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Scud Alert!
The History, Development and Military Significance of Ballistic Missiles on Tactical Operations

Bryon E. Greenwald

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The Institute of Land Warfare

ASSOCIATION OF THE UNITED STATES ARMY

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Scud Alert!
The History, Development and Military Significance of Ballistic Missiles on Tactical Operations

by Bryon E. Greenwald

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FOREWORD

While the Persian Gulf War confirmed the political and strategic utility of using ballistic missiles as a terror weapon, the effect of ballistic missiles on tactical operations has received much less attention. Despite growing evidence of technological advances in guidance and warhead systems that warrant concern, much of the current literature ignores the operational and tactical impact of ballistic missiles on the battlefield. Even the U.S. Army's most forward looking document, U.S. Army Training and Doctrine Command (TRADOC) Pamphlet 525-5, *Force XXI Operations* (1 August 1994), disregards the impact of these weapons on tactical operations. Thus, this study breaks new ground and demonstrates why military leaders and planners should pay more attention to the emerging tactical threat from ballistic missiles, unconventional warheads, and weapons of mass destruction.

This essay argues that changes in the nation's military strategy, the continued global proliferation of ballistic missiles and weapons of mass destruction, and the pace of technological improvements to those systems mandate that commanders and planners understand the military significance of ballistic missiles to their tactical battle space. This study traces the early history and recent development of ballistic missiles, concluding with an examination of the impact of ballistic missiles on tactical forces during force projection operations.

JACK N. MERRITT
General, U.S. Army Retired
President

October 1995

The spread of ever more sophisticated weaponry — including chemical, biological, and nuclear weapons — and of the missiles capable of carrying them represents a growing danger to international security. This proliferation exacerbates and fuels regional tensions and complicates U.S. defense planning. It poses ever greater dangers to U.S. forces and facilities abroad, and possibly even to the United States itself.[1]

George Bush, *National Security Strategy of the United States*, March 1990

We are threatened by the continued proliferation of advanced conventional arms, ballistic missiles of increasing range, and weapons of mass destruction. . . .[2]

Inevitably, an increasing number of supplier nations will become able to contribute to the proliferation of ballistic missiles and weapons of mass destruction.[3]

As the Patriot demonstrated during the Gulf War, ballistic missile defenses are crucial to protect our troops and allies against madmen or rogue nations.[4]

George Bush, *National Security Strategy of the United States*, January 1993

The proliferation of weapons of mass destruction represents a major challenge to our security.[5]

Weapons of mass destruction — nuclear, biological, and chemical — along with the missiles that deliver them, pose a major threat to our security. . . .[6]

William Clinton, *National Security Strategy of the United States*, July 1994

SCUD ALERT!
THE HISTORY, DEVELOPMENT AND MILITARY SIGNIFICANCE OF BALLISTIC MISSILES ON TACTICAL OPERATIONS

INTRODUCTION

The Persian Gulf War confirmed the utility of using tactical ballistic missiles as a political terror weapon. Iraq's launching of Scud missiles against Tel Aviv on 18 January 1991 threatened to draw Israel into the war and forced the United States to respond by rushing Patriot air defense systems to the region to protect key Israeli population centers. While the political and strategic significance of the 88 tactical ballistic missiles[7] Iraq launched at Israel and Saudi Arabia during the war appears obvious, the tactical effect of these missiles on the battlefield is less apparent.[8]

Despite growing evidence of technological advances in guidance and warhead systems that warrant concern, much of the current literature ignores the operational and tactical impact of ballistic missiles on the battlefield. Even the U.S. Army's most forward-looking document, U.S. Army Training and Doctrine Command (TRADOC) Pamphlet 525-5, *Force XXI Operations: A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century* (1 August 1994), does not address the impact of these weapons on tactical operations. Emphasizing the strategic and political impact of weapons of mass destruction, the pamphlet contends that

> the security challenge having the most serious ramifications for U.S. interests will come from the proliferation of WMD [weapons of mass destruction]. The strategic-political effects of WMD overshadow their military utility. WMD and theater ballistic missiles (TBMs) allow an adversary to extend its operational and strategic reach.[9]

While the extreme physical devastation and psychological dislocation resulting from the use of ballistic missiles and weapons of mass destruction will have far-reaching political and strategic effects, their impact on tactical military operations will also be significant. Thus, this monograph breaks new ground and demonstrates why military leaders and planners should pay more attention to the emerging tactical threat from ballistic missiles, unconventional warheads, and weapons of mass destruction.

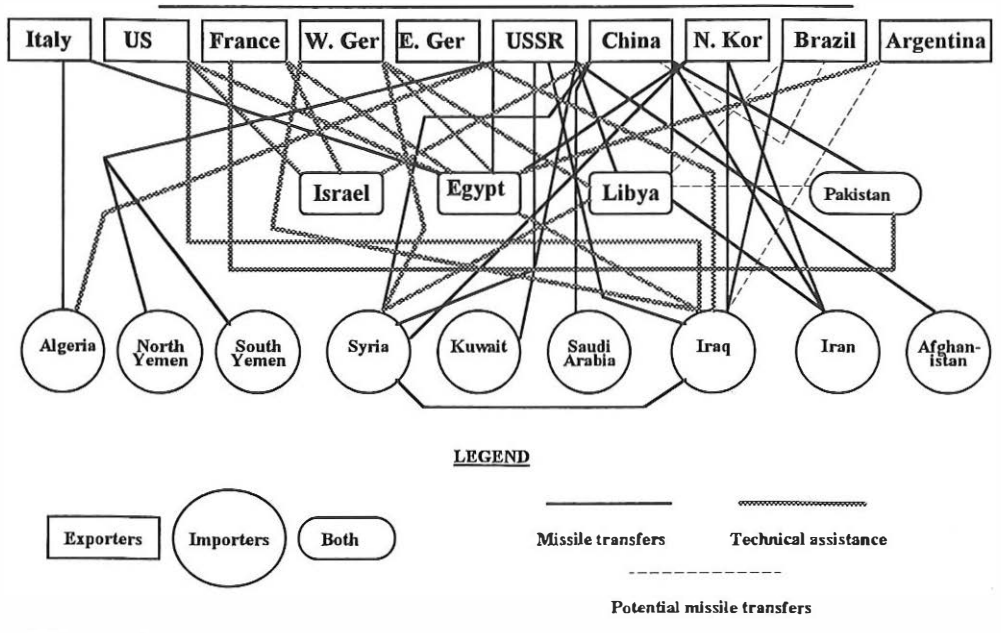
Changes in the nation's military strategy, the continued global proliferation of ballistic missiles and weapons of mass destruction, and the pace of technological improvements to these systems mandate that commanders and planners understand the military significance of ballistic missiles on the tactical battlefield. With the end of the Cold War,

the nation's shift from a strategy of forward presence to an increased reliance on force projection operations means that the armed forces will deploy to unstable areas of the world where host nation defense forces may be limited and force protection will be an immediate priority. Within that environment, the proliferation of tactical ballistic missiles among Third World nations combined with the predilection of some leaders to use them against U.S. forces — Libya in 1986 and Iraq in 1991 — provides both the means and precedent for a TBM attack on U.S. forces in the future.

