from bombers or transports, with no previous fighter experience. The multi-role design of the Phantom required that these

⁶ Marshall Michel III, *Clashes: Air Combat Over North Vietnam, 1965-1972* (Annapolis, Naval Institute Press, 1997), 163.

⁷ Michel, “Revolt of the Majors,” 63-4.

⁸ Hannah, *Striving for Air Superiority*, 96.

⁹ Robin Olds, *Fighter Pilot: The Memoirs of Legendary Ace Robin Olds* (New York: St. Martin's Press, 2010), 291-2.

pilots receive education in a wide range of roles, yet the limited time and pressure from manpower shortages caused these classes to focus on basic skills such as air refueling, formation flying, dive bombing, and only a token amount of basic air combat maneuvering (ACM). Despite the quality of new pilots dropping to “an alarming point,” standards continued to decline in an effort to fill more cockpits. As one evaluator noted, “mass production [took] precedence over training to expertness.”¹⁰

In the years prior to Vietnam, the Air Force had consistently moved away from air-to-air combat training. According to General Bruce Holloway, “Between 1954 and 1962, the USAF training curriculum for fighter pilots included little, if any, air-to-air combat. . . . As late as October 1963, it was reported that only four of thirty pilots in one fighter squadron had ever shot aerial gunnery.”¹¹ The reason for this neglect was the focus on using fighters for delivery of nuclear weapons and defense against enemy bombers as opposed to air combat. While bomber interceptions are technically “air-to-air” engagements, the parameters of such an attack do not conform to the traditional meaning of that role. To excel in interception required speed at the expense of maneuverability, the strength most needed to succeed in traditional air-to-air combat. The focus on interception caused the Air Force to neglect the type of air combat necessary against MiG fighters, as it relied on the use of long-range missiles against lumbering bombers, rather than the close, fast-turning dogfight environment often decided by guns.¹² As a result, the USAF abandoned training for complex maneuvering and air gunnery.

Air Force planners assumed that strikes against enemy airfields could destroy the

¹⁰ Michel, *Clashes*, 163-5; quoting Lt. Col. J.T. Miller, USAF, “Analysis of Aircrew Personnel Flying Out of Country Interdiction Missions,” April 1968, 76, 46. See also, Tilford, *Crosswinds*, 137.

¹¹ Bruce K. Holloway, “Air Superiority in Tactical Air Warfare,” *Air University Review* 19, no. 3 (March-April 1968), 8-9.

¹² Matthew P. Donovan, “Full Circle? The Transformation of Dedicated Adversary Air Training in the USAF” (Thesis, School of Advanced Airpower Studies, Air University, 1998), 8.

majority of enemy fighters. Thus, maintaining air superiority no longer required air-to-air fighters. Historian Robert Futrell indicated the result of these assumptions on training practices, stating, “Where training in air combat tactics had been stressed during the Korean War, the Air Force went away from such training in the 1950s.”¹³ The only remaining vestige of air-to-air combat in the USAF was a three-week course taught at Nellis Air Force Base's Fighter Weapons School (FWS).¹⁴ The course was optional, and although the focus of the instruction was on ACM, instructors placed tight restrictions on the maneuvers and engagements, limiting the school's effectiveness.¹⁵

Air combat training was notably absent from F-4 training programs. In 1952, F-86 Sabre pilots in the Korean War flew a minimum of forty-five air-to-air combat training flights. In 1965, F-4 pilots received ten.¹⁶ In 1966, the number dropped to nine. Simply noting the number of sorties is misleading, however. The F-4's complexity and multi-role capability required training in many subjects, and the 1966 syllabus does reveal that air combat received more training flights than any other area. The only area that received even close to this amount of in-flight training was “Ground Attack.” In their air combat training flights, upcoming pilots practiced various ACM techniques such as barrel rolls, rolling scissors, yo-yo attacks, and the various countermeasures for these techniques.¹⁷ While these maneuvers form the backbone of dogfighting, pilots had just over one hour to practice them – hardly adequate to develop the

¹³ Robert F. Futrell, *Ideas, Concepts, Doctrine: Vol. 2: Basic Thinking in the United States Air Force, 1961-1984* (Maxwell Air Force Base, Air University Press, 1989), 287-8.

¹⁴ Robert K. Wilcox, *Scream of Eagles: The Dramatic Account of the U.S. Navy's Top Gun Fighter Pilots and How They Took Back the Skies Over Vietnam* (New York: Pocket Star Books, 1990), 82.

¹⁵ *Ibid.*, 75.

¹⁶ Hannah, *Striving for Air Superiority*, 93-4.

¹⁷ For details on these maneuvers and how they are implemented in combat, see Robert L. Shaw, *Fighter Combat: Tactics and Maneuvering* (Annapolis: Naval Institute Press, 1985).

familiarity and instinctive ability to use these maneuvers.¹⁸

The academic section of the course consisted of twenty hours of Air Combat Tactics, compared to the thirty-one hours devoted to ground attack. The textbook for this course explained common combat maneuvers and their countermeasures. The course also spent considerable amount of time detailing the flight characteristics of the F-4, yet contained no such information about the enemy MiG fighters or their tactics.¹⁹ Thus, USAF F-4 pilots received somewhat of a focus on air combat training relative to other subjects, but the burden of fulfilling many roles led to a lack of specialization. The amount of air combat training was clearly inadequate, especially compared to pilots of previous wars.

Airline Captains, Not Fighter Pilots: Training in the Navy

The United States Navy structured its aircrews differently than the USAF, creating a unique set of advantages and flaws. The Navy placed no restrictions on the number of tours pilots could fly and largely eschewed a “universal pilot” model. Instruction split into a “two-track” system whereby pilots chose to focus on either fighter planes or non-fighter craft.²⁰ As a result, most new Navy Phantom pilots from 1961 through 1965 had a background in similar fighter and attack planes. Navy aircrews often stayed together, ensuring that pilots usually flew with the same RIO in the back seat, making it easier to build and maintain an effective relationship.²¹

The Navy could not follow the Air Force's practice of lowering training standards. All

¹⁸ “USAF Replacement Training Course: F-4C,” TAC Syllabus Course 111509F-RTU, September 1966, 2, 11-15; see also, John R. Gilchrist and Thomas S. Dewberry, “Forging F-4 Combat Crews” in *USAF Instructor's Journal* (Summer 1967), 68.

¹⁹ “Air Combat Tactics, Tactical Doctrine, and FAC Procedures,” 4453rd CCTW RTU Weapons School Course No. 111509F.

²⁰ Michel, *Clashes*, 168.

²¹ Hannah, *Striving for Air Superiority*, 96.

naval pilots had to be capable of landing on carriers, typically considered the most difficult task a pilot can perform. This inflexible requirement forced the Navy to adopt fixed standards for new trainees. The difficulty of these standards necessitated that the training process for naval aviators was six months longer than for their USAF counterparts.²²

In some respects, an average Navy F-4 pilot was better trained, more experienced, and more skilled than an average Air Force pilot. However, the Navy produced pilots at a much slower rate, creating a severe manpower shortage. Because there was no ceiling on the number of missions they could fly, losses of Navy pilots were proportionally higher. This created increased pressures on the surviving pilots and caused a drain on morale that grew over the course of the war. Additionally, while the “two-track” system allowed for more specialization than in the USAF, it was still fairly generic.²³

Training practices in both branches neglected air combat, although the Navy was less extreme than the SAC dominated Air Force. As Navy pilot Mike Shaw bluntly stated, “F-4B pilots tended to be trained like airline captains, rather than combat pilots.”²⁴ The defense of Navy vessels still necessitated fighter planes and pilots that could defend against enemy fighters and attack aircraft, yet the primary method for achieving this goal became interception – the same type of interception emphasized in the Air Force, consisting of high altitude, high speed, head-on attacks using long range missiles. F-4 pilot Mel Holmes described, “In the fleet, [the training program] was all intercept. Protect the carrier. Long-range missiles. That sort of thing. There was little air-to-air maneuvering.”²⁵ As part of this policy, and a symbol of the changing doctrine, in 1960 the Navy closed its Fleet Air Gunnery Unit (FAGU), sometimes referred to as

²² Michel, *Clashes*, 168.

²³ *Ibid*, 168.

²⁴ Davies, *USN F-4 Phantom II*, 45.

²⁵ Wilcox, *Scream of Eagles*, 10.

“dogfighting-bombing school.”²⁶ Through the combination of doctrine and the development of new technologies such as long-range missiles and radar tracking, the Navy and the Air Force, had decided to abandon ACM training for fighter pilots.²⁷

The only possibility for a Navy pilot to receive air combat training was an exchange program with the Air Force FWS. Outside of this limited, three-week program of questionable relevance, trainees received little to no air-to-air training. As historian Robert Wilcox has noted, as early as 1963, “a would-be F-4 fleet pilot was lucky to get two ACM hops [training flights] in the intercept-dominated syllabus. . . . Few knew what they were doing, and those who did got little out of it.” One trainee described these brief flights by saying, “They were a blur, and the big thing was not to crash into each other.”²⁸ Many did not receive even this scant amount of ACM training. Navy training procedures gave most new F-4 crews just two “familiarization” flights and ten brief sorties against target drones, not against other fighters. Revealing the focus of attention, these new pilots then endured “extensive ground attack indoctrination” followed by one hundred sorties teaching interception, the use of long-range missiles, cross country navigation, and “general airmanship.”²⁹ Although such training flights likely increased an aircrew's general familiarity with the Phantom, they left pilots unprepared for air-to-air threats. While some localization of training syllabi for Navy F-4 pilots took place, the basic course as outlined in the F-4 manual made few references to ACM. Out of forty-seven training lectures, seventeen dealt with interception while only one was devoted to “fighter vs fighter combat maneuvering.” Out of the twenty-one “phases” of flight training, only one, labeled “Aerobatics,”

²⁶ Davies, *USN F-4 Phantom II*, 4; Wilcox, *Scream of Eagles*, 10.

²⁷ Wilcox, *Scream of Eagles*, 14; Davies, *USN Phantom II*, 43.

²⁸ Wilcox, *Scream of Eagles*, 82, 80.

²⁹ Davies, *USN F-4 Phantom II*, 44.

even approached the concept of ACM.³⁰ Many pilots felt this lack of preparation, such as Steve Smith, a backseater in Navy F-4s, who recalled, “We really didn't have any tactics. I knew if we got involved with MiGs it might be a hairy situation, and what we had to do is be prepared to get our shots and get out. We could not fight with them. We were not prepared to fight with them.”³¹

The Navy did not completely abandon the role of air-to-air fighting. Traditional dogfighting survived through the F-8 Crusader. Its design rendered it, as one historian has noted, “an uncompromising air superiority fighter.”³² Referring to themselves as “the last of the gunfighters,” F-8 pilots were highly trained in ACM and air combat tactics, with a reputation of pride spilling into arrogance of their aircraft, which they believed was “the best in the world in air-to-air combat.”³³ Training for F-8 pilots emphasized ACM, mostly because their planes excelled in maneuverability and carried guns. While many Phantom pilots often complained of training shortcomings in post-tour interviews, not one Crusader pilot expressed a need for more air-to-air combat training.³⁴ However, the F-8 was an older craft, and growing stress on the aging airframes led to its gradual removal from combat duty. Phantoms increasingly replaced the Crusader in the air superiority role as the war continued.³⁵

Mirror Images and the “Fly Safe” Culture

The little air-to-air combat training that new F-4 pilots did receive was of limited value because neither the Air Force nor the Navy pursued what became known as “dissimilar air combat training” (DACT). F-4s flew in mock combat against planes with similar flight

³⁰ *F-4 Phantom II Pilot's Flight Operating Instructions* (Periscope Film, 2007, originally published by McDonnell Aircraft and the U.S. Navy, 1971), 2-1 – 2-3.

³¹ Wilcox, *Scream of Eagles*, 39.

³² Michel, *Clashes*, 11.

³³ *Ibid*; Wilcox, *Scream of Eagles*, 47.

³⁴ Michel, *Clashes*, 161.

³⁵ Cunningham, *Fox Two*, 134.

characteristics – usually other Phantoms – not against “dissimilar” planes that simulated MiGs. Unlike the Soviet fighters, the F-4 was much less agile and suffered from a thick engine exhaust that revealed its location.³⁶ Fighter ace Frederick C. Blesse recalls, “The MiG-17s and MiG-21s were light, relatively short-range aircraft which could turn far better than our heavy F-4.”³⁷

U.S. ACM training was a token effort at best. The *USAF Instructor's Journal* in 1967 described how air-to-air training flights began against non-maneuvering targets before a flight of F-4s split into designated “attacker” and “defender” groups and flew against each other. In the classroom, “the performance capabilities of the F-4 and MiG are compared, so that each crewman knows all the ways his aircraft can outmaneuver the MiG.”³⁸ Regardless of these claims, this training did not accurately mimic MiG fighters. Training against identical aircraft was problematic mostly because it created an expectation that fighters of the North Vietnamese Air Force (NVNAF) would act and react exactly as U.S. planes did, creating what one historian has termed “a parochial, 'mirror-imaging' mindset.”³⁹ These pilots did not discover the errors of these assumptions until their lives were at stake in battle.

The main reason for Air Force reluctance to include DACT was the view that such training was highly dangerous. During the 1960s as a whole, the Air Force placed an emphasis on safety that historian Marshall Michel labeled the “fly safe” culture.⁴⁰ Pilot fatalities during air combat training were rare but did occur. For example, in 1961, a training accident at the Nellis FWS claimed the life of one of the participants, which caused the cancellation of the remainder

³⁶ Michel, *Clashes*, 184. See also Hannah, *Striving for Air Superiority*, 90.

³⁷ Frederick C. Blesse, “Check Six,” *A Fighter Pilot Looks Back* (New York: Ivy Books, 1987), 149.

³⁸ Gilchrist and Dewberry, “Forging F-4 Combat Crews,” 71.

³⁹ Donovan, “Full Circle,” 9.

⁴⁰ Michel, “Revolt of the Majors,” 103.

of any ACM training for that year.⁴¹ The Navy also experienced accidents, such as a mid-air collision in 1967 during an air combat training flight that claimed the life of two upcoming pilots.⁴² Not all accidents were lethal, such as an incident in 1969 when Navy pilot Dan Pedersen experienced a technical failure during an intercept training flight. Both he and his RIO ejected to safety.⁴³ A similar incident occurred in May 1966, when a Navy F-4 stalled during a familiarization flight, forcing the pilot to eject while losing the plane.⁴⁴

Training accidents were uncommon, deaths during training even more so, and the USAF was determined to keep it that way. Air Force generals felt that the Phantom's design rendered it unsuitable for ACM, and were concerned that such training in the F-4 created further risk of accidents. This perceived danger was a very pressing concern for the USAF, which evaluated its RTU commanders not by how their students performed in the theater but purely by the number of students they graduated and the number of accidents in their unit. Instructors thus had incentive to limit ACM training or remove it completely. While the dangers of such training cannot be completely overlooked, historian Marshall Michel has noted the irony in this stance, stating, "The Air Force during this period was obsessed with flying safety; one of its official slogans was, 'Flying safety is paramount to the completion of the mission' – even if that mission was training to go into real combat."⁴⁵

The Navy, however, had a slightly different view of the safety issue. It was less reluctant to employ ACM training than the USAF partly because the dangers seemed relatively smaller. The Navy considered regular occurrences such as nighttime carrier landings far more dangerous

⁴¹ Hannah, *Striving for Air Superiority*, 94.

⁴² Wilcox, *Scream of Eagles*, 75, 83-9.

⁴³ *Ibid*, 178-81.

⁴⁴ "Aircraft Accident Report", U.S. Navy, 6 May 1966, reproduced in "F-4 Phantom II San Diego, California," <http://www.ub88.org/researchprojects/f4phantom/f-4-phantom.html> [accessed 2 May 2013].

⁴⁵ Michel, *Clashes*, 165.

than air combat training.⁴⁶ As journalist Zalin Grant described, “Landing on a carrier was tricky under the best of conditions. . . . At night landing could be positively testicle-shrinking.”⁴⁷ This openness towards ACM training grew throughout the war, as exemplified in the report of the lethal training accident in 1967 by Navy Captain S. W. Vejtasa, Commander, Air Fleet Miramar, which stated,

The aircraft accident described in this investigation . . . is of course most regrettable. In considering this particular air combat maneuver, thoughtful consideration was given relative to its value in the training syllabus because of the high potential danger it presents. The training of replacement pilots in air-to-air tactics is a necessity, albeit the high risk of mishap, and such training must continue.⁴⁸

Some voices in the Air Force echoed this mentality, expressing a need for more focus on air superiority. Major General Arthur C. Agan, in a 1965 study entitled “Air Force Doctrine on Air Superiority,” stated, “We must provide aircraft, armament, and training which will succeed in air-to-air combat against the best enemy aircraft. . . . Depending on what we actually achieve, we must adapt tactics to fight best against a given enemy.”⁴⁹ War planners such as Defense Secretary Robert McNamara continued to emphasize ground attack and CAS, ignoring Agan’s ideas.⁵⁰ As early as 1955, Frederick Blesse lamented that, “Pilots can never get enough air-to-air training, and what they do get needs to be maneuvering against other aircraft.” When he expressed these ideas to his superiors, he “never got much of a reaction.”⁵¹

Air Force policy makers worried about the Phantom's technical problems. The F-4 suffered from "departure," also called "adverse yaw." When engaging in difficult maneuvers such as tight turns at certain angles of attack, the plane tended to lose control – potentially fatal,

⁴⁶ Michel, “Revolt of the Majors,” 104.

