

AU/AWC/RWP126/96-04

AIR WAR COLLEGE

AIR UNIVERSITY

CROSSBOW AND GULF WAR COUNTER-SCUD EFFORTS  
LESSONS FROM HISTORY

by

Mark E. Kippbut, Lt Col, USAF

A Research Report Submitted To The Faculty

In Fulfillment Of The Curriculum Requirement

Advisor: Dr. Richard DiNardo

Maxwell Air Force Base, Alabama

April 1996

20010921 159

DISTRIBUTION A:

Approved for public release; distribution is unlimited.

Air War College  
Maxwell AFB, Al 36112

### **Disclaimer**

This study represents the view of the author and does not necessarily reflect the official opinion of the Air War College or the Department of the Air Force. In accordance with Air Force Instruction 51-303, it is not copyrighted, but is the property of the United States Government.

## *Contents*

|                                                  | <i>Page</i> |
|--------------------------------------------------|-------------|
| DISCLAIMER .....                                 | vi          |
| LIST OF TABLES .....                             | vi          |
| ABSTRACT.....                                    | vi          |
| INTRODUCTION .....                               | 1           |
| BACKGROUND.....                                  | 6           |
| CROSSBOW .....                                   | 9           |
| Overview.....                                    | 9           |
| Nature of V-Weapon Threat .....                  | 10          |
| Allied Intelligence and Warning.....             | 12          |
| Crossbow Planning .....                          | 14          |
| Crossbow Phase One—April 1943 to June 1944 ..... | 16          |
| Crossbow Phase One Results .....                 | 18          |
| Crossbow Phase Two—June 1944 to March 1945 ..... | 19          |
| Crossbow Phase Two Results .....                 | 23          |
| Crossbow Summary .....                           | 24          |
| Crossbow Sortie Allocations (1943-1945).....     | 25          |
| Strategic Air Forces .....                       | 25          |
| Tactical Air Forces .....                        | 26          |
| Crossbow Observations .....                      | 26          |
| OPERATION DESERT STORM.....                      | 31          |
| Nature of the Iraqi Scud Threat.....             | 33          |
| Coalition Intelligence and Warning.....          | 36          |
| Counter-Scud Planning .....                      | 40          |
| Counter-Scud Operations.....                     | 49          |
| Counter-Scud Operational Results .....           | 51          |
| Scud Hunting Sortie Allocations .....            | 58          |
| Counter-Scud Observations .....                  | 58          |
| FUTURE CONSIDERATIONS .....                      | 68          |
| CONCLUSIONS.....                                 | 81          |

|                    |    |
|--------------------|----|
| BIBLIOGRAPHY ..... | 83 |
|--------------------|----|

## *Tables*

|                                                 | <i>Page</i> |
|-------------------------------------------------|-------------|
| Table 1. V-1/V-2 Comparison .....               | 12          |
| Table 2. Al-Husayan v. Al-Hijarah Missiles..... | 35          |
| Table 3. Total Air Support.....                 | 58          |

*Abstract*

During the Gulf War Coalition air forces experienced great difficulties stopping Iraqi tactical ballistic missile operations directed against Israel and the Arabian Peninsula. This operation, although unique in some aspects, closely resembled Crossbow—Allied air operations designed to stop Hitler's first generation cruise and ballistic missile attacks against Great Britain and Continental Europe. The common thread shared by both World War II Crossbow and Persian Gulf War counter-Scud efforts was both failed to suppress enemy missile launches. The continued worldwide proliferation of ballistic missiles virtually guarantees the United States armed forces will again be confronted by the specter of suppressing enemy missile operations during our next conflict. This paper exams how future commands can better prepare themselves, through the practice of classical examination of history and critical analysis, to meet future ballistic missile challenges. It provides insights for operational planners by examining common lessons between the two campaigns, including planning shortfalls, appropriate use of intelligence and planning assumptions, targeting strategies, allocations of resources, planned effects on enemy operations, and recommendations for the future.

## Chapter 1

### Introduction

*Gulf lesson one is the value of air power . . . (it) was right on target from day one.*

—President George Bush, 29 May 1991

When President Bush spoke these words at the commencement of the US Air Force Academy following the Gulf War he was expressing the euphoria that virtually all airmen felt. After 70 years of promises, air warfare was finally redeemed. High above Southwest Asia (SWA) air power finally showed itself to be decisive—it found, fixed, fought, and destroyed the bulk of the Iraqi war machine *before* the start of the ground campaign. Desert Storm vindicated the prophets of air power and validated the fundamental tenets of USAF doctrine. While I agree with this in principle, I remain concerned that five years after the end of the war we continue to misinterpret many of its real lessons. One area for concern is in our failure to fully comprehend and appreciate why air power failed to eliminate the specter of Saddam Hussein's Scud short-range ballistic missiles (SRBM). Currently the tendency is to place the blame for this "Scud problem" squarely in the lap of the intelligence community by arbitrarily labeling it an "intelligence failure." This is the common theme found in most books on the war—Waller's *The Commandos*, Gordon and Trainor's *The Generals' War*, Winnefeld, et al., *A League of Airmen*, and Atkinson's *Crusade*.<sup>1</sup> What each author fails to appreciate is the root causes of our failure to properly

anticipate and respond to the Scud threat goes much deeper than an “intelligence failure.” Instead, it represented failures in doctrine and operational planning.

Two issues prevented us from first properly anticipating, then effectively countering the Iraqi Scud menace. First, as a group, US military officers are poor students of history. Our whole approach to history is Jominian. Reductionism governs our approach to doctrinal development. The result is prescriptive application of air power. Although we generally understand the overarching strategies employed in past wars, we fail miserably when it comes to comprehending the multitude of physical and psychological factors which govern the combat environment. Instead, we want history to provide the appropriate checklist that if followed provides the “cookie cutter” keys to success, hence our doctrine often becomes dogmatic in its application. For example, we all know that strategic bombing by the Eighth Air Force was principally responsible for achieving air superiority over the *Luftwaffe*, but how many of us truly understand *how* it was done? Another case-in-point is Crossbow, a forgotten campaign by Allied air forces in World War II (WW II), that was designed to counter the mounting German missile threat to England. Had Gulf War planners understood the dynamics of Crossbow campaign, they may not have repeated many of the same mistakes 50 years later in the Gulf War.

The second reason for our failure to appropriately address the Scud threat lies in our own doctrine of aerospace control, or air superiority. We boldly state that air power must first and foremost gain control of the aerospace environment. In our own cultural arrogance we contend that a war cannot be won without it. This view is flawed because our current air superiority philosophy, as based on the 1992 version of Air Force Manual (AFM) 1-1, *Basic Aerospace Doctrine*, is biased toward fixed-wing assets and suffers

from “mirror-imaging” analysis. Since we rely primarily on fixed-wing aircraft as our means of air war then aircraft must be the only things that are really important. This ignores a growing trend within the Third World wherein ballistic missiles play an important role in their war fighting strategies. Also, we assume once air superiority is gained that our enemy cannot possibly win the conflict. *This is dogma, not doctrine!* Both the Germans and the Iraqis had lost the battle for air superiority when they initiated the use of ballistic missiles, yet in both cases air power failed to prevent their use. In fact, ballistic missile use came close to changing the nature, and quite possibly the course of the war. This fundamental doctrinal flaw is being addressed in the initial drafts of the new Air Force Doctrine Document 1: *Air Force Basic Doctrine*, the successor to AFM 1-1.<sup>2</sup> But, redressing doctrine shortfalls requires more than just changing the words in our guiding doctrinal manuals, we must re-focus our thinking!

We must finally reject our Jominian biases toward “discovering the indisputable” laws of war that provide the absolute checklist for success and instead adopt a Clausewitzian view that demands we study history in more detail to gain a better appreciation of the factors that govern the execution of campaigns and wars. This approach will educate our judgment to allow us to know how to act; not tell us what to do. For Clausewitz it was not a matter of “*knowing that*” which is important, but of “*knowing how to act*” that is critical!<sup>3</sup> The study of history, therefore, will yield no specific formula, no specific guide for action; but instead, provides a means to educate the mind of the practitioner. A way to train judgment and discipline the mind in the best methods to prosecute war by applying the tools of our profession.<sup>4</sup>

My intent is to achieve several objectives. First, I will describe Crossbow and the counter-Scud efforts to reveal the impacts each had on overall allied air operations. Secondly, I will draw from these two efforts some influencing factors so future air planners can better appreciate the impact unanticipated threats have on campaign execution. Crossbow and our recent experience countering Scuds in the Gulf are a classic example of how a carefully planned strategy can be significantly upset when a new threat materializes and critical resources are misapplied trying to neutralize it. Finally, German missile attacks in WW II were only the opening act for future cruise and ballistic missile operations. Since 1945 an increasing number of nations have incorporated ballistic missile technology into their inventories. In all likelihood any belligerent the US faces in the future will possess ballistic missiles. Therefore, the lessons of Crossbow and the "Great Scud Chase"<sup>5</sup> still have relevance today to help guide operational-level commanders and planners tasked with devising campaign plans.

#### Notes

<sup>1</sup>The *Gulf War Air Power Survey* was somewhat kinder, referring to "a series of incorrect assumptions" being made by intelligence analysts, air planners, and commanders, although the last time this intelligence officer checked, planning assumptions fall within the purview of operational planners. *Gulf War Air Power Survey (GWAPS), Summary Report*, [Washington, DC: United States Government Printing Office, 1993], p. 89.

<sup>2</sup>Air Force Doctrine Document-1 (AFDD-1) (Draft), *Air Force Basic Doctrine*, (Maxwell AFB, AL: Air University, 15 August 1995), p. 11. The authors correctly are expanding the definition of Offensive Counter Air (OCA) to incorporate all enemy air and missile power, including fixed- and rotary-wing aircraft, unmanned aerial vehicles, cruise missiles, air defenses and *ballistic missiles* (emphasis added).

<sup>3</sup>Michael Howard, *Clausewitz* (Oxford: Oxford University Press, 1983), p. 32.

<sup>4</sup>Peter Paret, *Clausewitz and the State* (Oxford: Clarendon Press, 1976), pp. 328, 359.

<sup>5</sup>"*The Great Scud Chase*" is a phrase immortalized by former Air force Chief of Staff, General Merrill McPeak at a DOD news briefing given on 15 March 1991.

## **Chapter 2**

### **Background**

On 13 June 1944, just seven days after the Normandy invasion, a small unmanned German aircraft, designated the V-1, was launched from France toward England, where it impacted on a railroad bridge located in the center of London. This opened a new era in warfare—the use of long-range surface launched missiles. Before Germany's surrender Adolph Hitler ordered the launch of more than 30,000 V-1 and V-2 weapons.<sup>1</sup>

Since Nazi missiles first struck London, the world has continued to witness the continued use of these weapons against combatants and noncombatants. The latest example of mass use was during Operation Desert Storm when Iraq targeted cities in Israel and on the Arabian Peninsula. Both Hitler and Hussein targeted urban areas with missiles in order to conduct a “vengeance” campaign designed to incite civilian terror and thereby either erode public support for the on-going war effort or provoke a reaction that would fundamentally alter their enemy's war fighting strategy. Generally, conventionally armed ballistic missiles are inaccurate weapons which carry small warheads that caused relatively minor damage. However, despite minor physical damage, the missiles can achieve tremendous political impact and their employment in WW II and the Gulf potentially could have achieved what German or Iraqi surface forces could not—

breaking of the enemy's political will to continue the war and force an end to hostilities prior to the destruction of their military forces or loss of conquered territories.

This lesson was first learned by Hussein during the Iran-Iraq War when he exchanged a series of missile attacks with the Iranians during the 1988 "War of the Cities." Altogether, the Iraqis launched 200 missiles, primarily at Tehran, in response to an initial attack by Iranian missiles on Baghdad.<sup>2</sup> The attacks by both sides caused very little damage, but Iraqi Scuds carried a huge psychological and political value—the strikes boosted the Iraqi morale while causing almost 30 percent of Tehran's population to flee the city. The rocketing of Tehran by weapons capable of carrying weapons of mass destruction, along with the concurrent destruction of Iran's oil export capabilities and a strategic shift on the battlefield, is credited with forcing Iranian acceptance of a UN-sponsored peace agreement which fell far short of Tehran's demands for ending the war: the removal of Hussein from power and the payment of war reparations.

Yet, despite Iraq's demonstrated willingness to use missiles against population centers, Desert Storm commanders and planners seemed generally unprepared to anticipate the impact Scud attacks would have on the conduct of Coalition operations. They misjudged the political impacts of these weapons and underestimated the number of resources which would be required to attempt to suppress Iraqi missile operations. As in WW II, air power was utilized in the Gulf as the primary means to stop enemy missile launches, however in both cases the results were at best inconclusive and at worst, as some critics contend, an absolute failure. Allied air forces in 1944-45 and Coalition air forces in 1991 employed offensive and defensive efforts to counter enemy SRBM

operations. While defensive efforts played a critical role in countering the threat, this paper will only address offensive operations taken against enemy missiles.

The use of air power to counter enemy ballistic missile operations in both WW II and the Gulf represented the most logical option since it offered the greatest chance of success. But, as with all military operations, counter-missile operations were conducted by diverting resources from other critical mission areas, such as interdiction and close air support. By understanding just how difficult ballistic missile suppression operations were in WW II and the Gulf, future planners faced with similar circumstances can properly anticipate the requirements and effectively plan for the appropriate allocation of air power resources.

The Congressional Research Service lists many states as possessing, or moving to incorporate, ballistic missiles into their operational inventories. These include: China, Egypt, India, Iran, Iraq, Israel, Libya, North Korea, Pakistan, Russia, Saudi Arabia, South Africa, South Korea, Syria, Taiwan, and Yemen.<sup>3</sup> Almost any nations aspiring to regional power status will likely attempt to develop or procure ballistic missile technology because generally missiles cost less than aircraft and offer an excellent method of delivery of either conventional, nuclear, biological, or chemical warheads. Additionally, the trend is toward increasing range, accuracy, lethality, and sophistication. By the year 2000, over 20 states will possess either SRBMs or the technology required for their manufacture.<sup>4</sup>

#### Notes

<sup>1</sup>Wesley Frank Craven and James Lea Cate, eds., *The Army Air Forces in World War II*, vol. 3, *Argument to V-E Day, 1944-1945* (1948; new imprint, Washington, DC: Office of Air Force History, 1983), p.84

## Notes

<sup>2</sup>*Conduct of the Persian Gulf War, Final Report to Congress, Title V Report* (Washington: United States Government Printing Office, 1992), p. 13.

<sup>3</sup>John Harvey, "Regional Ballistic Missiles and Advanced Strike Aircraft—Comparing Military Effectiveness," *International Security*, Volume 17, Number 2, Fall 1992, p. 41. Despite the systematic reduction of Iraq's ballistic missile program during and after the Gulf War, Baghdad is still assessed to possess some ballistic missiles. GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 321.

<sup>4</sup>Secretary of Defense, *Annual Report to the President and Congress* (Washington, DC: United States Government Printing Office, January 1994), pp. 51-56; and, Robert M. Soofer, "Joint Theater Missile Defense Strategy," *Joint Force Quarterly*, Autumn 1995, pp. 71.

## Chapter 3

### Crossbow

#### Overview

In early June 1944, within days after the Allies launched operation Overlord, the invasion of occupied France, Germany unleashed a massive ballistic and cruise missile offensive against England. Originally, Hitler had established the end of December 1943 as the target date for the start of a combined V-1 and V-2 missile offensive.<sup>1</sup> Due to the cumulative effects of Allied offensive air operations and German technical delays; however, the first attacks did not occur until 12 June 1944. In 1943 the German objective was to attack the United Kingdom with approximately 94,000 tons of high explosives per month and by 1945 they estimated they could strike southern England with one million tons of explosives per year. *This equals 60 percent of the total Allied Combined Bomber Offensive (CBO) tonnage dropped during 1944, the best year of the CBO!*

Without question, if achieved, especially given the small geographic nature of southern England, the course of the war could have been altered. General Dwight D. Eisenhower conceded this point in *Crusade in Europe*:

... if the Germans had succeeded in perfecting and using these new weapons six months earlier, *our invasion of Europe would have been exceedingly difficult, perhaps impossible* ... if the Portsmouth-South-

hampton area had been one of the principal targets, *Overlord might have been written off* (emphasis added).

To counter the potential impact of German missile operations, the Allies executed operation Crossbow—the combined offensive and defensive air operations aimed at neutralizing the V-weapon threat to Overlord and Southern England. Ultimately, due in part to Crossbow, and other Allied operations, the Germans did not achieve their primary goals. Nevertheless, V-weapon suppression efforts had a tremendous impact on Allied air planning. Crossbow impacted not only the conduct of the CBO, but also strained the resources supporting Overlord.

Despite the Allies best efforts, the Germans succeeded in launching approximately 15,500 V-weapons between June 1944 and March 1945, thereby forcing Eisenhower to initially direct Crossbow to take priority over all other Allied air operations, including those in Normandy. By the end of the war suppression of V-weapons accounted for just over 69,000 strike sorties that delivered almost 137,000 tons of munitions. Clearly, the Germans created a major diversionary problem and if this threat was not neutralized quickly the continued diversion of scarce air power resources away from both the Normandy lodgment and the CBO could jeopardize the entire Allied war strategy.

### **Nature of V-Weapon Threat**

As a result of the restrictions imposed on German military forces following World War I, the German Army began experimenting with missiles powered by jets and rockets in the 1920s.<sup>2</sup> By the mid-1930s the basic long range missile designs were developed and successes in early guided missile experiments led to the German Army establishing the specifications for the A-4 missile, more commonly described by its propaganda name of

*Vergeltungswaffe Zwei* (V-2), in February 1936.<sup>3</sup> Hitler, however, initially showed little interest in this technology, but following the *Luftwaffe's* defeat in the Battle of Britain, and the series of heavy raids by the RAF Bomber Command on German cities, he increasingly saw utility in the V-2 and began to realize it had the potential to be the decisive weapons of the war. In July 1943, he gave his final approval for full-scale development and directed it be given the highest priority possible to attack England as soon as possible. Not to be out done by the German Army, the *Luftwaffe* formally began work on its own V-weapon, the FZG 76 jet-powered flying bomb, or *Vergeltungswaffe Ein* (V-1), in June 1942. Hitler also approved it for production for in 1943.