While current missile accuracy may limit the effectiveness of a conventionally armed tactical ballistic missile as a point weapon, the addition of a chemical, biological or nuclear warhead makes the TBM militarily significant regardless of circular error probable (CEP).[10] The improvements in missile accuracy and range that have occurred over the last twenty years will continue, making both conventionally and unconventionally armed missiles an ever-increasing threat to tactical forces. Finally, attempts at counterproliferation may slow but will not stop the emergence of these evolving weapon systems in the arsenals of developing countries. Several developing nations, including some that are hostile to the United States, possess indigenous missile and warhead programs that render them relatively impervious to American or international arms control and counterproliferation efforts. As the following chart demonstrates, some missile-producing nations, irrespective of their relationship with the United States, also have export agreements or development partnerships with nations that are either hostile to the United States or embroiled in regional disputes that may involve U.S. forces at some point in the future.[11]

TRANSFERS OF MISSILES AND RELATED TECHNICAL ASSISTANCE

from Industrialized Countries to Developing Countries, 1960-1994



Sources include: Janne E. Nolan, *Trappings of Power: Ballistic Missiles in the Third World* (Washington, D.C.: The Brookings Institution, 1991), p. 18; Martin Navias, *Ballistic Missile Proliferation in the Third World* (London: Brassey's, 1990), pp. 29-31. See note for additional references.[12]

This monograph highlights the history and development of the ballistic missile, surveys the current TBM threat environment, and examines the potential primary and secondary effects of ballistic missiles on the tactical commander's battle space during four phases of force projection operations — deployment and early entry, buildup and expansion, decisive operations, and redeployment and postconflict. To validate the potential TBM threat to tactical units, the threat survey (table 2, page 11) outlines the range, accuracy and warhead capabilities of contemporary missiles and lists the nations most likely to possess them. This monograph employs three criteria to evaluate the primary and secondary effects that a ballistic missile attack may have on the tactical aspects of force projection operations: the potential for increased casualties, the diversion of resources from the main effort in response to a TBM attack or threat of attack, and the degree of disruption (desynchronization) an attack creates in the commander's battle plan.

CRITICAL CONCEPTS

The discussion of ballistic missile development and current threat environment set the conditions for an informed examination of the effect of these weapons on tactical military operations. Therefore, it is important to define the three concepts — primary effect, secondary effect and tactical battle space — that form the boundaries of this monograph.

Primary effects are those that occur directly from a missile attack or from the threat of such an attack. In the Persian Gulf War, tactical commanders planned for Scud attacks on their units as they entered the theater, trained in assembly areas, passed through the breach, conducted decisive combat operations, and even as they signed the armistice at Safwan Air Field. Although the Iraqis did not use their Scuds to attack maneuver forces, the threat of an attack, particularly in view of Iraq's known use of chemical weapons and perceived nuclear potential, compelled tactical commanders to prepare appropriately for their use. A successful attack on the ports, the assembly areas, or the breach might have disrupted allied actions and greatly increased casualties.

While primary effects demonstrate the first-tier, direct impact of ballistic missiles on tactical forces, secondary effects are those tactical effects that devolve indirectly from a friendly response to the political and strategic use or threatened use of ballistic missiles by enemy forces. For example, in the Persian Gulf War, the political impact of Scud attacks on Israel forced General Schwarzkopf to divert 40 percent of his daily air sorties from attacking Iraqi formations and lines of communication to hunting Scud launchers in the western Iraqi desert. His actions represented a major diversion of combat power, extended the air effort by more than a week, and prevented the Army Central Command (ARCENT) from meeting its targeting goals prior to starting the ground war.[13] Moreover, the same attacks required the United States to use a portion of its limited airlift assets to bring Patriot units into Israel and other sites in the theater. In future force projection operations, the 94 C-5A Galaxy and 19 C-141 Starlifter sorties needed to fly a

six-battery Patriot battalion into a theater of operations will consume precious amounts of strategic lift and detract from the commander's ability to rapidly build up combat forces or a logistical base.[14]

While most sources acknowledge the political, strategic and even operational impact of ballistic missiles, the focus of this monograph is on the effect of these weapons on the tactical commander's battle space. Battle space, as defined by the U.S. Army's keystone warfighting doctrine, Field Manual 100-5, *Operations*, is a physical, three-dimensional volume that extends to the maximum capabilities of the commander to acquire and engage the enemy. In examining the impact of ballistic missiles on the tactical commander's battle space, the type, quantity and capability of the assets at the tactical commander's disposal delimit the area concerned. At the tactical level of war, "corps and divisions fight . . . battles and engagements." Thus, for the purpose of analysis, this monograph places the upper limit of tactical battle space at the area defined by the capabilities of the assets organic to an Army corps; the lower limit extends down to the area associated with a maneuver company.[15]

THE HISTORY, DEVELOPMENT AND CURRENT STATUS OF BALLISTIC MISSILES

In light of the recent use of ballistic missiles in the Middle East, a mythology has arisen concerning TBMs. Some of the erroneous perceptions include the beliefs that all missiles are alike; that the Persian Gulf War was the first time ballistic missiles had been used in combat; that they are extremely inaccurate and only good for terrorizing urban populations; and that they are militarily insignificant weapons.[16] An in-depth analysis of the history, development and use of ballistic missiles dispels these misconceptions and highlights their potential impact on the tactical commander's battle space.

Ballistic and Cruise Missiles

Largely due to the intense publicity the use of the Scud missile received during the Persian Gulf War, "Scud" has become, incorrectly, the nom de guerre for the several models of surface-to-surface missiles present in the world today. In reality, there are two types of surface-to-surface missiles — ballistic missiles and cruise missiles. A ballistic missile is an unmanned, rocket-powered weapon. It receives power from its engines and guidance from the guidance system only in the ascent. In the descent, it follows a ballistic (unpowered and unguided) trajectory. The majority of ballistic missiles are exoatmospheric.

Conversely, a cruise missile is an unmanned aircraft propelled by an air-breathing engine similar to those used in airplanes. Most modern versions employ inertial guidance systems as well as terrain comparison programs that link television or infrared images of the terrain to computer-generated images of the planned attack route to achieve pinpoint

accuracy. Like an aircraft, the cruise missile is endoatmospheric. Unlike most aircraft, however, the cruise missile provides an extremely small radar cross section and is therefore more difficult for air defense systems to detect and engage.[17]

Early Ballistic Missile History

Although the use of rockets and missiles in war extends back to Tamerlane's Battle of Delhi in 1399, the slow pace of technical advancement resulted in only sporadic employment of these weapons in the ensuing centuries. A brief flurry of interest reemerged around 1800 with the adaptation of an Indian rocket by Sir William Congreve for use by the British Army. In 1806, after setting the town of Boulogne, France afire with his rockets, Congreve proclaimed that "the rocket is, in truth, an arm by which the whole system of military tactics is destined to be changed." Yet despite Congreve's prophetic comment, the useful development of rockets and missiles as weapons of war had to wait until the twentieth century.[18]

Modern surface-to-surface missiles first saw wartime service with the firing of V-1 and V-2 weapons against London, Paris, Antwerp, Liege and Brussels during the latter stages of World War II. The V-1 "flying bomb" was a small cruise missile powered by a pulse jet that "buzzed" as it flew. It traveled at speeds up to four hundred miles per hour at altitudes between 3,000 and 5,000 feet and carried a ton of explosive. Early models ranged out to 250 kilometers. Later in 1945, the Germans boosted the range to 400 kilometers by replacing certain portions of the airframe with plywood and reducing the size of the warhead. In a final effort to increase the range of the missile, the Germans slung the V-1 under a Heinkel-111 airplane, creating the first air-launched cruise missile. The combined range of the aircraft and missile extended to nearly 1,300 kilometers. Its rudimentary guidance system kept the V-1 accurate to within 10 kilometers for every 160 kilometers of flight. Although quite inaccurate by modern standards, the V-1 was accurate enough to strike large urban areas such as Greater London.[19]

The V-2 was a single-stage, liquid-fueled ballistic missile equipped with an inertial guidance system. It weighed almost 13 tons, carried a one-ton warhead, and had a range of 350 kilometers. Powered by nearly nine tons of alcohol and liquid oxygen and controlled by gyroscopes or radio signals that moved large graphite vanes located behind the jet, the missile rose vertically for six miles before automatic controls turned it to 45 degrees for its final climb. Once it attained a speed sufficient to reach its intended range, the engine shut off and the missile flew in a "gigantic parabola" to the target. At its apex, the missile climbed to a height of fifty miles. Its peak speed was 4,000 miles per hour; it made the flight from Germany or the Netherlands to London in three or four minutes.[20]

In the last year of the war, the Germans successfully launched 19,395 V-1 cruise missiles and 2,952 V-2 ballistic missiles at cities in England and on the Continent. While Hitler's *Vergeltung* or "retaliation" campaign had little or no strategic effect on the Allied

war effort, it did inflict immense physical damage, killing over 13,000 civilians and soldiers and seriously wounding at least another 25,000. More importantly, the V-weapons had an immense psychological impact on the populace. Of these missiles, Winston Churchill wrote