⁴⁷ Zalin Grant, *Over the Beach: The Air War in Vietnam* (New York: Pocket Books, 1986), 160.

⁴⁸ Quoted in Wilcox, *Scream of Eagles*, 89.

⁴⁹ Quoted in Futrell, *Ideas, Concepts, Doctrine*, 471.

⁵⁰ Ibid.

⁵¹ Blesse, *Check Six*, 117.

even in a training environment. To prevent losses, the Air Force placed strict limits on angles of attack, altitude, airspeed, and G-forces during training flights, essentially forbidding F-4s from practicing under the conditions that characterized a dogfight. As one historian has noted, instructors often limited new pilots to flying “gentle circles around the base flagpole” before entering combat.⁵² Undoubtedly, these practices decreased the possibility of training accidents, yet they also sent pilots into the skies of Vietnam woefully unprepared.

The Air Force often receives criticism for its obsession with safety, especially when compared with the much higher risks and losses among aircrews in World War II. However, that war was of a decidedly different character than Vietnam, where the Air Force sought to exercise tighter control on the level of sacrifice among its men.⁵³ It is plausible that striving to protect lives in the training cycle resulted in higher losses of unprepared pilots in actual combat, yet attempting to calculate the veracity of that claim is nearly impossible and quite subjective.

Know Your Enemy

Some planners in both the Navy and Air Force sought to correct the lack of DACT and end the “mirror imaging” mindset. Such training relies on accurate knowledge of enemy aircraft to simulate their flight characteristics and tactics accurately. Despite a general lack of willingness for DACT with new pilots, both the Navy and Air Force zealously sought information on MiG fighters, mainly through three programs: “Feather Duster,” “Have Drill,” and “Have Doughnut.”

The existence of the USAF Project Feather Duster and its relatively early date (summer of 1965 and 1966) indicates that at least some Air Force planners sought to strengthen the air

⁵² Hannah, *Striving for Air Superiority*, 95-6.

⁵³ Wayne Thompson, *To Hanoi and Back : the United States Air Force and North Vietnam, 1966-1973* (Washington D.C., Smithsonian Institution Press, 2000), 288.

superiority role. The project report states this directly, noting, “The enemy has the capability to meet us in the air at any time under conditions of his choosing. To meet this threat it is imperative that we analyze the enemy capability and develop tactics which will favor our aircraft and armament systems over his.”⁵⁴ The Air Force conducted two studies using F-86 Sabres – which had nearly identical characteristics to the older MiG-15 – to simulate the MiG-17 and MiG-21 in air-to-air combat against several USAF planes at various altitudes with both planes taking offensive and defensive roles. These tests made little effort to simulate enemy tactics, as both sides used American fighter doctrine.⁵⁵ The accuracy of the simulation was questionable, as the F-86 was inferior to the newer generation of Soviet fighters. However, these aging planes were the best tools the Air Force had available.

The most important conclusion of Feather Duster was that, “The MIG-15/17/21 will all out-perform any of our fighters at Mach numbers below .9 at any altitude.” The study emphatically advised against engaging in dogfights: “Above all, do not enter into a shin-kicking, G-pulling contest with a MIG. He has more G's available to him at the lower Mach numbers (below .85) and any turns will cost you speed, forcing the battle to be fought in his advantage envelope.” The tests also emphasized the importance of early detection, determining that success often depended on seeing the enemy before he attacked.⁵⁶ If a pilot was unaware of an enemy's location before a battle began, as was often the case, then the use of advanced ACM would be useless. This raises the question of whether increased ACM training would actually have prevented U.S. losses. In any case, the project revealed that training and maneuver cannot compensate for a lack of situational awareness. The USAF disseminated the revelations of

⁵⁴ PACAF Tactics and Techniques Bulletin: Counter-Air Tactics Bulletin #45, 26 July 1966, 1.

⁵⁵ Ibid.

⁵⁶ Ibid, 5.

Project Feather Duster to the fighter units in the theater for modification of their tactics.⁵⁷ Yet, the Air Force clearly did not intend these tests to modify its training practices to any degree, as ACM flight training continued to decline and DACT remained forbidden.

Later in 1966, a Syrian pilot defected to Israel in a MiG-17 and made his plane available for U.S. testing in Project “Have Drill.” This test confirmed many of the conclusions of Feather Duster. At slower speeds, the surprisingly durable MiG-17 out-turned American planes and had excellent visibility. While its performance was excellent at a slower speed engagement, the plane had problems at higher speeds, where it could not turn as effectively and harsh buffeting rendered its gunsight ineffective.⁵⁸ Again, this information did not cause changes to institutionalized training procedures.

On 16 August 1966, another defector to Israel, an Iraqi Air Force captain, delivered a MiG-21. After Israel conducted its own tests on the plane, it arrived at Area 51 for a series of evaluations code named “Have Doughnut.”⁵⁹ In over 100 sorties, the MiG flew against all major U.S. aircraft, including the four main models of the F-4 Phantom, with the purpose of “Defining optimum air combat maneuvers (ACM) to be employed by US tactical aircraft in defensive or offensive situations to defeat the FISHBED E.”⁶⁰ The MiG did outperform the American planes, but only in medium and high altitudes. F-4s proved superior at low altitude and high speeds – by maneuvering vertically, the Phantom could maintain its advantage. The Soviet plane also had significantly limited visibility, especially to the rear.⁶¹

⁵⁷ History of the 479th Tactical Fighter Wing, Twelfth Air Force Tactical Air Command, 1 July – 31 December 1965, 13.

⁵⁸ Michel, *Clashes*, 75-7.

⁵⁹ John Lowery, “Have Doughnut,” *Air Force Magazine* (June 2010), 64-5.

⁶⁰ “Have Doughnut: Volume II (U), Tactical,” Defense Intelligence Agency, FTD-CR-20-13-69-INT Vol. II, 1 August 1969, 1-7.

⁶¹ “Have Doughnut,” 1-15, 16, 24.

After the Air Force completed its tests, the Navy conducted its own investigation of the MiG. It found many of the same results, demonstrating that “The F-4 and F-8 series airplanes have a tactical disadvantage in the ACM environment because of their large size and prominent smoke trails.”⁶² The Navy emphasized the need to maintain visual contact, attack in groups, and avoid one-on-one engagements with the Soviet fighters. Unlike the Air Force, the Navy concluded improvements in air-to-air training were necessary, including DACT. The project recommended that “ACM be practiced under controlled conditions against small airplanes with low wing loading, e.g., A-4F, F-5 [which accurately simulated MiG-21 characteristics],” and “Whenever possible, radar intercept and air combat training be conducted over land.” Additionally, the project recommended, “Squadron level training of RIO's/BN's be intensified in the area of air combat tactics,” and “ACM training of attack aircrews be intensified.”⁶³ USAF reports contained no such conclusions, but instead suffered from confirmation bias. As the report states, one of the USAF's goals was “Validating recommended ACM prescribed in current tactical manuals and publications.”⁶⁴ The Air Force was less interested in changing its doctrine or practices than in justifying its existing attitudes.

Have Doughnut was the beginning of a longer process of change, yet it had little immediate effect on training. As former pilot Gaillard Peck recalls, Have Doughnut revealed,

Lessons learned that could save you. . . . This exploitation and use of captured or borrowed MiGs was a great start to the training of our pilots. However, only a handful of pilots got to fight against the MiGs, and even fewer got to fly them. Thus, while a great event, it was not satisfying from a training standpoint.⁶⁵

⁶² "Have Doughnut," 2-62.

⁶³ Ibid, 2-63-4.

⁶⁴ Ibid, 1-7.

⁶⁵ Gaillard Peck, *America's Secret MiG Squadron: The Red Eagles of Project Constant Peg* (Long Island City, Osprey, 2012), 32.

A Time of Reflection

In the fall of 1968, President Johnson halted bombing operations on North Vietnam, ending the Rolling Thunder campaign. While air efforts continued in the South, and minor engagements still took place, the war against MiG fighters ceased until bombing resumed in the Linebacker campaigns four years later.⁶⁶ The Air Force and the Navy both used this calm period to evaluate their performance. American fighters experienced success for most of the Rolling Thunder period, but from October 1967 to March 1968, US planes claimed twenty-seven MiG kills while losing twenty-four planes for a ratio of 1.125:1. The U.S. record was worse when looking only at engagements against the newer MiG-21. During the same period, the US claimed five MiG-21 kills while losing sixteen planes to them for a ratio of 3:1 in favor of the Fishbed. Overall, MiGs became a more significant threat. In 1965, MiGs claimed only 1 percent of U.S. air losses. By the fall of 1968, this figure had risen to 22 percent.⁶⁷ Navy fighters during the same period claimed 30 MiG kills to nine losses for a ratio of over 3:1 – an improvement from the USAF data, but still pale in comparison to previous records.⁶⁸

Statistical data, when separated from important contextual information, can be misleading, or subject to various interpretations, and indeed the Navy and Air Force reached different conclusions of their performance in Rolling Thunder. The kill ratios stated above, often quoted by many analysts and historians, include all types of aircraft lost to MiG fighters, not just F-4s. For example, these figures include the loss of unarmed reconnaissance planes, bombers, and the RC-47, a variant of the DC-3 airliner, none of which designers intended for combat against enemy fighters. The impressive Korean War ratios do not include such craft. Examining

⁶⁶ Michel, “Revolt of the Majors,” 66.

⁶⁷ Michel, *Clashes*, 150.

⁶⁸ William Sayers, “The Red Baron Reports: What They Really Said” *Air Power History* 52 (Fall 2005), 9.

only Air Force F-4s on MiGCAP missions reveals fifty-seven MiGs shot down for ten losses – a ratio of 5.7:1 in favor of the USAF. Similarly, three large air-to-air engagements in 1967 – Operation Bolo in January, a large air-to-air battle on 19 April, and a series of isolated engagements from 13 May through 5 June – saw favorable kill ratios for the U.S. of 8:1, 4:1, and a shocking 12:1 respectively.⁶⁹ Altogether, F-4s during the entire Rolling Thunder campaign claimed seventy-six kills and nineteen losses.⁷⁰ Although the final year of Rolling Thunder saw improvements in NVNAF tactics causing heavier proportionate losses, the Air Force overlooked this downturn, convinced that there was no large performance problem.

The Navy was less optimistic, viewing their air-to-air record during Rolling Thunder as the worst in the history of U.S. naval warfare. Examining only Navy F-4s revealed sixteen MiG kills for seven losses, a 2.3:1 ratio. The F-8 Crusader's performance was better, claiming fourteen kills for three losses, yet the proud community of Navy fighters, pining for the inflated scores seen in Korea, deemed even this nearly 5:1 rate as unacceptably low. When the Navy included the statistics for all of its various aircraft, the ratio of MiG kills to losses was approximately 2:1. The Navy felt that pilots from a small third world country truly threatened American claims to air superiority. As Robert Wilcox noted, “Supposedly 'inferior' North Vietnamese pilots were, for all practical purposes, beating the Navy pilots.”⁷¹ In reality, although these loss rates were worse than either branch had experienced in the past, they still clearly favored the U.S. Additionally, the U.S. maintained a massive numerical advantage. As early as 1965, the U.S. fielded over 660

⁶⁹ Sayers, “The Red Baron Reports,” 8-9.

⁷⁰ “Air-To-Air Encounters in SEA (U),” Volume I: Account of F-4 and F-8 Events Prior to March 1967 (U), Institute for Defense Analyses Systems Evaluation Division, WSEG Report 116, October 1967, 17-18; “Air-To-Air Encounters in SEA (U),” Volume I: Account of F-4 and F-8 Events Prior to March 1967 (U), Institute for Defense Analyses Systems Evaluation Division, WSEG Report 116, October 1967, 15-20. Hereafter cited as Red Baron Reports Vol. I and II respectively.

⁷¹ Wilcox, *Scream of Eagles*, 99. See also, Michel, “Revolt of the Majors,” 97; Red Baron Report Vol. I, 17-18; Red Baron Report Vol. III, 15-20.

aircraft to the theater, while the North Vietnamese did not possess more than fifty-five operational MiGs available at any one time.⁷² American air superiority in a technical sense was never in danger of being lost. However, the costs of maintaining this superiority were much larger than in previous wars, to a degree that the Navy deemed unacceptable.

During the bombing halt, the Navy reevaluated several areas of its performance. Some Navy planners already favored training improvements and sought an opportunity to make proposals. In the words of Merle Gorder, an Operations Officer of several carriers and former F-8 squadron commander, “We all knew we needed more training.” A Navy Fighter Weapons School was “an idea whose time had come . . . I knew exactly what I was going to propose, it just had to be documented.”⁷³

Despite this willingness to consider training changes, the Navy initially followed the same course as the Air Force, seeking a technological solution. In the summer of 1968, it commissioned Frank Ault to conduct a detailed study of the performance problems of air-to-air missiles. His “Report of the Air-to-Air Missile System Capability Review,” often referred to as “The Ault Report,” revealed “a virtual jungle of problems.”⁷⁴ The report proposed several changes to missile procurement, handling, and utilization, as well as suggestions of a detailed technical nature relating to maintenance, testing, and development.

Two large themes dominated the report: design and training. Ault emphasized that the designed role of these missiles, like the planes that flew them, was interception of enemy bombers, not a dogfight environment.⁷⁵ The control systems of these missiles were particularly

⁷² Boniface, *MiGs Over North Vietnam: The Vietnam People's Air Force in Combat* (Mechanicsburg, Stackpole Books, 2010), 14, 73.

⁷³ Quoted in Wilcox, *Scream of Eagles*, 102.

⁷⁴ “Report of Air-To-air Missile System Capability Review (U),” Naval Air Systems Command, 1 January 1969, 17. This source is cited hereafter as “Ault Report.”

⁷⁵ Ault Report, 27, see also 21.

problematic, forcing pilots to take their eyes off the sky and handle a confusing number of complicated switches. As Ault describes, “U.S. fighter pilots have been required to fight a ‘heads-up’ engagement in Southeast Asia with a ‘heads-down’ system. This is, of course, particularly true for the F4.”⁷⁶ To address these issues, the Navy introduced upgrades to all its missiles and to the F-4 itself, including the USAF-designed AIM-7E-2 “dogfight Sparrow,” a new version of the Sidewinder (the AIM-9G), and an improved version of the Phantom – the F-4J – all of which deployed to the theater in the late 1960s.⁷⁷

Ault's study revealed that many pilots lacked training in the use of these missiles, and thus fired them in non-ideal conditions outside the weapon's intended design. Most pilots simply fired by “eyeball and intuition.”⁷⁸ Ault expanded this critique, pointing to the lack of air-to-air and ACM training as a key issue. The focus on air-to-ground warfare had caused a

Consequent dilution of air-to-air training and readiness. . . . Improved aircrew performance should be possible through increased missile and target allowances, better range facilities, more realistic air combat maneuvering training, a concentrated effort on aircraft missile system qualification (as well as aircrew firing qualification), and improved tactics and doctrine.⁷⁹

Although this critique made up a smaller portion of the final report than the maintenance and technology issues, the notes on training practices garnered much attention from Navy leadership and provided a springboard for those who sought to push their agenda of training improvement. Many pilots in the F-8 community who had been lobbying for the return of air combat training influenced Ault's report. They reached their conclusions regarding the creation of a new school before the appearance of the final report.⁸⁰ Gorder soon provided the

⁷⁶ Ault Report, 21.

⁷⁷ Michel, *Clashes*, 185.

⁷⁸ Ault Report, 35.

⁷⁹ *Ibid*, 21.

⁸⁰ Michel, *Clashes*, 186.

documentation of these ideas, writing, “Since the Fleet Air Gunnery Unit [FAGU] was decommissioned in 1960, there has been a great loss of expertise and continuity in the air-to-air weapons system capability within Navy fighter squadrons. There is a need to establish a fighter weapons school to reverse this trend.”⁸¹

The new Navy Fighter Weapons School (NFWS), later known as “Top Gun,” opened in Spring of 1969, staffed by hand-picked instructors who experimented with the F-4 Phantom at the edges of its performance envelope, far beyond the limited maneuvers typical of pilot training. They found that the Phantom was more capable than previously thought. NFWS instructor Jim Ruliffson recalled, “We didn't know how good of an airplane we had. . . . You had to explore the edges day in and day out.”⁸² Many of the instructors discovered and practiced what previous tests such as Feather Duster and Have Doughnut had previously revealed: that the Phantom was faster and could out-climb MiG fighters, and at higher speeds even turn and maneuver with them. Nevertheless, resistance to training these advanced techniques, both from military leadership and from the Phantom's manufacturer, McDonnell, kept pilots from attempting them or even knowing of them. Wilcox has noted, “Most Phantom pilots were either ignorant or afraid of these capabilities. They'd been told the plane was primarily an interceptor, that it hadn't been built for what pilots like [the NFWS instructors] were routinely doing with it.”⁸³

The new school also instituted DACT, using A-4 Skyhawks to simulate MiG fighters. This was the beginning of a larger shift. Michel noted, “In the history of American military training, the importance of a formal course using DACT cannot be overstated. . . . It was the birth of 'realistic training,' which was to become the great American military innovation of the

⁸¹ Quoted in Wilcox, *Scream of Eagles*, 108.