Both weapons were designed to essentially deliver the same size warhead to the same range. The German concept of operations called for the bombardment of Great Britain from the French coast using a combination of V-1 and V-2 weapons, plus a long range "super gun" fixed artillery system which never reached operational status. Series production of the V-1 was to be 6,000 per month with a total production of 60,000 airframes. The V-2 was to be built at a rate of 900 per month, although later Hitler ordered the number increased to 2,000, for a total production effort of 12,000 missiles. Neither production level was ever reached, but eventually some 30,000 V-1s were built, of which over 16,500 were used, and almost 6,000 V-2s were built with about 3600 operationally launched. A comparison of their capabilities are as follows:

**Table 1. V-1/V-2 Comparison**

| <b>V-1 (FZG 76 Flying Bomb)</b>                                                                      | <b>V-2 (A-4 Ballistic Missile)</b>                                                                   |
|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Range: 160 miles<br>Max Speed: 350 mph<br>Warhead: 1,870 lbs<br>Length: 25.4 feet<br>Span: 17.7 feet | Range: 190 miles<br>Max Speed: 3,800 mph<br>Warhead: 2,200 lbs<br>Length: 47 feet<br>Span: 11.7 feet |
| <u>Production and Employment (est)</u><br>Planned: 60,000<br>Built: 30,000<br>Used: 16,500           | <u>Production and Employment (est)</u><br>Planned: 12,000<br>Built: 6,000<br>Used: 3,600             |

Essentially Hitler began to view the V-weapons, especially the V-1 and V-2 as weapons that could achieve what the *Luftwaffe* could not do, force Great Britain to agree to a negotiated settlement to the war. For example Colonel Walter Dornberger, program manager for the V-2 missile, advised Hitler that following the start of the V-weapons offensive against Southern England that “such a storm of protest and war-weariness [will result] that the [British] government *will* be overthrown.”<sup>4</sup> Therefore, V-weapons were viewed as more than merely “vengeance” weapons for reprisal against the United Kingdom, Hitler believed “with it we will force England to her knees.”<sup>5</sup> Additionally, the Allies became increasingly concerned that a massive assault on London and Southern England could force either the postponement or significant disruption of Overlord.

### **Allied Intelligence and Warning**

By late-1942 the British government was receiving increasingly frequent reports of new German “secret weapons.” By March 1943 a substantial body of information was gathered and “unambiguous warning” of German intentions to develop long range

weapons to attack Britain, possibly with chemical, biological, or nuclear weapons was given to Prime Minister Churchill and the War Cabinet. In response, Churchill set-up a special panel to consolidate all available intelligence on German rocket programs and to recommend potential counter-measures. The technical estimates put together by this committee and Air Ministry intelligence were very accurate for both the V-1 and V-2 programs. These were fully circulated throughout the British government between June and September 1943. By November 1943, the threat had fully materialized and the War Cabinet directed an intensification of on-going reconnaissance and bombing operations.

Throughout 1943, intercepted German communications, agent reports, POW debriefings and photographic evidence linked the activities at Peenemünde, a military research facility on the German Baltic coast, with large unconventional military installations under construction along the northern coast of France. By late 1943 all of the pieces of the puzzle had come together—Hitler had developed new weapons to attack England and it was clear Allied commanders would be required to stop the employment of these mysterious weapons before they could alter the outcome of the war. The British were focused on the V-2 as the more significant threat, but after an extensive aerial reconnaissance effort in late-1943 revealed the extent of the V-1 program the decision was made to develop a counter-measure plan.

Without hesitation they turned to air power. This effort was code named Crossbow in December 1943, and eventually it included all Allied efforts against German V-weapons—both defensive and offensive.<sup>6</sup> Initial intelligence estimates properly categorized the magnitude of the threat. Both agent reports and Ultra, the information derived from decrypted German communications, provided substantial warning of German intentions

and capabilities. The breakdown in communication came as a result of the failure by the British government to properly divulge the full weight of their intelligence to US authorities until December 1943.

At this point in the war the US was fully dependent upon British intelligence services for virtually all information on German military capabilities. Once all of the critical details were disclosed, American leadership, both military and civilian, rapidly realized the impact V-weapons could have. The most conclusive intelligence estimate was forwarded by Eisenhower to Generals "Hap" Arnold and George Marshal in December 1943. It claimed "the equivalent of at least a 2,000 ton bombing attack [could be achieved] in a period of 24 hours."<sup>7</sup> This compares favorably with German planning figures which called for a maximum of just over 3,000 tons per day by mid-1944.<sup>8</sup>

### **Crossbow Planning**

To determine planning requirements, the Allies established a series of combined planning cells to determine the best strategy for reducing missile capabilities; yet none of the organizations effectively and fully integrated operations to the satisfaction of either the US and Great Britain. In December 1943, a combined Crossbow office was established when London finally shared their full details of the magnitude threat with the US. This office, dominated by British officers, directed Anglo-American operations against all elements of German long range missile programs including research facilities, manufacturing plants, storage sites, launch sites, and airborne intercept operations until July 1944. Throughout Crossbow the British were focused on the physical destruction of the V-weapon launching facilities as the best means to stop German operations.

Prior to December, countermeasure operations were largely conducted by Royal Air Force (RAF) units with some support by the United States Army Air Force (USAAF). Once formalized, Crossbow operations continued until essentially March 1945 when the threat to Great Britain was finally eliminated, although the last V-weapon was launched only a few days prior to Germany's surrender in May 1945. *The objectives of Crossbow were to "delay the beginning of attacks and to limit their intensity once begun."*<sup>9</sup> Overall, the principle focus of the campaign was from August 1943 until August 1944 as the number of associated targets proliferated and counter-measure operations intensified. Only after July 1944 was a fully integrated combined organization created and as a result formally coordinated countermeasure plans were not developed and approved until after the threat had diminished.

Crossbow offensive operations can be divided into two phases: Crossbow I, April 1943 to early-June 1944, and Crossbow II, mid-June 1944 to May 1945. The first phase consisted of the initial identification of the V-weapons target set, primarily by aerial reconnaissance, and attacks against German-based research facilities plus the operational launch and support facilities being built in France. The second phase was more active, and arguably more critical, because it attempted to stop missile operations once strikes against England and other targets started. This phase broadened the focus of bombing to include supply sites, supporting infrastructure, and production facilities. The net result of both phases was the entire enemy V-weapon "system" was attacked—research and development facilities, manufacturing plants, transportation nodes, supporting electric grids, storage areas, and launch sites.

To British planners from August 1943 until August 1944 none of the potential target sets except the launch sites in France appeared to be very lucrative. USAAF leadership took a differing view and from the beginning of Crossbow wanted to focus bombing efforts on production and electric grids supporting the launch sites, but they were overruled until after August 1944.<sup>10</sup> In retrospect, a final analysis shows that no single target or target set existed which could have halted German missile operations—the positive effects Crossbow had on hindering missile employment resulted only from the cumulative effects of repeated operations against all elements of the V-weapon “system.”

### **Crossbow Phase One—April 1943 to June 1944**

Crossbow operations started in earnest in April 1943 when the RAF inaugurated an aerial reconnaissance based on tips from agents and Ultra of potential launch areas on the continent. Between 1 May 1943 and 31 March 1944, nearly 40 percent of all reconnaissance sorties flown from the United Kingdom were devoted to Crossbow. The focus of reconnaissance operations was to photograph the area extending from the French coast inland up to 100 km from the Belgium-French border southeastward to the French coast. This area covered a 300-km deep approach to London and Bristol. Eventually every square foot of land was photographed from Ostend, Belgium, southwest along the coast to France to Le Havre, as well as the entire northern half of the Cherbourg peninsula.<sup>11</sup>

During this effort, 103 V-weapon associated sites were identified, seven “large” sites and 96 V-1 ski launch sites, so named because they resembled ski-jumps. The seven “large” sites were mainly underground with reinforced concrete walls seven-to-ten meters thick. Although in 1943-1944 all seven sites were assessed to be V-2 launch facilities,

post-war inspection showed only one was intended to support V-2 launches; the others six were either V-1 launch sites or associated with general V-weapons production, storage, and assembly. Each of the 96 ski sites contained reinforced concrete structures including two 90 meters long ski buildings specially designed to launch V-1s. These numbers compare well with German records which revealed they identified 150 potential V-1 launch sites, of which 96 were under construction; of these, 74 were over half complete and 22 complete by early-1944.

Offensive air operations against V-weapon facilities began on 17 August 1943 when 571 RAF bombers dropped nearly 2,000 tons of high explosives and incendiaries on Peenemünde, the V-weapon research facility on the Baltic coast. The success of this attack is disputed, but three firm conclusions can be drawn: (1) the Germans received full warning of Allied intentions to target their new weapons; (2) they proceeded to disperse V-weapon developmental activity from Peenemünde, primarily to Poland; and, (3) the Allies gained time because it delayed further V-2 testing by a two months.<sup>12</sup>

Within ten days of the Peenemünde raid the Eighth Air Force, at British request, and without fully knowing "why," began a series of attacks against the "large" sites in France. Ultimately, air attacks were expanded to cover all of the V-weapon targets and all tactical and strategic elements of Allied Air Forces stationed within Britain participated. The initial medium bomber operations against the smaller ski sites were ineffective and costly; therefore, in December 1943 Eighth Air Force heavy bombers were first employed in large numbers against these sites.<sup>13</sup> By spring of 1944 a more or less fixed pattern of bombing operations emerged. Large raids flown by heavy bombers, primarily B-17s, which were supplemented by almost continual raids by medium bombers and small-scale fighter-

bomber attacks. This established the basis for a British-American dispute over the best application of air power resources that was never fully resolved.<sup>14</sup>

### **Crossbow Phase One Results**

Between August 1943 and early-June 1944, the USAAF and RAF inflicted Category A damage (neutralized for several months) on V-1 ski sites 107 times (including re-attacks).<sup>15</sup> By the spring of 1944 the German's abandoned the vast majority of these sites—bombing had forced them to fundamentally alter their plans for V-1 and V-2 employment.<sup>16</sup> Starting in February 1944, they developed a “modified” ski-site, requiring less preparation to support V-1 operations. These sites utilized extensive camouflage, concealment, and deception (CC&D) and mobility techniques to enhance survivability.<sup>17</sup> The same practices for V-2 operations were adopted later. The Allies almost immediately became aware of the “modified” ski-sites; however, direct attack was almost impossible due to the small signature of each site combined with the German's highly effective CC&D program.

By May 1944, the Germans had moved adequate supplies of V-1 components to initiate an offensive prior to D-day; however, due in part to Allied bombing another month was required to bring the 155th Flak Regiment (W), the unit responsible for V-1 operations, to full readiness.<sup>18</sup> In retrospect this 30 day delay cost the German's their *only* chance of achieving their primary objectives since an early assault may have forced a postponement of Overlord. Herein lies Crossbow's greatest achievement. By disrupting initial production and deployment schedules, Allied air attacks amplified the technical delays the German's were experiencing. These cumulative disruptions allowed D-Day to

be executed without interference, thereby sealing the fate of the Third Reich. The United States Strategic Bombing Survey (USSBS) concluded:

There is good evidence that countermeasures delayed the beginning of V-1 attacks by *three* months or more . . . delay in the beginning of V-2 attacks amounted to approximately *six* months.<sup>19</sup>

To achieve these results, the Allies flew 25,100 sorties; 9,850 strategic and 15,300 tactical between December 1943, the official start of Crossbow, and June 1944. Anglo-American forces lost 154 aircraft and 771 airmen, including 79 aircraft and 610 airmen by the USAAF. At times the demands for Crossbow attacks diverted sorties from Overlord preparations, principally from the medium bomber force, although during this phase Crossbow did not seriously impact CBO missions.<sup>20</sup> Spaatz expressed some concerns to Eisenhower and Arnold, but it never became an overriding critical issue. Overall, the tonnage expended on Crossbow targets amounted to almost eight percent of the total tonnage dropped by the USAAF and the RAF between December 1943 and June 1944.<sup>21</sup>

### **Crossbow Phase Two—June 1944 to March 1945**

The second phase of Crossbow started six days after D-Day after V-1 attacks were initiated against England from the “modified” ski sites. On the night of 12/13 June the 11 V-1s were launched and four struck London. At first the Allies reacted with only a single strike—36 B-17s delivering 101 tons of bombs against a V-1 supply site. This limited response later became politically unacceptable because on the night of 15/16 June, nearly 300 V-1s were launched against England, with 73 striking London. The potential impacts on British and American morale were tremendous and Eisenhower saw an additional risk to his supply lines.<sup>22</sup> Prime Minister Churchill, representing the desires of the British War

Cabinet, immediately ordered General Eisenhower, who fully supported the requirement, to take all possible measures to neutralize the V-1. Shortly thereafter General Eisenhower, using his authority to direct all Allied bombing efforts, ordered, through Air Marshal Tedder, Crossbow operations to take priority over everything except urgent requirements in Normandy. On 16 June Tedder issued a memo providing explicit direction:

. . . Crossbow targets are to take first priority over everything except the urgent requirements of the battle; this priority to obtain until we can be certain that we have definitely gotten the upper hand in this particular business.<sup>23</sup>

In response, Eighth Air Force and RAF Bomber Command were directed against known V-1 sites and supply facilities. To reinforce the seriousness of the situation, Eisenhower again provided further guidance on allocations two days latter. He ordered the V-1 sites to "receive first priority over all other targets, either in France or Germany."<sup>24</sup> Within two weeks, 8,310 sorties delivering 23,431 tons of bombs were diverted from other missions. This shows the Germans had created a diversionary problem of the first magnitude and if this threat was not neutralized quickly the diversion of scarce air power resources away from the Normandy lodgment and the CBO could potentially jeopardize the entire Allied war strategy, especially if the Germans mounted a successful counter-offensive against the Normandy beachhead.

From the beginning of Crossbow II, Spaatz objected to the amount of effort being devoted to attacking V-weapon sites. Spaatz, like most USAAF commanders in Europe, believed the bombings of launch sites by heavy bombers accomplished little. He contended that the Germans had hardened the "large" sites, making them essentially impervious to bombing, and the smaller V-1 launch facilities were too difficult for heavy bombers to

successfully hit.<sup>25</sup> He was correct in his analysis for small V-1 launch sites, but not for the seven "large" V-weapon complexes. Despite some initial problems, by June 1944 USAAF and RAF fighter and medium bombers were more successful in achieving Category One damage against V-1 sites than heavy bombers. On the other hand, bombardment by heavy bombers against the "large" sites did force the Germans to abandon them by the spring of 1944, however they continued to repair bomb damage partly because the Allies kept attacking them. In essence the "large" sites became "bomb magnets" and a large number of sorties and munitions were wasted by repeatedly attacking them.

The British, however, who controlled Crossbow target selection until July 1944, refused to accept these points and continued to direct heavy bomber sorties against non-operational V-weapon facilities with negligible results. Spaatz finally appealed directly to Eisenhower in late June to allow strategic bombers to turn their primary focus away from Crossbow, but the increasing political pressure on the British government from public reaction required Eisenhower to *increase* rather than *decrease* the frequency of attacks against French V-weapon sites.<sup>26</sup>

June through August 1944 was the most critical period of Crossbow. During this period the V-1 assault on London reached its climax; approximately 6,700 V-1s were launched against England,<sup>27</sup> the vast majority directed against London. Despite the Allies best efforts, German operations remained virtually unchanged throughout the summer with an average of 81 V-1s launched per day (316 on 2 August). Of these about 65 percent hit "something."<sup>28</sup> RAF defenses successfully shot-down most of the rest.

During this period the demands placed on Allied air resources reached its peak due to multiple on-going operations competing for the same resources. These included support to

ground force operations, transportation plan targets, the CBO, and Crossbow. However, the vast number of resources available to the Allies prevented any crisis. One point often argued is that Crossbow *was a significant factor in delaying the full initiation of the CBO* by the Eighth Air Force. The USSBS and other post-war studies concluded that the effect on diverting Eighth Air Force bombers from the CBO was minimal.<sup>29</sup> Only 12 percent of Eighth Air Force missions available during June 1944–March 1945 were diverted to support Crossbow; however, when other operational factors (weather and *other* requirements) are considered the total diversion from the CBO amounts to only 6,100 sorties being diverted from missions against CBO targets.<sup>30</sup>

The impact on RAF Bomber Command was more significant and amounted to 40 percent of total effort in July and August 1944 being diverted.<sup>31</sup> The greatest diversions, however, occurred within the tactical air forces; especially starting in January 1944 and continuing until September 1944. Basically, during the summer of 1944 tactical air forces either flew missions in direct support of the French battle area or Crossbow. All other targets, such as transportation, fuel dumps, airfields, electrical, and other electronic installations were tasked to the strategic air forces.<sup>32</sup>

German V-1 operations against England stopped on 3 September after the 155th Flak Regiment (W) was ordered to cease operations and evacuate across the Somme River following the Allied breakout from Normandy. By mid-September all V-weapon sites in France were over-run by Allied ground forces. Following the loss of French sites, the Germans shifted their focus to V-2 attacks against England from Holland while resuming V-1 attacks using both a bomber launched variant and a ground launched extended range variant. These operations lasted from 4 September 1944 until 3 April 1945. Despite the

introduction the V-2, German operations after early September were viewed with less alarm by both the British public and government. This resulted in a reduction in emphasis by Supreme Headquarters, Allied Expeditionary Force (SHAEF). Nevertheless, Crossbow operations continued, albeit at a lower tempo and therefore the strain caused by resource allocations diminished. By the end of the war, the Germans launched some almost 19,700 V-1 and V-2 missiles, including almost 10,365 Vs the United Kingdom.<sup>33</sup>

Allied operations after August 1944 were characterized primarily by fighter-bomber and medium-bomber operations against suspected launch sites or areas. Heavy bombers reoriented their focus to the CBO, although they continued to attack V-weapon associated production facilities and industries in Germany. Additionally, both RAF Bomber Command and the Eighth Air Force conducted attacks against airfield, primarily in Holland, associated with air-launched V-1 operations.<sup>34</sup>

### **Crossbow Phase Two Results**

This phase can be characterized as three months of crisis followed by eight months of relative calm. Although the strategy and tactics used against the V-weapons varied from June 1944 to April 1945, nothing seemed to effectively stop, or even hinder, German missile launches. By May 1945 all elements of the V-weapon target set had been attacked, from production facilities to operational infrastructure and launch sites.

Despite the application of a significant amount of force, air power failed to stop, or significantly slow, German missile operations after June 1944. During the July-August 1944, the period of the highest intensity for V-1 operations against England (almost 85 launches daily), more than 250 V-1 associated targets were attacked; however, launches

against England from French soil only stopped after Allied ground forces over-ran V-1 launch areas. Even this success was temporary, since V-2 missile attacks opened against England on 8 September 1944 when the first of 1,115 missiles struck.

However, unlike the response to the V-1 threat, the Allies determined that limited resources would be targeted against the V-2s. These were primarily heavy bomber strikes against production facilities and fighters flying armed reconnaissance over suspected V-2 operating locations. The reason for this shift in strategy was due in part to the nature of the weapon, the V-2 offered virtually no warning before it struck its target. Also, the ground war had shifted heavily in the Allies favor and "victory" before spring was highly likely. Overall, air efforts against the V-2s, like those against V-1s, have little effect in slowing the tempo of missile launches and ultimately it was the success of Allied ground operations which forced an end to German missile strikes.