> [they] imposed upon the people of London a burden perhaps even heavier than the air-raids of 1940 and 1941. Suspense and strain were more prolonged. Dawn brought no relief, and cloud no comfort. . . . The blind impersonal nature of the missile made the individual on the ground feel helpless. There was little that he could do, no human enemy that he could see shot down.[21]

Interestingly, although both missiles carried the same size warhead, the V-2 caused nearly twice as many casualties as the V-1. The slower speed of the V-1 permitted Allied planes and antiaircraft artillery to intercept it occasionally, while its engine noise served to warn people to take cover. Conversely, the V-2's supersonic speed guaranteed the penetration of Allied air space, while its lack of engine noise made the missile's impact a surprise, preventing any manner of early warning or protective action.[22]

Recent Ballistic Missile Development

Despite losing World War II, the Germans continued to influence missile development during the early stages of the Cold War. After the war, both the United States and the Soviet Union used captured V-weapons (and German scientists) in the early phases of their missile programs. Of the two superpowers, the Soviet Union, through its export of missiles to developing nations, did more to propagate the German ballistic missile legacy.[23]

Of the several potential Soviet missile systems available for export, the SS-1C or Scud B missile (NATO designation) has become the sine qua non of developing ballistic missile programs. It is not without reason that the Scud missile has entered the lexicon of military planners and defense analysts as a synonym for tactical ballistic missile. The Soviet Scud B is the most widely proliferated surface-to-surface missile in the world today. As of early 1993, there were 22 countries with Scud B missiles in their arsenals.[24]

Drawing heavily on the original V-2 design, the Soviet Union developed and mass produced the Scud B in the 1960s for deployment with Soviet and Warsaw Pact forces. In response to requests from the then client states of Syria, Libya and Egypt, the Soviets developed a special export version (designated R-17E), the first of which reached Egypt in 1973 and was used in the 1973 Arab-Israeli War. The export version had a throw weight of one metric ton (1,000 kg or 2,200 lb) and a range of approximately 300 kilometers, and came with the same eight-wheeled, high-mobility transporter-erector-launcher (TEL) used by the Soviets. Its circular error probable (CEP) ranged between 400 and 1,000 meters.[25]

Soviet Scud missile exports flourished from the 1970s through the early 1990s. In addition to Egypt, the following countries received Scud missiles from the Soviet Union: Iraq (1974 and again in the mid-1980s), Syria (1974), Libya (1976), and the People's Democratic Republic of Yemen (1979). The greatest transfer and indeed the largest employment of ballistic missiles since World War II took place in the late 1980s when the Soviets shipped approximately 2,000 Scud missiles to Afghanistan for use by the Afghan government against the guerrilla forces.[26]

From this nucleus of primary Scud importers, secondary and tertiary groups of Scud users have emerged. North Korea, for example, acquired Scud B missiles and transporter-erector-launchers from Egypt in 1981. In 1987, North Korea sent modified Scud B missiles to Iran for use in the Iran-Iraq "War of the Cities." The North Koreans have since licensed modified Scud B manufacturing lines in Egypt, Syria, Iraq, Iran and possibly Cuba. These modified missiles have a slightly longer range — about 320 kilometers with a 2,200-pound warhead. Various sources estimate the accuracy of the modified missile at about 400-1,000 meters, the same as the basic Scud B.[27]

In addition to building and exporting a modified version of the Scud B, North Korea also initiated development of three extended-range variants of the missile. This effort took two different paths. The simpler of the two approaches merely made further modifications to the already modified Scud B. By reducing the size of the Scud B warhead, the North Koreans increased the range on their Scud Mod C missile to 500 kilometers. They may have also added an improved inertial guidance system to enhance the CEP. In 1990, for potentially as much as $500 million, Iran purchased Scud Mod C missiles and North Korean assistance in converting an Iranian missile maintenance facility to produce indigenous Mod C missiles. North Korea followed up this missile transfer with the sale of Mod C missiles to Syria; about sixty missiles and 12 TELs began arriving in April 1991.[28]

The more difficult of the two approaches taken by North Korea to increase the range of the modified Scud B missile involved a complete redesign of the missile system based on "Scud" technology. This resulted in the manufacture of the Nodong 1 and 2 missiles. The estimated range of the Scud Mod D or Nodong 1 missile is between 1,000 and 1,300 kilometers, a distance that includes all of the Korean peninsula, Kyoto and Osaka in Japan, Beijing and Shanghai, and parts of Russia. The North Koreans had trouble with the accuracy of the Nodong 1 missile and may limit deployment until the Nodong 2 or Scud Mod E missile is available. Reports estimate that the Nodong 2 will have a range between 1,500 and 2,000 kilometers. Unlike the Nodong 1 and its predecessors, the Nodong 2 is either a multistage or clustered missile. North Korea's inexperience with these types of missiles may delay fielding of the Nodong 2.[29]

China has followed the example set by the Soviet Union and North Korea in missile development and export sales. The Chinese have greatly expanded their ballistic missile production since their initial foray in the 1960s. Like the North Koreans, the Chinese

have pursued two lines of missile production. The CSS/Dongfeng line of strategic nuclear missiles, designed for use by the People's Liberation Army, expanded from the CSS-1 deployed in 1967 to include the CSS-2, CSS-3 and CSS-4 (known in China as the DF-3, DF-4 and DF-5). The CSS-2 (DF-3) has a range of 3,000 kilometers and a CEP of 1,000 meters. The Chinese sold a conventional version with a range of 2,700 kilometers to Saudi Arabia in 1987. The CSS-3 (DF-4) and CSS-4 (DF-5) missiles are two-stage, liquid-fueled missiles with ranges of 7,000 kilometers and 10,000 kilometers respectively.[30]

In 1984, the Chinese began a second line of missile production aimed primarily at the Third World export market. The "M" family of missiles are solid-fueled, tactical ballistic missiles. The M-9 is a single-stage missile with computer-aided inertial guidance and terminal control. It carries a 500-kilogram payload and has a range of 600 kilometers and a CEP of 300 meters. The Chinese have sold the M-9 to Syria and Libya. The M-11 is a two-stage system with the same guidance and payload characteristics as the M-9. It has a range of 300 kilometers. Reports indicated that Pakistan had purchased the M-11 in 1991, but as of October 1994 had not yet received operational missiles from China. Part of this purchase may have included Chinese technical assistance to help Pakistan with its own short-range Hatf I (80 km) and medium-range Hatf II (300 km) ballistic missile programs.[31]

Of all the missile importers and exporters discussed so far, Iraq has been the most profligate builder, developer and user of Scud missiles and their derivatives. In the early 1980s, Iraq initiated a missile development program that started with the building of rocket artillery to gain experience and graduated to the modification of imported Scud missiles before the allied bombing in early 1991 and subsequent United Nations sanctions and inspections combined to shut it down. In 1982, Iraq fired its first Scud B missile at Iran. The 300-kilometer range of the missile, however, proved inadequate to strike the Iranian capital, Teheran, located 500 kilometers away from the Iraqi border. To overcome this shortfall, the Iraqis modified their Scud B missiles by lengthening the fuel tanks and lightening the warhead. This resulted in two longer-range missiles, the Al-Hussein, with a range of 650 kilometers, and the Al-Abbas, with a range of 950 kilometers. Although they increased the range of their missiles, the Iraqis did nothing to improve their accuracy. This only exaggerated the error already present in the generic Scud B guidance system (CEP 450 meters). The resultant doubling and trebling of range created a similar effect with respect to circular error probable. The Al-Hussein had a 1,000-meter CEP and the Al-Abbas fell out at around 1,500 meters.[32]

Over the course of the Iran-Iraq War (1980-88), the two sides fired more than 478 Scud-type missiles at each other. Iran fired about 117 North Korean Scud B missiles at Iraq, while the Iraqis launched a mixture of approximately 361 Scud B, Al-Hussein and Al-Abbas missiles. During the Persian Gulf War, Iraq used its Al-Hussein missiles primarily against targets in Israel and its longer-range Al-Abbas missiles against Saudi Arabia and Bahrain.[33]