⁸² Wilcox, *Scream of Eagles*, 117-8.

⁸³ *Ibid*, 123-4.

post-Vietnam era.”⁸⁴ To help facilitate their teaching, the NFWS developed a key new piece of technology known as the Air Combat Maneuvering Range (ACMR), a computer system tied to video cameras that tracked detailed statistics and flight characteristics of planes during simulated dogfights, calculated simulated weapons fire, and recorded views from multiple angles. “The ACMR proved a quantum leap in the learning and teaching of air combat skills.”⁸⁵ Thus, the Navy's response to the “crisis” of air combat during the Rolling Thunder years was to seek a combination of technological and training solutions to improve its air-to-air performance.

Rebuilding the Air Force: We Have the Technology

The Air Force, by contrast, sought exclusively technological improvements and resisted changes to training procedures. In 1966, the F-4D model entered service, with vastly improved electronics, navigation systems, radar, power generators, and fuel efficiency. The two large innovations in the D model consisted of the Lead Computing Optical System (LCOSS) and the Weapons Release Computer System (WRCS) that automated precision targeting and weapons release. This decreased the pilot's workload, increasing his freedom of action and enhancing situational awareness. McDonnell delivered just short of 800 of these new models to the Air Force by February 1968 and immediately began developing more improvements for the 'E' model. This version experienced severe design problems and conflicts with Navy requirements, but eventually added several new features to enhance air-to-air effectiveness. The existing Boundary Layer Control systems, helpful for Naval carrier operations, were not only unnecessary for the Air Force, but combined with the heavier loads carried on Air Force planes, contributed to the risk of adverse yaw conditions which caused potentially lethal departure. The

⁸⁴ Michel, “Revolt of the Majors,” 100, 102.

⁸⁵ Ibid, 103.

E model featured computer-controlled leading edge slats (LES) that eased the problem and increased the plane's safety. Perhaps the most significant improvement was an internally mounted canon. In a significant shift, Air Force leaders fought stubbornly for this this design change in the face of resistance from engineers.⁸⁶ These same leaders previously insisted on the gun's irrelevance to future wars, and the decision to mount an internal cannon in the nose of the Phantom represented a reversal of this attitude within the Air Force – a recognition that dogfighting was indeed still necessary.

This change had been building for some time, as many pilots, especially those with experience in past wars, had grown increasingly frustrated with the lack of a gun on the F-4. Blesse summed up the attitude of many pilots when he stated, “I had felt for years we went the wrong direction in the Air Force when we decided guns were no longer necessary. This was 'the missile era,' they said. . . . My experience in Korea seemed to tell me otherwise.”⁸⁷ Earlier, Blesse had remedied this situation by rewiring externally mounted Gatling gun pods that could be loaded into the F-4's bomb racks. In mid-1967, he met with General Momyer and Robin Olds to propose implementation of the pods in combat. Olds rejected the idea out of hand, claiming he “wouldn't touch that with a ten-foot pole,” while Momyer reluctantly agreed, telling Blesse, “I think you have a hole in your head, but go ahead with your gun project and keep me informed.”⁸⁸ Olds felt that the presence of a gun would tempt his pilots into starting a dogfight they had no hope of winning, risking their lives unnecessarily.⁸⁹

Yet most pilots did express a desire for a gun on the F-4, as did analysts conducting Operations Research, who studied F-4 engagements to determine when the plane had an

⁸⁶ Anthony M. Thornborough, *USAF Phantoms: Tactics, Training, and Weapons* (New York: Arms and Armour Press, 1988), 13-8.

⁸⁷ Blesse, *Check Six*, 148-9.

⁸⁸ *Ibid*, 149-51.

⁸⁹ Olds, *Fighter Pilot*, 317.

advantage and recommend changes in tactics and armament to capitalize on such situations. The Air Force discovered that the F-4 rarely experienced an ideal interception, and the requirements for visual identification of enemy planes limited the usefulness of missiles. The USAF had hard data showing that despite previous assumptions, close-range dogfights were indeed very likely in the skies of Vietnam. This data, more so than pilot complaints, prompted the addition of the longed-for internal cannon.⁹⁰

Another key technological innovation was the development of the APX-80, also known as “Combat Tree.” This system interrogated the IFF (Identify Friend or Foe) signals of other aircraft at long range, allowing American pilots to identify long-distance radar contacts as friendly or enemy – This freed pilots from the requirement of close-range visual identification, and removed a key advantage of the North Vietnamese Ground Controlled Intercept (GCI) system. It also allowed the Sparrow missile to utilize its ideal performance envelope.⁹¹

The USAF also made improvements to the missiles themselves, designing the AIM-7E-2 “dogfight Sparrow.” It featured two modes, one identical to the previous version of the Sparrow, the other designed for close-range attacks against maneuvering targets. The Sidewinder missile experienced upgrades as well, but the new version (the AIM-9E) failed, as none of its improvements included the warhead, fuse, or motor and so its performance remained essentially the same as earlier models. In 1968, the USAF began developing the AIM-9J with the goal of modifying it for a dogfight environment. However, it made no improvements to missile calibration, transport, or maintenance practices, which were documented sources of many of the malfunctions.⁹²

⁹⁰ Glenn E. Bugos, *Engineering the F-4 Phantom II: Parts Into Systems* (Annapolis, Naval Institute Press, 1996), 155-7.

⁹¹ Michel, *Clashes*, 181.

⁹² *Ibid*, 182-3.

These technological changes all point to a clear shift in Air Force thinking. Before the Vietnam War, the USAF viewed close-range air combat and dogfighting – the common expression of the air superiority mission – as outdated and irrelevant. The Air Force designed almost all its technological improvements during the bombing halt specifically to increase the Phantom's efficacy in these close-range environments, revealing recognition that air superiority in the traditional sense was indeed still a key component of the air war. Some historians accuse the Air Force of “technological exuberance” and an “unwavering commitment to a specific technological paradigm [that] obfuscate[s its] ability to recognize and adapt its technologies to shifting tactical and strategic environments.”⁹³ Yet the Air Force in 1968 did exactly that: it recognized a problem with its previous assumptions and adapted its technology to a changing threat environment. While the Air Force has historically displayed exuberance for developing cutting edge technology, such advancements are often large contributors to victory. Such fascination is only dangerous when it causes the Air Force to abandon previous modes of warfare, as they did with traditional air superiority roles. Yet their ability to recognize this issue and attempt to remedy it is commendable.

Despite this tacit admission that previous abandonment of the air superiority mission was incorrect, the USAF did not view the air-to-air performance issue in 1968 in as drastic terms as did the Navy, and thus it was content to rely solely on technological changes, avoiding training improvements by adhering to the “fly safe” culture. It did admit some degree of performance failure, but promptly blamed this on the political restrictions from Washington leadership. This attitude grew to such a degree that the USAF placed the idea of using air power to win the war definitively – deemed impossible under political restrictions – at a lower priority than building

⁹³Steven A. Fino, “Breaking the Trance: The Perils of Technological Exuberance in the U.S. Air Force Entering Vietnam” *The Journal of Military History* 77 (April 2013), 626.

new technology for the future and preserving valuable aircrews.⁹⁴

In 1968, Momyer became head of Tactical Air Command (TAC). As a former fighter ace, and the previous director of Air Training Command, some might have expected him to revise TAC's training practices, or to place a higher premium on air-to-air combat. He did neither. As an early advocate of removing guns from fighters, he considered the air-to-air efforts until 1968 a complete success simply because North Vietnamese air attacks did not threaten U.S. ground forces – which was true, but primarily because the NVNAF did not fly bombers until 1972 and then only in small numbers.⁹⁵ Regarding the low kill ratios, Momyer regarded a 2:1 kill ratio as “a very acceptable rate.”⁹⁶ Those who shared Momyer's views could potentially claim that changes to training procedures might not be effective in preventing U.S. losses. Data showed that surprise attacks – situations in which aircrews were completely unaware of any danger – caused 81 percent of all U.S. air losses. A pilot who is unaware of the fact that he is in a fight cannot defend himself, regardless of his level of training.⁹⁷

Some writers blame Momyer for lacking vision, or accuse him of outright careerism. However, he was hardly at fault for attempting to preserve the lives of aircrews by preventing training accidents. Although the MiG threat had risen considerably by 1968, most pilots did not engage in dogfights, and, with the halt of activities over North Vietnam, air-to-air combat with MiGs was unlikely. Thus, his refusal to adopt riskier training procedures is defensible for its prudence. His attempt to hold the line and preserve Air Force policies that had been in place since the beginning of the war may reveal a lack of bold leadership, but the blame for a system that had long devalued the air superiority mission cannot rest with him alone, especially since

⁹⁴ Thompson, *To Hanoi and Back*, 287-8.

⁹⁵ Michel, “Revolt of the Majors,” 102, 104, 106-7; Boniface, *MiGs Over North Vietnam*, 82.

⁹⁶ William W. Momyer, *Air Power in Three Wars* (Maxwell Air Force Base, Air University Press, 2003), 178.

⁹⁷ *Ibid*, 11.

U.S. air superiority was not truly threatened. As Momyer confidently declared,

The air superiority that was established and maintained in World War II and Korea was even more pronounced in Vietnam. . . . Through pilot skill, improvisation, and training, the air battle over the skies of North Vietnam was fought and won. . . . The end result for the North Vietnamese Air Force was that we could use their air space to perform combat missions, and they couldn't use ours. That is what air superiority means.⁹⁸

Such sentiments are mostly factually true, although air superiority in Vietnam hardly seems "more pronounced" than that in previous wars. In any case, these attitudes gloss over the high cost of maintaining such superiority, a cost Momyer found acceptable, but others within the Air Force found intolerable, demanding improvements to training. Olds expressed this in a 1967 interview, saying, "At home, they don't train the kids right. They can't apparently. You go up and match two similar aircraft with two similar fuel loads and you're not learning anything."⁹⁹

Colonel Charles Gabriel (later the USAF Chief of Staff), as commander of the 432nd Tactical Reconnaissance Wing at Udon, expressed similar sentiment, noting, "The single most deficient area of aircrew preparation for SEA [Southeast Asia] operations has been that of aerial combat training."¹⁰⁰

The USAF did not ignore the possibility of training changes completely. In December 1967, Momyer himself enacted a program for upgrading GIBs to air commander status through a ten-week training program that included twenty-eight training sorties. The emphasis of this program was on ground attack, yet three of the sorties focused on aerial combat.¹⁰¹ In 1968, the Air Force attempted to introduce some limited DACT using the F-106, whose delta-wing design could simulate certain characteristics of the MiG-21. This program included only instructors at

⁹⁸ Momyer, *Air Power in Three Wars*, 178-9.

⁹⁹ "Interview of Col Robin Olds," United States Air Force Oral History Program, K239.0512-160, 12 July 1967, 45.

¹⁰⁰ Project CORONA HARVEST: USAF Air Operations Against North Vietnam, 1 July 1971-30 June 1972, 8 June 1973, 138, quoted in Donovan, "Full Circle," 12-3.

¹⁰¹ History of the 8th Tactical Fighter Wing 1 October – 31 December 1967, 12; see also Ltr from Gen. William Momyer, "F-4 Pilot Upgrading," 21 November 1967.

the FWS, with no attempt to spread this type of training to regular Air Force units.¹⁰² While the USAF was unwilling to institutionalize DACT, such training indicates a willingness to consider the possibility, and awareness of methods to incorporate it. These ideas lay dormant until the end of the war but eventually led to more drastic changes.

Through the Rolling Thunder period, many wing commanders received considerable leeway in the handling of their units, and some of them taught air-to-air tactics on their own initiative. In April 1967, Blesse, then a pilot in the 366th TFW, realized that none of his fellow pilots had air combat experience. He took it upon himself to hold briefings based on *No Guts, No Glory*, an air combat manual he had written about his experiences in World War II. The group studied the book, applied its tactics, and continually modified them to fit the situation in the theater, with considerable success. According to Blesse, “Our air-to-air war only lasted about six weeks but we bagged eleven MiGs in that time – more than any wing in Southeast Asia.”¹⁰³

As commander of the 8th TFW, Robin Olds also led his pilots in *ad hoc* air-to-air training. As early as 1966, he had written *Tactical Doctrine*, a detailed textbook on air-to-air tactics, specifically against MiGs.¹⁰⁴ Beyond this academic instruction for his pilots, Olds also conducted air-to-air practice with them as often as possible. His wing engaged in a

Considerable amount of blackboard skull practice and of actual application of practice here in our own local area – even after coming home from a long mission we had enough fuel to burn to afford five to ten minutes of practice tactics. We always do it. . . . I never let them rest. They practice every single moment. We don't want to waste a moment in the air.¹⁰⁵

Olds was in a unique position because, stationed with him at Ubon was a Royal Australian Air Force detachment of F-86 Sabres – the same planes used by the Feather Duster program to

¹⁰² Michel, “Revolt of the Majors,” 104.

¹⁰³ Blesse, *Check Six*, 154.

¹⁰⁴ Robin Olds, *8th Tactical Fighter Wing Tactical Doctrine Second Edition*, December 1967, 84-110.

¹⁰⁵ “Interview of Col Robin Olds,” 6.

simulate the MiG-17. This provided an opportunity for valuable DACT. As Olds reported, “We, on a briefed, planned basis, tangle with them almost every day. We usually do this coming home from missions, no matter how tired you are. . . . They have helped us tremendously in evolving tactics against the more maneuverable MiG-17.”¹⁰⁶

Other USAF figures at home in the United States attempted to introduce new training as well. In 1970, Major Roger Wells, an instructor at the Air Force FWS, developed an academic course that detailed Soviet fighters and tactics. He first taught this course in 1971 at the FWS and soon took it to other fighter bases globally. Recognizing the advantages to DACT, Wells and other FWS instructors lobbied to use the few MiGs available to the U.S. in air-to-air combat training. While there was no opposition to academic instruction regarding enemy forces, Air Force leadership drew the line at taking the valuable captured MiGs into the air for simulated combat. One of Momyer's deputies blocked the idea, deeming it “too radical and dangerous.”¹⁰⁷

Conclusion

Throughout the Rolling Thunder period, air-to-air training for F-4 crews suffered drastically. Although pilots did receive a large amount of training time on air combat techniques compared to other subjects, the multi-role nature of the F-4 and the Air Force's concept of the “universal pilot” caused a massive decrease in ACM training relative to pilots in previous wars. This lack of training focus, among other factors, contributed to what many in the fighter community have viewed as a dismal combat performance record during Rolling Thunder.

¹⁰⁶ “Interview of Col Robin Olds,” 45-6.

¹⁰⁷ Michel, “Revolt of the Majors,” 110-11.

To counter this perceived performance problem, both the Navy and Air Force recognized their lack of focus on the air superiority role and sought technological solutions including upgrades to the Phantom and the development of new missiles designed for a dogfight environment. The Navy did not stop at these improvements alone. Influenced by the F-8 fighter community, the Navy implemented broad changes in its training program, creating the NFWS also known as “Top Gun.” This school focused on teaching advanced dogfighting techniques and included the valuable addition of DACT. Until the school proved itself, it remained at the fringe of the Navy organization, relatively isolated and autonomous. The Air Force, by contrast, did not wish to risk the lives of their crews in such seemingly dangerous training procedures, partly because the MiG threat was generally less dangerous than other elements of the North Vietnamese air defense system, and because Air Force leaders did not view U.S. air superiority as threatened.

Much of the Vietnam literature praises the Navy for taking the “correct” approach to countering the MiG threat, while it tends to malign the Air Force in general and Momyer in particular for failing to recognize training deficiencies and relying too heavily on technology. While the Air Force demonstrated a timidity and reluctance for bold risk-taking, it also made a prudent move that protected the lives of its aircrews and increased its technological advantages. When analyzed objectively, MiGs were not the largest threat in the theater, and a pilot's chances of encountering a dogfight were relatively small. Whether training changes could have prevented U.S. losses was debatable given available data. Thus, the USAF's decision seems reasonable in context.

A reliance on technology is only dangerous when it causes the Air Force to abandon entire modes of conflict, as it did with the devaluation of the air superiority role in the years

between Korea and Vietnam. However, the development and use of technology is still a key component to victory in warfare of any kind. By recognizing the necessity of the traditional expressions of air superiority in close-range dogfighting scenarios, the Air Force corrected its oversight and sought to refine its technology to excel in that role. The Linebacker campaigns of 1972 soon put the relative efficacy of the changes instituted by both the Navy and Air Force to the test as the F-4 Phantom flew back into air combat with MiGs in the skies over Vietnam.