### **Crossbow Summary**

While the Allies succeeded in destroying or neutralizing most V-weapon targets, the Germans displayed an incredible capability to continue launching V-1s and V-2s. The USSBS concluded air attacks against the entire V-weapon "system" slowed the introduction of the V-1 and V-2 by three-to-six months. Therefore Crossbow achieved one of its stated objectives: *"delaying the beginning of the attacks."* The result was the Allies successfully acquired the time needed to execute Overlord before the full impact of Hitler's "secret" weapons could be realized. Both Generals Eisenhower and Bradley make this point in their autobiographies.<sup>35</sup> *This allows phase one of Crossbow to be labeled a "success;" however, without question, the second phase, Crossbow II, must be labeled a*

*dismal failure*. Air power failed to achieve its objective of “*limiting the intensity*” of either the V-1 or V-2 once German launch operations began.<sup>36</sup> German sources contend that they never failed to launch due to direct intervention by Allied air power or a shortage in weapons.<sup>37</sup> On the other hand, Allied leaders devoted a significant effort to suppressing the threat at the expense of other critical missions such as the CBO, transportation plan, and Overlord support. The overwhelming number of assets at their disposal allowed Allied commanders to handle the diversions with minimal disruption to the overall war strategy and it was only during the critical summer months of 1944 that the diversion of resources significantly impacted the execution of other mission areas.<sup>38</sup>

### **Crossbow Sortie Allocations (1943-1945)<sup>39</sup>**

#### **Strategic Air Forces**

Crossbow operations between August 1943 and April 1945 consumed 68,913 strike sorties which delivered 136,789 tons of munitions. Overall, strategic air forces flew 53 percent of all Crossbow sorties (36,795) and delivered 84 percent of all tonnage (114,790). This equates to 5.6 percent of all strategic air force sorties and 6.8 percent of all tonnage delivered between 1939-1945. During the height of Crossbow, August 1943 to August 1944, 14 percent of all strategic air force sorties and 16 percent of total tonnage was devoted to it.

#### **Tactical Air Forces**

Tactical air forces flew 47 percent of all Crossbow sorties (32,091) while delivering only 16 percent of the total tonnage (21,999). From August 1943 to August 1944 tactical

air forces devoted 17 percent of total sortie generation and 13 percent of total tonnage to Crossbow operations.

- Strategic Air Forces (8th AF and RAF Bomber Command): 36,795 or 5.6 Percent of all Sorties Flown
- Tactical Air Forces [9th AF and RAF 2nd (TAF): 27,491 or 17 Percent of all Sorties Flown
- RAF Fighter Command: 4,600 or 79 Percent of all Offensive Sorties Flown
- Reconnaissance: 4,000 or 40 Percent of all Sorties Flown

### **Crossbow Observations**

The Crossbow provides many valuable lessons, especially regarding combined operations. Throughout the planning and execution of Crossbow the entire campaign was characterized by communications breakdowns and arguments over strategy and tactics. First and foremost was in the area of intelligence sharing. The reluctance by the British to divulge the details of the German missile programs until December 1943 severely hampered planning. This reluctance, driven by their desires to not share the full extent of their knowledge until after they had a full understanding of the German programs, caused many American military leaders to misjudge the magnitude and potential impacts of the V-weapons. Had the British government disclosed the full extent of their knowledge sooner, the formulation of a coherent Allied strategy may have solidified before the on-set of the V-1 crisis.

Second, once Crossbow was established, an extensive debate erupted over the best methods of achieving neutralizing the threat. The British believed the destruction of the ski launch sites by heavy bombers would provide the best “means to an ends” while American airmen believed destruction of the supporting infrastructure (production, transportation, and electric support) by heavy and medium bombers would complement fighter-bomber

attacks against the ski sites.<sup>40</sup> These differences were never fully resolved and only after extensive air operations failed to slow V-1 launch rates in June-July 1944 was the American strategy fully accepted and implemented.

The net result was there was a significant confusion in policy and strategy resulting in wasted resources. For example, even after Allied intelligence confirmed the “large” and “fixed” ski sites were non-operational in July 1944, political pressure by the British government required Spaatz to continue to send B-17s and B-24s against them. This resulted in the creation of “bomb magnets.” Throughout 1944 the Germans attempted to prove, as much to themselves as to the Allies, that they could rebuild or repair faster than the Allies could destroy. As a result, the Allies were using precious resources to attack militarily insignificant targets while ignoring the legitimate requirements of either pursuing the CBO or better supporting the ground operations.

The psychological impacts of the V-weapons out far weighed the physical destruction they caused. Had the Germans been successful in mounting an operation similar to the one they originally planned then they could have achieved their objectives. However, due to a combination of factors, the eventual operation was not as destructive as planned. But, the critical factor, especially in a democracy, is not always related to the amount of physical destruction endured by the populace. British morale sank following the initiation of V-weapon operations and the Allies were forced to respond. Again, the lack of a coherent, agreed strategy resulted in commanders “throwing” resources at the problem to instill confidence in the population that they were doing “something,” even if it was not successful. This is the position the Allies found themselves in by June 1944

Overall, as previously stated, while Crossbow operations did delay the introduction of V-weapons until May-June 1944, it did not seriously hinder or halt launch operations once initiated. In retrospect it appears it would have been more effective to adopt a strategy closer to American recommendations augmented by additional defensive operations.<sup>41</sup> This opinion is reinforced by the fact that the greatest impacts on V-weapons employment operations resulted mainly from the indirect benefit bombing caused on disrupting the German production distribution system and the eventual over-running of launch facilities by Allied ground forces. Ultimately, air operations were unable to stop V-2 launch operations. Against this backdrop, we now shift our focus ahead nearly fifty years to 1990–1991 and the challenge faced by United States and Coalition forces when confronted by Iraqi ballistic missiles during the Gulf War.

### Notes

<sup>1</sup>The “V” designation originally meant *Versuchmuster* (experimental type), but was later interpreted as *Vergeltungswaffe* (vengeance weapon) by German propaganda services.

<sup>2</sup>Some historians argue that it was the Allies who sparked German interest in exploring the military applications of missiles because of the terms of the Treaty of Versailles (1919) forbid the manufacture of heavy artillery.

<sup>3</sup>By 1939 one third of Hitler’s aerodynamic research budget was devoted to ballistic missile programs.

<sup>4</sup>R. J. Overy, *The Air War, 1939-1945* (New York: Stein and Day Publishers, 1980), p. 81.

<sup>5</sup>Dieter Holsken, *V-Missiles of the Third Reich, The V-1 and V-2* (Sturbridge, Massachusetts: Monogram Aviation Publications, 1994), p. 169.

<sup>6</sup>The focus of my paper is on offensive counter-measures, but the Allies also poured a tremendous amount of resources into defensive measures; by the height of the V-1 assault some 2,000 barrage balloons, 400 batteries of anti-aircraft artillery, and 22 squadrons were deployed to defend London. Jozef Garlinski, *Hitler’s Last Weapons* (New York: Time Books, 1978), p. 162.

<sup>7</sup>Headquarters, European Theater of Operations, G-2, memorandum to the Chief of Staff, United States Army, providing all known details on German V-weapon programs, 13 December 1943, p. 4.

## Notes

<sup>8</sup>United States Strategic Bombing Survey (USSBS), Military Analysis Division, *V-Weapon (Crossbow) Campaign*, 1945, p. 4.

<sup>9</sup>*Ibid.*, p. 2.

<sup>10</sup>Richard G. Davis, *Carl A. Spaatz and the Air War in Europe* (Washington: Smithsonian Institution Press, 1992), p. 428.

<sup>11</sup>Craven and Cate, pp. 89-93.

<sup>12</sup>F.H. Hinsley, *British Intelligence in the Second World War*, Abridged Edition, (London: Her Majesty's Stationary Office, 1993), p. 421.

<sup>13</sup>Typically it required 195 tons delivered by B-17s to neutralize a ski site, whereas it required about 235 tons when medium bombers were utilized.

<sup>14</sup>In early 1944 the AAF conducted a series of tests at Eglin Field to determine the best method to attack the V-1 sites—these tests concluded that low-altitude attacks by fighter-bombers using 1,000–2,000 lb. bombs were more effective than either medium or heavy bombers. This point was never really accepted by the RAF or Air Marshall Leigh-Mallory, *C-in-C*, AEAf. Craven and Cate, pp. 97-99.

<sup>15</sup>Craven and Cate, p. 105.

<sup>16</sup>Post-war analysis shows neither V-1s nor V-2s were successfully launched from “fixed” sites.

<sup>17</sup>Phillip Henshall, *Hitler's Rocket Sites* (New York: St. Martin's Press, 1985), p. 188.

<sup>18</sup>David Johnson, *V-1 and V-2, Hitler's Vengeance on London* (New York: Stein and Day, 1981), p. 46.

<sup>19</sup>USSBS, *V-Weapon (Crossbow) Campaign*, p. 2.

<sup>20</sup>In March 1944, Eisenhower directed the acceleration of Crossbow operations, but maintained Pointblank as the primary mission objective for strategic air forces. This policy held until 19 April 44 when Crossbow became the number one priority. At this point the CBO was essentially placed on hold until after D-Day preparations were completed.

<sup>21</sup>Major General Haywood Hansell, *The Air Plan that Defeated Hitler* (Atlanta: Higgins-McArthur/Lohgino & Porter, Inc.), p. 200.

<sup>22</sup>General Dwight David Eisenhower, *Crusade in Europe* (New York: Doubleday, 1948), pp. 259-260.

<sup>23</sup>Craven and Cate, p. 527.

<sup>24</sup>Davis, p. 428.

<sup>25</sup>*Ibid.*

<sup>26</sup>The casualties from the V-1 attacks were grave: 5,864 killed; 40,371 injured; some 24,500 buildings destroyed and 52,293 so badly damaged the inhabitants were forced to leave. The magnitude of the problem the British government faced from V-1 attacks is illustrated following: over a million Londoners moved to the country at their own expense while another 250,000 traveled at government expense to remove small children and their mothers from harm's way.

<sup>27</sup>The breakout for this period is: 12 June-14 July: 2,934; 15 July-15 August: 2,667; and, 15 August-3 September: 1,115.

## Notes

<sup>28</sup>The primitive guidance system on the V-1 did not allow for pin-point targeting, therefore if the missile exploded on British soil it was considered a successful mission.

<sup>29</sup>Juliette Hennessy, *Tactical Operations of the Eighth Air Force*, USAF Historical Study 70 (Maxwell AFB, AL: USAF Historical Division, Air University, 1952), p. 175.

<sup>30</sup>*Ibid.*, p. 176.

<sup>31</sup>USSBS, *V-Weapon (Crossbow) Campaign*, p. 33.

<sup>32</sup>Craven and Crate, p. 529.

<sup>33</sup>Additionally, another 9,496 V-1 and V-2 missiles were launched against Continental targets, primarily Antwerp in an effort to disrupt Allied supply lines. SHAEF A-2 (Intelligence) Study, *Report of 'V' Section on Continental CROSSBOW (September 1944–March 1945)*, July 1945.

<sup>34</sup>*Ibid.*, p. 543.

<sup>35</sup>Eisenhower, p. 260 and General Omar Bradley, *A General's Life* (New York: Simon & Schuster, 1983), p. 238.

<sup>36</sup>USSBS, *V-Weapons (Crossbow) Campaign*, p. 2.

<sup>37</sup>Phillip Henshall, *Hitler's Rocket Sites* (New York: St. Martin's Press, 1985), p. 187.

<sup>38</sup>Walter Boyne, *Clash of Wings, World War II in the Air* (New York: Simon and Schuster, 1994), p. 338.

<sup>39</sup>USSBS, *V-Weapon (Crossbow) Campaign*, pp. 25-29.

<sup>40</sup>The British and Americans agreed the "large" sites required attack by heavy bombers to be effective.

<sup>41</sup>Defensive operations were increasing effective and by mid-August they were successfully shooting down 74 percent of all V-1s crossing the coast. This improved to 83 percent by September. F.H. Hinsley, *British Intelligence in the Second World War* (Abridged Edition), (London: Her Majesty's Stationary Office, 1984), p. 567.

## **Chapter 4**

### **Operation Desert Storm**

The situation coalition planners faced in the Gulf War was not significantly different from those air planners grappled with in World War II.<sup>1</sup> Much like our invasion of Hitler's "Fortress Europe" which were designed to liberate Nazi-held areas, the focus of United Nations (UN) sanctioned and US-led operations was on the liberation of Kuwait during Desert Storm. The liberation of Kuwait also allowed the US to concurrently conduct operations designed to achieve other national objectives, most notably reduce Iraq's ability to continue to intimidate the regional nations through coercion.

To force the Iraqis to end their illegal occupation the UN issued a series of UN Security Council (UNSC) resolutions, culminating in the 29 November 1990 authorizing the Coalition forces assembled from 38 nations to use "all means necessary" to enforce previous UNSC resolutions if Iraq did not unconditionally withdrawal from Kuwait by 15 January 1991.<sup>2</sup> By mid-January, Coalition forces included approximately 1,800 combat aircraft and 540,000 ground troops. In total Coalition force exceeded 660,000 airmen, marines, sailors, and soldiers from around the world.<sup>3</sup> This represented the largest concentration of multi-national combat forces assembled together since the end of WW II. On 17 January 1991, Coalition forces began the execution of Desert Storm, a phased campaign designed to achieve UN and US objectives.

Once the decision was made in the late-fall 1990 to reinforce US forces in the Gulf, the spearhead for any counter-offensive operation, with the US (VII) Corps from Germany and additional combat units from the United States, it was clear that Hussein had few strategic options remaining to retain Kuwait since the strategic combat power relationships within the Gulf shifted decisively in the Coalition's favor. One option he did retain was the use of Scud missiles against Israel, to provoke a reaction he hoped would undermine the integrity of the Coalition, and against Saudi Arabia to intimidate Riyadh. Within 24 hours of the opening of Desert Storm, Iraq launched the first of at least 88 Scuds at Israel and the Arabian Peninsula.<sup>4</sup> This forced Coalition leaders to turn to air power to suppress the threat. Hussein, like Hitler, created a diversion of significant magnitude. Before the end of the Great Scud Chase, as the effort became known, several strategies were attempted and large numbers of Coalition sorties and strikes were consumed. Approximately 4,750 anti-Scud sorties were planned throughout the war, including the change or addition of 553 sorties. Daily Scud hunting sorties numbered between 75 and 160, or about 5 percent of planned daily sorties. The anti-Scud strategy had essentially three parts: first, pre-planned attacks against production, storage, and fixed sites; 24-hour patrols to disrupt pre-launch activities; and, 24-hour patrols to attack launch sites after they fired their missiles.<sup>5</sup>

Unlike the planners in WW II, US commanders and operations planners in the Gulf had the benefit of over a half-century of ballistic missile operations to prepare themselves for this onslaught. Therefore, while many of the mistakes made in by planners in designing and executing Crossbow are understandable, the initial under-estimation of Iraqi ballistic missile forces coupled with underestimating its impacts by General H. Norman Schwarz-

kopf, the Commander-in-Chief, United States Central Command (CINCCENT) and his Joint Force Air Component Commander (JFACC), Lieutenant General Charles Horner, Commander, US Air Forces, Central Command (CENTAF), and their planning staffs was inexcusable.<sup>6</sup>

Contrary to the post-war assessments made by several authors,<sup>7</sup> the existence and extent of Iraq's ballistic missile programs was fairly well understood. Although in retrospect some US pre-war technical estimates were less than 100 percent accurate, the general capabilities of Iraqi missile programs were well documented.<sup>8</sup> Additionally, Iraqi employment practices during its eight-year war with Iran, 1980-1988, were also well cataloged both by the US intelligence community and the academic world.<sup>9</sup> This information was available to military planners and highlights the fundamental problem that exists within the USAF today—we do a poor job of studying history to prepare for future conflicts.<sup>10</sup> Had Gulf War planners, both in Washington and theater, fully appreciated air powers difficulties during Crossbow and examined Hussein's employment of ballistic missiles during the Iran-Iraq war, there would have been fewer surprises.

### **Nature of the Iraqi Scud Threat**

The Iraqis developed a flirtation with employment of ballistic missiles against cities in the early part of the Iran-Iraq war. It was not until near the end of the war that they developed the necessary technology to range the Iranian capital and other major population centers. By 1988 Hussein came to view ballistic missiles as potential "*war winners*" after waging a highly successful "city-busting" campaign.<sup>11</sup> Between late February and mid-April 1988, Iraq launched almost 200 new extended-range Scud, the Al-Husayn,

missiles at Tehran and other Iranian cities. This effort, combined with continued Iraqi bomber raids and Iranian fears of that either could deliver chemical weapons, stretched the limits of the morale of the already war-weary Iranians.<sup>12</sup> Reportedly key Iranian government officials, along with over a million Iranians, fled Tehran by late-April.<sup>13</sup> The net result was that Tehran, following a series of highly successful Iraqi ground offensive operations, agreed to accept a humiliating United Nations-brokered cease-fire and end its eight-year war with Baghdad. Hussein had good reason to believe that his missile forces had a direct hand in forcing the Iranians to terminate the conflict and that ballistic missiles can be used to achieve strategic results. This would lead him to later employ almost 100 missiles against targets in Israel and Saudi Arabia during the Gulf War.

By the middle of 1990, the Iraqis had three mobile SRBMs in its inventory and all were based on nearly 40-year-old Soviet technology.<sup>14</sup> The basic Soviet-supplied 160 mile range SS-1/ Scud and two indigenous produced variants, the 325 mile Al-Husayn and the 400 mile Al-Hijarah.<sup>15</sup> A third, longer-range variant, the 430 mile Al-Abbas, was in development and was neither fielded nor used during the Gulf War.<sup>16</sup> Neither the basic Scud nor the indigenous produced Iraq systems possessed the accuracy to target discrete military installations or point targets, therefore all were intended to strike cities or other large area targets. From the outset of the crisis, therefore, Iraq's missiles were judged to be more of a psychological than a military threat. The two extended-range Scud missile systems used were:<sup>17</sup>

**Table 2. Al-Husayan v. Al-Hijarah Missiles**

| <b>Al-Husayn</b>                                                            | <b>Al-Hijarah</b>                                                             |
|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Range: 325 miles<br>Warhead: 200 lbs<br>CEP: 10,000 feet<br>Length: 40 feet | Range: 400 miles<br>Warhead: 200 lbs<br>CEP: > 10,000 feet<br>Length: 40 feet |
| <u>Production and Employment (est)</u><br>Possessed: Unknown<br>Used: 88    | <u>Production and Employment (est)</u><br>Possessed: Unknown<br>Used: 5       |

Hussein's Gulf War SRBM employment strategy was fairly straight forward and simple to understand. By attacking Israel with ballistic missiles he hoped to provoke a reaction that would result in Israeli aircraft or missiles over flying either Saudi Arabia or Jordan (or both) during a retaliatory strike against Iraq. He reckoned the Arab members of the coalition could never accept fighting along side Israel against another Arab state. Thus by striking Israeli cities he hoped to strike at the heart of Coalition unity.<sup>18</sup> A very Clausewitzian strategy indeed! To accomplish this Hussein had a robust, redundant ballistic missile force that had proven its ability during the Iran-Iraq war to accomplish strategic objectives.<sup>19</sup>

Despite this knowledge, US military authorities throughout the Gulf were seemingly caught by surprise when Hussein first initiated his missile attacks. Many senior leaders admit that they underestimated the impact of Hussein's missiles because of the Scud's notorious inaccuracy and small warhead weight.<sup>20</sup> General Schwarzkopf regarded the missiles as "militarily irrelevant." General Horner thought the missiles were "lousy weapons" and Horner's chief air planner, Brigadier General Buster Glosson, believed they were "not militarily significant."<sup>21</sup> All three were very wrong for two reasons. First, the

accuracy of the weapon had little to do with their political impact; the mere fact that the missiles might be carrying chemical or biological warheads greatly threatened Israeli leaders. Secondly, they failed to take appropriate military responses to attempt to stop the Iraqi missile launches. It was only after significant pressure was placed upon theater leadership from Washington that CINCCENT "got the message" and redirected his forces to attempt to stop, or at least try to suppress, missile launches.<sup>22</sup>

### **Coalition Intelligence and Warning**

Unlike the struggle WW II air planners faced in understanding the nature and scope of a completely new type of weapon, Gulf planners had far more experience and information to base their judgments upon. Iraqi SRBM technical capabilities were well understood and vast amounts of information on potential Iraqi employment strategies were available. Also, although the absolute number of Scud missile airframes available to the Iraqis was unknown, the Defense Intelligence Agency (DIA) had judged at least 600 had probably been delivered to the Iraqis by the Soviet Union.<sup>23</sup> Post-war disclosures showed Baghdad purchased around 800 missiles, many of which had been utilized to build Iraqi extended-range Scuds.<sup>24</sup> All three Iraqi produced Scud-variants could be launched from either fixed sites or mobile launchers. The Soviet-developed Scud is a mobile system launched from the eight-wheel MAZ-543 transporter-erector-launcher (TEL). The Iraqis retained the concept of mobility for their indigenously modified Scud systems. The TEL for the Al-Husayn and Al-Hijarah is either the MAZ TEL or the Al Waleed, an Iraqi modified Swedish-built SAAB-Scania heavy trailer to serve as a mobile-erector-launcher (MEL).<sup>25</sup>

The Iraqis utilized Soviet doctrine for the deployment and employment for their SRBMs. Launching procedures and time requirements were well known.<sup>26</sup> Based on Soviet and Middle Eastern models, the US intelligence community judged that the Iraqis would employ the system from mobile, concealed locations and that missile crews would maximize the cover of darkness for protection while moving to and from launch locations. Furthermore, Iraqi missile crews would require 60-90 minutes to set-up and launch a missile from a pre-surveyed site. This analysis proved correct during the course of the conflict.