Table 1

BALLISTIC MISSILE USE

Year	Event	Missile	Quantity
1944-45	German attacks on Allies	V-2	2,952
1973	Egyptian and Syrian attacks on Israel	Scud	3
1980-88	Iran-Iraq War		478
	Iraq	Scud*	172
	Iran	Scud	40
	"War of the Cities"		
	Iraq	Scud*	189
	Iran	Scud	77
1986	Libyan attacks on U.S. Coast Guard base, Lampedusa, Italy	Scud	2
1989-91	Afghan Government use on Mujahideen	Scud	1,228 to 2,000
1991	Iraqi attacks during the Persian Gulf War	Scud*	88
	On Israel		42
	On Saudi Arabia		43
	On Bahrain		3
1994	Yemeni Civil War	Scud	Unknown

*Scud and/or derivative missiles.[34]

The rapid proliferation of ballistic missiles among developing countries over the last decade has spawned a debate about their actual ability to affect the conduct of tactical operations. The issue centers on whether ballistic missiles or combat aircraft represent a more efficient means for developing nations to exercise military power. At first glance, aircraft appear more advantageous. They are reusable, more versatile, and capable of achieving better accuracy than their single-shot ballistic brethren. Ballistic missiles, however, confer prestige and enhance deterrence, two benefits that combat aircraft do not necessarily provide.[35] More importantly, for Third World nations engaged in combat against the United States, ballistic missiles may be the only viable means to attack U.S. troops. The power of U.S. Air Force and Navy aircraft and Army air defenses to deter or destroy any potential air attack denies an enemy the luxury of adopting any other course of action.

In the Persian Gulf War, the most recent conflict between a Third World air force and U.S. armed forces, no enemy aircraft overflew United States or coalition forces. The United States and her allies had air supremacy then and are likely to continue to have it in any conflict in the foreseeable future. This would seem to drive the virtual attrition rate of Third World aircraft facing a U.S.-led deployment to well above 50 percent, the maximun crossover point many analysts believe neccessary to make ballistic missiles more cost effective than aircraft. Thus, the likelihood that an adversary would test his air force against that of the United States is small. Instead, given such attrition, a third world adversary planning an attack on U.S. forces would probably find it more cost-effective to launch ballistic missiles than to employ combat aircraft.[36]

While this may seem extreme, it was essentially Iraq's strategy during the Persian Gulf War. The Iraqis understood that the speed of their missiles gave them a chance at penetrating coalition air space, something their air force could never do. At the very least, given the continued asymmetry between U.S. and Third World air forces, it is reasonable to expect a potential adversary to employ a mixture of missiles and aircraft — maybe more missiles than aircraft — against deploying U.S. forces. This expectation, combined with the likelihood that any future foe will have improved the accuracy and yield of his ballistic missiles, poses an ever-increasing threat to deploying tactical forces.

Third World Missile Status

The ballistic missile threat to U.S. tactical forces is real and quantifiable. Table 2 outlines this threat by nation and type of missile. All references to range, payload and CEP are approximate and based on unclassified information.[37] While this threat information is as comprehensive as possible, limited access to a number of countries on the list prevents a complete and exact indexing of ballistic missile capabilities. Moreover, for reasons of deterrence, most nations may prefer to leave others guessing as to the actual extent of their capabilities. Nonetheless, this index highlights several trends in the emerging missile threat to U.S. forces.

The most obvious trend is the spread of Scud and Scud-derivative missiles throughout the Third World. This is attributable to the proliferation begun by the Soviet Union and carried on since its collapse by such nations as Iraq and North Korea. Of particular note is the emergence of Chinese missiles in several developing countries. This indicates how effective the Chinese have become in marketing their more modern "M" series missiles and may demonstrate the viable limits of Scud-derivative proliferation.

Another notable characteristic concerns the range of most missiles. The majority of ballistic missiles have ranges under 1,000 kilometers. When equipped with improved guidance systems and warheads, these missiles will possess the range, accuracy and lethality to pose a militarily significant threat to tactical units. Similarly, the majority of missile payloads can carry over 1,100 pounds. This is the minimum weight believed

Table 2

THIRD WORLD BALLISTIC MISSILE INDEX

NATION	MISSILE	RANGE (kms)	PAYLOAD (pounds)	CEP (meters)	WARHEAD
AFGHANISTAN	Scud B	300	2200	400-1000	conv/chem
ALGERIA	FROG-7	70	960	400	conventional
ARGENTINA	Alacan	200	1100		
BRAZIL	MB/EE-150	150	1100		
	MB/EE-600	600			
	MB/EE-1000	1000			
	SS-300	300	2200		
CHINA	8610 (M-7)	180	1100		
	M-9	600	1100	300	conventional
	M-11	300	1100	300	conventional
	CSS-2/DF-3	3000	3000	1000	conv/nuclear
	CSS-3/DF-4	7000	2200		nuclear
	CSS-4/DF-5	10,000			nuclear
EGYPT	Scud B	300	2200	400-1000	conv/chem
	Scud C	500	1500	<Scud B	conv/chem
	Sakr-80	80	440		conv/submun
	Vector	600	1000		
INDIA	Privthi	250	1000		
	Agni	2500	1500-2000	50	
IRAN	Ognab	40	660		conventional
	Nazeat	130			
	Scud B	300	2200	400-1000	conv/chem
	Scud Mod C	500	1500	<Scud B	conv/chem
IRAQ	FROG-7/Laith	70	960	400	conventional
	Scud B	300	2200	400-1000	conv/chem
	Al-Hussein	650	1100	1000	conv/chem
	Al-Abbas	950	660	1500	conv/chem
LIBYA	FROG 7	70	960	400	conventional
	Scud B	300	2200	400-1000	conv/chem
	Al Fatah	950	1100		
	M-9	600	1100	300	conventional
NORTH KOREA	Scud Mod B	320	2200	400-1000	conv/chem
	Scud Mod C	500	1500	<Scud B	conv/chem
	Nod ong I	1000	2200		conv/chem
	Nodong 2	1500-2000			conv/chem
PAKISTAN	Hatf I/IA	80-100	1100		
	Hatf II	300	1100		
	Hatf III	600	1100		
	M-11	300	1100	300	conventional
SAUDI ARABIA	CSS-2/DF-3	2700	3000	1000	conventional
SYRIA	FROG 7	70	960	400	conventional
	Scud B	300	2200	400-1000	conv/chem
	Scud Mod C	500	1500	<Scud B	conv/chem
	M-9	600	1100	300	conventional
	SS-21	120	1000	30	conv/chem
YEMEN	FROG 7	70	960	400	conventional
	Scud B	300	2200	400-1000	conventional
	SS-21	120	1000	30	conventional

necessary to transport a nuclear warhead and may serve as an indicator of the direction some missile programs may follow in the future. Finally, a variety of warheads ranging from conventional high explosives and submunitions to unconventional chemical and nuclear munitions are already available to several developing countries. This proliferation of warhead technology underscores the potential threat to U.S. forces employed in future force projection operations from ballistic missiles of ever-increasing range, accuracy and lethality.