CHAPTER 5

TAKE WARNING: AIR COMBAT DURING THE LINEBACKER CAMPAIGNS

After the bombing halt in 1968 that ended the Rolling Thunder campaign and the air combat accompanying it, the Air Force and Navy instituted several changes, primarily technological upgrades in the case of the Air Force and training improvements for the Navy. Renewed combat in 1972 tested these changes and revealed that naval training was paying dividends. Top Gun graduates and other Navy pilots saw a drastic increase in their effectiveness against MiG fighters. Randy Cunningham and his co-pilot William Driscoll, while not official graduates of the school, had received a significant amount of Top Gun training and became the first American aces of the war. The United States Air Force's (USAF's) efforts were less effective, and its Phantoms initially performed much worse than they had in 1967 and 1968, earning a negative kill ratio for the first time in the war. The technological improvements made during the bombing halt clearly proved inadequate.

Fortunately, the Air Force was able to reverse this situation through further technological improvements, namely Project Teaball, a unified Ground Controlled Intercept (GCI) system similar to the one used by North Vietnam during the entire war. By taking the Soviet ground control model and applying it in a slightly different way, Air Force pilots received a level of situational awareness they had not previously experienced. This early warning system granted them the initiative to attack MiGs on their own terms. Teaball, when it functioned correctly, created massive success for the USAF in air combat and made the F-4 Phantom a deadly menace to its enemies.

Despite a general lack of air-to-air combat from the end of 1968 through 1972, American interdiction efforts against the Ho Chi Minh Trail in Laos continued, and in 1970 MiGs returned

to action, if only for a few brief encounters. In January, two MiG-21s attacked an HH-53 rescue helicopter. In March of the same year, Navy F-4s escorting a reconnaissance flight engaged and shot down a MiG-21 and a MiG-17.¹ These brief encounters were stark exceptions to the general lack of air combat during this time.

In 1971, the North Vietnamese Air Force (NVNAF) increased its efforts to harass American missions in Laos. Most of the U.S. aircraft used for interdiction strikes were slow moving propeller craft, helicopters, or the cumbersome yet devastating B-52 bombers, all of which were vulnerable to attack from the nimble MiG interceptors. The North Vietnamese fighters increasingly harassed interdiction forces, focusing on B-52 formations during the fall of 1971. Their primary tactic was a low altitude approach, beneath U.S. radar coverage, quickly climbing to an attack position at the last moment, making a single attempt against the bomber before immediately retreating at high speed. These hit-and-run, “pop-up” attacks mimicked the tactics perfected by the NVNAF in 1967 and 1968, again primarily operating under strict coordination from GCI.² Neither side achieved any confirmed kills during this period, although a MiG-21 claims to have successfully shot down one B-52.³

The increase in MiG activity, combined with the introduction of Surface-to-Air Missiles (SAMs) and an expansion of anti-aircraft artillery (AAA) in Laos produced American responses. Air bases at Udorn and Da Nang placed an increasing number of F-4s on alert status specifically to deal with the air-to-air threat. Despite many technological improvements to these aircraft, they were unsuccessful in shooting down any threatening MiG fighters. Additionally, large numbers

¹Marshall Michel III, *Clashes: Air Combat Over North Vietnam, 1965-1972* (Annapolis: Naval Institute Press, 1997), 190-1. See Also, “U.S. Air-to-Air Victories during the Vietnam War, Part 2,” Air Combat Information Group, http://www.acig.org/artman/publish/article_244.shtml [accessed 19 April 2013]; and “Vietnamese Air-to-Air Victories, Part 2,” Air Combat Information Group, http://www.acig.org/artman/publish/article_246.shtml [accessed 19 April 2013].

²Michel, *Clashes*, 193.

³“Vietnamese Air-to-Air Victories, Part 2.”

of F-105 Thunderchiefs, previously withdrawn from the theater, returned to Southeast Asia to help suppress other ground-based air defense systems.⁴ The largest form of escalation came in response to North Vietnamese shelling of Saigon in December 1971. U.S. military planners at that time predicted that Hanoi was preparing for a large invasion, most likely in February 1972. The shelling, which President Richard Nixon claimed violated the terms of the 1968 bombing halt agreement, provided a justification to concentrate airpower in an attempt to dissuade the predicted invasion.

From 26-30 December, the USAF flew over one thousand sorties as in Operation Proud Deep Alpha. These strikes focused on supply targets and air defenses in North Vietnam below the 20th parallel.⁵ The operation was largely unsuccessful. Bad weather and poor planning plagued the strikes and rendered many of the attacks ineffective. It also failed to dissuade MiG activity, which increased at the start of the new year, from twenty-one known attempts on the Laos interdiction effort in December 1971, to thirty-three incursions in January of 1972.⁶

During the first few months of 1972, Nixon pursued renewed negotiations with North Vietnam and continued to boost airpower in the region, sending increasing numbers of F-4s and thirty-seven more B-52s to the theater. His appeal to negotiations failed. After several postponements of potential peace talks, on 30 March 1972, North Vietnam launched an attack known as the Easter Offensive. This massive, three pronged attack provided Nixon with both justification and domestic support for retaliation. While still committed to the overall withdrawal of American ground forces, the President ordered further buildup of airpower. Over one hundred more B-52s arrived in the theater, constituting over half of the bombers in Strategic Air

⁴ Michel, *Clashes*, 192-4.

⁵ Mark Clodfelter, *The Limits of Air Power: The American Bombing of North Vietnam* (New York: The Free Press, 1989), 151.

⁶ Michel, *Clashes*, 196-7.

Command's (SAC's) inventory. Naval airpower also increased, adding two additional carriers to the pair already stationed in the Gulf of Tonkin. By the summer, six carriers crammed the Gulf, representing the largest concentration of naval firepower during the entire war. The number of F-4 Phantoms in Southeast Asia nearly doubled, from 185 just before the offensive to a total of 374 in May – approximately 100 more than had ever been in the theater at any one time previously. This massive consolidation of airpower launched Operation Freedom Train on 5 April. These strikes were also limited, concentrating on supply and air defense targets such as the large number of SAM sites below the 18th parallel. Despite more success against these targets than seen during Operation Proud Deep Alpha, a USAF study reported that Freedom Train failed to diminish the flow of supplies and material.⁷

During these operations, the air-to-air war intensified as MiGs flew an increasing number of sorties, expanding their efforts into the southern areas below the 20th parallel. These flights approximately doubled from five per day late in 1971 to an average of ten daily flights early in 1972.⁸ This time, U.S. forces proved massively successful against MiG fighters. From 30 March through 8 May, the U.S. shot down eleven MiGs, almost all of which were the previously deadly MiG-21s. The Air Force and Navy claimed six and four of these kills respectively, the remaining one shredded by B-52 gun turret operators. During this period, MiGs killed only one F-4, although Vietnamese sources claim two more unconfirmed.⁹ While MiG engagements did increase, they were still quite rare compared to the frequency of attacks in 1968.

With further attempts at negotiation failing and convinced that Hanoi was confident of an imminent victory, Nixon sought to escalate the conflict. Communicating with Soviet leadership,

⁷ Clodfelter, *The Limits of Air Power*, 153-4; John T. Correll, *The Air Force in the Vietnam War* (Arlington: Aerospace Education Foundation, 2004), 9.

⁸ Futrell, et. al., *Aces and Aerial Victories: The United States Air Force in Southeast Asia 1965-1973* (Maxwell AFB: Albert F. Simpson Historical Research Center, Air University, 1976), 83.

⁹ “U.S. Air-to-Air Victories during the Vietnam War, Part 2,” “Vietnamese Air-to-Air Victories, Part 2.”

Nixon grew satisfied that such escalation would not provoke international intervention, freeing him to use air and naval power with more aggression. Speaking to National Security Advisor Henry Kissinger, Nixon stated, “I intend to stop at nothing to bring the enemy to his knees.”¹⁰ To this end, Nixon approved a strategic air campaign designed to destroy the war-making capabilities of North Vietnam that included many targets from the initial Joint Chiefs of Staff (JCS) list of suggested Rolling Thunder targets. The plan was more aggressive than previous campaigns, allowing simultaneous strikes on various targets, strikes on enemy air defenses, and included the controversial mining of Hai Phong harbor. Most notably, the concept of gradual escalation was absent. Rolling Thunder had relied on slow increases in pressure and target selection to persuade Hanoi's acquiescence. Nixon's new campaign, first designated “Rolling Thunder Alpha,” and later renamed to “Operation Linebacker,” was far more direct. As General William Momyer, then commander of Tactical Air Command (TAC), noted, planners intended these attacks to “force North Vietnam to realize the futility of trying to conquer South Vietnam by force. . . . The purpose underlying the entire campaign was to break the enemy's will and ability to continue fighting.”¹¹ Linebacker began on 10 May, with an attack on Paul Doumer Bridge in Hanoi, and continued until late October of 1972. With the advent of such vigorous bombing efforts, the MiG fighters of the NVNAF came out in force, and the air-to-air war renewed in earnest.

Nothing to Compare: New Gear, New Men, and New Strategies

During Operations Proud Deep Alpha and Freedom Train, MiG tactics remained similar to those developed in 1968: single high-speed attacks under GCI control, or using one MiG

¹⁰ Quoted in Clodfelter, *The Limits of Air Power*, 157.

¹¹ William W. Momyer, *Air Power in Three Wars* (Washington, D.C.: Office of Air Force History, 1985), 32-3. See also, Clodfelter, *The Limits of Air Power*, 158.

element to draw escort fighters away and allow a second element to attack. Wheel formations remained prominent as MiGs orbited specific points awaiting the opportunity to strike.¹² During these operations, and as Linebacker unfolded, U.S. forces employed a host of new technologies to give them an edge in air-to-air combat. The “Combat Tree” identification system interrogated enemy IFF (Identify Friend or Foe) signals to identify radar contacts from long distance, theoretically allowing long range Sparrow missiles to use their full thirteen-mile range.¹³ This did not always unfold as intended in actual combat as restrictive rules of engagement still prevented some attempts at long-range attacks. Combat Tree's true worth was the early warning it gave pilots of the location of MiGs in the area, allowing them to begin an engagement earlier on their own initiative.¹⁴ The Air Force's F-4 'E' model improved weapons control interfaces, featured wing slats to improve agility and stability, and included an internal cannon for close-range kills, complementing its missile armament.¹⁵ The F-4E thus was a response to pilot complaints during the Rolling Thunder period, and a tacit admission by the Air Force that air superiority, gained through a traditional dogfighting context, was indeed still relevant to modern warfare.

Linebacker also employed drastically different strike formations than those used in Rolling Thunder. In part, the new formations reflected the new set of technological tools available to strike planners and were a response to the growing MiG threat, evidenced by their much larger combat air patrol (CAP) forces. Significantly, the new strikes represented a growing tendency in Air Force planning towards specialization. The USAF modified its aircraft to

¹² Michel, *Clashes*, 196-7, 236.

¹³ Richard S. Ritchie, United States Air Force Oral History Program, Interview #K239.0512-630, 11 Oct 72 and 30 Oct 72, 1, 24-5.

¹⁴ Michel, *Clashes*, 194.

¹⁵ M. O. Beck, “The New Phantom Switchology,” *USAF Fighter Weapons Review* (Summer 1973), 26-7; Ritchie Interview, 65-6; Anthony M. Thornborough, *USAF Phantoms: Tactics, Training and Weapons* (New York: Arms and Armour Press, 1988), 17.

perform more distinct roles, and pilots began to specialize in particular missions. This contrasted the earlier “universal pilot” and multi-role aircraft design philosophy that had so long permeated the USAF. The most useful new tool was chaff – thin strips of metal thrown into the sky in order to interfere with enemy radar signals and mask the location of bombing formations. Chaff had been available during Rolling Thunder, but the Air Force lacked an effective dispenser for it until the Linebacker Campaign, when many F-4s underwent modifications to fire chaff cartridges. During a strike, several F-4s flew ahead of other aircraft and laid a “chaff corridor.”

Theoretically, the rest of the strike could fly through this corridor and complete their mission, while enemy radar would detect only a large indistinguishable cloud of contacts. This plan was somewhat effective, although the corridor's existence was quite brief and strike aircraft often flew outside the thin corridors, making themselves vulnerable to enemy ground defenses such as SAMs or AAA. Another key tool (although not new to Linebacker) was “Iron Hand” flights, affectionately known as “Wild Weasels.” These flights consisted of four aircraft, usually F-4s or F-105s, half carrying specialized air-to-ground missiles, and the others loaded with conventional bombs. Planners and pilots considered these missions among the most hazardous in Southeast Asia, tasked with attacking SAM sites head-on. When a SAM radar activated, the flight could launch a “Shrike” missile designed to home in on radar signals and destroy the site. With the site's location revealed, the accompanying aircraft followed with a conventional bomb attack. The delicate timing of a SAM site revealing its location by activating its radar and the interval between a Wild Weasel flight and the following bombing formation created a high speed, electronic “cat and mouse” game. Directly attacking SAM sites with little protection placed these flights under considerable risk, and their effectiveness was controversial, as the destruction of SAM sites was difficult to confirm. Yet even if they failed to destroy launch sites, the presence

of the Weasels did often suppress SAMs, keeping them from activating and firing.¹⁶

Linebacker organized these various elements into a large strike force. Each flight included eight to sixteen main strike planes. Eight to sixteen escort planes accompanied these as protection from MiGs. In front of this flew eight to sixteen chaff-dispensing planes, also escorted by eight to sixteen fighters. Four to eight Wild Weasel aircraft preceded these flights. Twelve to twenty planes acting as MiGCAP protected the formation. Additionally, further out from the formation, other planes flew "Barrier CAP" (BARCAP) to provide further protection from enemy MiGs. In support of these craft flew several fuel tankers with their own CAP flights and weather reconnaissance and photo-reconnaissance flights. According to F-4 ace pilot Richard S. Ritchie, "depending on the target and the size of the force, there were generally seventy-five to one hundred and ten airplanes."¹⁷ The vast majority of these planes served a support and protection role while the number of planes performing the actual bombing of a target was relatively small.

Because of the vast amount of resources used for these strikes, and the time involved in staging them, bombing missions flew much less frequently than in the Rolling Thunder period. Usually only one Linebacker strike flew each day, yet weather problems forced cancellations of 30 to 50 percent of them. Because the number of strikes was so limited, and the priority was on attacking targets that directly related to the flow of war-making supplies to the South, the USAF could not pursue its previous strategy of attacking airfields to destroy MiG forces on the ground. Planners felt that time and resources were hardly adequate to attack the large number of relevant targets such as bridges, railroad yards, and power facilities. As a result, airfields received a much lower targeting priority. Strike planners also realized that attempting to destroy MiGs on

¹⁶ Momyer, *Air Power in Three Wars*, 129-31.

¹⁷ Ritchie Interview, 70-1; see also, Michel *Clashes*, 217-226.

the ground by bombing airfields would not likely be effective in any case. By this time, the North Vietnamese did not usually keep their MiGs on airfields, but hidden miles away from their runways. High-speed taxiways connected the runways to the often heavily camouflaged revetments, effectively hiding enemy MiGs from sight while still allowing them to take off quickly on short notice.¹⁸

The NVNAF also introduced several changes during Linebacker. A new version of the MiG-21 “Fishbed,” the ‘J’ model, corrected some of the plane’s maneuverability and stability issues, rendering it more agile and effective in air-to-air confrontations.¹⁹ This change was fairly minor compared to the introduction of a new aircraft, the MiG-19 “Farmer.” The 19 was in some senses an upgraded version of the 17, just as the 17 had been an upgraded version of the MiG-15. Like these earlier planes, the Farmer’s design focused specifically on the fighter role. It was less flexible and ineffective in any other role, yet it performed quite well in the fighter mission due to its superior agility. Despite this, the MiG-19 was a remnant of the previous generation of fighter planes, a fact its designers recognized. Manufacturers produced few 19s due to the belief that it would soon become obsolete, overtaken by newer fighters still in development.²⁰ The Farmer was Chinese built, equipped mainly with two or three internal cannons although some carried air-to-air missiles. As aviation historian Peter Davies has described, “The MiG-19 was the Russian equivalent of the F-100 Super Sabre,” also an updated version of a Korea-era aircraft, the F-86 Sabre.²¹ This newly introduced MiG fighter was essentially a replacement for the outdated MiG-17, filling a gap between the older “Fresco” and the “Fishbed.” While the MiG-21 continued as the primary NVNAF fighter for the remainder of the war, the 19 was still a

¹⁸ Ritchie Interview, quoting General Vogt, 72-3.

¹⁹ Ibid, 6.

²⁰ Arthur P. Geesey, “Air-to-Air Engagements in SEA,” unpublished CHECO manuscript, 50.