In an apparent attempt to improve accuracy against Israel, Iraq constructed five fixed launching sites in its western desert near the Jordanian border. These complexes contained 28 launch positions which would allow the Al-Husayn missile to hit all major Israeli major cities, nuclear facilities in the Negev desert, and Syria. The existence of these launch sites resulted in several air planners believing that if they were destroyed, the threat to Israel would be diminished.<sup>27</sup> As a result planners quickly focused on neutralizing these fixed sites early in the campaign believing that if destroyed it would deny Hussein his primary trump card—the immediate attack of Israel to provoke a response which would shatter Coalition unity. This strategy was shortsighted because it minimized the role of Iraqi mobile Scud operations.

In retrospect the role the fixed sites played in Iraqi strategy is unclear. Iraq had the ability to target Israel using mobile launchers and although the use of fixed sites may marginally improve the chances of the Al-Husayn and Al-Hijarah, the poor accuracy of the system prohibited its use against anything but large area targets, such as cities. Therefore, the possibility exists that the fixed sites were never intended to be used operationally and

instead represented an elaborate deception effort. The very nature of air power requires airmen to focus operations against fixed targets and this bias makes them highly susceptible to deception through the use of high-fidelity replicas of high-value installations. Certainly the Iraqi's, probably through their relationship with the Soviets, *the masters of modern deception*, considered the use of "dummy" launch facilities to divert Israeli, and later Coalition, air power in order to help protect Hussein's true missile capabilities.

Post-war analysis shows the Iraqis also invested heavily in an elaborate camouflage, concealment and deception (CC&D) effort to improve the overall survivability of their mobile missile force by using 25-50 full-size, high fidelity decoys which complicated targeting confused the battle damage assessment process.<sup>28</sup> Again, the Iraqi reliance on CC&D efforts should not have come as a surprise given the close military and political association between Iraq and the former Soviet Union. Soviet military doctrine places significant emphasis on the use of CC&D practices and it was therefore logical to assume the Iraqis would also employ these techniques.<sup>29</sup>

Although the actual size of Hussein's missile airframe arsenal was over-estimated, the size of his TEL and MEL force was very accurately assessed. In August 1990, the US estimated Hussein had at least 22 mobile MAZ-543 launchers plus the 28 fixed launchers. Furthermore, it was assessed that Hussein's "missile-men" had pre-surveyed a number of launch sites within Iraq and Kuwait from which they could launch their missiles with relative confidence of hitting targets in Saudi Arabia and Israel.

Throughout 1990, the size and capabilities of the Iraqi SRBM force was under continual refinement as more information became available. DIA established a special

Scud Cell at the Washington-based Joint Intelligence Center set-up in the basement of the Pentagon. This group became the focal point for processing all Iraqi-related missile information available in the Washington area and funneling it to theater. The Scud Cell provide a continuous series of estimates to both CENTCOM and CENTAF that examined such pertinent issues as: (1) the dispersal of Iraqi missiles from their garrisons; (2) anticipation the Iraqis would utilize the cover of darkness or poor weather to mask employment; and (3) anticipated Iraqi employment strategies, including pre-preemptive attacks and launches against Israel. The culmination of this effort was in early December 1990 when DIA, responding to a CENTAF request for information (RFI), provided a full appraisal of the Iraqi Scud force including the expected launch sequences, existence of pre-surveyed launch points in the western Iraqi desert, use of dispersed logistical support, and the correct size of the mobile TEL and MEL force.<sup>30</sup> The number of mobile launchers available to the Iraqis has been a source of contention since the war and is often sighted as the reason why Coalition forces were not more successful in stopping the launches.<sup>31</sup> Pre-war estimates and post-war analysis do not differ by great margins. The lowest pre-war estimate placed Iraqi MAZ-543 TEL holdings around twelve while the upper estimates ranged around twenty-two.<sup>32</sup> Post war analysis places the number at 36 (33 operational) including 22 MAZ-543 TELs and 12 Al Waleed MELs.<sup>33</sup> This assessment is supported by the conclusions reached by the Gulf War Air Power Survey (GWAPS),<sup>34</sup> the survey commissioned following the war by the United States Air Force to examine all aspects of air warfare employed in the Gulf.<sup>35</sup> It also reflects the very accurate intelligence picture enjoyed by Coalition planners despite the normal unreliability of information Clausewitz cautions commanders and planners must expect to exist. The December 90 RFI response

corresponds very closely with Iraqi wartime employment practices and post-war assessments of the size of Hussein's SRBM force and capabilities.<sup>36</sup> This same estimate also explained why few indicators would be available to allow pre-launch targeting of missile launch operations by any aircraft other than those in the immediate vicinity.

Overall, the intelligence community had done its job. It properly assessed the size and technological capabilities of the Iraqi ballistic missile force. It also properly assessed how and when Hussein would employ this capability and what were his likely objectives. It was now up to the operational planners to properly sequence the attack of the SRBM capabilities to achieve the objectives as established by the President, Secretary of Defense, and CINCCENT.

### **Counter-Scud Planning**

To fully understand how coalition counter-Scud operations were conducted, it is necessary to first consider the how the air campaign plans for Desert Storm were derived and why various factors influenced how air operations were integrated into the CINC's Joint Campaign. First, we will examine the influences, factors, and background behind the development of air campaign plans. Then we will examine how these plans were woven into the CINC's strategic vision for campaign execution and how counter-Scud efforts were integrated.

General Schwarzkopf, his subordinate commanders, and planners developed unique perceptions of overall Iraqi military capabilities and the role of Hussein's ballistic missile forces. These perceptions later played a decided role in the priority Coalition forces assigned to ballistic missile forces and also determined the level of effort that would be

used while countering Iraqi Scuds in Desert Storm. Four separate planning efforts reflect these issues.

The first occurred shortly after General Colin Powell assumed the office of Chairman of the Joint Chiefs of Staff. In October 1989, he directed General Schwarzkopf to begin planning for a Southwest Asia (SWA) conflict that would be radically different from previous CENTCOM planning for over a decade. General Powell directed CENTCOM to plan operations which: first, focused on Iraq as the primary regional aggressor; second, assumed the Soviet Union would not be involved in the conflict and no longer represented the chief threat to regional stability; and, third, allocated CENTCOM more resources than it was previously apportioned under the existing Unified Command Plan (UCP).<sup>37</sup> This guidance resulted in the initial development by CENTCOM of Operations Plan 1002-90, *Defense of the Arabian Peninsula*, by the spring of 1990. This plan, like most other at the time, envisaged three main operational phases: deterrence against an aggressor state that demonstrated hostile intent; defensive operations, where US and host-nation or alliance forces would defend against an attack; and, a counteroffensive phase where US and coalition forces would restore the pre-war borders and defeat the invading force.<sup>38</sup> Consistent with Cold War strategic thought, OPLAN 1002-90 placed little effort on realizing any significant changes in regional political dynamics or altering the pre-conflict regional balance of power. In 1990, OPLAN 1002-90 was still at least a year away from being a fully developed and coordinated plan.

This shift in the wartime planning leads to the second area where we see General Schwarzkopf's vision of a regional conflict against Iraq and the role SRBMs would play. Following shortly after General Powell's guidance, General Schwarzkopf directed an

exercise be held in the summer of 1990 which portrayed a hypothetical invasion of the Arabian Peninsula by Iraq. This exercise, Internal Look, was conducted only weeks before the actual invasion of Kuwait by Iraq. This exercise provides a clear understanding of how General Schwarzkopf envisioned a war and how US forces would conduct operations. It focused almost exclusively on the defeating Iraqi forces by applying virtually all available combat power on the invading forces. Little attention was paid to conducting attacks against the national infrastructure or leadership. Also, Iraq's nuclear, biological, chemical, and Scud-associated facilities played a very minor role in the exercise. Internal Look 90, like every Central European exercise, had a decidedly defensive orientation. Clearly the CENTCOM and CENTAF staffs believed SRBMs would play almost no role in a future conflict. This is reflected by only seven Scud related targets, out of 293, appearing on the exercise target list.<sup>39</sup>

The third area were CENTCOM and CENTAF's views on the role Scuds might play and their relative importance emerges in early August 1990 after the Iraqi invasion of Kuwait. General Horner, acting as CENTCOM (FWD) and CENTAF, directs the development of the "Punishment Air Tasking Order (ATO)." This was intended to be a focused, but limited, retaliatory attack against an Iraqi preemptive chemical attack. The intent of General Horner was to retaliate against a number of targets in Iraq to discourage further Iraqi action. Seventeen economic, military, and political targets were selected for attack. Despite the assumption the initial Iraqi attack would be carried-out by SRBMs, no Scud facilities were scheduled to be hit.<sup>40</sup>

The final area that reflects CENTCOM and other planners minimizing the threat posed by Iraqi Scuds is reflected throughout Instant Thunder, the Air Staff developed

strategic air campaign General Schwarzkopf requested in early August 1990 shortly after the Iraqi invasion of Kuwait. This campaign plan has many supporters and critics and the purpose of this paper is not to re-address all of the arguments on Instant Thunder's merits or shortfalls. Instead, it is to show where and why Instant Thunder was deficient in properly addressing the Iraqi Scud threat to US and Coalition strategic and operational success.

As it was initially developed, Instant Thunder included attacks on the Iraqi Scud infrastructure to eliminate the SRBM threat against Israel. Unfortunately, the focus of Instant Thunder's counter-Scud strategy was on attacking Scud garrisons and the fixed launch sites in the western desert. The assumption Instant Thunder planners made was if Iraq was denied use of its fixed sites, then the threat against Israel was eliminated. As events will show, this, as well as several other assumptions, was fundamentally flawed.<sup>41</sup> The planners of Instant Thunder also made command of the air the top priority for the campaign. In their view, by obtaining air superiority over the enemy, air power could then "incapacitate Iraqi leadership and destroy its key military capabilities."<sup>42</sup> The strategic intent of the authors of Instant Thunder, which was soon adopted by General Schwarzkopf, was to use air power to strategically weaken the Iraqi regime in the hopes of creating conditions that would result in the overthrow of Hussein by the Iraqi people.

Instant Thunder was not executed as it was envisioned by the Checkmate planners, but it did become the foundation of the air campaign later unleashed by the Coalition.<sup>43</sup> Instant Thunder, as well as Desert Storm, does reveal the underlying bias many Air Force officers have toward the application of air power. First, is an overwhelming belief that air power can separate the regime from the populace it governs. Second, is faith that air

power can so disrupt the enemy's command and control functionality that a condition of "strategic paralysis" will occur and therefore the regime will be incapable of further resistance. Finally, that aerospace control is exclusively focused on dominance of the enemy's fixed-wing air forces—that the enemy's ballistic missile force is irrelevant since an airman's cultural bias reflects the belief that ballistic missiles can not possibly alter the nature of the war once air superiority is lost. Like the flawed assumptions made by the Instant Thunder planners, these dogmatic beliefs could have under cut the achievement of US national policy objectives in the Gulf War had Hussein successfully baited Israel in to joining the conflict.<sup>44</sup>

After Instant Thunder was developed it was handed-off to in-theater CENTAF planners. Despite initial hostility expressed toward the Instant Thunder by General Horner, the plan's intellectual underpinnings were adopted and refined by the Special Planning Group, a highly compartmented cell under CENTAF tasked with developing the strategic air portions of Desert Storm.<sup>45</sup> This group, headed by Brigadier General Buster Glosson, was labeled the "Black Hole" and it soon became a highly secretive operation. By the middle of September the key assumptions and fundamental concepts of strategic air portion of Desert Storm were established.<sup>46</sup> Through out the next four months these concepts did not change significantly. Planners only focused on increasing the number of targets attacked within the overall concept as more resources became available. This resulted in the overall strategy designed to render Iraqi Scuds ineffective remaining constant from August through the opening hours of Desert Storm.<sup>47</sup> Only after our initial efforts to suppress Scud launches failed did the strategy change. At no point prior to the start of the air campaign did theater planners determine the need to establish an airborne

counter-Scud combat air patrol (CAP). This approach later became the centerpiece of Coalition search-and-destroy suppression efforts.<sup>48</sup>

The linkages between our strategic political objectives, constraining the escalation of the conflict while simultaneously reducing the long-term Iraqi ballistic missile threat to the region, and subordinate military tasks required to accomplish these goals can be easily documented. Shortly after the Iraqi invasion of Kuwait, President Bush specified US national policy objectives for the conduct of any future military operations against Iraq. These were:<sup>49</sup>

- Immediate, complete, and unconditional withdrawal of all Iraqi forces from Kuwait;
- Restoration of Kuwait's legitimate government;
- Security and stability of Saudi Arabia and the Persian Gulf; and
- Safety and protection of American citizens abroad.

As the third policy objective implied, even during the early days of August 1990, the President decided that in addition to the restoration of Kuwait, Coalition forces would be tasked to eliminate Hussein's capabilities to continue to threaten the region. Implied in this objective was the destruction of Iraq's ballistic missile force and any weapons program intended to mate a warhead carrying a weapon of mass destruction (WMD). President Bush's objectives were central to all subsequent political and military strategies adopted throughout Operations Desert Shield and Desert Storm, therefore any and all operations had to be designed to support the achievement of these objectives.

Based upon the President's goals, Secretary of Defense, Dick Cheney, and General Powell, provided implementing guidance to General Schwarzkopf. This guidance became the bedrock for Coalition military objectives and strategy. To achieve the President's

objectives, General Schwarzkopf, in concert with Secretary Cheney, identified five primary military objectives for Operation Desert Storm:<sup>50</sup>

- Neutralization of Hussein's national command and control system;
- Eject Iraqi Armed Forces from Kuwait;
- Destroy the Republican Guard;
- As Early as Possible, Destroy Iraq's Ballistic Missile, NBC Capability;
- Assistance in the restoration of the legitimate government of Kuwait.

From these objectives, General Schwarzkopf refined his mission statement which specifically focused on the need to "as early as possible, destroy Iraq's ballistic missile and NBC capabilities."<sup>51</sup> He went on to declare the following as the key theater military objectives in CENTCOM Operations Order 91-001, 17 January 1991, which directed combined military operations during Desert Storm:<sup>52</sup>

- Attack Iraqi political-military leadership and command and control;
- Gain and maintain air superiority;
- Sever Iraqi supply lines;
- Destroy nuclear, biological and chemical production, storage, and delivery capabilities;
- Destroy Republican Guards forces in the KTO; and
- Liberate Kuwait City.

Based upon his guidance from Washington, CINCCENT developed a four phased Theater Campaign to accomplish the mission and achieve US national objectives. His campaign was designed to exploit Iraqi weaknesses and emphasize Coalition strengths by conducting an operation designed to conduct coordinated, multi-national, multi-axis air and surface attack to isolate the Iraqi regime from its forces, neutralize Hussein's immediate offensive capabilities, and fix Iraqi ground forces within the KTO so they could be destroyed. The four phases of the Theater Campaign for Desert Storm were:<sup>53</sup>

- Phase I: The Strategic Air Campaign
- Phase II: Air Supremacy in the KTO
- Phase III: Battlefield Preparation
- Phase IV: Offensive Ground Campaign

As demonstrated by the initial presidential direction, General Schwarzkopf had little latitude concerning Iraqi ballistic missile capabilities—President Bush wanted Iraq's Scuds, along with its NBC program, destroyed as quickly as possible. By accomplishing these objectives, it was assumed the regional threat posed by Hussein would be eliminated and the "security and stability of Saudi Arabia and the Persian Gulf" would be maintained.

To help accomplish his objectives, General Schwarzkopf turned to the use of air power and his JFACC, General Horner, to achieve his counter-Scud strategy. The Black Hole was tasked to determine how to best accomplish counter-Scud mission. General Horner directed Iraqi Scud capabilities to be targeted and eliminated as quickly as possible, primarily during Phase I of the overall campaign. In-turn, the Black Hole planners adopted the concepts initially developed by the Checkmate planners.