THE EFFECT OF BALLISTIC MISSILES ON TACTICAL BATTLE SPACE

Since their employment in World War II, ballistic missiles have improved in range, accuracy and warhead capacity to the point where they now pose a significant threat to tactical units. Although some examination of the impact of ballistic missiles on deployed forces occurred coincident to the discussion of their history and development, the following analysis specifically highlights the primary and secondary effects of ballistic missiles on the tactical commander's battle space during the deployment and early entry, buildup and expansion, decisive operations, and redeployment and postconflict phases of force projection operations. While anticipating continued ballistic missile development and the increased availability of advanced conventional and unconventional warheads, this analysis employs potential North Korean and Persian Gulf conflict scenarios as a backdrop for discussion. It superimposes events from the past on concerns of the present and technical developments from the immediate future to produce a vision of how a potential enemy might employ tactical ballistic missiles against U.S. forces. With respect to the emerging threat from ballistic missiles and weapons of mass destruction, "Third World" does not mean third rate. In the context of force projection operations, a ballistic missile attack can have a militarily significant effect on tactical forces and, in some cases, seriously damage their chances for success on tomorrow's battlefield.[38]

Deployment and Early Entry

United States forces are most vulnerable during the deployment and early entry phase of force projection operations. An enemy may be unwilling or unable to employ ground or air forces against deploying units, but can attack ports of debarkation with ballistic missiles from secure locations hundreds of kilometers away from the entry area. During this phase, an enemy will attempt to prevent or delay U.S. forces from entering the theater by using his ballistic missiles to attack ports, airfields and logistics bases.[39]

The primary effect of such an attack would be to close the airfield or port at least temporarily while surviving personnel treated casualties and removed debris. If the enemy employs submunitions in his attack, there is the likelihood of increased damage to arriving aircraft, resulting in additional casualties and debris. In the case of a chemical attack on an airfield, the number of casualties would increase, while the damage to facili-

ties would decrease. Moreover, the presence of a chemical agent would limit flight operations and slow the inprocessing of newly arriving combat forces. In a scenario where the commander needs to transition forces rapidly from arrival in theater to combat operations, such an attack risks disrupting the flow of troops, upsetting the commander's tempo of operations and potentially invalidating his plan. If the attack occurred on a tactical airfield, the damage to aircraft would reduce the available sorties and disrupt the tempo of air operations. The loss of tactical aircraft would impact on the ability of the commander to attack enemy ground troops, interdict their supply lines, hunt for ballistic missile launchers, and protect his air space.

Likewise, a chemical attack on port facilities in the rear area would cause a large number of casualties, particularly among unprotected civilians. Consider the impact an Iraqi chemical attack on the port of Jubayl might have on the psyche of the civilian stevedore work force during a future Persian Gulf conflict. Even if most survive the initial attack, it is doubtful that many would return to work the next day. During the Persian Gulf War, Scud attacks on Jubayl and Dammam caused four civilian ship captains to pull back out to sea, delaying the unloading of combat elements of the much-needed VII Corps. Similar delays during future deployments could mean the difference between victory or defeat in a rapidly progressing operation.[40]

In addition to their political and strategic impact, the use or threat of use of ballistic missiles on the airfields, ports or population centers of an allied nation supporting U.S. forces would have serious secondary tactical effects. The most obvious example involves the Iraqi attacks on Israeli population centers during the Persian Gulf War. These attacks risked bringing Israel into the war and destroying the allied coalition's political and military structure. This would have changed the correlation of forces, possibly requiring a revising of the operations plan, and left U.S. forces vulnerable to attack from formerly allied nations such as Syria. Concern over similar attacks into Turkey and the resultant potential for lost basing rights drove military planners to send Patriot batteries to Turkey to intercept any incoming Iraqi Scud missiles.[41]

The loss, through either missile attack or intimidation, of an intermediate staging base or the forward portion of a communications zone located in an allied nation would degrade significantly the commander's ability to bring forces and supplies into theater and execute his war plan. One nation particularly vital to U.S. military deployments in Asia is Japan. An attacking North Korean force, however, could range the coast of Japan with Scud Mod C missiles from positions just south of Seoul, South Korea. Even worse, using the Nodong 1 missile (1,000-1,300 kilometer range), the North Koreans can reach Osaka and Tokyo from locations outside their capital of Pyongyang. While it is unlikely that the Japanese would prevent U.S. forces from staging out of Japan, improvements in North Korea's missile program and the potential for such an attack compelled the Japanese to purchase the Patriot missile system from the United States. Concern over assured access to bases in Japan obliged the United States to agree to sell the Patriot missile system — a system based on highly advanced computer and aerospace technology — to

Japan, a competitor in the global computer and aerospace industry. Moreover, in the event of war, the political pressure to destroy mobile launchers and alleviate the threat of missile attacks on Japan will force a diversion of aircraft and intelligence assets in a situation reminiscent of the Persian Gulf War. Compared to the relatively flat sands of Iraq, however, the mountainous terrain in Korea will make it even more difficult to find the launchers. This difficulty will cause an even greater diversion of air assets away from attacking ground formations than occurred during the "Great Scud Hunt" in the Persian Gulf War. Given the remote nature of the Korean theater of operations and the expected rapidity of a North Korean attack, any diversion of assets away from stopping a North Korean offensive could prolong the conflict, lead to increased casualties, and limit the ability of tactical commanders to achieve victory on the battlefield.[42]

Buildup and Expansion

During the buildup and expansion phase of force projection operations, an enemy will continue to attempt to disrupt the deployment of forces into the theater with missile attacks on ports, airfields, logistics bases and tactical assembly areas. To deter, or if necessary defeat, such an attack by North Korea, General Gary Luck, the commander of United States forces in South Korea, asked that a Patriot battalion deploy to Korea in the spring of 1994. Concerned with protecting the vital assets he needed for the initial fight as well as maintaining the flow of reinforcements and supplies into Korea in the event of a North Korean attack, General Luck positioned the arriving Patriot batteries at key airfields and ports on the peninsula.[43] At the tactical level the primary effects of such an attack would be the likely desynchronization of the commander's operation due to a lack of combat troops and equipment necessary to accomplish key parts of his plan, as well as an increase in casualties.

A ballistic missile attack on large logistics sites and tactical assembly areas would have a similar effect. During Operation Desert Storm, the commander of the Patriot-Hawk air defense task force assigned to protect VII Corps expressed the importance of preventing such an attack. As part of his Commander's Intent, Lieutenant Colonel Lawrence Dodgen wrote:

> The enemy's greatest threat is his ability to upset the timing of the operation or to contaminate/damage critical elements of the Corps by missile . . . attack. While in TAA [tactical assembly area] Juno, Patriot is to protect the force from attack with logistics, 11AB [11th Aviation Brigade], and command and control as the priorities. Early positioning of HIMAD [high to medium air defense] forces allows for rapid logistics build up. . . .[44]

Lieutenant General Paul Funk, commander of the U.S. Army's III Corps, confirmed this danger with respect to his unit's potential deployment to South Korea to thwart a future North Korean attack. He commented that given the restricted nature of the terrain

in Korea, a ballistic missile attack had more potential lethality than one might face in Saudi Arabia. He emphasized that the lack of room in Korea to disperse his maneuver forces and logistics sites left them at risk.[45] Depending on the type of warhead employed, a successful missile attack in this situation could cause heavy casualties, destroy or contaminate countless supplies, and render scores of soft-skinned vehicles inoperable.

During this phase, a missile attack on political, strategic or operational targets poses significant secondary effects for tactical forces. The loss of an intermediate staging base for soldiers and supplies would limit the commander's ability to execute his tactical plan. Furthermore, as in the Iraqi Scud attacks on Israel, the diversion of air assets to find and suppress the mobile launchers could delay the onset of offensive operations. The attacks on Israel caused the diversion of not only combat aircraft, but also the Joint Surveillance Target Attack Radar System (JSTARS) from its coverage of the ongoing ground battle at Khafji to hunt for Scuds in Western Iraq. In an attempt to allay Israeli concerns, political leaders in Washington, D.C. directed General Schwarzkopf to move one of only two JSTARS aircraft in Saudi Arabia. The issue is not whether the decision was correct, but that the launching of Scuds at Israel had important tactical side effects, including blinding the ground commanders to what was occurring during the first ground battle of the Persian Gulf War.[46]

Just as an attack on a logistical base or assembly area in VII Corps or III Corps would create problems for the corps commander, so too would an attack on a theater-level facility. A successful missile attack on King Khalid Military City and Log Base Bravo during the Persian Gulf War would have amounted to piercing what Lieutenant General John J. Yeosock, the Third Army Commander, considered his operational center of gravity. Consequently, the 11th Air Defense Artillery Brigade positioned Patriot batteries there to protect those vital Third Army assets. The tactical effects of a successful attack would have rippled throughout the command, severely interrupting the movement of forces and supplies west in preparation for the ground attack, and disrupting both the XVIII Airborne Corps and the VII Corps plans.[47]

Decisive Operations

The objective of the commander during combat operations is to achieve a quick, decisive victory with minimal casualties. A successful ballistic missile attack during this phase can prevent the commander from achieving his goal. During decisive operations, when combat forces are moving and fighting, the enemy will use his ballistic missiles to interdict the friendly movement of troops and supplies and attack friendly forces as they congregate to pass through choke points on the battlefield.