²¹ Peter E. Davies, *USN F-4 Phantom II vs. VPAF MiG-17/19: Vietnam, 1965-73* (New York: Osprey, 2009), 33.

dangerous adversary due to its superior maneuverability compared to the Phantom, leading Ritchie to describe the plane as “underrated.”²²

Along with new aircraft, the NVNAF received classes of new pilots trained during the bombing halt. Instructors refined the effective tactics used in 1968 and taught them to a new group of young North Vietnamese aircrews. Many U.S. pilots also rotated out of service, as Air Force personnel policies dictated the removal of many experienced pilots, replacing them with inexperienced crews untrained in air-to-air combat. As F-105 and F-4 pilot Ed Rasimus recalls, because of “the AF policy of no involuntary second tours, there were a lot of F-4 front seats to fill, so the job was opened up to new pilot training grads. . . . [The] requirement was supposed to be prior fighter qualification, but there was apparently considerable latitude in who could fill the slots.”²³ Thus, the North Vietnamese experienced an increase in relative air combat skill level as American crews degraded. Concurrently, the North Vietnamese augmented their GCI network, incorporating improvements in signal interception (SIGINT): the ability to listen in on American communications and deliver detailed information to MiG pilots. They also greatly expanded the range of their operations by repairing and building new airfields. Until this point, MiGs had operated primarily from Phuc Yen, Kep, and Gia Lam. All three of these bases were North of Hanoi, limiting the reach of the MiG forces. By the time of Linebacker, the NVNAF added Yen Bai, also North of Hanoi, as well as Dong Suong and Quang Lang, each increasingly further south. It also prepared new airfields at Vinh and Dong Hoi, extremely close to the Demilitarized Zone, potentially allowing MiGs to access South Vietnamese airspace.²⁴

²² Ritchie Interview, 3.

²³ Ed Rasimus, *Palace Cobra: A Fighter Pilot in the Vietnam Air War* (New York: St. Martin's Press, 2006), 26-7; see also, Geesey, “Air-to-Air Engagements in SEA,” 45-6.

²⁴ Michel, *Clashes*, 190; See Also Boniface, *MiGs Over North Vietnam*, 73, 80, although Boniface contends that there were far fewer operational MiG fighters and far more pilots than U.S. intelligence sources indicate. Boniface cites no specific North Vietnamese documents, relying on oral interviews only. He claims there were hundreds of

North Vietnamese pilots had long relied on GCI to direct their movements. American forces used the concept to some degree yet tended to rely more on the initiative and skill of individual pilots. During the years of Rolling Thunder, both the Navy and Air Force fielded several systems that provided extensive radar coverage of the theater. The goal of these systems was not to directly vector American planes or dictate their attack patterns as the North Vietnamese did, rather they sought to increase situational awareness, warning pilots of impending attack by indicating the presence and location of MiGs. From 1965 through 1968, a confusing web of systems performed this early warning role. An Air Force operated ground radar at Da Nang known as the control and reporting center (CRC) supplied radar coverage to the South and East. Adjacent to this facility was the primary mission planning facility for the Seventh Air Force, code named "Motel." Motel provided orders for all missions into North Vietnam and was responsible for controlling those missions by collating other data sources and passing relevant information to pilots. Another radar further North at Dong Ha known as "Waterboy," covered the southern areas of North Vietnam, although few air-to-air engagements occurred there at that time. For engagements out of the range of these systems, the Air Force continually flew an EC-121 known as "College Eye" to provide further radar detection. While College Eye provided excellent coverage over water, it was often ineffective over land. Other radar stations existed in Thailand, including "Brigham," at Udorn, and "Invert," at Nakon Phanom. These stations contributed ground control and navigational assistance, although their range was quite limited, providing almost no coverage of North Vietnam itself. The Navy used a system called "Red Crown," a ship-based radar located in the Gulf of Tonkin, to provide early

pilots and few planes, and that most of these aircraft experienced maintenance problems that kept them on the ground. Ritchie, in his 1972 Interview, 74, contends that the opposite was the case: the approximately 150 MiG fighters suffered few maintenance issues, but a severe North Vietnamese pilot shortage seemed to keep them from being utilized.

warning of approaching MiGs. There was some limited cooperation between Red Crown and College Eye during Rolling Thunder. During those years, none of these systems were effective for strikes further North than the nineteenth parallel, where air combat was more likely, and some of these systems, such as Red Crown, could not effectively track planes below 10,000 feet, a severe limitation since MiG tactics often included very low altitude approaches.²⁵

In 1967, new EC-121s known as “Rivet Top” arrived in the theater with specialized SIGINT surveillance equipment designed to intercept North Vietnamese communications and quickly pass on vital information to American pilots. Rivet Top was a massive success. In its limited time of employment, American forces claimed twenty MiG kills, thirteen of which received direct contributions from Rivet Top.²⁶ The late arrival of these systems during Rolling Thunder kept them from contributing to the air-to-air effort in a larger way. At the beginning of the Linebacker Campaign, the Navy's Red Crown ship returned, and the Air Force instituted a system known as “Disco,” essentially a slightly upgraded version of College Eye. Under Disco, multiple EC-121s provided a larger area of radar coverage and continued the SIGINT role provided by the Rivet Top equipment, although the system suffered many of the same problems that plagued the College Eye system.²⁷

Effective GCI proved to be one of the key determinants of victory in air combat. While the MiG high-speed hit-and-run tactics were clearly difficult for American forces to counter, GCI controllers dictated those tactics to North Vietnamese pilots. Denying the initiative of individual pilots through strict ground control was a key feature of Soviet airpower doctrine, reflective of Russian authoritarianism. NVNAF pilots received stringent instructions on almost all aspects of

²⁵ Momyer, *Air Power in Three Wars*, 150-5.

²⁶ Michel, *Clashes*, 114.

²⁷ Futrell, et. al., *Aces and Aerial Victories*, 14; Momyer, *Air Power in Three Wars*, 155, Michel, *Clashes*, 226.

their flight in real-time from their controllers, who were often pilots themselves. This situation was obvious to American intelligence agents who intercepted North Vietnamese radio transmissions and recorded conversations between pilots and controllers. As Ritchie described,

The average North Vietnamese fighter pilot is strictly tied to the ground radar control officer, who is a pilot, and he follows the instructions from the ground implicitly. They tell him when to go burner, when to arm his missiles, when he's clear to fire, when to jettison his tanks, when to break off, where to land, and what heading to turn to; everything is controlled from the ground.²⁸

During much of the Cold War era, American forces often spoke of a qualitative difference between them and their communist enemies, viewing themselves as superior in training and technology.²⁹ Yet in the skies over North Vietnam, a Soviet model of centralized control that bypassed individual pilot skill and aircraft performance negated this difference— if it existed at all. Some American pilots and air war planners recognized that the lack of such a system among U.S. forces was a detriment. According to General John Vogt, director of the Joint Staff and later commander, Seventh Air Force,

“The last eight months of Rolling Thunder, the enemy command and control system had been so refined and so perfected, with Soviet technical help, that we were barely breaking even in our loss-to-victory ratios. . . . The operation cost us an airplane almost every time we went up there. The enemy had adopted high speed [one pass] tactics using the MiG-21, good vectoring, and good control by his radars. We had nothing to compare with it in those days.”³⁰

Ritchie went as far as to state that in the case of B-52 strikes, flying a protective escort without GCI warning of incoming MiGs was “useless.” According to him, employment of U.S. GCI “was one of the primary reasons that we were able to engage MiGs and effect kills.”³¹

²⁸ Ritchie Interview, 74-5.

²⁹ For a brief summary of the belief in a qualitative edge for NATO forces in the Cold War era, see Robert M. Citino, *Blitzkrieg to Desert Storm: The Evolution of Operational Warfare* (Lawrence: The University Press of Kansas, 2004), 229-33.

³⁰ M. F. Porter, “Linebacker: Overview of the First 120 Days,” Project CHECO Report, 27 Sept 1973, 48.

³¹ Ritchie Interview, 37, 8.

Essentially, American forces had struggled heavily in air combat engagements during the last few months of Rolling Thunder because Soviet airpower doctrine proved superior. Effective MiG tactics, combined with (and dictated by) a Soviet model of centralized control, gave the North Vietnamese a large advantage, balancing an American qualitative and quantitative superiority. However, although the NVNAF used a strict GCI model during the entire war, not until mid to late 1968 did its tactics evolve into such an effective form. These tactics did not allow MiGs to gain air superiority but simply maintain a near 1:1 ratio against American planes. Such an even trading of blows could not lead to true victory, though it did allow the NVNAF to achieve their primary goal of interrupting American bombing strikes, preventing them in many cases from hitting their targets. Yet the NVNAF could not sustain such high losses for long.

Some U.S. leaders and pilots recognized that the lack of effective GCI was a key contributor to their struggles even as Linebacker began, yet Americans conceived of GCI differently than the North Vietnamese. The Soviet model relied on two main elements: access to accurate information, and strict control by ground controllers. American GCI proved hampered in the first case because of the severe limitations of their equipment. College Eye, Disco, Red Crown, and other radars possessed a restricted range and proved ineffective in the areas with highest air-to-air activity, in addition to being prone to frequent technical failures.

An equally serious bureaucratic problem complemented these technological problems. Interception of North Vietnamese transmissions was the responsibility of the National Security Agency (NSA), not the military, and thus strict rules applied. Intelligence agents labeled the intercepted data as classified, and could not pass it on to aircrews, as American pilots did not have proper security clearance for this jealously guarded data. Although seemingly ridiculous, this protective stance was not without reason. Historian Marshall Michel has noted, “The fact

that the United States was listening to North Vietnamese transmissions was a closely guarded secret. How long could this be kept secret if, every time a MiG was about to attack, the U.S. aircraft was warned over the radio?”³² Using the data could undoubtedly aid American pilots, but using it too frequently could potentially alert the North Vietnamese that the U.S. was intercepting their signals.³³

This created a dangerous dilemma for American planners who needed to balance using the data with keeping its existence secret. However, leaders in the Air Force and the NSA demonstrated a complete lack of discernment by choosing to ignore this dilemma altogether, refusing to pass on any information to American pilots in combat. This created a sense of ill will among American pilots. As one historian has noted, “U.S. pilots, already frustrated by the small amount of data provided to them, felt betrayed when they learned that some losses over Vietnam could have been prevented if intelligence data had been shared with them.”³⁴ This animosity grew so prevalent that it received a name: “green door syndrome,” so labeled because in many combat wing bases in the theater, classified information was kept in vaults usually behind a green door.³⁵ In any case, the first element of effective GCI – access to accurate information – was extremely limited for American forces.

The second element of effective GCI – strict direction by ground controllers – worked well for North Vietnamese pilots, but their American counterparts had no desire to implement such a system. Perhaps because of a differing cultural mindset, or simply because of pride, for U.S. pilots and planners, the version of GCI they longed for was simply the first element: access

³² Michel, *Clashes*, 115; see also, Walter J. Boyne, “The Teaball Tactic” *Air Force Magazine* (July 2008), 68.

³³ For a fuller examination of this idea, see Gilles Van Nederveen, “Wizardry for Air Campaigns: Signals Intelligence Support to the Cockpit,” Research paper for the College of Aerospace Doctrine, Research, and Education, Airpower Research Institute, Maxwell: 2001), 2-3.

³⁴ *Ibid*, 24.

³⁵ *Ibid*.

to real-time information that they could then use at their own discretion. As Ritchie summarized, “We need the information that comes from the airborne GCI. Not necessarily a strict GCI environment, and not tied to the GCI controller the way the MiGs are, but we definitely need the information that the GCI can give us.”³⁶ In the American conception, GCI was simply a source of information, and an extremely important one, the lack of which was causing a costly stalemate in the air-to-air war at the end of Rolling Thunder and as Linebacker began.

A New Bag of Tricks: Renewed Combat

Linebacker formations were large and unwieldy, limiting their frequency and the number of targets they could strike relative to the amount of resources they required. Yet they were undoubtedly effective in dealing with air defenses. Chaff corridors provided protection from the SAM threat, and the extensive CAP flights proved more successful in dealing with MiG attacks in the first month of the campaign. During Rolling Thunder, the NVNAF relied on hit-and-run tactics that U.S. crews were unable to counter. New technologies, especially Combat Tree, combined with friendly GCI support from Red Crown and Disco allowed U.S. pilots to regain the initiative. Long-range early warning of approaching MiG fighters allowed CAP flights to break off early and engage the MiGs proactively on their own terms, as opposed to the Rolling thunder period, where F-4s often could not react quickly enough to effectively deal with attacking MiGs.³⁷

The first day of Linebacker witnessed two large air battles, dramatically escalating the air war and setting the tone for the rest of the campaign. The Air Force, during an attack on the Paul Doumer Bridge in Hanoi, detected approaching MiGs with their Combat Tree equipment and

³⁶ Ritchie Interview, 8.

³⁷ Michel, *Clashes*, 220-22.

quickly attacked. After engaging the first group of North Vietnamese fighters, a second group of MiGs surprised them, approaching unseen from low altitude, expanding what became a close dogfight. Additionally, a lone MiG-19 attacked a separate flight of F-4s, destroying one before making a hasty retreat. The Navy, in a large strike near Haiphong harbor, encountered an even larger MiG battle. The Navy employed early warning from Red Crown, but more importantly used communications jamming to block North Vietnamese signals and separate the enemy pilots from their GCI controllers. This removed the chief North Vietnamese advantage, allowing Navy pilots, crediting their Top Gun training, to chew through the attacking MiGs in what Navy pilot Randy Cunningham described as a “Turkey Shoot.”³⁸ USAF Phantoms shot down four MiGs for two losses, while Navy F-4s destroyed eight fighters for three losses. Cunningham claimed three of those kills, making him the first ace pilot of the Vietnam War, only days after he received a “Dear John” letter from his wife.³⁹

A single isolated battle cannot accurately depict the larger nature of the campaign, yet these encounters reveal a number of issues that became common for air combat in Linebacker. The key to American success was not necessarily tactical or technological but combining these elements to provide a vast increase in pilot situational awareness. The importance of early warning given by GCI was thus paramount to U.S. success in these encounters. For American forces, Red Crown and Disco provided knowledge of enemy fighter locations in plenty of time for CAP flights to prepare, build up their speed, and engage in favorable conditions. Early warning was the extent of American employment of GCI – it did not attempt to control U.S. flights in actual combat. Pilots simply enjoyed enhanced situational awareness, freeing them to

³⁸ Randy Cunningham, *Fox Two: The Story of America's First Ace in Vietnam* (Mesa, AZ: Champlin Fighter Museum, 1984), 116.

³⁹ Statistical data from “U.S. Air-to-Air Victories during the Vietnam War, Part 2,” “Vietnamese Air-to-Air Victories, Part 2;” Overviews of the encounter can be found in Michel, *Clashes*, 212-7; Cunningham gives a vivid description of the Navy side of the battle in Cunningham, *Fox Two*, 92-116.

use their individual ability. For Navy aviators, this meant employing their newly honed Top Gun skills. In a sense, this extensive training – consisting of many practice missile firings and air-to-air combat training against other aircraft that simulated MiG characteristics – was simply another way to increase situational awareness by rendering pilots more accustomed to the stresses of combat and giving them familiarity with many combat scenarios. While GCI allowed U.S. pilots to take the initiative, Top Gun training helped them keep that initiative by remaining calm as the battle unfolded. Jerry Beaulier, a graduate of Top Gun’s first class, remembers, “What the training did for me is it kept my feet on the ground. It kept me thinking properly. I didn’t get buck fever. . . . You know all the things that are going to happen to you before you get there. You got a whole bag of tricks.”⁴⁰ At the same time, by jamming enemy communications, North Vietnamese pilots, accustomed to strict control from the ground, could not enjoy a similar situational awareness.

The battles on 10 May also demonstrated the increasing specialization of Air Force wings. Most of the kills of that fight, and of the entire month, were the work of the 555th Tactical Fighter Squadron (TFS), proudly referred to as the “Triple Nickel” squadron, a part of the larger 432nd Tactical Fighter Wing (TFW). As part of a broader shift in its doctrine, the Air Force assigned specific tasks to the various TFWs in the theater. The 8th TFW concentrated on the ground strike role, the 388th performed anti-SAM operations and escort, and the 432nd specialized in the air-to-air role. The latter therefore received most of the Combat Tree equipment, communicating extensively with Red Crown and Disco to seek out enemy MiGs and attack them before they threatened a strike formation. This specialization revealed the USAF’s acknowledgment that these various roles required distinct skill sets, a movement away from the

⁴⁰ Quoted in Wilcox, *Scream of Eagles*, 198.