General Horner's guidance for counter-Scud planning was based upon his desire to achieve three objectives. First, to keep Israel out of the war; second, to destroy Iraq's Scud-associated production facilities; and third, to find and destroy Scud TELs which threatened the Arabian Peninsula. Initially, planners envisioned sending only a few missions against the western launch sites and a limited number of other Scud-associated production or support facilities. Planners selected the following target sets for attack during Phase I of the campaign to "reduce [the] offensive threat to regional states and friendly forces:"<sup>54</sup>

- Fixed Launchers
- Support Bases
- Known Surveyed Launch Sites for Mobile Launchers
- Hardened Aircraft Shelters Which Might Hide Mobile Launchers
- Facilities Supporting the Long-Term Development and Production of SRBMs

However, after the war started and Iraq began launching missiles, counter-Scud operations rapidly expanded and eventually consumed the daily sortie generation equivalent of a fighter wing.<sup>55</sup>

What should be readily apparent is Iraq's ballistic missile program was considered to be a critical target by the President and his principle advisors as early as August 1990.<sup>56</sup> However, due to faulty assumptions first made by Checkmate planners, and later reinforced in the Black Hole, the focus of all initial counter-Scud efforts was solely orientated on attacking the fixed sites in western Iraq and SRBM production and storage facilities.<sup>57</sup> By striking these target sets the planners had hoped to both neutralize the short-term threat to Israel while eliminating the long-term threat to the region.<sup>58</sup> The theater commanders and planners recognized the mobile launcher-targeting problem was too difficult to solve and that despite all best efforts some TELs would escape and launch their missiles.<sup>59</sup> Black Hole planners, reflecting the views held by the senior leadership of both CENTCOM and CENTAF, regarded the employment of Iraqi Scuds as "nuisance weapons" and the best strategy the Coalition could use was to absorb the attacks. In their view to attempt to locate and destroy mobile Scud TELs was viewed as sortie intensive and counter-productive.<sup>60</sup> As a result, neither the Black Hole planners nor the CENTCOM's campaign planners devise a pre-war a search-and-destroy scheme for dealing with the Iraqi employment of Scuds launched from mobile launchers.<sup>61</sup> Only after

the Iraqis began launching Scuds at Israeli cities from dispersed, mobile launchers did Generals Schwarzkopf and Horner respond by devising counter-Scud strategies.<sup>62</sup>

The low priority planners initially placed on counter-Scud efforts is also reflected by the growth in the sheer number of SRBM associated targets. In August 1990, there were only 24 total Scud-associated targets, but by mid-January this number grew to 121.<sup>63</sup> Subsequent post-war analysis has concluded that by July 1992 there were at least 154 targets located within Iraq, a 583 percent growth in the total number of Scud-related targets from August 1990.<sup>64</sup> This represents the largest growth in any single strategic target category. The problem of the growth in the number of Scud-associated targets was almost identical to the one faced by Allied planners in WW II when V-weapon associated targets grew from under 10 to over 100 between April and June 1944.

### **Counter-Scud Operations**

In the opening hours of Desert Storm counter-Scud efforts progressed as planned. Strikes were focused against the fixed sites, storage facilities, and a limited number of hardened aircraft shelters that were suspected of harboring Scud TELs. Within hours of the first Coalition air attacks, Hussein initiated launches against Israel on the afternoon of 17 January 1991. These launches revealed the true Scud threat—mobile launchers capable of moving quickly from hidden sites, firing, then hiding again before an air attack could be mounted. Before the end of the war at least 88 missiles were launched using these tactics at Israel, Saudi Arabia, and Bahrain causing only 42 deaths, 450 casualties, and destroying or damaging some 10,750 structures.<sup>65</sup> However, despite his best efforts, Hussein could not provoke an Israeli aggressive response, although tremendous political pressure was

applied to Washington by Jerusalem forcing significant diversions of air resources from other pre-planned missions. General Charles Horner remarked after the war that the greatest pressure place upon him during the war was to stop, or reduce, Scud launches. During the course of Desert Storm, the Coalition scheduled and flew 1460 strikes against Scud-related targets. This represented 5 percent of all offensive air efforts and 15 percent of all strategic attack sorties.<sup>66</sup> The majority of these, 50 percent, were directed against fixed launching sites or other “structures” (e.g., aircraft shelters, overpasses) suspected of hiding TELs.<sup>67</sup> Of the remaining strikes, 30 percent were directed against infrastructure or production facilities with only 15 percent conducted against exposed TELs. Despite this effort, air power was no more successful at slowing or stopping Scud launches than it was during the Crossbow campaign over 45 years earlier.

By the third day of the air war, Coalition “hunter-killer” aircraft remained airborne over suspected launch areas, soon known as “Scud launch boxes,” 24 hours per day. Theoretically, these CAPs could rapidly react to either airborne or ground-based queuing or targeting, although in practice these too had little success. If the CAP aircraft did not attack a Scud-related target while on-station, they were directed elsewhere to other targets of opportunity. Counter-Scud missions eventually absorbed as many resources as did all other strategic air operations conducted against the Iraqis, except attacks on air bases or ground forces. It clearly out-distanced suppression of enemy air defenses (SEAD), destruction of military-associated production facilities, and the severing of the lines of communications (LOC) supporting the Kuwait Theater of Operations (KTO).<sup>68</sup> Scud CAPs remained active throughout the war—General Horner was required by

Washington to maintain a constant air presence over western Iraq to demonstrate US concern to the Israelis by disrupting any potential launch operations.

Aircraft were used to deter launches by flying along roads believed to support Scud movements. They would drop a weapon at pre-determined intervals to disrupt Iraqi missile operations. As the air war progressed, highway overpasses, culverts, bridges, and other suspected Scud hiding places were attacked using precision-guided munitions, mainly laser-guided bombs (LGB), a very wasteful application of a high-value resources against unconfirmed targets. Entire areas were targeted with CBU-89 area denial mines to hamper the Scud TELs mobility and deny them use of suspected assembly and launching areas. A key element in this strategy was the employment of British and US special operations forces who provided vital targeting information for attacks on suspected Scud missile sites.<sup>69</sup>

### **Counter-Scud Operational Results**

To judge the overall effectiveness of Gulf War counter-Scud efforts, we should return to the original objectives of the campaign: (1) the destruction of ballistic missile production facilities and the infrastructure reduce the post-war long-term regional threat; and, (2) the destruction of Iraqi launch capabilities to maintain Israel's neutrality and minimize the impact for Gulf States. These are the measures employed by GWAPS authors to judge overall effectiveness.<sup>70</sup>

While on the surface it appears the counter-Scud operations enjoyed some success in achieving these objectives, closer examination reveals three major shortcomings. First, post-war inspections by United Nations teams have shown that Iraq's long-term ballistic

missile program, while disrupted by the war, was not destroyed. Second, there is no technical evidence a single TEL was actually destroyed by air or special forces attack during the war.<sup>71</sup> This despite the claims of some 100 TEL "kills" by Coalition aircrews and special forces.<sup>72</sup> Fixed sites were apparently neutralized, but it can be argued these strikes were ineffective since the Iraqis relied exclusively on mobile launchers for employment. The exact impact Coalition operations had against mobile systems is more problematic. Iraqi launch operations never stopped and only diminished somewhat over time, although during the last week of the war launch operations increased in tempo and there were some indications Iraq might attempt one final large attack against Israel.<sup>73</sup> At best it can be determined counter-Scud efforts only maintained "pressure" on Iraqi missile operations and the indications were CAP operations were increasingly successfully at harassing, but never halting Iraqi launch operations.

Finally, although Israel did not enter the war, it could be argued that a combination of factors worked together in keeping it out of the conflict: political efforts made by the US, Israeli observation of coalition counter-Scud efforts, and the movement of Patriot surface-to-air missile units to Israel. Counter-Scud operations, it can be argued, did achieve some success by denying Iraq the ability to "mass salvo" launches at Israel, thereby enhancing the apparent effectiveness of the Patriot. By decreasing the Iraqi potential to saturate our defenses, Patriot units could attempted to engage the inbound warheads and reassure Israeli citizens whose anxieties, like those of Londoners in WW II, could have brought tremendous political pressure upon their respective governments.

Air efforts did appear to have some impact in reducing Iraqi Scud operations as reflected by the decrease in the number of launches over time. Launches averaged almost

five per day for the first ten days of the war (49 missiles), then dropped to an average of only one per day for the next 39 days (39 missiles).<sup>74</sup> The use of Scud CAPs and aerial-denial munitions required the Iraqi's to modify their operations by forcing the use of unsurveyed launch sites and shorting the length of pre-launch preparations to increase survivability, further reducing the accuracy of an already inaccurate system.

However, despite this rosy assessment, the cold reality is air power failed to stop Scud employment. This failure can be attributed to multiple reasons, but the root causes can be traced to three primary planning issues.<sup>75</sup> First, the lack of appreciation theater leadership had for the political impacts of Scud attacks against Israeli population centers. Second, the faulty assumption made in the Pentagon in August 1990 that Hussein could not threaten Israel without the use of his 28 fixed sites in Western Iraq. Finally, if Coalition forces were required to find and destroy mobile Scud TELs that intelligence would provide adequate queuing for aircraft and that Iraqi CC&D efforts would not complicate targeting.

The first failure certainty is not unique to Desert Storm planners. As discussed, neutralization of the Scud was always a low pre-war priority for CENTCOM. This is reflected by the comments made by senior leadership and the fact that pre-war CENTCOM exercises minimized the SRBM threat. Only seven Scud-associated facilities made CENTAF's July 1990 exercise INTERNAL LOOK target list (of a total of 218), while none were on CENTCOM's target list (of a total of 293).<sup>76</sup> Later, during the development of Instant Thunder, the Scud threat again was perceived as a distraction and as a result the attack of Scud facilities only played a small role in the development of an overall targeting strategy. The focus for airmen was on neutralizing fixed sites and

destroying Scud garrisons, storage, and production facilities.<sup>77</sup> No real thought was given to dealing with the mobile launchers except for the concept of keeping some number of fighter-bombers on strip alert to attack launch preparations based on queuing by national or theater sensors. Planners assumed, incorrectly, that intelligence would provide 1-3 hours warning of launch preparations based on expected “distinctive” signatures which would allow Coalition forces to locate and attack the launch site.<sup>78</sup> This is a classic case of “wishing away” the threat. In December 1990, DIA, over 30 days prior to the start of the war, provided definitive guidance to both CENTCOM and CENTAF that: (1) mobile Iraqi missile crews were dispersed and would not require more than 60 minutes to launch a missile, (2) the intelligence indicators air planners were relying upon to identify and target launch sites would not exist, (3) the Iraqis were prepared to use pre-surveyed sites and were taking steps to enhance survivability, and (4) attacking mobile launch operations would be very difficult, if not impossible.<sup>79</sup>

The second faulty planning assumption made by both Checkmate and Black Hole planners was even more damaging since it assumed away an proven enemy capability. During the Iran-Iraq war Hussein demonstrated time and time again that he had the capability to hit Tehran with SRBMs launched from Iraqi territory.<sup>80</sup> The distances from Iraqi border areas are the same as those from the western desert to Israeli cities and therefore it should have been apparent to even the most casual observer that Iraqi mobile launchers could be utilized to conduct operations against Israel. The fixation with the fixed sites, coupled with the under appreciation of the mobile missile threat, lead to CENTAF planners failing to anticipate the need to develop plans for conducting round-the-clock Scud CAPs.<sup>81</sup>

Finally, planners made one final fundamental planning error when they assumed decoys and other CC&D efforts would not greatly complicate targeting.<sup>82</sup> This assumption disregarded known Iraqi practices of Soviet *maskirovka* principles<sup>83</sup> while also ignoring evidence gathered during pre-war Air Force and Navy tests designed to determine the degree of difficulty aircrews would likely face in finding and destroying highly mobile targets. During Desert Storm, over 80 percent of the Scud launches occurred at night, and the lack of success in locating TELs during pre- and post-launch operations reiterated the findings from Touted Glean.<sup>84</sup> This test amply demonstrated the difficulty US aircraft, such as the F-15E, would have in finding a field deployed MAZ-543 TEL. Again, planners had clear and unambiguous information suggesting the strategy developed in August 1990 would not work, but apparently chose to ignore it since it conflicted with their preconceived ideas of how air power should be applied. Dedicated search and destroy missions against Scud TELs simply did not fit the existing Air Force doctrinal mold for achieving success.

Ultimately, during the heat of battle, these critical planning assumptions proved incorrect. This all culminated in significant pressure being placed on both Generals Schwarzkopf and Horner to divert significant numbers of sorties, as well as other resources, to attempt to suppress the Scud threat. This diversion of resources, although not hindering the accomplishment of other missions due to the plethora of aircraft available to CINCCENT, did fail to clearly and decisively accomplish any goals established for counter-Scud efforts. It can be argued that the Scud was Hussein's most effective weapon—it drew off significant numbers of sorties from other missions and provided him with his only real offensive potential.<sup>85</sup> The bottom line is despite a tremendous amount of

effort and post-war statistical analysis by the GWAPS to put a positive spin on counter-Scud efforts, suppression efforts failed to achieve either of their pre-war objectives and only Israeli restraint<sup>86</sup> and post-war UN enforcement methods ensured the political objectives set by President Bush in August 1990 were achieved.<sup>87</sup>

### **Scud Hunting Sortie Allocations**

Scud hunting was intense and lasted throughout the war, ultimately consuming several thousand sorties. The actual number of counter-Scud sorties is difficult to determine with finite accuracy. The GWAPS office attempted to resolve this issue, but the differences in databases and methods of labeling and recording data resulted in a number of inconsistencies and discrepancies. CENTAF planners planned for 4,750 counter-Scud sorties which resulted in least 1,460 strikes against Scud or other SRBM associated targets; additionally, another 1,000 identifiable Scud patrols were flown. This effort excludes reconnaissance sorties. In general terms, therefore, counter-Scud efforts equated to between 2 and 5 percent of all 55,075 fixed-wing offensive sorties generated by Coalition aircraft during the war, 4 percent of all scheduled sorties and 11.5 percent of all new sorties added to the Air Tasking Order (ATO).<sup>88</sup> The total number of strikes dedicated to counter-Scud efforts was even higher when compared against the total number of strategic attack sorties generated, accounting for 15 percent of all attacks directed against the eight core target categories used by the Black Hole to develop Phase I of General Schwarzkopf's Joint campaign.<sup>89</sup> The offensive sorties flown by the coalition included:

**Table 3. Total Air Support**

|                       |        |
|-----------------------|--------|
| Air Interdiction      | 38,277 |
| Close Air Support     | 06,128 |
| Offensive Counter Air | 10,670 |
| Total                 | 55,075 |

In total, the coalition generated 118,661 fixed-wing sorties of all types throughout the 42-day war, an average of just over 2800 sorties per day. Of this, less than half, or just over 1300, were offensive actions that may or may not have resulted in a weapons release.

To carry this analysis further, the GWAPS not only attempted to determine sortie generation but also determine the number of weapons delivered against a specific target. For example, if an F-117 carrying two GBU-27 laser-guided 1000-lb. bombs dropped one each on a command and control center and a Scud site then it was credited with flying one sortie and conducting two strikes. As a result some aircraft, such as the F-117, conducted significantly more strikes (1,788) than sorties (1,299). However, for ninety-five percent of aircraft sorties one sortie equaled one strike. During the war, coalition aircraft conducted 1,460 counter-Scud strikes which represented 3.5 percent of all total strikes (41,309). This effort equated to about the same number of strikes conducted against the Iraqi C3 network, LOCs, and surface-to-air missile sites; furthermore, it was greater than the effort devoted to all NBC-associated targets, national government, naval, or military-related industry targets.

More importantly, many of the aircraft assigned to Scud strikes were unique and valuable assets. Of the 1,460 strikes, almost 45 percent were conducted by aircraft capable of laser-guided deliveries, including F-15Es, F-117As, and A-6Es. This is even more astonishing given there were only some 225 combat aircraft capable of laser-guided

deliveries in theater at the start of the campaign. As these figures demonstrate, not only did the all counter-Scud operations require a large number of sorties *and* strikes, given the relative ineffectiveness of the "The Great Scud Chase," but that this effort also consumed sorties by high-value assets which were also needed to destroy other point targets, such as bridges. By the end of war nearly 20 percent of F-15E sorties, 4 percent of F-16 sorties, 3 percent of F-111F sorties, and 2 percent of A-10 sorties were dedicated to missions against Scud targets. Additionally, significant numbers of B-52, A-6, A-7, F-117, F/A-18, and British GR-1 sorties also conducted Scud missions.<sup>90</sup>

### **Counter-Scud Observations**

Dozens of observations can be drawn from Gulf War counter-Scud operations, however I will restrict this discussion to the three which I feel are the most significant. These are:

- Prewar intelligence was sufficient to support a wider range of suppression planning efforts; the shortfall was planners did not consider all of the options
- Faulty planning assumptions and doctrinal "blindness" inhibited planners and therefore national political aims were not supported by operational execution
- Counter-Scud operations were very resource intensive

First, prewar intelligence on Iraqi missile programs and potential employment methods was more than adequate to support operational planning. The Iraqi government evoked a shroud of secrecy around their SRBM and WMD programs to provide protection and forestall outside interference. Despite difficulties in other areas, the US intelligence provided a dearth of information on Iraqi ballistic missile forces including technical estimates, order-of-battle, facility listings, past-employment patterns, and fairly accurate projections of how Hussein would use his force. GWAPS contended these

estimates, despite arguments by some post-war critics who base their opinions more on emotion than fact, were very accurate.<sup>91</sup> Real intelligence-operations interface problems surfaced after the true nature of the mobile threat appeared because air planners had made some dubious assumptions which proved very wrong. As a result, they placed blame on the inability of the intelligence community to provide appropriate queuing and targeting information. Even if intelligence could have provided accurate queuing data, it is doubtful aircrews could have effectively engaged the targets due to inadequate on-board sensors and Iraqi CC&D efforts. The reality is mobile systems are designed to be survivable and common sense would suggest relying on doctrinal templating or assuming away a demonstrated enemy capability is ill-advisable. Touted Gleen showed acquisition of Scud TELs, even with precise targeting information, was virtually impossible. The GWAPS made the following observation:

... the probability of finding Iraq's mobile launchers and destroying them from the air ... *was very close to nil* (emphasis added) ... Coalition aircrews faced an insurmountable sensor limitation.<sup>92</sup>

The solution would have been employment of a long-dwell dedicated, day-night reconnaissance capability to either circle above or monitor from the ground the Scud boxes to provide adequate queuing and targeting information combined with a 24-hour Scud CAP. The only real capability the US had to perform this function was special forces, however General Schwarzkopf rejected this option until after the Iraqi Scud efforts were well underway.<sup>93</sup> Still, as Touted Gleen decisively demonstrated, the ability of aircrews to attack pre- or post-launch operations probably remained problematic.<sup>94</sup>

Also, a review of the MAP shows Black Hole planners never intended to establish a 24-hour counter-Scud CAPs and only adopted this approach after Iraqi Scud initiated

missile launches. Operationally, we failed—we allowed Hussein to gain initiative and as a result had to expended lives and resources recover it. As with any complex problem involving prediction of enemy actions, US intelligence could never have provided all of the answers air planners were seeking. Airmen focused counter-Scud efforts on fixed targets sets while other attack options were only initiated after Washington provided CENTCOM with little alternative.

Planners recognized the identification, continuous tracking, and targeting of the entire Iraqi mobile missile force was impossible due to the shear numbers of possible hide locations and the relatively small number of Iraqi TELs (36 total with 33 operational).<sup>95</sup> However, this does not excuse their failure to establish plans for Scud CAPs from the initiation of Coalition combat operations. Also, given the wide-ranging possibilities for communication options, attempting to deny command and control was an equally unreasonable and unachievable objective. At best planners should have recognized they could only disrupt or possibly hinder launch operations. Fundamentally, theater commanders and air planners were seeking Jominian answers when intelligence could only provide Clausewitzian responses.