During the Persian Gulf War, an ideal time for the Iraqis to attack friendly maneuver forces with ballistic missile attacks would been have as VII Corps breached Iraqi frontline positions on 24 February 1991. In a postwar conversation, General Frederick M.

Franks, Jr., the VII Corps commander during Operation Desert Storm, expressed particular concern about chemically-armed ballistic missiles landing on his soldiers "in the breach," especially if Iraqi minefields slowed their penetration.[48] To counter this threat, VII Corps ordered two Patriot batteries from the Corps Patriot battalion to the breach site to provide defense against ballistic missiles.[49]

For soldiers hit with such an attack, the effects would have been devastating. One participant, when asked about the likely effect of a chemical attack on breaching forces, commented that the soldiers in Abrams tanks and Bradley infantry fighting vehicles might have survived thanks to the overpressurization of the chemical protection system installed on those vehicles, but that soldiers in other vehicles would have been contaminated. This assumes that the tank and infantry squads riding with their hatches open had been warned in time to close their hatches and activate their overpressure systems before entering the contaminated area.[50]

Moreover, in at least one battalion, staff officers and headquarters personnel following the combat forces through the area stopped and dismounted their vehicles to survey the situation. As they gathered together, a senior noncommissioned officer commented that they were all vulnerable to an attack by indirect fire. If that fire had been from ballistic missiles armed with fuel-air explosives, the battalion staff would have been killed and all of the light-skinned vehicles — command and control shelters, supply vehicles and fuel tankers — destroyed. Such an attack would have decapitated the battalion, removing most of the unit's planning personnel. Additionally, the loss of vehicles, particularly fuel vehicles, would have forced that battalion to run out of fuel. While the 1st Infantry Division had spare combat vehicles to replace destroyed tanks and infantry fighting vehicles, it did not have any additional fuel tankers. Thus, while there may have been enough bulk fuel within the 1st Division and VII Corps, the inability to distribute that fuel to front-line units risked disrupting the division and corps battle plans.[51]

In certain situations, the political or strategic use of ballistic missiles by the enemy may also have the secondary tactical effect of inhibiting the movement of reinforcements and supplies to critical points on the battlefield. Consider the case of a war in Korea, where political considerations will force the Combined Forces Command (CFC) to defend the approaches to Seoul. To do so, the CFC may need to move forces and supplies in and around Seoul. A North Korean missile attack on Seoul, regardless of whether it carried chemical munitions, would affect the populace psychologically to the point where the ensuing mass exodus of refugees would clog the vital road networks needed by the military forces. This phenonenon was evident in Teheran during the Iran-Iraq War and in Tel Aviv throughout Operation Desert Storm. Seoul is the fourth most populous city in the world with a projected population of almost 22 million people by the year 2000. It has a population density of 49,101 people per square mile — five times that of Tel Aviv. If North Korea lived up to the pledge one of its diplomats made in April 1994, to turn Seoul "into a sea of fire," the consequent exodus could easily overcome efforts by Korean authorities to control it. Furthermore, if the North Koreans used chemical munitions on

Seoul, the immense congestion in the city portends massive casualties, potentially drawing United States and South Korean medical and logistical personnel and supplies away from the front to provide disaster relief.[52]

Redeployment and Postconflict

Although most significant combat activities will have ceased as U.S. forces transition into the redeployment and postconflict phase of force projection operations, an enemy may still launch a "last ditch" missile attack against U.S. forces. In this event, an enemy would target large facilities and collections of soldiers such as ports, airfields and assembly areas. The impact of a ballistic missile attack during this phase would have a debilitating psychological as well as physical effect on tactical forces. While the congestion of departing forces suggests the potential for higher casualties, the shock of such an attack might far outweigh the physical effects of the bombardment. A successful ballistic missile attack on a victorious army may call into question the concept of victory, undermine the political rationale for initially deploying forces, and put future deployments at risk. An attack with weapons of mass destruction could damage or contaminate port and airfield facilities, delaying or preventing the redeployment of U.S. forces. Given that the national military strategy envisions fighting two nearly simultaneous major regional contingencies, the inability to redeploy forces from one theater to another rapidly could jeopardize the chances for tactical, operational and strategic success in the second major regional contingency.

CONCLUSION

Ballistic missiles and weapons of mass destruction represent a credible tactical threat to U.S. forces engaged in force projection operations. The proliferation of improved missile guidance, propulsion and warhead technologies among Third World nations will only serve to increase the lethality of this threat to U.S. forces in the future. As nations improve the quality and quantity of their missile arsenals, missiles will assume ever-increasing utility over combat aircraft. In a conflict with the United States, the power of the U.S. Air Force and Navy to ground any enemy air force will reinforce this belief, tempting an adversary to use his ballistic missile arsenal to best advantage. Moreover, after a slow but continuous expansion of the use of ballistic missiles in combat, the precedent for an attack on U.S. forces has been set. The Libyan attacks in 1986 represented a meager but determined attempt to strike back at the United States for its air raids earlier that year. The attacks by Iraq during the Persian Gulf War, however, opened the door for similar large-scale attacks in the future. The expected advancements in missile and warhead technology will permit foes to strike at U.S. forces from longer distances with greater accuracy and lethality. If successful, these attacks will have a militarily significant effect on the conduct of the deployment and early entry, buildup and expansion, decisive operations, and redeployment and postconflict phases of force projection operations.

Tactical commanders from battalion to corps must understand and appreciate the devastating effect of attacks by ballistic missiles and weapons of mass destruction on their battle space. These attacks could delay or prevent the entry of forces into the theater of operations, slow the movement of soldiers and equipment from ports and airfields, disrupt the timing and synchronization of decisive operations, necessitate the diversion of essential resources, and cause innumerable casualties. A successful ballistic missile attack could invalidate the concept of "decisive victory with minimal casualties" and undermine the potential for success in future force projection operations. Therefore, commanders must incorporate the threat from ballistic missiles and weapons of mass destruction into their tactical plans or suffer the attendant consequences.

ENDNOTES

1. George Bush, *National Security Strategy of the United States, March 1990* (Washington, D.C.: Government Printing Office, 1990), p. 9.

2. George Bush, *National Security Strategy of the United States, January 1993* (Washington, D.C.: Government Printing Office, 1993), p. 1.

3. *Ibid.*, p. 16.

4. *Ibid.*, p. 17.

5. William J. Clinton, *A National Security Strategy of Engagement and Enlargement, July 1994* (Washington, D.C.: Government Printing Office, 1994), p. i.

6. *Ibid.*, p. 11.

7. During the Persian Gulf War, Iraq launched 88 Scud-B/Al-Hussein missiles: 43 at Saudi Arabia, 42 at Israel, and three at Bahrain. See Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report* (Washington, D.C.: Government Printing Office, 1993), p. 84. Additionally, during the first three days of the ground operation (21-23 February 1991), the Iraqis fired a combination of 91 Brazilian-made Astros II and FROG-7 rockets at allied forces in Saudi Arabia and Kuwait. See Joseph S. Bermudez, Jr., "Iraqi Missile Operations During Desert Storm," *Jane's Soviet Intelligence Review*, vol. 3, no. 3, March 1991, pp. 131-135; Bermudez, "Iraqi Missile Operations During Desert Storm — Update," *Jane's Soviet Intelligence Review*, vol. 3, no. 5, May 1991, p. 225.

8. Ballistic missile attack and defense is a relatively new field of study. It was an outgrowth of the study of nuclear theory, emerging in the mid-1980s with a focus on NATO and the Warsaw Pact. As the United States and the Soviet Union began eliminating entire classes of nuclear weapons, defense analysts started to study the effects of short-range, conventional ballistic missiles on the battlefield. With the end of the Cold War and evidence of missile proliferation in the Third World, study has turned to ballistic missile production and use by developing countries.