“Universal Pilot” concept. Planners and pilots regarded air-to-air roles, especially MiGCAP, as the most difficult. One Air Force report stated, “MIGCAP required the highest skill and experience level of any F-4 mission, demanding highly specialized and thoroughly trained fighter pilots for the role.”⁴¹

The battle also revealed some problems for American forces. Malfunctions continued to plague air-to-air missiles despite the several improvements. The Air Force continued to struggle with the use of “Fluid Four” formations. To maintain high speeds relative to the slow-moving strike force, CAP flights often used a “weave” pattern, with fighters swinging horizontally in relation to the strike formation. This enhanced visibility for spotting incoming MiGs, yet the movement revealed a flight's location to enemy radar. The large width of Linebacker formations forced escort flights to break into groups of two. While the Navy found a two-plane formation superior against MiG forces, USAF crews lacked training for two-plane tactics, which degraded the combat effectiveness of these flights. If MiGs did penetrate the various CAP flights, they found the large, unwieldy strike formation quite vulnerable to attack.⁴²

The first month of Linebacker was a technical success for U.S. forces in terms of air-to-air combat, demonstrating a slight but unimpressive improvement from the stalemate position at the end of Rolling Thunder. From 10-31 May 1972, F-4s claimed an overall 2.3:1 ratio against MiG fighters. Yet the difference between the two branches was striking. Air Force F-4s claimed ten kills for six losses, a 1.7:1 ratio, actually worse than the 2:1 they saw during the problem period at the end of Rolling Thunder. Navy Phantoms saw a significant improvement, claiming thirteen MiGs for only four losses, a 3.25:1 ratio.⁴³ Navy pilots tended to credit the Top Gun

⁴¹ Geesey, “Air-to-Air Engagements in SEA,” 28-35, quote on 35. See also, Michel, *Clashes*, 207.

⁴² Michel, *Clashes*, 223-4. For more on missile problems, see 229-30.

⁴³ “U.S. Air-to-Air Victories during the Vietnam War, Part 2,” “Vietnamese Air-to-Air Victories, Part 2.”

school, although this overlooks the Navy's use of communication jamming to gain an edge against the NVNAF. The Air Force's lack of air-to-air training often takes the blame for the poor showing of its pilots. The USAF did employ such training on a small, ad-hoc level, but it focused on technological improvements such as the internal cannon, missile performance, and most importantly the Combat Tree equipment. These proved clearly inadequate as USAF air-to-air efficacy declined at the opening of Linebacker.

An Old-Fashioned Butt Kicking

The situation soon grew worse. In June 1972, the NVNAF responded to its May losses, enacting several changes to their strategy, beginning by increasingly targeting chaff flights. Because these flights preceded Linebacker formations, they were more vulnerable. This effort was part of an overall strategy to coordinate SAMs and MiGs into a more unified defense system, as preventing the dispersal of chaff rendered SAM sites more effective. During Rolling Thunder, SAMs and MiGs did not attack simultaneously, as the missiles were as dangerous to North Vietnamese planes as American ones. During Linebacker, this changed. Through strict GCI control and careful coordination, the NVNAF was able to use both defenses together without risking fratricide. MiG forces relied less on gun attacks, increasing the use of Atoll missiles, which proved successful. North Vietnamese pilots quickly discovered that the Navy had grown much more adept at air-to-air combat than the USAF, and therefore focused their attacks on Air Force formations. Rumors circulated among American aircrews that Phuc Yen airfield displayed a large sign admonishing North Vietnamese pilots, "Rule One – don't eat yellow snow. Rule two – don't attack gray Phantoms," gray indicating Navy planes as opposed to the USAF's

green camouflage.⁴⁴ Most importantly, the North Vietnamese increased their surveillance efforts, intercepting American transmissions and attacking vulnerable flights. As one Air Force report stated, “It was quite obvious that the [North Vietnamese] monitored and reacted to U.S. low-fuel or 'bingo' calls. MiGs attempted on several occasions to engage U.S. aircraft after 'bingo' fuel calls were made.”⁴⁵

The problems with the Air Force's fluid four formation grew more pronounced. One F-4 flight leader described a desire to use teams of two rather than four due to increased problems keeping the larger flight together, saying, “I had to spend 90 percent of my time keeping somebody in the flight from getting shot down [and] could not go about the business of MiGCAP.”⁴⁶ In other cases, strict adherence to the “single shooter” policy meant that a wingman could not attack if the flight leader was attempting to shoot down a target, even if that wingman obtained full missile lock in an advantageous attack position.⁴⁷

The statistics from the summer months of 1972 demonstrate the dramatic reversal these changes in MiG tactics brought. In June and July, Air Force Phantoms claimed eight MiGs, with the Navy shooting down only three. While the Navy only lost one F-4 to MiGs, the USAF lost fourteen.⁴⁸ The Navy could technically still claim their previous 3:1 ratio; the Air Force had sunk to its lowest ratio during the war, 0.57:1. General Vogt described the period with a study in understatement, simply stating, “They really started getting to us.”⁴⁹ F-4 pilot Russ Everts expressed the problem more directly, stating, “For the first three months of Linebacker the MiGs

⁴⁴ Cunningham, *Fox Two*, 64.

⁴⁵ Red Baron III, Vol. III, Section I, 30, quoted in Michel, *Clashes*, 234-5.

⁴⁶ Red Baron III, Vol. IV, 252, quoted in Michel, *Clashes*, 233.

⁴⁷ Michel, *Clashes*, 233.

⁴⁸ “U.S. Air-to-Air Victories during the Vietnam War, Part 2,” “Vietnamese Air-to-Air Victories, Part 2.”

⁴⁹ Quoted in Porter, “Linebacker: Overview of the First 120 Days,” 46.

gave us an old fashioned butt kicking, pure and simple.”⁵⁰ For the first time in the war, the kill ratios clearly favored the North Vietnamese.

The success of the NVNAF was troubling for the Air Force, prompting General John “Jack” Ryan, then Air Force Chief of Staff, to investigate the issue. He tasked several subordinates with issuing a twenty-five question written test on air combat basics and the systems of the F-4 to the pilots in Southeast Asia. The results were telling. Only 10 percent of pilots passed the test, and the average score was 40 percent. The startling results of the written test forced General Momyer, who had previously resisted any alterations to training procedures, to accept the team's recommendation for major changes to USAF training. Their main suggestion was the creation of an “Aggressor” squadron to simulate MiGs in air combat training. This was in some ways an extension of the academic course on the Soviet fighters taught at the Nellis Fighter Weapons School by Major Roger Wells. In other ways, it was a variation of the Navy's Top Gun training. The institution of the Aggressor squadron, approved by Ryan in 1972, brought dedicated air-to-air training and dissimilar air combat training (DACT) back to the Air Force, heralding a huge shift in USAF policy and doctrine. However, these changes did not see fruition until the end of the war, and thus had no effect on air combat in Vietnam.⁵¹

The Most Effective Show We've Had: Project Teaball

Although the USAF's institutional training changes did not take effect until after the war, August 1972 brought a significant change that dramatically affected the air-to-air war. Prompted by the increasing concerns of General Vogt about the shortcomings of American GCI, General Ryan demanded the creation of an improved early warning system to alert pilots to approaching

⁵⁰ Quoted in Marshall Michel III, “The Revolt of the Majors: How the Air Force Changed After Vietnam” (PhD. Diss., Auburn University, 2006), 145.

⁵¹ Michel, “Revolt of the Majors,” 146-52.

MiGs. Disco and the various other radar systems were simply unsatisfactory. Some air war planners, including Delmar Lang of the NSA, had previously advocated a consolidated system of SIGINT and GCI control similar to one enjoyed by F-86 Sabre pilots in the Korean War. Lang had offered to create such a system in Vietnam but USAF leadership repeatedly turned him down, resistant to the idea of allowing pilots access to raw classified intelligence data. In August 1972, the MiG threat had grown so significant that General Vogt overrode those concerns and established just such a system, codenamed “Teaball,” at Nakhom Phanom Air Force Base in Thailand.⁵²

Teaball monitored North Vietnamese communications and incorporated the radar signals from the many other USAF and Navy sources. The system’s backbone was a highly classified computer system known as “Iron Horse” that was able to take the vast amount of data from multiple sources and quickly synthesize it into a composite display showing a near real-time picture of the location of all friendly and enemy aircraft over North Vietnam. Teaball operators then sent this information directly to pilots via Ultra-High Frequency (UHF) radio signals relayed through a KC-135 code named “Luzon.” Lieutenant Colonel William Kirk, working with Lang to create Teaball, was able to release classified material to pilots by removing specific data collection information, giving pilots only pertinent data on nearby threats and their approach vectors. Despite Teaball's obvious value, many aircrews still harbored a sense of betrayal towards the intelligence community. Kirk worked to build trust between the two groups and overcome “green door syndrome” by personally visiting every single wing in the theater to brief them on Teaball's capabilities, the accuracy of its data, and the methods he used to contact pilots directly. To make the information as understandable as possible, he passed the data to pilots in

⁵² Boyne, “The Teaball Tactic,” 69; Nederveen, “Wizardry for Air Campaigns,” 25.

the same familiar format of Red Crown warnings. He instructed them to “pay attention when I call you on your discrete UHF channel.”⁵³ Finally, the U.S. had a large-scale GCI system with extended coverage. However, its implementation differed from the North Vietnamese GCI system. Teaball simply provided information to pilots, giving them early warning of MiG locations. While the American ground controllers often suggested courses of action, individual pilots retained their freedom, able to handle threats with their own discretion.

Teaball was extraordinarily successful, and brought about a dramatic shift in the air-to-air war. Of the nearly sixty air-to-air engagements during this period, Teaball provided critical assistance in sixteen of them. Beyond assisting in kills, Teaball was quite effective at preventing losses by warning pilots of approaching threats. When examining only MiGCAP missions, American F-4s claimed eighteen kills with five losses, a nearly 6:1 ratio. Those losses occurred almost exclusively at times when Teaball was down due to technical failure, demonstrating just how critical the system was to the American effort.⁵⁴ From the introduction of Teaball in August until the end of Linebacker operations in late October, Air Force F-4's claimed twenty-one MiGs shot down for only six losses. The Navy, who encountered MiGs much less frequently during this period, claimed two kills and only one lost Phantom, producing a combined ratio of approximately 3.3:1.⁵⁵ General Vogt extolled the significance of Teaball, saying

This is the most effective show we've had during the entire war with the battle against the MiGs, over a sustained period. The answer was that we went into a much more sophisticated system for providing warning for the defending pilots. . . . This proved one thing – if you can show the American fighter pilot where [the enemy] is in sufficient time, he'll shoot him down. . . . Following the commencement of Teaball, American pilots enjoyed definite air superiority over North Vietnam.⁵⁶

⁵³ Nederveen, “Wizardry for Air Campaigns,” 25-6; Boyne, “The Teaball Tactic,” 69-70.

⁵⁴ Sayers, “The Red Baron Reports,” 12.

⁵⁵ “U.S. Air-to-Air Victories during the Vietnam War, Part 2,” “Vietnamese Air-to-Air Victories, Part 2.”

⁵⁶ Quoted in Porter, “Linebacker: Overview of the First 120 Days,” 46-7.

Teaball provided other advantages, such as accurate recording of air combat for later review and analysis. This allowed aircrews and war planners to replay air engagements and learn from them, studying enemy tactics while evaluating and modifying their own. Because this information originated from radar and intercepted communications, it was accurate, not subject to potential alterations of a pilot's limited perception and memory. This information was useful for both operational planning and the training process. It also proved invaluable for search and rescue efforts. Teaball data could pinpoint the location of downed aircrews, enabling rescue craft to arrive much sooner than in earlier periods.⁵⁷

As critical as Teaball was for reversing the heavy U.S. losses of the summer of 1972, it was riddled with technological problems and extremely unreliable. The largest weakness of the system was the delay in information processing. Teaball pulled information from a wide variety of sources, then had to organize, contextualize, and integrate it into a form that was easily communicable and useful for pilots. The Iron Horse computer did the bulk of this work, but even with its help, there was an average delay of two minutes between receiving information and delivering it to pilots. In a dogfighting situation, two minutes is a massive time span. For this reason, Teaball's role was limited to providing early warning and allowing pilots to gain the initiative before a fight. Once actual combat began, most pilots relied on more timely information from Disco or Red Crown if in range.⁵⁸ Additionally, the UHF radio relays suffered from frequent outages that prevented communication between Teaball analysts and pilots.⁵⁹ Communication problems existed on both ends of the line, as the F-4's radio was notoriously unreliable as well. Ritchie elaborated on these issues, saying,

⁵⁷ Nederveen, "Wizardry for Air Campaigns," 28-9.

⁵⁸ Ibid, 31.

⁵⁹ Ibid, 28-9.

Many times the information was there but there were radio relay problems, and just plain old radio problems, due to the fact that a lot of the equipment, particularly in the [Disco EC-]121s, is very old equipment. Equipment reliability is a tremendous problem. In fact, the UHF radio was the most serious problem in the LINEBACKER operation.⁶⁰

Teaball's introduction was not the only change in summer of 1972. On 10 July, the Air Force held a conference to analyze Linebacker missions in detail and determine methods to increase effectiveness. The response to this meeting was so positive that in August, similar debriefings, known as "Linebacker Conferences," occurred daily. Each mission received detailed scrutiny and analysis to identify enemy tactics and potential weaknesses and adjust accordingly. The main contribution of these meetings was an increase in radio discipline, which had been a serious problem before this point. In a welcome display of inter-service cooperation, in August and September the Navy sent a group of F-8 Crusader pilots with Top Gun training to fly simulated combat missions against USAF F-4 pilots. These flights revealed the vulnerability of Air Force Fluid Four formations and indicated a need for improvements in Air Force training practices. Such changes did not occur until after the war, yet some of the USAF pilots involved in this rare example of DACT noted that they learned lessons that helped them in combat and assisted in shooting down MiG fighters.⁶¹ These meetings contributed to the massive change in the air-to-air war that began in August 1972.

This reversal forced the NVNAF to scale back their operations, flying fewer missions and attempting to counter Teaball's tracking ability by turning off their IFF signals. However, this separated them from their own GCI, their chief advantage to this point. While American pilots experienced significant success in air-to-air engagements, some MiGs did manage to penetrate U.S. escorts and attack Linebacker bombing formations using the same high-speed hit-and-run

⁶⁰ Ritchie Interview, 8, emphasis in original.

⁶¹ Michel, *Clashes*, 258-9; see also Clodfelter, *The Limits of Air Power*, 165-6.

tactics as before. Most of these successful MiG attacks occurred when Teaball experienced failure. U.S. planners attempted to hamper MiG effectiveness further by renewing attacks on airfields. On 1 October, U.S. bombers destroyed five MiGs on the ground, damaging nine more.⁶² The total MiG force at this time numbered approximately 150 fighters according to American intelligence.⁶³ However, North Vietnamese sources indicate that maintenance issues and a lack of parts took a heavier toll on the MiG fleet than did the bombing, and that the NVNAF possessed less than thirty-five operational fighters in June 1972. The small force was also losing the strict organization that had previously rendered it so powerful. Younger MiG pilots showed less discipline than their predecessors as emotions ran high. Many of them recklessly abandoned pre-planned tactics and instructions from their ground controllers, contributing to their heavy losses at the end of Linebacker. As North Vietnamese pilot Nguyen Nhat Chieu described this period, “Pilots died like green bamboo shoots in a storm.”⁶⁴ Just as the U.S. grew more organized in its approach through increases in post-mission analysis, tactics evaluations, and most importantly the implementation of Teaball, the NVNAF was falling apart – in some cases literally, as MiGs lay in the countryside, useless for want of repair.

All these elements contributed to the reversal that began in August, yet Teaball was clearly the defining factor, enhancing American air superiority more than any other single component. The data clearly suggests that when Teaball was active, the U.S. enjoyed overwhelming success, completely reversing the trend of June and July. The early warning system removed the chief advantage of the NVNAF: surprise. Improvements to tactics, changes in training procedures, and technological improvements to aircraft and missiles all correlate with

⁶² Michel, *Clashes*, 260-4.

⁶³ Momyer, *Air Power in Three Wars*, 143.

⁶⁴ Boniface, *MiGs Over North Vietnam*, 107, 111.

improvements in air-to-air performance for American aircrews. Yet statistically, Teaball provided the most dramatic increase in air-to-air success, raising the Air Force from a negative ratio in June and July to a nearly 4:1 exchange rate from August through October. This is incredibly clear given the almost direct correspondence of success when Teaball was active, as opposed to failure when it was down. General Vogt described this relationship, noting, “When Teaball would break down on any given day . . . we lost airplanes. One very dramatic illustration: we had a marine aircraft up there . . . [that was] shot down at precisely the five minute period when Teaball was off the air!”⁶⁵

Teaball allowed for a dramatic increase in situational awareness – information and communication were key. Other training and technological improvements, without accurate information and clear communication, could only provide incidental changes in air-to-air performance. Such awareness allowed for a greater level of flexibility and enabled the technology and training improvements to be used to their fullest extent. Teaball thus constitutes not simply an American version of North Vietnamese GCI, but a way to combine the various facets of American training and technology into a cohesive, working system. This system was highly effective and sealed American air superiority for the remainder of the campaign.

⁶⁵ “Linebacker: Overview of the first 120 Days,” 68.