The next observation highlights a more significant problem. Operational planners, both in Washington during the construction of Instant Thunder and theater during the construction of Desert Storm, made several faulty planning assumptions that resulted in under-estimating the capability and potential impact of the threat. Additionally, the same planners wore doctrinal “blindness” which further inhibited their ability to anticipate the requirement to suppress SRBMs. As a result, the US and world community was not well served because operational efforts did not support the accomplishment of national

objectives. Commanders and planners failed to appreciate the impacts Hussein's missiles would have on the political and military environment affecting Coalition strategy. They also misjudged the emphasis the President and his advisors were placing on stopping the threat against Israel. These mistakes were further compounded by their underestimation of the technical capabilities of Hussein's SRBM force, believing that since the Scud was an old design and inaccurate, that it was irrelevant. Finally, despite mounting intelligence that suggested a re-examination of the overall counter-Scud employment strategy, planners continued to rely on assumptions made six months earlier, thousands of miles from the theater. They fixated on the fixed launch sites and virtually ignored the mobile missile problem until forced to by Washington. Had they studied history better, they would have recognized two similarities to the Crossbow campaign. First, the magnitude and complexity of suppressing ballistic missile operations; and second, missile attacks against civilian populations, especially if a potential WMD risk exists, will have far-reaching strategic and operational impacts.

Finally, once counter-Scud operations were initiated, they rapidly became very resource intensive. This is reflected in the pre-war growth of the number of Scud-related targets and the wartime demands for a constant airborne presence over the Scud boxes. A large amount of pre-war data existed which showed that Scud-hunting would require an extensive surveillance and reconnaissance effort, as well as highly trained aircrews to execute the attacks. Scud CAPs, despite their relative ineffectiveness, were the only real option, but these were not initially utilized due to the faulty assumptions discussed previously. This chain of events shows how operations are interrelated and how successful mission execution is dependent on the use of proper assumptions. Ultimately, Scud

missions consumed more sorties than virtually any other target set within the strategic portion of the air campaign. Thousands of sorties and almost 1,500 strikes were devoted to this effort. Our over abundance of air power in the Gulf made this issue moot, but in a more resource constrained environment, or if opposed by a more dynamic and forceful opponent, our planning failures may not be so easily overcome.

### Notes

<sup>1</sup>The primary difference centered around the enhanced mobility of Iraqi Scud launchers and the improvements in technology which would allow more accurate 24-hour, all-weather counter-missile operations.

<sup>2</sup>*Conduct of the Persian Gulf War, Title V*, p. 21.

<sup>3</sup>GWAPS, *Summary Report*, p. 7.

<sup>4</sup>GWAPS, *Summary Report*, p. 87. After the war, Iraq claimed it launched 93 modified-Scuds to UN authorities documenting and destroying Iraqi ballistic missile, nuclear, chemical, and biological weapons programs.

<sup>5</sup>GWAPS, *Volume I, Part II, Command and Control*, p. 247.

<sup>6</sup>After the war General Colin Powell, Chairman of the Joint Chiefs of Staff, acknowledged in hindsight more effort should have been placed during the first few hours of the air campaign on the elimination of Iraqi Scud capabilities. James A. Winnefeld, Preston Niblack, and Dana J. Johnson, *A League of Airmen: US Air Power in the Gulf War* (Santa Monica, California: RAND Corporation, 1994), p. 269.

<sup>7</sup>An example is found in *GWAPS, Summary Report*, pp. 123-124.

<sup>8</sup>Thomas Christie and William Barlow, *Desert Storm Scud Campaign* [Washington: Institute for Defense Analyses (IDA)], p. I-13.

<sup>9</sup>The best description of Iraqi and Iranian ballistic missile capabilities and employment practices was first published in 1990 by Anthony Cordesman and Abraham Wagner's *The Lessons of Modern War, Volume II, The Iran-Iraq War*, (San Francisco: Westview Press, 1990). This book accompanied many CENTCOM and CENTAF staff officers to the Gulf throughout the summer and fall of 1990. Unfortunately most apparently did not read this book since it very accurately described what would become the cornerstone for Iraqi strategy and tactics.

<sup>10</sup>The time to study history as an aid to planning is not during a crisis period, but during tranquil periods when time for reflection exists. Ideally the study of history should become a centerpiece of an officer's personal professional development program.

<sup>11</sup>Thomas L. McNaugher, *Ballistic Missiles and Chemical Weapons: The Legacy of the Iran-Iraq War* (Washington: The Brookings Institute, 1990), p. 5.

<sup>12</sup>*Conduct of the Persian Gulf War, Title V Report*, p. 13.

<sup>13</sup>*Ibid.*

<sup>14</sup>*Ibid.*

## Notes

<sup>15</sup>*Conduct of the Persian Gulf War*, Title V Report, pp. 13-14.

<sup>16</sup>GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 319.

<sup>17</sup>*Ibid.* and GWAPS, *Summary Report*, p. 87.

<sup>18</sup>Michael Gordon and Benard Trainor, *The General's War: The Inside Story of the Conflict in the Gulf* (New York: Little, Brown and Company, 1995), pp. 228-233.

<sup>19</sup>The debate continues over how effective this strategy would have been. General Schwarzkopf takes a pessimistic view while his JFACC, General Horner suggests an Israeli counter-strike would not have disrupted the Coalition. The GWAPS judged: "... there is little doubt that [Israeli] attacks on Arab territory, *whatever the provocation* would have serious political consequences." GWAPS, *Volume II, Part I, Operations*, pp. 179-180.

<sup>20</sup>GWAPS, *Volume I, Part I, Planning*, p. 103.

<sup>21</sup>*Ibid.*, pp. 103-104 and Gordon and Trainor, p. 229.

<sup>22</sup>Colin Powell with Joseph E. Persico, *My America Journey* (New York: Random House, 1995), pp. 510-511.

<sup>23</sup>GWAPS, *Volume I, Part I, Planning*, pp. 210-211.

<sup>24</sup>Richard Hallion, *Storm Over Iraq, Air Power and the Gulf War* (Washington: Smithsonian Institution Press, 1992), p. 178. In many cases it required two or three basic Scud airframes to make a single Iraqi extended-range modified Scud missile. After the war, The UN Special Commission team responsible for the elimination of Iraq's weapons of mass destruction and ballistic missile programs verified the destruction of around 140 missiles. Altogether, the missiles destroyed by the UN, those fired during the Gulf War and the Iran-Iraq war, and those utilized to create extended range Scud variants accounts for 570-640 Scud-B airframes. Due to the uncertainty in determining exactly how many Scud airframes the Iraqis had received speculation continues that Iraq retains some 100-200 Scud-B airframes. GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 321.

<sup>25</sup>GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 320.

<sup>26</sup>The GWAPS concluded Iraqi employment strategies remained uncertain in the months prior to the war, however review of the Gulf War Collection, Air Force Historical Research Agency (AFHRA), Maxwell Air Force Base, reveals multiple assessments were made by a variety of national and theater intelligence agencies concerning Iraqi basing and employment philosophies. Virtually all the assessments, especially those by Defense Intelligence Agency (DIA) stated there was little uncertainty that Hussein would employ ballistic missiles against regional population centers, including Israel, if Coalition military action was taken to liberate Kuwait. The threat was taken so seriously that much of the discussions focused upon an Iraqi preemptive option.

<sup>27</sup>General Horner predicted to Secretary Cheney in December 1990 that the air campaign would "preclude" Iraqi missile attacks. GWAPS, *Volume II, Part I, Operations*, p. 182.

<sup>28</sup>Air Force Intelligence Agency (AFIA/INID), *Denial and Deception Digest 91-02*, 12 February 1991, and Christie and Barlow (IDA), p. I-18. Air Force Historical Research Agency (AFHRA), *Gulf War Collection*.

## Notes

<sup>29</sup>During the war allied aircrews claimed some 80 mobile launcher kills, yet the post-conflict *Gulf War Air Power Survey* (GWAPS) concluded there was no evidence the Coalition destroyed any mobile launchers and most, if not all of the kills were actually against high-fidelity decoys or other vehicles bearing a similar signature. GWAPS, *Summary Report*, pp. 83-90.

<sup>30</sup>These estimates are contained in the AFHRA, *Gulf War Collection*, CIS-37-CIS-44.

<sup>31</sup>For the two best examples of critics of the intelligence community who contend the under-estimate of the number of mobile launchers constituted an intelligence "failure" see Hallion's *Storm Over Iraq*, p. 179, and Winnefeld, Niblack, and Johnson's *A League of Airmen*, p. 132. These authors contend the number of launchers possessed by the Iraqis was closer to 225, but neither presents any evidence to support this contention.

<sup>32</sup>In addition to the initial estimates sanctioned by the US Intelligence Community, several rumors were circulating around Washington during August 1990 suggested Iraq might possess several hundred, if not thousands of mobile launchers. This highlights the difficulty planners can face during crisis periods in acquiring accurate and reliable information. Author interview with several members of Checkmate, 25-29 March 1996.

<sup>33</sup>This includes data acquired by the UN inspection teams, intelligence collected during the war, and defector reporting. GWAPS, Volume II, Part II, *Effects and Effectiveness*, pp. 320-322.

<sup>34</sup>*Ibid.*, p. 321 and GWAPS, *Summary Report*, p. 87. The GWAPS concluded the Iraqis started the war with a total mobile launcher inventory in the high twenties to mid-thirties.

<sup>35</sup>*Ibid.*, p. ix.

<sup>36</sup>Defense Intelligence Agency (DIA) Memorandum, *Iraqi Scud Assessment*, February 1991. AFHRA, *Gulf War Collection*. Report remains classified, unclassified portions extracted by the author.

<sup>37</sup>GWAPS, *Summary Report*, p. 29.

<sup>38</sup>*Ibid.*, pp. 29-30.

<sup>39</sup>GWAPS, *Summary Report*, p. 32.

<sup>40</sup>*Ibid.*, pp. 33-34.

<sup>41</sup>One of the most significant criticisms of Instant Thunder was that the plan's underlying strategy was determined more by doctrinal considerations concerning the *appropriate* use of air power at the operational level of war rather than by using all available intelligence to determine the true nature of the Iraqi government, its elements of national power, and how these might be used by Hussein to obtain his political objectives. Overall, the strategic concepts upon which Instant Thunder rested was based on only the most general understanding of Iraq, its society, infrastructure, and military capabilities. GWAPS, *Summary Report*, p. 137.

<sup>42</sup>GWAPS, *Summary Report*, p. 36.

## Notes

<sup>43</sup>This is the primary thesis of Colonel Robert Reynolds author of *Heart of the Storm: The Genesis of the Air Campaign Against Iraq* (Maxwell AFB: Air University Press, 1995).

<sup>44</sup>Some argue CENTAF did attempt to break from traditional doctrinal stereotypes and this was reflected by the five basic objectives of Desert Storm's air campaign which focused on elimination of Hussein's ability to project power and the isolation of the Iraqi regime from its forces and population (Winnefeld, Niblack, and Johnson, p. 71); however, the distribution of attacks during the war clearly shows the greatest application of air power, outside of Iraqi ground forces, was against enemy airfields. GWAPS, *Summary Report*, p. 65.

<sup>45</sup>*Ibid.*, p. 38.

<sup>46</sup>GWAPS, *Volume II, Part I, Operations*, p. 31.

<sup>47</sup>Glosson was quoted as stating, "We never changed the plan after the 13th day of September...the only thing we did...was to do [execute] more of the plan simultaneously." Winnefeld, Niblack, and Johnson, p. 73.

<sup>48</sup>GWAPS, *Summary Report*, p. 43.

<sup>49</sup>*Conduct of the Persian Gulf War, Title V Report*, p. 19.

<sup>50</sup>*Ibid.*, p. 73.

<sup>51</sup>*Ibid.*

<sup>52</sup>*Ibid.*, p. 74.

<sup>53</sup>*Ibid.*

<sup>54</sup>GWAPS, *Volume I, Part I, Planning*, p. 165-166.

<sup>55</sup>James Coyne, *Air Power in the Gulf* (Arlington, Virginia: Air Force Association, 1992), p. 55.

<sup>56</sup>The President, in pre-war guidance, stated that efforts should be made to preclude missile strikes on Israel, Saudi Arabia, and other countries in the region. This view point was continually reinforced by other high political and military members of the government throughout the DESERT STORM planning sequence. GWAPS, *Volume I, Part I, Planning*, p. 165-166.

<sup>57</sup>AFHRA, *Gulf War Collection*, File CHSH-5 (Instant Thunder briefing), p. 8.

<sup>58</sup>GWAPS, *Summary Report*, p. 43.

<sup>59</sup>GWAPS, *Volume I, Part I, Planning*, p. 166.

<sup>60</sup>AFHRA, *Gulf War Collection*, 17 August 90 CENTCOM/CENTAF briefing to CJCS on the nature and capabilities of the Iraqi ballistic missile threat.

<sup>61</sup>*Ibid.* and GWAPS, *Summary Report*, p. 43

<sup>62</sup>The degree to which Washington worried about Scuds more than theater leadership became evident in October when Joint Chiefs of Staff planners, at the instance of Secretary Cheney, considered placing ground forces in suspected Scud launching areas threatening Israel. Although discarded, this concept resurfaced in December. GWAPS, *Volume I, Part I, Planning*, p. 103.

<sup>63</sup>*Ibid.*, p. 214.

<sup>64</sup>*Ibid.*, p. 219.

## Notes

<sup>65</sup>Hallion, p. 186.

<sup>66</sup>GWAPS, *Summary Report*, p. 65.

<sup>67</sup>GWAPS, *Volume II, Part 2, Effects and Effectiveness*, p. 330.

<sup>68</sup>*Conduct of the Persian Gulf War, Title V Report*, p. 159.

<sup>69</sup>Douglas C. Waller, *The Commandos*, (New York: Simon and Schuster, 1994), pp. 346-351.

<sup>70</sup>GWAPS, *Summary Report*, pp. 78-90.

<sup>71</sup>Despite the lack of technical evidence, based on the number of attacks and analysis of post-war intelligence, it is likely a limited number of TELS were destroyed. GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 340.

<sup>72</sup>Coalition crews reported destroying about 80 TELS and special forces another 20. Most reports probably extended from the results of a highly effective Iraqi CC&D effort and attacks against misfortunate Iraqi fuel tanker trucks that possessed "Scud-like" signatures. GWAPS, *Summary Report*, p. 83.

<sup>73</sup>GWAPS, *Summary Report*, p. 88 and Waller, pp. 346-348.

<sup>74</sup>*Conduct of the Persian Gulf War, Title V Report*, p. 165.

<sup>75</sup>GWAPS, *Volume II, Part II, Effects and Effectiveness*, pp. 321-323.

<sup>76</sup>GWAPS, *Summary Report*, p. 32.

<sup>77</sup>AFHRA, *Gulf War Collection*, File CHSH-5, Instant Thunder briefing to President.

<sup>78</sup>GWAPS, *Summary Report*, p. 79.

<sup>79</sup>AFHRA, *Gulf War Collection*, DIA Message to USCINCCENT responding to CENTCOM's request for information (RFI) concerning Iraqi Scud capabilities and operations, 7 December 1990.

<sup>80</sup>According to Iranian sources, 71 percent of the modified Scuds launched by Iraq during the "War of the Cities" fell on Tehran. GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 319.

<sup>81</sup>GWAPS, *Summary Report*, p. 43.

<sup>82</sup>GWAPS, *Summary Report*, p. 79.

<sup>83</sup>*Maskirovka* is the Soviet developed practice of using the aggregate measures of camouflage, concealment, masking, and deception to mislead and complicate adversary efforts to understand and counter friendly plans and capabilities. The Iraqis adopted a series of active and passive protection efforts, combined with an aggressive security program, to complicate an adversary's efforts to effectively targets Iraqi military capabilities. GWAPS, *Volume II, Part II, Effects and Effectiveness*, pp. 54-55.

<sup>84</sup>A pre-war test, code named Touted Gleem, demonstrated conclusively that F-111F, F-15E, and LANTIRN-equipped F-16 fighters had less than a 50 percent chance of acquiring the Scud TEL even when the aircrews had precise target coordinates. TELS proved "virtually impossible to find" if the missile was not erect. This trend continued during the war when on 42 separate occasions pilots visually observed a launch, yet in only eight cases the aircrews maintained visual to allow them to employ weapons. GWAPS, *Volume II, Part II, Effect and Effectiveness*, p. 335.

<sup>85</sup>GWAPS, *Volume I, Part II, Command and Control*, p. 190.

## Notes

<sup>86</sup>Powell, p. 512.

<sup>87</sup>The Iraqis claimed 19 TELs and MELs survived the war, all of these were confirmed destroyed by post-war UN inspection teams. GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 320.

<sup>88</sup>GWAPS, *Volume I, Part II, Command and Control*, pp. 216-245.

<sup>89</sup>GWAPS, *Summary Report*, p. 65.

<sup>90</sup>GWAPS, *Volume II, Part I, Operations*, p. 189.

<sup>91</sup>GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 320.

<sup>92</sup>*Ibid.*, pp. 334-336.

<sup>93</sup>Waller, p. 340.

<sup>94</sup>GWAPS, *Volume II, Part II, Effect and Effectiveness*, p. 336.

<sup>95</sup>Afhra, *Gulf War Collection*, File CIS-44, DIA Memorandum, *Iraqi Scud Assessment*, February 91.

## **Chapter 5**

### **Future Considerations**

The similarities between Crossbow and Desert Storm counter-Scud operations are remarkable. Had the Gulf War planners been more cognizant of the issues related to the overall inability of the Allies to suppress German missiles, they may not have been so confident in Coalition air power's ability to suppress Iraqi Scuds. In August 1990, due to a multitude of factors, including the pressures of rapidly developing a basic campaign concept and the lack of a detailed understanding of Iraq, Checkmate planners were required to make a number of assumptions. The result was Instant Thunder was built not on in-depth analysis of Iraq, but instead based on how air power should be best utilized.<sup>1</sup> This is clearly a Jominian approach to campaign planning, the subordination of critical thought to doctrine by creating an indisputable list of principles that if applied against any foe will always result in success.<sup>2</sup> Had the Gulf War planners been better students of both Clausewitz and more familiar with his theory of war which mandates the use of historical analysis to train one's mind to think critically, they would have recognized the shortcomings to this approach.

Without question, the counter-missile efforts conducted in both WW II and Desert Storm consumed a tremendous number of unanticipated and unplanned resources. Despite intensive application of air power, neither effort had a significant impact on stopping

missile launches. Although some air power proponents argue counter-missile operations did slow the number of launches, ground force advances ultimately proved more effective at halting V-1 and V-2 launches.<sup>3</sup> Similarly, in the Gulf the collapse of Iraqi forces within the KTO, brought about by the Coalition's over-overwhelming combined arms offensive, ended Iraqi Scud launches.