   The use of ballistic missiles in both the Iran-Iraq War and the more recent Persian Gulf War reinforced this trend. Currently, this field of study is dominated by defense analysts and think tank employees who focus primarily at the political and strategic level of war. As an adjunct to the field of ballistic missile study, there has emerged a parallel concern over the use of weapons of mass destruction. The two issues are normally addressed together in the same publications. Some of the major works are: Janne E. Nolan, *Trappings of Power: Ballistic Missiles in the Third World* (Washington, D.C.: The Brookings Institution, 1991); Martin Navias,

Ballistic Missile Proliferation in the Third World (London: Brassey's, 1990) and *Going Ballistic: The Build-up of Missiles in the Middle East*(London: Brassey's, 1993); and W. Seth Carus, *Ballistic Missiles in the Third World: Threat and Response* (New York: Praeger Publishers, 1990).

Due to the focus on political and strategic issues surrounding ballistic missiles and weapons of mass destruction, solutions tend toward arms control agreements such as the Nuclear Non-Proliferation Treaty and the Treaty of Tlateloco as well as export control agreements such as the Missile Technology Control Regime and away from active defenses against attack. As recent events involving North Korea's nuclear arsenal demonstrate, however, arms control agreements can be surreptitiously ignored or openly abrogated. Moreover, as the proliferation of missile and warhead technology shows, the actual enforcement of restraints on technology transfer is a complicated and challenging matter.

9. TRADOC Pamphlet 525-5, *Force XXI Operations: A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century* (U.S. Army Training and Doctrine Command, 1 August 1994), pp. 2-7.

10. Circular error probable or circle of equal probability (CEP) is the distance from the intended target in which 50 percent of the missiles will probably land.

11. In the last ten years, several nations have established missile partnerships. Iraq, Egypt and Argentina joined together to develop the Condor II ballistic missile. Iran received North Korean help to modify Soviet Scud missiles. Taiwan, South Africa and China supposedly received aid from Israel. In turn, China sold DF-3A missiles to Saudi Arabia and offered to develop missile prototypes for Middle Eastern nations willing to underwrite the cost. Brazil and China formed a joint venture to develop space-launch vehicles. One spinoff from this relationship is the development of a ballistic missile with export potential. Also, Libya has approached Brazil, Pakistan and others in an effort to buy missiles and missile technology (Nolan, *Trappings of Power*, p. 18). For an incisive analysis of Third World defense investment, ballistic missile production, and technology transfer, see Nolan, *Trappings of Power*, particularly chapters 2, 3 and 5.

12. Joseph S. Bermudez, Jr. "Ballistic Ambitions Ascendant: North Korea's Ballistic Missile Program," *Jane's Defence Weekly*, 10 April 1993, pp. 20-21, and "Iraqi Missile Operations During Desert Storm," *Jane's Soviet Intelligence Review*, vol. 3, no. 3, March 1991, pp. 131-135; Richard A. Bitzinger, "Arms to Go: Chinese Arms Sales to the Third World," *International Security*, vol. 17, no. 2, Fall 1992, pp. 84-111; John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," *International Security*, vol. 17, no. 2, Fall 1992, pp. 5-41; Barbara Starr, "USA Links Chinese Ties to Missile Exports," *Jane's Defence Weekly*, 15 October 1994, p. 6.

13. "The Great Scud Hunt" also required the use of scarce intelligence assets and the creation of a special 877-man Joint Special Operations Task Force (JSOTF) to find mobile Scud launchers. See Robert H. Scales, *Certain Victory: The U.S. Army in the Gulf War* (Fort Leavenworth, Kans.: CGSC Press, 1994), pp. 184-187.

14. The data on airlift sorties assumes a six-battery Patriot battalion, eight launchers per battery, and a battalion headquarters. Data was provided by the Directorate of Combat Developments, U.S. Army Air Defense Artillery School and Center, Fort Bliss, Texas. Adjusting these figures to their C-141 equivalent (multiply the number of C-5As by a factor of 2.5), the cost in airlift becomes apparent. To move the Patriot battalion in question would require approximately 254 C-141 equivalent sorties or 31 percent of what it took to move the entire 82d Airborne Division (832 C-141 sorties) to Saudi Arabia for Operations Desert Shield and Desert Storm. For airlift data on the 82d Airborne Division, see Scales, *Certain Victory*, pp. 50-51.

15. U.S. Army Field Manual 100-5, *Operations* (hereafter cited as FM 100-5) (Washington, D.C.: Department of the Army, 1993), pp. 6-2, 6-12. See also TRADOC Pamphlet 525-5, p. 3-8. With advances in technology, information age information reporting, and compressions in time-space relationships, defining battle space by levels of command, size of units, types of units, or types of equipment may become obsolete or at best confusing. In certain circumstances, events may be defined as either strategic, operational or tactical based on their effect or contribution to achieving strategic, operational or tactical objectives. Commanders at every level must be aware that in a world of constant, immediate communications and advanced, long-range weaponry, any single event may cut across the three levels of war. See Joint Publication 3-0, *Doctrine for Joint Operations* (Washington, D.C.: The Joint Staff, 1993), p. II-1.

16. During the Persian Gulf War, the author participated in a radio talk show on military affairs and discussed ballistic missile and antimissile (Patriot) operations. The conclusions about misperceptions are drawn from that experience as well as from discussions with some senior military officers in the ensuing three years.

17. Carus, *Ballistic Missiles in the Third World*, p. 2; Robert Shuey et al., *Missile Proliferation: Survey of Emerging Missile Forces* (Washington, D.C.: Congressional Research Office, 1988), p. 1n.

18. Cited in Bernard Brodie and Fawn Brodie, *From Crossbow to H-Bomb*, 1st Midland ed. (Bloomington, Ind.: Indiana University Press, 1973), pp. 44 and 127.

19. The air-launched V-1 was less accurate than the ground-launched version. Instead of launching from a known location on the ground, it relied on the location of the

aircraft for its initial positioning. Due to the heavy losses inflicted on the Luftwaffe by allied bombers and fighters, most air-launches occurred at night over the North Sea with pilots counting on their instruments (and their nerves) to get them to the right spot in the air. Headquarters, United States Forces European Theater, Report of the General Board, Study #38, pp. 38-40, cited in R.J. Backus, "The Defense of Antwerp Against the V-1 Missile," (M.A. thesis, Command and General Staff College, 1971), p. 10; M. C. Helfers, *The Employment of V-Weapons by the Germans in World War II*, Office of the Chief of Military History (Washington, D.C.: Department of the Army, 1954), p. 37; Winston Churchill, *The Second World War: Triumph and Tragedy* (Boston: Houghton Mifflin Company, 1953), p. 39; See also Kenneth P. Werrell, *The Evolution of the Cruise Missile*, (Washington, D.C.: Government Printing Office, 1985).

The British employed a three-tiered strategy — passive defense, active defense and attack operations — in their fairly successful defense of London against the V-1. They used air raid alerts and deep air raid shelters to safeguard the people; antiaircraft artillery, fighter aircraft and barrage balloons to stop the incoming missiles; and bombers to strike the V-1 launch sites, storage areas and factories. Of the more than 7,500 missiles fired at London, only about 2,400 got through the defenses. Total civilian casualties were 6,184 killed and 17,981 seriously wounded. There is no record of the number of wounded who did not require hospitalization. At least 75,000 homes were destroyed. For more on the British battle against the V-1, see Churchill, *Triumph and Tragedy*, pp. 38-49; General Sir Frederick Pile, *Ack-Ack: Britain's Defence Against Air Attack During the Second World War* (London: George G. Harrap & Co., 1949), pp. 311-368; and Backus, "The Defense of Antwerp Against the V-1 Missile," pp. 12-21.

20. Churchill, *Triumph and Tragedy*, pp. 49-52; Pile, *Ack-Ack*, pp. 386-388. System Planning Corporation, *Ballistic Missile Proliferation: An Emerging Threat*, (Arlington, Va.: System Planning Corporation, 1992), p. 5.