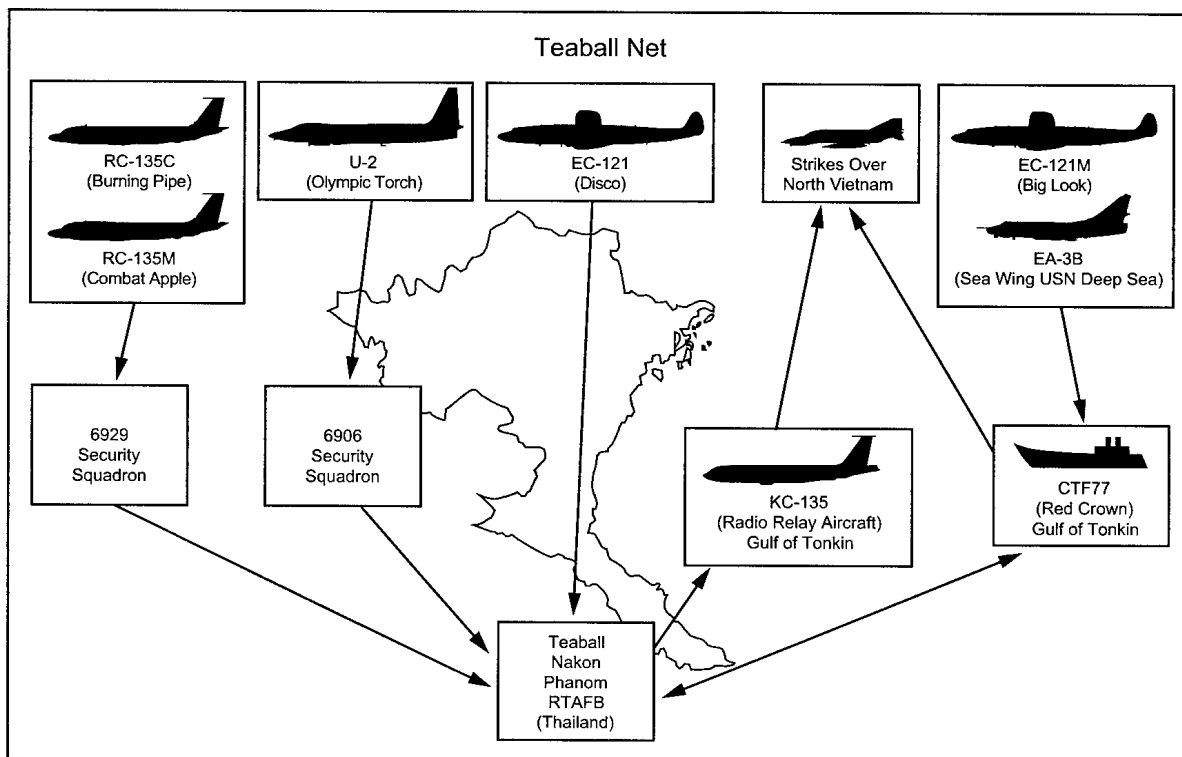


Figure 2 This graphic depicts the flow of information from various radar and SIGINT sources, to the Teaball center and eventually disseminated to pilots. From Nederveen, "Wizardry for Air Campaigns," 28.

Caught in the Apocalypse: Linebacker II

Throughout October 1972, a series of negotiations in Paris finally provided a breakthrough. These peace talks concluded on 21 October, and on the 23rd, Nixon suspended all bombing of targets above the 20th parallel, effectively ending the Linebacker Campaign. However, Henry Kissinger's 26 October declaration that "We believe peace is at hand," proved premature, as events soon unfolded that necessitated the year's bombing campaign be renamed "Linebacker I," to distinguish it from a renewal of strikes against the North. Perhaps ironically, it was the South Vietnamese government that refused to accept the peace proposal, spawning a resumption of negotiations and attacks. Limited B-52 strikes occurred on North Vietnamese

targets in November in an attempt to persuade the Hanoi government to accept altered peace proposals. In mid-December, American frustration with the lack of progress in negotiations led to a new bombing campaign, simply named “Linebacker II,” that began on the 18th of the month. The original plan called for only three days of strikes, yet continued impediments to the negotiation process extended the bombings to the 29th.⁶⁶

The goals and methods of Linebacker II differed from previous bombing efforts in its brutality. Earlier campaigns, modeled after the strategic bombing efforts of other wars, focused on reducing the enemy's ability to wage war through attacking supplies and the means of production. This goal was present in Linebacker II, but the new campaign's main goal was instead the desire to psychologically disrupt the enemy – including civilians. Admiral Thomas A. Moorer, then Chairman of the Joint Chiefs, described the goals of the campaign to the commander of Strategic Air Command (SAC), saying, “I want the people of Hanoi to hear the bombs.”⁶⁷ To maximize terror, the new plan consisted almost entirely of B-52 strikes. These massive planes inflicted enormous damage due to its colossal bomb capacity of 70,000 pounds.⁶⁸ The psychological effect of these aircraft was well known. The Viet Cong Minister of Justice, Truong Nhu Tang, described a B-52 strike as being “caught in the Apocalypse. The terror was complete. One lost control of bodily functions as the mind screamed incomprehensible orders to get out.”⁶⁹

American planners knew that the lumbering B-52s were vulnerable to MiG strikes and

⁶⁶ Clodfelter, *The Limits of Air Power*, 168-83.

⁶⁷ From letter, Brigadier General Harry Cordes to Brigadier General James R. McCarthy, n. d., AFHRC, file number K416.04-13, vol. 12, 3, 9; quoted in Clodfelter, *The Limits of Air Power*, 184; see also Momyer, *Air Power in Three Wars*, 33-4.

⁶⁸ Specifications for the B-52 taken from the United States Air Force Web Site, see “B-52 STRATOFORTRESS,” posted 5 May 2013, <http://www.af.mil/information/factsheets/factsheet.asp?id=83> [accessed 20 May 2013].

⁶⁹ Truong Nhu Tang, *A Viet Cong Memoir* (New York: Vintage Books, 1985), 168; quoted in Clodfelter, *The Limits of Air Power*, 183.

took steps to limit the danger. The bombers flew with similar support formations as previous Linebacker missions, including chaff corridors, Wild Weasel SAM suppression, and large MiGCAP sorties. The most significant change in these strikes was the decision to fly them at night. This was partly to enhance the psychological effect, as night attacks seemed more disturbing than day strikes. It also limited the effectiveness of MiG fighter forces by taking away the ability to see their targets. This limitation also worked to the detriment of U.S. forces, yet the reliance of both sides on radar and guided missiles still rendered the night environment a dangerous one. Daytime strikes did still occur with similar formations as previous Linebacker missions.⁷⁰ During these night attacks, SAMs proved a much more pressing threat to the B-52 force. In only eleven days, the North Vietnamese launched over 1,000 SAMs at U.S. bombing formations, tearing fifteen B-52s from the sky.⁷¹

Surprisingly, MiG flights rarely appeared during Linebacker II. Few engagements took place, even considering the brief duration of the campaign. U.S. forces reported only twenty-six sightings of MiGs during these attacks. Analysts credited airfield strikes and intensive radar jamming for limiting the NVNAF's effectiveness. Additionally, North Vietnamese GCI became almost useless as it depended on MiGs using their IFF transponders – but keeping these transponders active made the MiGs vulnerable to the increased number of Combat Tree equipped Phantoms. The constant hammering of strikes all night and day stretched the resources of the NVNAF and reduced the MiG threat drastically.⁷² F-4 Phantoms claimed five destroyed MiGs for three losses. Almost all of these engagements occurred against Air Force planes, with the Navy claiming only one of these kills and suffering no lost F-4s. The B-52s proved capable of

⁷⁰ Momyer, *Air Power in Three Wars*, 240-3; Michel, *Clashes*, 273-4; Clodfelter, *The Limits of Air Power*, 184-5.

⁷¹ Momyer, *Air Power in Three Wars*, 137.

⁷² Michel, *Clashes*, 275-6.

defending themselves to some degree, their gunners destroying three North Vietnamese fighters. While SAMs wreaked havoc on the B-52 force, the U.S. maintains that MiGs destroyed only one B-52. North Vietnamese sources claim two additional B-52 kills including one through a MiG kamikaze-style attack when pilot Vu Xuan Thieu crashed his fighter into one of the large bombers. This remains unconfirmed.⁷³

As with other bombing campaigns, the true measure of air superiority is the ability of bombers to attack their targets freely. While SAMs did initially prevent Linebacker II strikes from attacking their targets until the B-52s modified their tactics, the MiGs had little deterrent effect on these missions. The 1.7:1 kill ratio favoring the Phantom at first glance appears weak compared to the victories of the previous months, yet the very small sample size of air-to-air engagements combined with the unique nature of the mission limits meaningful analysis of air combat during this brief campaign. The true measure of effectiveness was the fact that U.S. bombing strikes – after adjusting tactics to handle the SAM threat – could freely attack their targets. MiGs did not pose a significant threat to this effort due to the combination of many factors, but the technological improvements in American radar-based weapons and SIGINT clearly provided the largest contribution. The Air Force's technological exuberance paid dividends. The increased situational awareness pilots received from Combat Tree and Teaball proved its worth by rendering the MiGs impotent in Linebacker II.

By 28 December 1972, North Vietnam had exhausted its SAM supply and was little capable of defending itself from the B-52 raids. When Hanoi expressed its desire to renew serious negotiations, Nixon halted all bombing north of the 20th parallel. With the signing of final

⁷³ “U.S. Air-to-Air Victories during the Vietnam War, Part 2 ,” “Vietnamese Air-to-Air Victories, Part 2,” Boniface, *MiGs Over North Vietnam*, 141, 145.

settlements on 23 January 1973, air-to-air combat in the Vietnam War drew to a close.⁷⁴

Conclusion

At the close of the Rolling Thunder campaign in late 1968, both the Navy and Air Force faced a drastic diminution of their effectiveness in air-to-air combat and consequentially held a thin, shrinking grasp on air superiority in Southeast Asia. During the bombing halt that effectively curtailed air combat until the Linebacker campaigns of 1972, the Air Force enacted mostly technological improvements to its aircraft and weapons systems while the Navy introduced the Top Gun school to better train their pilots. The efforts of both branches centered on increasing air-to-air performance, and the Linebacker campaigns put them to the test.

Initially, the Navy's efforts proved far superior. From May through July 1972, Navy F-4s claimed sixteen MiG kills for only five losses, a better than 5:1 ratio. The first American aces of the war were Navy pilots with Top Gun training, Randy Cunningham and William Driscoll. Comparatively, Air Force Phantoms – participating in more engagements overall – in the same period garnered eighteen kills for twenty losses – an actual negative ratio, far worse than the poor performance seen in the last problematic few months of Rolling Thunder. The first three months of renewed combat during Linebacker I showed that while the Navy excelled, Air Force Phantoms had actually gotten worse and were statistically losing the air war despite the various solutions attempted during the bombing halt. Upgrades to weapons systems and to the plane itself did not overcome problematic training and personnel practices that put inexperienced, unprepared pilots in the cockpits of F-4s in 1972.

However, as the Red Baron reports indicated, training likely had less effect on air-to-air

⁷⁴ Clodfelter, *The Limits of Air Power*, 188-9, 198-200.

losses than some planners thought, as successful MiG attacks most often originated from behind with U.S. pilots unaware of any danger. Even well trained pilots cannot use their superior training in such a situation. Thus, the key to reversing the Air Force's negative performance was a technological change that drastically increased situational awareness – ironically an adaptation of a Soviet model. Project Teaball accomplished this by creating a central hub to collect all radar data and previously classified intelligence sources, granting pilots early warning of MiG locations in real time. The North Vietnamese had enjoyed the advantage of such a system throughout the entire war, employing it in a dictatorial fashion, directing every action of their pilots from the ground. American conception of GCI was not nearly as strict. Pilots, given early warning of enemy locations, were free to engage on their own terms, enabling them to make use of improvements to training and technology. Teaball provided a way to incorporate the various advantages held by American F-4 pilots into a comprehensive system. Although Teaball was unreliable, its efficiency is clear when examining the data. When the system was active, American pilots experienced success. When the system was offline due to technical failure, U.S. forces struggled.

The Air Force often receives criticism for its technological exuberance, but technological innovation was in fact the key to repairing the disastrous air-to-air situation at the beginning of Linebacker. Those who credit the Navy with taking the “correct” approach by emphasizing training tend to ignore the importance of Naval communications jamming – a technological advantage. Improved training did clearly contribute to American successes, as did other technological upgrades, yet the translation of the Soviet GCI model into an American context was the key development in the air war in Vietnam, creating a greater statistical shift in American performance than any other single factor, and allowing pilots to use these other factors

to their fullest extent. Top Gun worked, but Teaball worked better.

Despite its limitations, the Phantom performed perhaps as admirably as its designers could have expected in the first years of the war. As the MiG threat grew, the F-4's weaknesses, especially in the air-to-air role, became obvious. Yet both branches proved receptive to change. USAF and Navy decisions during this period clearly reveal a reinstatement of the air superiority role as their improvements focused on enhancing the Phantom's effectiveness in the air-to-air role. By the latter portion of the Linebacker I campaign the Phantom was armed with technology and pilot training that more accurately reflected the character of the Vietnam War, propelling it to success against its airborne enemies.

CHAPTER 6

CONCLUSION: THE FAILED EXPERIMENT

Evaluating the performance of the F-4 Phantom II in Vietnam is a complicated task. It was the poster child for pre-war Air Force doctrine, namely, the quasi-religious devotion to strategic bombing that minimized all other roles of airpower, especially air superiority. War planners designed planes either to deliver nuclear weapons, or to intercept enemy bombers, which they assumed had similar characteristics to American bombers. Air superiority was dead. Thus, the F-4 was a fighter plane possessing few characteristics of traditional fighters. It was large, cumbersome, and built around the concept of long-range attacks, sacrificing the agility and armament necessary of true air superiority craft. Technical problems also plagued the plane, such as the notoriously faulty radios, high risk of departure, and tell-tale black smoke trails. The F-4 was not even the best performing plane for its intended roles. During its design process, it proved inferior to Vought's upgraded Crusader prototype in every tested category. It originated as a project the Navy did not solicit but funded anyway in order to save McDonnell, a contractor it regarded as too big to fail. The F-4 avoided joining the pile of discarded prototypes only because of Navy leadership's preexisting preference for dual-seat, twin-engine aircraft. Finally, the Air Force adopted the Phantom largely because the craft proved more versatile than its other interceptors at a time when Defense Secretary Robert McNamara was pushing the concept of commonality that emphasized multi-role planes used by multiple branches.

The F-4 was exactly the plane the military wanted it to be: a high-speed, poorly maneuvering interceptor based on long-range attacks that could also service ground attack and support missions. While the Phantom would undoubtedly have performed extremely well in its designed role of intercepting enemy bombers, it ironically never had to. Instead of saving the

world from nuclear Armageddon in the hypothetical World War III, the F-4 instead flew in a limited war over the jungles of a tiny third world country that many Americans had trouble locating on a map. The enemies it faced were not large lumbering bombers threatening nuclear annihilation, but missiles, ground fire, and maneuverable MiG fighters much more adept at air combat. The deadliest enemy for the Phantom, one of the most powerful and expensive planes in U.S. history to that point, was an individual on the ground with a small machine gun.

Air-to-air combat, while not the most prevalent threat in Vietnam, highlighted the shortcomings of the Phantom and of Air Force doctrine. Judging the F-4 in this role depends largely on how one chooses to measure success. Raw combat statistics favor the F-4, although by a narrow margin. Depending on the sources used, Phantoms killed two to three MiGs for every loss during the entire war as a whole, although incorporating unconfirmed North Vietnamese claims places the ratio at a more even 1:1. Looking closer at the war as it unfolded, the F-4 at times achieved rates as high as 5:1 while sometimes swinging into a negative exchange rate. Kill ratios are revealing, but a more accurate metric for the achievement of air superiority is the ability to freely execute bombing missions over enemy territory. By this measure, the Phantom also struggled. MiGs proved quite adept at interrupting U.S. bomb strikes, and while the F-4 occasionally racked up impressive kill counts, it was unable to prevent such interruption until late in the Linebacker campaign.

What success the Phantom did achieve was in spite of the plane, not because of it. In the last few months of the Rolling Thunder period, F-4s failed in their role of protecting enemy bombing strikes from MiG attacks, leading to a long period of evaluation during the four year bombing halt. The Phantom revealed the flaws in Air Force doctrine, proving that air combat was still necessary. Breathing life back into air superiority, the Air Force and Navy instituted a

host of changes: new missiles, new radar systems, the reinstatement of guns, new control schemes, and new training methodologies, all designed to increase air-to-air combat effectiveness. Many historians point to the initial failure of some of these new Air Force technologies and hold up the Navy as an example of “correct” adaptation. The creation of the Navy Fighter Weapons School, or “Top Gun,” indeed had a powerful, measurable effect on air combat in Vietnam. Yet, the true game-changer was an Air Force-driven technological change known as Project Teaball – an American adaptation of the Soviet model of ground radar. The system combined surveillance of enemy communications and a vast variety of radar data, synthesized by a supercomputer, to give real-time information to pilots about enemy activities. With this early warning system, F-4 crews gained a level of situational awareness that allowed all the other developments in technology, tactics, and training to be used to their fullest. During this time the Air Force succeeded in protecting bombing formations while netting a nearly 4:1 kill ratio against MiGs – more impressive considering almost all the losses incurred during this period happened when Teaball was down due to technical failure.