In Desert Storm, as in WW II, ballistic missiles posed one of the most serious strategic challenges of the war, yet in both cases the magnitude of the threat was not properly addressed during initial planning efforts. In both cases, doctrinally myopic planners predictably focused on traditional methods of attacking known or suspected support infrastructure and launch sites to undercut Iraqi operations. Although some success was achieved in reducing the post-war Iraqi capability to threaten the region with ballistic missiles, both Crossbow and Gulf War counter-Scud operations proved ineffective at stopping wartime enemy launches.<sup>4</sup> Strikes against fixed sites denied their use to the enemy, but attacks against mobile launchers proved illusionary. Despite large number of resources being dedicated success was not readily apparent. Individual TELs proved impervious to detection or destruction. Counter-missile operations consumed more resources than planners initial anticipated and the diversion of resources from other mission areas became difficult to manage. Ultimately, air power did not undermine Hussein's Scud force. In both WW II and the Gulf, the enemy reacted to allied air attacks by using passive protection measures to improve the survivability of his forces. Future commanders and planners must recognize these factors when devising plans to achieve campaign objectives.

Due to the growing proliferation of SRBMs, it is likely we will be faced with more difficult challenges than our predecessors. Technological enhancements, combined with increased employment sophistication, will probably make future counter-ballistic and cruise missile operations more difficult and will likely require even more resources. As most observers recognize, Hussein effectively tied-up hundreds of aircraft and thousands of sorties with a handful of Scud TELs and several hundred missiles. Additionally, he retained the capability throughout the war to threaten Coalition unity and strategy. Ballistic missiles offer smaller, resource constrained states cost effective alternatives to fielding large manned air forces. DOD's final report on Persian Gulf War was clear on this point.<sup>5</sup>

Locating and destroying mobile missiles proved very difficult and required substantially more resources than planned. This could be a more serious problem in the future against an enemy with more accurate missiles or one who uses weapons of mass destruction. (emphasis added)

It is imperative the DOD and the Air Force *now* begin to intensify our efforts at developing appropriate doctrine, tactics, techniques, and procedures for neutralizing enemy SRBMs. Our aerospace control doctrinal concepts and definitions need to be expanded to include both the enemy's aviation and missile assets. The trends since 1944 reflect greater ballistic missile integration into combat operations—the Iraqis used them against Iran and during the Gulf war, the Soviets used them against Afghan rebels, and other third world nations have employed them in both intra- and interstate warfare settings. Countering ballistic missile operations must become integral to our planning efforts and exercise scenarios. Dedicated exercises, such as the *Roving Sands* series, are a

step forward, but greater attention must be placed in indoctrinating theater missile defense principles throughout the US forces.<sup>6</sup>

Desert Storm also created a new attitude among the American public about war—an attitude that demands low US casualty rates and rapid victories. When General Schwarzkopf declared the Coalition had air supremacy early in the war, he was focused on achievement of supremacy over Iraq's conventional aviation assets, not its missiles. This claim somewhat misled the American people because it implied we dominated the total aerospace environment and therefore Iraq's operational reach was effectively neutralized. However on 25 February 1991, ten days after the last Iraqi aircraft was shot down and three days before the war ended, a Scud missile slammed into a US barracks in Dhahran killing 28 American soldiers and wounding 100 more. This event accounted for 25 percent of all American deaths and 25 percent of all wounded by enemy action.<sup>7</sup> Since this event happened late in the war, it had little effect on public support, but if it had occurred during the initial stage of the air campaign, its impact may have weakened American resolve to continue to support the war effort.<sup>8</sup>

By examining WW II and Gulf War counter-missile operations future commanders and planners can glean many valuable insights to help guide future operations.

First, planners must not allow themselves to become doctrinally constrained when developing air campaign concepts. Even after full details of the potential impacts of German and Iraqi missile programs were known, theater leadership did not fully appreciate the magnitude of the threat.<sup>9</sup> The initial counter-strategies developed in both cases mimicked our approaches to countering conventional air forces by focusing on fixed installations, including production facilities, launch locations, and support infrastructure.

Little thought was given to suppressing mobile launchers and CINCCENT's personal reluctance to employ special forces to monitor and target Scuds significantly undercut our abilities to influence Iraqi operations. As military officers know very well, plans rarely survive first contact with the enemy and therefore flexibility must exist to ensure they can adjust to unforeseen circumstances.

Planners must accept the reality that countering enemy ballistic missile operations will be resource and time intensive. Institutionally and within DOD, we accept the achievement of air superiority is an over-riding priority of the Joint Force Commander and that such operations takes time and effort. The same logic must be applied when understanding the neutralization of enemy ballistic missile forces. In WW II, as in the Gulf, counter-missile operations consumed significant numbers of sorties and strikes. Future SRBM suppression efforts will likely continue this trend. This was demonstrated by Roving Sands '95 when 17 percent of all air efforts were devoted to ballistic missile attacks over a five day period. Despite this level of effort, friendly forces only succeeded in reducing the enemy missile infrastructure by 40 percent.<sup>10</sup>

Second, attaining air supremacy does not guarantee "victory." When Hitler unleashed the V-1 and V-2, the Allies had virtual mastery of the skies over Europe, yet Germany succeeded in launching over 15,000 missiles using improvised sites that were almost impervious to attack. Almost 50 years later Iraq began launching Scuds after Coalition forces had achieved air supremacy. This distinction is important because many current theorists, such as Colonel John Warden contend "victory" is not possible without air superiority.<sup>11</sup> Neither the Germans nor the Iraqis possessed air superiority, yet had V-1 operations began shortly before D-Day, rather than shortly after, or Iraq successfully used

a chemical warhead on an Israeli population center, both conflicts could have ended differently.

Aerospace control implies denying enemy aviation and missile forces use of the environment, but current Air Force doctrine focuses on countering enemy air forces as the primary way to achieve aerospace control. A careful reading of the current AFM 1-1 reveals the USAF does not even consider neutralizing enemy surface-to-surface missile operations as contributing to aerospace control. Clearly current Air Force doctrine is deficient in this area, especially since counter-missile operations in WW II and the Gulf became major tasks that had to be accomplished before the theater commander could achieve his military objectives. This doctrinal oversight must be corrected if air power is to remain capable of countering the next generation of threats. The August 1995 draft AFDD-1, the successor to AFM 1-1, begins to address this shortfall by including ballistic and cruise missiles, however it also states:<sup>12</sup>

. . . offensive operations are most effective when conducted against theater missiles *before they are launched* (emphasis added) . . . preemptive destruction of known missiles and launch facilities may greatly limit subsequent theater missile attacks against friendly forces.

This logic makes one wonder if the author appreciate the findings on ballistic missile suppression contained in either the USSBS or GWAPS. Although advances in mating sensor and computer technology has reduced, if not eliminated the ability of ballistic missile to find sanctuary, the complete and rapid neutralization of enemy missile forces remains unlikely. Pre-launch suppression of individual mobile launchers will remain a difficult challenge until the advent of long-dwell, all-weather sensors that can monitor a force once it disperses. Until then, alas, most planners will continue to rely upon the path

of doctrinal dogma . . . *if its easiest to destroy aircraft on the ground, then the same must be true for ballistic missiles.* What is clear is dominance of enemy airspace will be required during the near-term to allow intelligence and command and control gathering aircraft, such as the U-2 and JSTARS, to operate with impunity over enemy territory to detect enemy missiles and direct strike aircraft operations.

Third, planners must anticipate the greatest diversions of resources in response to a new threat will occur only after it fully materializes. A "*kitchen sink factor*" materializes due to political pressures for immediate results. Enhancements in telecommunications and real-time news reporting will only increase the pressure placed on theater commanders to halt enemy missile launches. The pressure will be greatest when civilian populations are at risk or the integrity of a political coalition is threatened. In the case of Crossbow, the application of thousands of sorties did not force the Germans to cease operations—launches stopped only after Allied ground forces over-ran launch areas. In Desert Storm, air power's inability to stop Scud launches directed at Israeli cities placed tremendous stress on both the Bush administration and Coalition unity. Israeli suggestions they would respond militarily could have had unpredictable consequences for Coalition unity. Later Israel demonstrated restraint, but only after the US maintained a 24-hour Scud CAP and the Israeli's were allowed to nominate targets to CENTCOM and CENTAF by way of Washington. It is not difficult to imagine the impact counter-Scud efforts would have had on Instant Thunder if it been executed in the fall of 1990. Fewer available combat aircraft, especially PGM capable; the predictable expansion of the target base; and, the strains due to unanticipated mission requirements possibly would have doomed Instant Thunder from achieving its objectives.

Fourth, planners must expect the intelligence information flow to trail operations in highly dynamic situations. Information flows will never work as effectively as planned and ambiguity will continue to exist regardless of how computerized we become. A classic example of this principle in practice was the primary operations planner responsible for coordinating counter-Scud operations within the Black Hole did not have the appropriate security clearances which allowed him to gain access to all of the available intelligence information.<sup>13</sup> Also, strike operations are always more difficult in the real world than expected. The target base will be incomplete, uncertainty will exist in determining enemy intentions, the enemy will react and adjust to our efforts, battle damage assessments (BDA) will lag mission planning cycles, and uncontrollable factors, such as weather, will reduce individual sortie effectiveness. Intelligence did a remarkable job of framing the threat posed by both V-weapons and Scuds—technical analysis of missile capabilities was accurate while enemy intentions were well understood. This led to little ambiguity in warning or initial target selection, however once launch operations started, accurate sensor queuing and weapon system targeting was nearly impossible. The limitations for prosecuting air attacks against mobile launchers was due more to sensor limitations and informational architectures than intelligence being incapable of providing precise location data.<sup>14</sup> The failure by CINCCENT to consider the employment of Special Operations Forces to address the Scud problem earlier severely handicapped Coalition air efforts once Iraqi launch operations were initiated. Space-based and non-manned airborne/surface surveillance technologies, such as long-dwell airborne all-weather sensors, will provide greater queuing assistance; however, ground-based terminal targeting capabilities provided

by special operations forces will remain pivotal to the effective suppression of enemy ballistic missile operations in the near-term.

Another factor that will create uncertainty and hamper operational effectiveness is enemy CC&D efforts. Both the German's and Iraqi's were highly effective at using low-level technologies to protect their missile forces. Also, fixed facilities, especially missile launch facilities can become "bomb magnets," whether initially intended by the enemy or not. In the case of the German's repair effort at the seven "large" sites reinforced this phenomena. In the future, enemy efforts to create these conditions can have a significant impact, especially as the US moves to greater reliance on high-cost, precision-guided munitions.

Fifth, faulty assumptions will corrupt planning and can significantly undermine an overall strategy. This was more evident in the Gulf than WW II. In developing initial offensive air plans, planners made several assumptions concerning Iraqi Scud capabilities in early August 1990 that proved faulty. Unfortunately, these assumptions were never adjusted and they continue to provide the basis for counter-Scud planning throughout Desert Shield.<sup>15</sup> The real failure by air planners in the Gulf was not altering operational concepts as new information became available which fundamentally shifted planning assumptions. Assumptions are only intended to take the place of facts when critical information elements are unavailable, but needed to continue planning. Once the information is acquired, the assumption needs to be replaced or altered and plans adjusted to compensate. During the six months proceeding Desert Storm this process did not take place despite the existence of accurate intelligence information. As a result, Iraq severely caught CENTCOM and CENTAF off-guard when they began mobile launcher operations.

Sixth, the application of air power must support the attainment of operational and national objectives, not attempt to validate Air Force doctrine. Although this seems trivial, events in both WW II and the Gulf showed that air commanders and planners can often allow their pre-conceived prejudicial views of air power employment to over ride the guidance they received from higher political and military commands. Despite significant pressure, WW II and Gulf War air commanders and planners neglected to push preparations for an aggressive counter-SRBM efforts because they regarded these weapons as having little consequence. Instead they chose to focus on other efforts, some of which appeared to have little impact on the current situation. This approach results in the perception held by many that air power is more interested in justifying its own doctrine and independence than winning the war.

Seventh, due to growing public awareness of military operations and enhancements in mass-media technological there is blurring of the distinction between the tactical, operational, and strategic levels of warfare. Understanding the linkages and the interwoven relationships between objectives and actions at each level is now more important than ever. Global telecommunications have fundamentally altered the political-military environment—we must learn to expect and react to instantaneous feedback from political leaders and the global audience. The media's ability to show the real-time exploits of American forces creates an environment wherein single tactical actions, regardless of how seemingly insignificant, can have strategic significance. The American public has developed impatience with the "chronic indecisiveness of war."<sup>16</sup> Americans now demand decisive, rapid action that achieves immediate results. Commanders and planners no longer

enjoy the luxury of long periods of time to determine if their plans are appropriate or require adjusting. The future demands tactical and operational flexibility and agility!

The political process will generate pressure to shift operational emphasis if tactical efforts are perceived to be either ineffective or not contributing to “ending the war.” The media-generated drama played out in Israel and Saudi Arabia each time a Scud was launched during the Gulf War is only one example of what the future portends. Planners must become better prepared to respond to a wide-range of contingencies while at the same time developing the mental toughness to rapidly adjust on-going operations. Our natural tendency is to resist change, but by only developing the ability to embrace change will military efforts remain relevant to the needs of the nation. We must be prepared to understand all of the impacts of our actions and better learn to anticipate friendly, as well as, enemy reactions. Only pre-crisis preparation will ensure we maintain a decisive edge—learning required skills through “on the job training” after the crisis starts is no longer an acceptable option.

Finally, future ballistic missile suppression operations will require dedicated, Joint efforts to eliminate enemy ballistic missile forces. Joint doctrine acknowledges this fact and Joint Pub 3-01.5, *Doctrine for Joint Theater Missile Defense (JTMD)*, highlights the requirement for effective JTMD operations to integrate both offensive and defensive approaches. This is similar in many respects to current counter air concepts to neutralize enemy fixed-wing air power.<sup>17</sup> Intelligence integration using space-based, airborne, and surface-based systems is critical. Fundamentally, successful TMD requires a “family of systems” approach combined with Joint warfighting techniques. Airborne Scud CAPs continued to provide the best capability to respond to on-going enemy missile launch

operations. Computer integration and logic processing enhancements is providing great promise for enhancing launch point estimations and queuing for terminal attack operations. Finally, simulations and exercises remain critical in testing the synchronization between sensor and shooter links. Centralized command and control is critical to coordinating effectively planning, integrate, and execute of both surface and air attacks against mobile launcher locations. Operational staffs must understand how to integrate air power with operational fires to counter enemy SRBMs. Proven Joint warfighting concepts, such as J-SEAD, provide excellent models for future planners.

#### Notes

<sup>1</sup>GWAPS, *Volume I, Part I, Planning*, p. 214.

<sup>2</sup>Col John Warden, Instant Thunder's principle architect and later Commandant of the Air Command and Staff College, later codified his fundamental theory of the universal application of air power in "The Enemy as a System," *Airpower Journal*, Spring 1995, pp. 41-55.

<sup>3</sup>In the Autumn 1995 edition of *Joint Force Quarterly*, General Fogleman, Chief of Staff, USAF, forcefully argues our aggressive Scud hunt paid significant dividends. By capitalizing on our dominance of Iraqi airspace, we denied Hussein use of his fixed sites, limited the employment options for his mobile missile forces, forced heavy reliance on weather and darkness to improve survivability, and reduced his overall operational tempo. General Ronald R. Fogleman, "Theater Ballistic Missile Defense," *Joint Force Quarterly*, Autumn 1995, pp. 75-79.

<sup>4</sup>In the Gulf War United Nations inspection and destruction teams were required to finish the job of eliminating Hussein's Scud force and even today the success of this effort is debatable.

<sup>5</sup>*Conduct of the Persian Gulf War, Title V Report*, p. 188.

<sup>6</sup>*Roving Sands* is a annual Joint Staff directed exercise focused on theater ballistic missile defense operations, including operations designed to offensively explore ways to neutralize enemy ballistic capabilities.

<sup>7</sup>Hallion, p. 185.

<sup>8</sup>Another near-catastrophe occurred when earlier a Scud almost hit the *USS Tarawa* while she was docked at Dhahran adjacent to a munitions stockpile. It is not difficult to envision the political and psychological impact on the American people if a US capital vessel would have been lost. GWAPS, *Volume II, Part I, Operations*, p. 191.

<sup>9</sup>As late as February 1944 General Spaatz was convinced the V-weapons associated construction was a German hoax designed to cause panic and drain resources. Richard

## Notes

Davis, *Carl A. Spaatz and the Air War in Europe* (Washington: Smithsonian Institution Press, 1992), pp. 426-432.

<sup>10</sup>Fogleman, p. 78.

<sup>11</sup>This is one of John Warden's central themes in *The Air Campaign, Planning for Combat* (Washington: National Defense University Press, 1988).

<sup>12</sup>AFDD-1, p. 12.

<sup>13</sup>Mr. Barry D. Watts, Chief, Operations and Effects, GWAPS Staff, interview with author, 15 February 1996, Maxwell Air Force Base, Montgomery, Alabama.

<sup>14</sup>Acquisition of the TELs by strike aircraft proved virtually impossible as demonstrated by pre-war tests and wartime operations. GWAPS, *Volume II, Part II, Effects and Effectiveness*, p. 335.

<sup>15</sup>*Ibid.*, pp. 321-322.

<sup>16</sup>John Keegan, *A History of Warfare* (New York: Vintage Books, 1993), p. 57.

<sup>17</sup>Joint Pub 3-01.5 is composed of four integrated operations: *passive missile defense*, friendly efforts to minimize the effects of enemy missiles; *active missile defense*, intercept operations; *attack operations*, offensive efforts to neutralize enemy launch capabilities; and, *command, control, communications, computers, and intelligence*, capabilities to coordinate all friendly JTMD efforts. Joint Pub 3-01.5, *Doctrine for Joint Theater Missile Defense* (Washington: United States Government Printing Office, March 30, 1994).

## Chapter 6

### Conclusions

*The conduct of war is an intellectual process.* The belligerent who out thinks his opponent will probably succeed in achieving his objectives. Both Hitler and Hussein had the ability to exploit the use of ballistic missile technology to help achieve their war aims. Hitler failed because he focused on the wrong targets, had he directed his V-1 and V-2 attacks against cross-channel operations instead of London, his chance of success would have been higher. Likewise, Hussein never really attempted to utilize the principle of mass to attack Israel. Had he opened his Scud efforts with a massed attack against Tel Aviv, Israel would probably have had little choice but to militarily respond. Instead, he never attempted to achieve mass which in turn allowed us to wage a battle of attrition against his missile forces. The success of our counter-Scud operations is debatable, however air power did demonstrate some ability to delay and disrupt the tempo of enemy operations. Although we did not initially evaluate correctly the true nature of the threat, we did react better than our opponent once the challenge was presented and ultimately prevailed.

It remains that there are no absolute governing principles in war. No simple checklists or theories that map the absolute correct methods to best apply military power. Warfare is too complex, too nonlinear to be able to reduce its understanding to a series of scientific equations. As Clausewitz observed over 175 years ago, the practice of war is an art

requiring intellectual mastery, not mindless observance of a series of principles or application formula.<sup>1</sup> Military action produces not a single enemy reaction, but dynamic interactions. Because war is a mixture of physical and psychological activities, a universal theory of war which attempts to provide absolute guidelines is unattainable. Ultimately, the study of the theory of war “is meant to educate the mind of the future commander, or, more accurately, to guide him in his self-education, not accompany him to the battlefield, just as a wise teacher guides and stimulates a young man’s intellectual development but is careful not to lead him by the hand for the rest of his life.”<sup>2</sup> Therefore, the best path to understanding future warfare lies in mastering the past. If the US Air Force is to maintain its current status as the world’s air and space leader, then it must train its leadership to become better students of history. The linkages between history and doctrine are clear and unmistakable. Although history yields no formula or specific template, it does provide an excellent exercise for developing our judgment as military officers and helps to focus our minds to think meaningfully about warfighting. If our doctrine is to remain strong and applicable to the modern world, our understanding of history must prove equally as strong.

#### Notes

<sup>1</sup>Paret, *Clausewitz and the State*, p. 371.

<sup>2</sup>Ibid.

## ***Bibliography***

### **Air Force Historical Research Agency (AFHRA) Sources**

- Air Force Intelligence Agency. *Denial and Deception Digest 91-02*, 12 February 1991.
- Defense Intelligence Agency. *Iraqi Scud Activity Assessment*, 4 October 1990.
- Defense Intelligence Agency. *Iraqi Scud Activity Assessment*, 22 November 1990.
- Defense Intelligence Agency. *Message to USCINCCENT responding to CENTCOM Request for Information on Iraq Scud Capabilities and Operations*, 7 December 1990.
- Defense Intelligence Agency. *Iraqi Scud Assessment*, February 1991.
- Central Intelligence Agency. *Daily Battle Damage Assessment Reports, Office of Imagery Analysis*, 23 January 1991–12 February 1991.
- Christie, Thomas P. and Barlow, William. *Desert Storm Scud Campaign*. Washington: Institute for Defense Analyses, 1992.
- Deptula, Dave, Lt Col, USAF, and Rogers, Mark, Maj, USAF. *Planning Notes for Air Operations during Desert Storm*, September 1990–February 1991.
- Headquarters, Allied Expeditionary Air Force. *Air Commander-in Chief Letter to Commanding General, USAAF*. 29 March 1944.
- Headquarters, Allied Expeditionary Air Force. *Air Commander-in Chief Letter to Commanding General, USAAF in the UK*. 1 December 1943.
- Headquarters, Army Air Forces. *Army Air Forces Crossbow Committee Report on Countermeasure Recommendations*. 26 January 1944.
- Headquarters, Army Air Forces. *Report to Chief of the Air Staff, Army Air Forces on Crossbow Mission to the United Kingdom*. 6 April 1944.
- Headquarters, Army Air Forces. *Commanding General, USAAF Letter to Air Commander-in-Chief, AEF*. 13 April 1944.
- Headquarters, European Theater of Operations, G-2, United States Army. *Crossbow Memorandum to Chief of Staff, United States Army Providing All Known Details of German V-weapon Programs*. 13 December 1943.
- Headquarters, European Theater of Operations, G-2, United States Army. *Memorandum, Summary of Crossbow Activity Against the United Kingdom*. 2 April 1945.
- Headquarters, United States Air Force. *Instant Thunder Briefing to the President and National Security Council*. 12 August 1990.
- Headquarters, United States Air Force. *Briefing to Secretary of the Air Force on Iraqi Ballistic Missile Capabilities*. 28 January 1991.
- Headquarters, United States Central Command. *Briefing to the Chairman, Joint Chiefs of Staff on CINCCENT's Views of the Potential Iraqi Scud Threat*, 17 August 1990.

Headquarters, United States Central Command. *Operational Plan, Operation Desert Storm*, 17 January 1991.

Headquarters, United States Strategic Air Forces in Europe. *Commanding General Letter to Commanding General, USAAF, Washington, DC, Commenting on Colonel Jack Hickman's Crossbow Study*. 5 April 1944.

Headquarters, United States Strategic Air Forces in Europe. *Memorandum on Analysis of the Accuracy of the German Flying Bomb (V-1)—12 June to 1 October 1944*. 11 November 1944.

Headquarters, United States Air Forces, Central Command. *Annex B, Intelligence, Operation Desert Storm*. 17 January 1991.

Headquarters, United States Air Forces, Central Command. *Master Attack Plan (MAP), Operation Desert Storm*. February 1991.

Headquarters, United States Air Forces, Central Command. *Notes and Minutes from Planning Meetings and Discussions, Operation Desert Storm*. 1990–1991.

Hennessy, Juliette. *USAF Historical Study No. 70, Tactical Operations of the Eighth Air Force*. Montgomery: Air University, 1952.

Joint Chiefs of Staff. *J-2 (Intelligence) Message to CENTCOM/J-2, CENTAF/IN, and ARCENT/G-2 providing an Assessment of Anticipated Iraqi Scud Operations*, 28 December 1990.

Joint Crossbow Working Committee. *Meeting Minutes*. 27 July 1944–05 September 1944.

Office of the Secretary of the Air Force. *Allied Operations Planning Documents*, 30 July 1990–15 February 1991.

Office of the Secretary of the Air Force. *Effectiveness of Air Power, Gulf War Air Power Survey (GWAPS) Notes and Sources, Task Force VII, Box 27, Folder 371, Volume 2*, 1991–1992.

Office of the Secretary of Defense. *Desert Storm Missile Working Group III Meeting Summary Minutes*, 30 May 1991.

Supreme Headquarters Allied Expeditionary Forces (SHAEF), Air Defense Division, A-2 (Intelligence).. *Report of 'V' Section on Continental Crossbow (September 1944 to March 1945)*. July 1945.

United States Strategic Bombing Survey. Military Analysis Division. *V-Weapon (Crossbow) Campaign*. Washington: GPO, 1945.

War Department General Staff, Military Intelligence Division (G-2). *Memorandum, German Long-Range Rockets*. 19 October 1943.

War Department General Staff, Military Intelligence Division (G-2). *Memorandum, Current Trends in German Long-Range Rocket Developments*. 07 December 1943.

War Department General Staff, Military Intelligence Division (G-2). *Memorandum, Estimates of Probable Bombardment Capacity of German Long-Range Rocket Projectiles and Targets*. 15 December 1943.

War Department General Staff, Military Intelligence Division (G-2). *Memorandum, Estimate of Possible Effects of German Secret Weapons Upon United Nations Operations*. 29 December 1943.

War Department General Staff, Military Intelligence Division (G-2). *Memorandum, First Periodic Estimate on Enemy Secret Weapons*. 10 January 1944.

## Published References

- Air Force Manual 1-1, *Basic Aerospace Doctrine of the United States Air Force*, Volume I and II. Washington, DC: United States Government Printing Office, 1992.
- Air Force Doctrine Document 1 (First Draft), *Air Force Basic Doctrine*. Maxwell Air Force Base, Alabama: Air University, 15 August 1995.
- Arnold, H. H. General of the Air Force. *Global Mission*. New York: Harper and Row, 1949, 1989.
- Atkinson, Rick. *Crusade: The Untold Story of the Persian Gulf War*. New York: Houghton Mifflin Company, 1993.
- Berquist, Ronald E. *The Role of Air Power in the Iran-Iraq War*. Montgomery, Alabama: Air University Press, 1988.
- Bradley, Omar N. General of the Army. *A General's Life*. New York: Simon & Schuster, 1983.
- Bailey, Ronald H. *The Air War in Europe*. Alexandria, Virginia: Time-Life Books, 1979.
- Beck, Alfred M., with Nalty, Bernard; Shiner, John; and, Watson, George. *With Courage, The US Army Air Forces in World War II*. Washington, DC: United States Government Printing Office, 1994.
- Beyerchen, Alan, "Clausewitz, Nonlinearity, and the Unpredictability of War." *International Security*, Vol. 17, No. 3 (Winter 1992/93), pp. 59-90.
- Boyne, Walter J. *Clash of Wings, World War II in the Air*. New York: Simon and Schuster, 1994.
- Bradley, Omar N. General of the Army. *A General's Life*. New York: Simon & Schuster, 1983.
- Brown, Anthony C. "C:" *The Secret life of Sir Stewart Menzies, Spymaster to Winston Churchill*. New York: MacMillan Publishing Company, 1987.
- Carter, Kit C. and Robert Mueller. *US Army Air Forces in World War II, Combat Chronology, 1941-1945*. Washington, DC: United States Government Printing Office, 1973, 1991.
- Carus, W. Seth. *Ballistic Missiles in Modern Conflict*. New York: Praeger Press, 1991.
- Collier, Basil. *The Battle of the V-Weapons, 1944-1945*. New York: William Morrow & Company, 1965.
- Conduct of the Persian Gulf War, Final Report to Congress, Title V*. Washington, DC: United States Government Printing Office, 1992.
- Conduct of the Persian Gulf Conflict, Interim Report to Congress, Title V*. Washington, DC: United States Government Printing Office, 1991.
- Cooksley, Peter G. *Flying Bomb, The Story of Hitler's V-Weapons in World War II*. New York: Charles Scribner's Sons, 1979.
- Cordesman, Anthony H. and Wagner, Abraham. *The Lessons of Modern War, Volume II: The Iran-Iraq War*. San Francisco: Westview Press, 1990, 1991.
- Coyne, James P. *Air Power in the Gulf*. Arlington, Virginia: Air Force Association, 1992.
- Craven, Wesley F. and James Lea Cate. *The Army Air Forces in World War II, Vol. III, Europe: Argument to V-E Day, 1944-1945*. Washington, DC: United States Government Printing Office, 1948, 1951, 1983.

- Davis, Richard G. *Carl A. Spaatz and the Air War in Europe*. Washington, DC: Smithsonian Institution Press, 1992.
- Donald, David and John Gourley. "Joint Stars: The Eyes of the Storm." *World Air Power Journal*, Summer 1992, pp. 27-33.
- Dornberger, Walter, Major-General. *V-2*. Trans. Cleugh, James and Geoffrey Halliday. New York: Viking Press, 1954.
- Eisenhower, Dwight D, General of the Army. *Crusade in Europe*. New York: Doubleday, 1948.
- Fadok, David, Major, USAF. *John Boyd and John Warden: Air Power's Quest for Strategic Paralysis*. Maxwell Air Force Base, Alabama: Air University Press, 1995.
- Fogleman, Ronald R., General, USAF. "Theater Ballistic Missile Defense." *Joint Force Quarterly*, Autumn 1995, pp. 75-79.
- Garlinski, Jozef. *Hitler's Last Weapons, The Underground War Against the V-1 and V-2*. New York: Time Books, 1978.
- Gorden, Michael R. and Trainer, Benard E. *The General's War: The Inside Story of the Conflict in the Gulf*. New York: Little, Brown and Company, 1995.
- Gulf War Air Power Survey (GWAPS) Report, Volume I, Part I and II, Planning and Command and Control*. Washington, DC: United States Government Printing Office, 1993.
- GWAPS Survey Report, Volume II, Part I and II, Operations and Effects and Effectiveness*. Washington, DC: United States Government Printing Office, 1993.
- Handel, Michael I. *Intelligence and Military Operations*. Portland, Oregon: Frank Cass and Company, 1990.
- Hallion, Richard P. *Storm Over Iraq, Air Power and the Gulf War*. Washington, DC: Smithsonian Institution Press, 1992.
- Hansell, Haywood S. Major General, USAF (Ret). *The Air Plan that Defeated Hitler*. Atlanta, Georgia: Higgins-McArthur/Longino & Porter, Inc, 1972.
- . *The Strategic Air War Against Germany and Japan*. Washington, DC: United States Government Printing Office, 1986.
- Harris, Arther, Marshal of the RAF. *Bomber Offensive*. New York: MacMillan Company, 1947.
- Harvey, John R. "Regional Ballistic Missiles and Advanced Strike Aircraft—Comparing Military Effectiveness." *International Security*, Vol. 17, NO 2, Fall 1992, pp. 41-83.
- Henshall, Phillip. *Hitler's Rocket Sites*. New York: St. Martin's Press, 1985.
- Hinsley, F. H. *British Intelligence in the Second World War (Abridged Edition)*. London: Her Majesty's Stationery Office, 1993.
- . *British Intelligence in the Second World War, Vol. III*. London: Her Majesty's Stationery Office, 1984.
- Holsken, Dieter. *V-Missiles of the Third Reich; The V-1 and V-2*. Sturbridge, Massachusetts: Monogram Aviation Publications, 1994.
- Horner, Charles A., Lieutenant General, USAF. "The Air Campaign." *Military Review*, September 1991, pp. 16-27.
- Huntington, Tom. "V-2, The Long Shadow." *Air and Space Magazine*, March 1993, pp. 80-90.

- Johnson, David. *V-1 and V-2, Hitler's Vengeance on London*. New York: Stein and Day, 1981.
- Joint Publication 3-01.5, *Doctrine for Joint Theater Missile Defense*. Washington, DC: United States Government Printing Office, March 30, 1994.
- Jones, R. V. *Reflections on Intelligence*. London: Mandarin Paperbacks, 1989, 1990.
- . *The Wizard War, British Scientific Intelligence, 1939-1945*. New York: Coward, McCann & Geoghegan, Inc., 1978.
- Keaney, Thomas and Cohen, Eliot. *Gulf War Air Power Survey Summary Report*. Washington, DC: United States Government Printing Office, 1993.
- Keegan, John. *The Mask of Command*. New York: Penguin Books, 1987.
- Kennedy, Gregory P. *Vengeance Weapons 2, The V-2 Guided Missile*. Washington, DC: Smithsonian Institution Press, 1983.
- Krakau, Major A. "The Soviet Preference for Conventional Warfare in Europe, Part 1: The Fundamental Concept." *Soldat und Technik*, No. 9, September 1988, pp. 524-528. Trans. FBIS/JPRS, Eastern European Report, 16 February 1989, pp. 3-6.
- . "The Soviet Preference for Conventional Warfare in Europe, Part 2: Strategic and Operational Consequences." *Soldat und Technik*, No. 10, October 1988, pp. 588-593. Trans. FBIS/JPRS, Eastern European Report, 16 February 1989, pp. 7-12.
- Losev, Major-General I. and Lt Col A. Yakovlevich. "Desert Storm Revisited, or Lessons from the Persian Gulf War." *Vestnik Protivovozdushnoy*, 7 July 1992, pp. 36-38. Trans. FBIS/JPRS, Central Eurasia Report, 11 November 1992, pp. 57-59.
- MacDonald, Charles B. *The Mighty Endeavor, The American War in Europe*. New York: Da Capo Press, 1969, 1986.
- Mann, Edward C. III, Colonel, USAF. *Thunder and Lightning: Desert Storm and the Airpower Debates*. Maxwell Air Force Base, Alabama: Air University Press, 1995.
- McNaugher, Thomas L. *Ballistic Missiles and Chemical Weapons: The Legacy of the Iran-Iraq War*. Washington, DC: The Brookings Institute, 1990.
- Mets, David. *Master of Airpower, General Carl A. Spaatz*. Novato, California: Presidio Press, 1988.
- Murray, Williamson. *Luftwaffe*. Baltimore, Maryland: The Nautical and Aviation Publishing Company of America, 1985.
- Owen, Robert. *Tedder*. London: Collins Press, 1952.
- Paret, Peter. *Clausewitz and the State*. Oxford: Clarendon Press, 1976.
- Perret, Geoffrey. *Winged Victory*. New York: Random House, 1993.
- Reynolds, Richard T., Colonel, USAF. *Heart of the Storm: The Genesis of the Air Campaign Against Iraq*. Maxwell Air Force Base, Alabama: Air University Press, 1995.
- Powell, Colin, General, USA, with Persico, Joseph E. *My American Journey*. New York: Random House, 1995.
- Powell, Stewart M. "Scud War, Round Two." *Air Force Magazine*, April 1992, pp. 48-53.
- . "Scud War, Round Three." *Air Force Magazine*, October 1992, pp. 32-35.
- Puryear, Edgar, F. *19 Stars, A Study in Military Character and Leadership*. Novato, California: Presidio Press, 1971.

- Putney, Diane T. *Ultra and the Army Air Forces in World War II: An Interview with Associate Justice of the U.S. Supreme Court Lewis F. Powell, Jr.* Washington, DC: Office of Air Force History, 1987.
- Reaching Globally, Reaching Powerfully: The United States Air Force in the Gulf War.* Washington, DC: Office of the Secretary of the Air Force, September 1991.
- Scales, Robert, Brig Gen, USA; Johnson, Terry, LTC, USA; and Odom, Thomas, MAJ, USA. *Certain Victory: The US Army in the Gulf War.* Washington, DC: United States Government Printing Office, 1993.
- Schwarzkopf, Norman H., General, USA. *It Doesn't Take a Hero.* New York: Bantam Books, 1992.
- . "Central Command Briefing." *Military Review*, September 1991, pp. 96-108.
- Soofer, Robert M. "Joint Theater Missile Defense Strategy." *Joint Force Quarterly*, Autumn 1995, pp. 70-74.
- Soviet Military Power: An Assessment of the Threat.* Washington, DC: Department of Defense, 1988.
- Spector, Leonard S. *Deterring Regional Threats from Nuclear Proliferation.* Washington, DC: United States Government Printing Office, 1992.
- The Air Force and US National Security: Global Reach—Global Power.* Washington, DC: Office of the Secretary of the Air Force, June 1990.
- United States Strategic Bombing Survey. *Summary Report (European War).* Washington, DC: United States Government Printing Office, 1945.
- "Use of Cruise Missiles in the Persian Gulf War." *Krylya Rodiny*, April 1992, pp. 18-19. Trans. FBIS/JPRS, Central Eurasia Report, 28 October 1992, pp. 44-45.
- van Creveld, Martin. *Command in War.* Cambridge, Massachusetts: Harvard University Press, 1985.
- . *Technology and War.* New York: The Free Press, Macmillan, Inc., 1989.
- . *The Transformation of War.* New York: The Free Press, Macmillan, Inc., 1991.
- von Clausewitz, Carl. *On War.* Trans. and Editing Howard, Michael and Peter Paret. Princeton, New Jersey: Princeton University Press, 1976.
- Warden, John A. III., Colonel, USAF. *Air Campaigning, Planning for Combat.* Washington, DC: National Defense University Press, 1988.
- . "The Enemy as a System." *Airpower Journal*, Spring 1995, pp. 41-55.
- Watson, Bruce, B.L. Cyr, Bruce George, and Peter Tsouras. *Military Lessons of the Gulf War.* London: Greenhill Books, 1991, 1993.
- Webster, Charles and Noble Frankland. *The Strategic Air Offensive Against Germany, 1939-1945, Vol. II: Endeavor.* London: Her Majesty's Stationery Office, 1961.
- . *The Strategic Air Offensive Against Germany, 1939-1945, Vol. III: Victory.* London: Her Majesty's Stationery Office, 1961.
- . *The Strategic Air Offensive Against Germany, 1939-1945, Vol. IV: Annexes and Appendices.* London: Her Majesty's Stationery Office, 1961.
- Winnefeld, James A. *A League of Airmen: US Air Power in the Gulf War.* Santa Monica, California: RAND Corporation, 1994.
- Wirtz, James J. *Counterforce and Theater Missile Defense: Can the Army use an ASW Approach to the Scud Hunt?* Carlisle, Pennsylvania: United States Army War College, 1995.

Woodward, Bob. *The Commanders*. New York: Simon and Schuster Inc, 1991.