This reversal of doctrine continued to evolve in the post-war period. Project Teaball’s concepts evolved into the role of Airborne Early Warning and Control Systems (AWACS), a role that did exist previously, yet gained increased significance and has since become a staple of air operations. The Air Force eventually developed a new aircraft designed specifically for AWACS, the E-3 Sentry. Observing the success of Top Gun trained Navy pilots, the Air Force instituted major changes to its own training practices by adding air combat training with dissimilar aircraft, even flying captured MiGs against American pilots in training. These became the “Aggressor Squadron” – a group of pilots and planes that play as the “bad guys” to simulate accurate combat conditions for new trainees. The Air Force and Navy also began development of

new aircraft designed for the air superiority role, resulting in the effective F-15 Eagle, still used fifty years later as the primary Air Force fighter. Along similar lines, the Navy developed the F-14 Tomcat, an equally powerful fighter plane optimized for air-to-air combat. The very structure of Air Force leadership underwent a change as well, as the new “fighter mafia” replaced the old guard of former bomber pilots. Yet, as the pendulum of history swings, similar trends that created the problematic F-4 continue to rear their heads. The F-35 Joint Strike Fighter, currently languishing in development as one of the most expensive military projects in American history, is in many ways a repeat of the Phantom, favoring versatility over specialization, suffering from heavy “mission creep” as it attempts to fulfill requirements from the Air Force, Navy, and Marine Corps.

Some view the F-4 as an example of the Air Force's over-reliance on technology, its failures exemplifying the fact that technology alone cannot win wars. This view certainly has some truth to it, but a more proper view of the Phantom's failures casts it not as a failure of technology itself, but of technology misapplied. The Air Force has earned criticism for its narrow doctrine in the years preceding Vietnam, yet it showed flexibility in recognizing its problems and adjusting through further technological development applied in areas more appropriate to the conflict. We cannot overlook the large role that technology played in Vietnam. While technology alone cannot win a war, the neglect of it can certainly lose one. Technologies such as radar targeting, chaff, homing missiles, guided weapons, communications, and signals interception among others proved invaluable in the war. Without a devotion to technology, the Air Force would have suffered far worse than it actually did in Vietnam.

The F-4 was essentially a failed experiment. Built on early Cold War doctrine, it tested the idea that strategic bombing and nuclear delivery were the only important elements of the air

war. The F-4 proved this doctrine to be completely false, and while this experiment revealed this irrelevance, the plane itself did not fail. Of course, the Vietnam War was an overall failure militarily and politically, yet in the battle for the skies, the F-4 Phantom fought through much adversity, both external and self-imposed, to eventually prove victorious in its various roles, including the air-to-air arena. Buoyed up by developments in tactics, improvements in technology, and the increasing effectiveness of its crews, the F-4 achieved success in spite of its limitations.

APPENDIX
LIST OF ABBREVIATIONS

AAA – Anti-Aircraft Artillery	LES – Leading Edge Slats
ACM – Air Combat Maneuvering	LCOSS – Lead Computing Optical System
ACMR – Air Combat Maneuvering Range	MiGCAP – MiG Combat Air Patrol
ACT – Air Combat Training	NFWS – Navy Fighter Weapons School
AIM – Air Intercept Missile	NSA – National Security Agency
ATC – Air Training Command	NVNAF – North Vietnamese Air Force
BARCAP – Barrier Combat Air Patrol	OPLAN – Operations Plan
BuAer - Navy Bureau of Aeronautics	POL – Petroleum, Oil, and Lubricants
BVR – Beyond Visual Range	RIO – Radio Intercept Officer
CADC – Central Air Data Computer	RTU – Replacement Training Unit
CAP – Combat Air Patrol	SAC – Strategic Air Command
CAS – Close Air Support	SAM – Surface-To-Air Missile
CINCPAC – Commander in Chief, United States Pacific Command	SEA – Southeast Asia
CINPACAF – Commander in Chief of Pacific Air Forces	SIGINT – Signals Interception
CRC – Control and Reporting Center	SOR – Specific Operational Requirements
DACT – Dissimilar Air Combat Training	TAC – Tactical Air Command
FAGU – Fleet Air Gunnery School	TFS – Tactical Fighter Squadron
FWS – Fighter Weapons School	TFW – Tactical Fighter Wing
GCI – Ground Controlled Interception	TFX – Tactical Fighter Experimental
GIB – Guy In Back	UHF – Ultra High Frequency
ICBM – Inter-Continental Ballistic Missile	USAF – United States Air Force
IFF – Identify Friend or Foe	VPAF – Vietnamese People's Air Force
JCS – Joint Chiefs of Staff	WRCS – Weapons Release Computer System
	WSO – Weapons Systems Officer

BIBLIOGRAPHY

Published Primary Sources

- “B-52 STRATOFORTRESS.” United States Air Force Factsheet, posted 5 May 2013.
<http://www.af.mil/information/factsheets/factsheet.asp?id=83> [accessed 20 May 2013].
- Beck, M. O. “The New Phantom Switchology.” *USAF Fighter Weapons Review*. (Summer 1973): 26-30.
- Blesse, Frederick C. “Check Six,” *A Fighter Pilot Looks Back*. New York: Ivy Books, 1987.
- Crow, Graham P. “Toward Better Flying Training.” *USAF Instructor's Journal*, Summer 1968: 31-35.
- Cunningham, Randy. *Fox Two: The Story of America's First Ace in Vietnam*. Mesa, Arizona: Champlin Fighter Museum, 1984.
- F-4 Phantom II Pilot's Flight Operating Instructions*. Periscope Film, 2007, originally published by McDonnell Aircraft and the U.S. Navy, 1971.
- Gilchrist, John R. and Thomas S. Dewberry, “Forging F-4 Combat Crews.” *USAF Instructor's Journal*. (Summer 1967): 68-70.
- “Jet Strategic Bombardment.” *Air University Review Quarterly*. Vol. 5 (Spring 1952): 19.
- Momyer, William W. *Air Power in Three Wars*. Maxwell Air Force Base: Air University Press, 2003.
- Olds, Robin. *Fighter Pilot: The Memoirs of Legendary Ace Robin Olds*. New York: St. Martin's Press, 2010.
- Rasmus, Ed. *Palace Cobra: A Fighter Pilot in the Vietnam Air War*. New York: St. Martin's Press, 2006.
- Roy, Vincent P. “Double Attack Revisited.” *USAF Fighter Weapons Review*. (Spring 1971): 26-32.
- Smith, Frederick H. “Current Practice in Air Defense.” *Air University Review*. Vol. 6 (Spring 1953): 31-39.

Non-Published Primary Sources:

- “Air Combat Tactics, Tactical Doctrine, and FAC Procedures,” 4453rd CCTW RTU Weapons School Course No. 111509F.
- “Air-To-Air Encounters in SEA (U),” Volume I: Account of F-4 and F-8 Events Prior to March

1967 (U), Institute for Defense Analyses Systems Evaluation Division, WSEG Report 116, October 1967.

“Air-To-Air Encounters in SEA (U),” Volume II: F-105 Events Prior to 1 March 1967 (U), Institute for Defense Analyses Systems Evaluation Division, WSEG Report 116, September 1968.

“Air-To-Air Encounters in SEA (U),” Volume III: Events from 1 March 1967 to 1 August 1967 and Miscellaneous Events, Institute for Defense Analyses Systems Evaluation Division, WSEG Report 116, February 1969.

Elliott, Arlie R. “Combat Boxer (Evaluation of the AIM-7E-2 Missile).” Final Report Phase III. PACAF Eval Plan 206-68. January 1969.

Geesey, Arthur P. “Air to Air Engagements in SEA, 1968-72.” Unpublished CHECO manuscript.

“Have Doughnut: Volume II (U), Tactical,” Defense Intelligence Agency, FTD-CR-20-13-69-INT Vol. II, 1 August 1969.

History of the 479th Tactical Fighter Wing, Twelfth Air Force Tactical Air Command. 1 July – 31 December 1965.

History of the 479th Tactical Fighter Wing, Twelfth Air Force Tactical Air Command. 1 January – 30 June 1967.

History of the 4453rd Combat Crew Training Squadron Replacement Training Unit, Twelfth Air Force, Tactical Air Command. 1 July – 31 December 1966.

History of the 8th Tactical Fighter Wing. 1 October – 31 December 1967.

History of the 8th Tactical Fighter Wing. 1 January – 31 March 1968.

History of the 15th Tactical Fighter Wing. Ninth Air Force, Tactical Air Command. 1 July – 31 December 1966.

Letter from General William W. Momyer. “F-4 Pilot Upgrading.” 21 November 1967.

Olds, Robin. *8th Tactical Fighter Wing Tactical Doctrine Second Edition*. December 1967.

Olds, Robin. “Interview of Col Robin Olds.” United States Air Force Oral History Program, K239.0512-160. 12 July 1967.

Olds, Robin. United States Air Force Oral History Program, Briefing, K239.0512-222. 29 Sept 1969.

PACAF Tactics and Techniques Bulletin: Counter-Air Tactics Bulletin #45. 26 July 1966.

Porter, M. F. "Linebacker: Overview of the First 120 Days." Project CHECO Report. 27 Sept 1973.

"Report of Air-To-air Missile System Capability Review (U)," Naval Air Systems Command, 1 January 1969.

Ritchie, Richard S. United States Air Force Oral History Program. Interview #K239.0512-630. 11 Oct 72 and 30 Oct 72.

Siemann, John W. "Combat Snap (AIM-9J Southeast Asia Introduction." Project CHECO Report. 24 Apr 74.

"Squadron History: 433rd Tactical Fighter Squadron." 1 Oct. 67 – 31 Dec. 67.

"Squadron History: 433rd Tactical Fighter Squadron." 1 Jan. 68 – 31 Mar. 68.

"USAF Replacement Training Course: F-4C." TAC Syllabus Course 111509F-RTU. September 1966.

Secondary Sources

Air Combat Information Group. "U.S. Air-to-Air Victories during the Vietnam War, Part 1," http://www.acig.org/artman/publish/article_243.shtml [accessed 11 April, 2013].

Air Combat Information Group. "U.S. Air-to-Air Victories during the Vietnam War, Part 2," http://www.acig.org/artman/publish/article_244.shtml [accessed 19 April 2013].

Air Combat Information Group. "Vietnamese Air-to-Air Victories, Part 1," http://www.acig.org/artman/publish/article_245.shtml [accessed 11 April 2013].

Air Combat Information Group. "Vietnamese Air-to-Air Victories, Part 2," http://www.acig.org/artman/publish/article_246.shtml [accessed 19 April 2013].

Angelucci, Enzo and Peter M. Bowers, *The American Fighter*. New York: Orion, 1987.

Baer, George W. *One Hundred Years of Sea Power: the U. S. Navy, 1890-1990*. Stanford: Stanford University Press, 1994.

Boniface, Roger. *MiGs Over North Vietnam: The Vietnam People's Air Force in Combat, 1965-75*. Mechanicsburg, Pennsylvania: Stackpole Books, 2008.

Boyne, Walter J. "MiG Sweep." *Air Force Magazine* 81 No. 11 (November 1998): 46-51.

Boyne, Walter J. "The Teaball Tactic." *Air Force Magazine*. (July 2008): 67-70.

- Bugos, Glenn E. *Engineering the F-4 Phantom II: Parts Into Systems*. Annapolis: Naval Institute Press, 1996.
- Correll, John T. *The Air Force in the Vietnam War*. Arlington: Aerospace Education Foundation, 2004.
- Citino, Robert M. *Blitzkrieg to Desert Storm: The Evolution of Operational Warfare*. Lawrence: The University Press of Kansas, 2004.
- Clodfelter, Mark. *The Limits of Airpower: The American Bombing of North Vietnam*. New York: The Free Press, 1989.
- Davies, Peter E. *USN F-4 Phantom II vs VPAF MiG-17/19: Vietnam, 1965-73*. New York: Osprey, 2009.
- Davis, Larry *F-4 Phantom II's in Action*. Carrollton, Texas: Squadron/Signal Publications, 1984.
- Donovan, Matthew P. "Full Circle? The Transformation of Dedicated Adversary Air Training in the USAF." Thesis, The School of Advanced Airpower Studies, Air University, Maxwell Air Force Base, Alabama, 1998.
- Drendel, Lou. *...And Kill MiGs: Air to Air Combat in the Vietnam War*. Carrollton, Tex.: Squadron/Signal Publications, 1984.
- Drendel, Lou. *F-4 Phantom II's in Action*. Warren: Squadron/Signal Publications, 1972.
- Drendel, Lou. *USAF Phantoms in Combat*. Carrollton, TX: Squadron/Signal Publishing, 1987.
- Fino, Steven A. "Breaking the Trance: The Perils of Technological Exuberance in the U.S. Air Force Entering Vietnam." *The Journal of Military History* 77 (April 2013), 625-655.
- Futrell, Robert F. *Ideas, Concepts, Doctrine, Volume II: Basic Thinking in the United States Air Force, 1961-1984*. Maxwell Air Force Base: Air University Press, 1989.
- Futrell, Robert F., et al. *Aces and Aerial Victories: The United States Air Force in Southeast Asia 1965 – 1973*. Maxwell Air Force Base, The Albert F. Simpson Historical Research Center: Air University, 1976.
- Grant, Zalin. *Over the Beach: The Air War in Vietnam*. New York: Pocket Books, 1986.
- Hannah, Craig C. *Striving for Air Superiority: The Tactical Air Command in Vietnam*. College Station: Texas A&M University Press, 2002.
- Holloway, Gen. Bruce K. "Air Superiority in Tactical Air Warfare." *Air University Review* 19 (March-April 1968), 8-9.
- Jenkins, Dennis R. "General Dynamics F-111 Aardvark." *Air Warfare: An International Encyclopedia, Vol. 1*. Walter J. Boyne, ed. Santa Barbara: ABC-CLIO, 2002.

- Jones, Lloyd S. *U.S. Fighters*. Fallbrook: Aero Publishers, 1975.
- Love, Jr., Robert W. *History of the United States Navy, Volume 2: 1942-1991*. Harrisburg: Stackpole Books, 1992.
- Lowery, John. "Have Doughnut." *AIR FORCE Magazine*. June 2010: 64-67.
- Manning, Thomas A. *History of Air Training Command, 1943-1993*. Randolph Air Force Base, Tex.: Office of History and Research, Headquarters, Air Education and Training Command, 1993.
- Michel, Marshall. "The Revolt of the Majors: How the Air Force Changed After Vietnam." PhD Diss., Auburn University, 2006.
- Michel, Marshall. *Clashes: Air Combat Over North Vietnam: 1965-1972*. Annapolis, Naval Institute Press, 1997.
- Nalty, Bernard C., ed. *Winged Shield, Winged Sword: History of the United States Air Force Vol 2*. Washington, D.C.: Air Force History and Museums Program, United States Air Force, 1997.
- Peck, Gaillard. *America's Secret MiG Squadron: The Red Eagles of Project Constant Peg*. Long Island City, Osprey, 2012.
- Sayers, William. "The Red Baron Reports: What They Really Said." *Air Power History* 52 (Fall 2005): 4-13.
- Shaw, Robert L. *Fighter Combat*. Annapolis, Naval Institute Press, 1985.
- Spick, Mick. *All-Weather Warriors: The Search for the Ultimate Fighter Aircraft*. London: Arms and Armour Press, 1994.
- Thompson, Wayne. *To Hanoi and Back: The United States Air Force and North Vietnam, 1966-1973*. Washington, D.C.: Smithsonian Institution Press, 2000.
- Thornborough, Anthony M. *USAF Phantoms: Tactics, Training, and Weapons*. New York: Arms and Armour Press, 1988.
- Tilford, Earl H. *Crosswinds: The Air Force's Setup in Vietnam*. College Station: Texas A&M University Press, 1993.
- Van Nederveen, Gilles. "Wizardry for Air Campaigns: Signals Intelligence Support to the Cockpit." Research paper for the College of Aerospace Doctrine, Research, and Education, Airpower Research Institute, Maxwell: 2001.
- Van Staaveren, Jacob. *Gradual Failure: The Air War Over North Vietnam*. Washington, D.C., Air Force History and Museums Program, 2002.

- Werrell, Kenneth P. *Sabres over MiG Alley: The F-86 and the Battle for Air Supremacy in Korea*. Annapolis: Naval Institute Press, 2005.
- Wilcox, Robert K. *Scream of Eagles: The Dramatic Account of the U.S. Navy's Top Gun Fighter Pilots and How They Took Back the Skies Over Vietnam*. New York: Pocket Star Books, 1990.
- Williams, Amy E. *The American Fighter Plane*. New York: Barnes and Noble Books, 2004.
- Ziemke, Caroline F. "In The Shadow of the Giant: USAF Tactical Air Command in the Era of Strategic Bombing, 1945-1955." PhD diss., Ohio State University, 1989.