21. Churchill, *Triumph and Tragedy*, p. 39.

22. The V-1 campaign began on 13 June 1944 and occurred in three phases. From 13 June to 5 September 1944, the Germans launched missiles from northern France. From 15 September 1944 to 15 January 1945, they used the Heinkel 111 to air-launch V-1s at London. V-1 attacks resumed on 3 March 1945 and continued until 29 March, when the British antiaircraft artillery downed the last missile. During the V-1 campaign, the Germans successfully launched 7,558 missiles at London, 8,696 at Antwerp, and 3,141 at Liege. The V-2 campaign began on 8 September 1944 and continued until the Allies liberated the launching area near The Hague in April 1945. During the V-2 campaign, the Germans launched 1,190 missiles at London, 1,610 at Antwerp, 151 at Brussels, and one at Paris. British casualties totaled 6,184 killed and 17,981 seriously wounded from V-1 attacks and 2,724

killed and 6,467 seriously wounded from V-2 attacks. The V-2 attacks on Belgium totaled 4,152 killed. (Churchill, *Triumph and Tragedy,* pp. 48-55; Backus, "The Defense of Antwerp Against the V-1 Missile," pp. 12-14.)

23. This comment requires at least one caveat. Specifically, the Germans were not shy about lending their expertise after the war. With German help, Egypt became the first developing nation to begin its own missile program. With extensive assistance from German engineers, the Egyptians deployed a family of liquid-propellant missiles as early as 1963. They never fired the missiles, and when the Germans were forced from Egypt, the program collapsed. System Planning Corporation, *Ballistic Missile Proliferation,* pp. 5-6.

24. The following nations possess Scud-B missiles: Afghanistan, Algeria, Azerbaijan, Belarus, Bulgaria, Czech Republic, Egypt, Georgia, Hungary, Iran, Iraq, Kazakhstan, North Korea, Libya, Poland, Romania, Russia, Slovakia, Syria, Ukraine, Vietnam and Yemen. (Duncan Lennox, "Missile Race Continues," *Jane's Defence Weekly*, 23 January 1993, p. 20.)

25. The Soviets first supplied FROG rockets in the 1960s and 1970s, sending FROG 7s to Egypt (1968), Iraq and North Korea (1969), Syria (1973), Algeria (1975), Libya (1978), The Peoples' Democratic Republic of Yemen [PDRY] (1979), and Kuwait (late 1970s). Scud exports began in the 1960s and continue into the 1990s. See Navias, *Going Ballistic*, pp. 63-64.

The Scud-B CEP varies according to source consulted. For example, Duncan Lennox ("Iraq's Scud Programme — the Tip of the Iceberg," *Jane's Defence Weekly*, 12 March 1991, p. 303) lists it at 450 meters, while Janne E. Nolan (*Trappings of Power*, pp. 67-68) carries it at 980 yards. Martin Navias (*Going Ballistic,* p. 13) lists the Scud-B at 400-500 meters CEP. This monograph assumes a CEP of 450 meters.

26. Martin Navias (*Going Ballistic*, pp. 63-64, 140-142) contends that government forces fired somewhere between 1,228 and 1,554 (possibly even all 2,000) Scuds at the Mujahideen.

27. Bermudez, "Ballistic Ambitions Ascendant," p. 22; System Planning Corporation, *Ballistic Missile Proliferation: An Emerging Threat*, p. 16; Bermudez, "Syria's Acquisition of North Korean 'Scuds'," *Jane's Intelligence Review,* vol. 3, no. 6, June 1991, pp. 249-251.

28. One indication of the status of the North Korean economy and the importance of Iranian financing is the report that Iranian forces received their new missiles even before North Korea fielded them in its own army. (Bermudez, "Ballistic Ambitions Ascendant," p. 22.) Syria reportedly paid for the missiles it received from

North Korea with part of the $2 billion it received from Saudi Arabia for its participation in the Persian Gulf War. (Bermudez, "Syria's Acquisition of North Korean 'Scuds'," pp. 249-251.) Iran also may have received North Korean assistance in manufacturing a chemical warhead for their new missile. See Navias, *Going Ballistic*, pp. 80-81. Navias also reports that in October 1991 the United States warned Israel not to attack a North Korean cargo ship, the *Mopu*, which they believed was carrying the Scud Mod C missiles. The United States feared that an Israeli attack might have damaging implications for the upcoming Madrid summit.

29. An indicator as to the extent of continued Russian (and ultimately German) influence over ballistic missile development, Russia recently prevented a number of missile designers from travelling to North Korea. These designers were from the Makeyev design bureau responsible for "Scud" design and, according to Joe Bermudez, Jr., have addressed North Korea's multistaging or clustering problems. Bermudez, "Ballistic Ambitions Ascendant," p. 22.

30. System Planning Corporation, *Ballistic Missile Proliferation*, p. 14. After an early interest in tactical range ballistic missiles, the Chinese turned to strategic range weapons in an effort to deter the superpowers, the United States before the 1970s and the Soviets after the late 1960s. Only in the mid-1980s when they became aware of the export potential of tactical ballistic missiles (TBMs) did the Chinese turn to making and marketing short range ballistic missiles. Interestingly, in reflection of their interests over time, the Chinese designed the Dongfeng series of missiles to strike specific strategic targets: the DF-2 (Japan), DF-3 (Philippines), DF-4 (Guam) and DF-5 (the continental United States). This designation determined the range of the missile. Conversely, with their eye on the Third World export market, the Chinese named the "M" family of missiles to correspond to the English word "missile." Perhaps the best description of the Chinese missile program is John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," pp. 5-41. See also Starr, "USA Links Chinese Ties to Missile Exports," p. 6; and Yan Kong and Tim McCarthy, "China's Missile Bureaucracy," *Jane's Intelligence Review*, vol. 5, no. 1, 1 January 1993, pp. 36-41.

31. The M-9 and M-11 missiles, when used by the PLA, are known as the DF-15 and DF-11. In addition to the M-9 and M-11, there have been reports of other "M" series missiles — the M-7, M-8, M-12 or M-18 — under production, including one supposedly with a range of 1,000 kilometers. (System Planning Corporation, *Ballistic Missile Proliferation*, p. 15; John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs," pp. 10-11.)

With respect to tactical ballistic missiles and weapons of mass destruction, China's arms exports go beyond merely selling surface-to-surface missiles. In 1989, they sold Iraq and Pakistan magnets used in high-speed centrifuges to make weapons-

grade uranium. In 1990, the Chinese sold lithium hydride to Iraq and Libya. The chemical has potential uses in the manufacture of nerve agents, missile fuel and nuclear weapons. In 1991, they provided Algeria and Iran with advice on how to match nuclear weapons with air and missile delivery systems. Moreover, they are reportedly aiding these nations in developing nuclear weapons programs, including building a plutonium reactor in Algeria. For the extent of Chinese arms sales, see Bitzinger, "Arms to Go: Chinese Arms Sales to the Third World," pp. 84-111.

32. Navias, *Going Ballistic*, pp. 101-105; Lennox, "Iraq's 'Scud' Programme," pp. 301-303.

33. Lennox, "Iraq's 'Scud' Programme," p. 301; Bermudez, "Iraqi Missile Operations During Desert Storm," p. 132.

34. For V-2 figures, see Churchill, *Triumph and Tragedy*, p. 39. For Persian Gulf War figures, see Keaney and Cohen, *Gulf War Air Power Study Summary Report*, p. 84. For other figures, see Navias, *Going Ballistic*, pp. 128-172.

35. While the issues of prestige and deterrence are outside the scope of this monograph, they nonetheless form part of the motivation for developing nations to acquire ballistic missiles. As a symbol of a nation's military might and technical prowess, ballistic missiles enhance national prestige and stature among other developing nations. In a certain sense, the possession of ballistic missiles replicates the political prestige associated with the possession of battleships earlier in the 20th century. In that regard, the concept of actual military utility may in fact give way to the perception of the same. Moreover, actual usefulness may yield to the need of some developing countries to demonstrate an industrial strength and wherewithal equal to that of developed nations. Brazil and South Africa are two examples of nations where the possession of ballistic missiles holds only limited military utility yet provides a symbol of strength and technical capability. Additionally, the ability to manufacture missiles and other military hardware magnifies the symbolic value attributed to possession. Indigenous manufacturing not only showcases a nation's technical sophistication, but it also highlights that country's military self-sufficiency and apparent independence from foreign political influence. For a further explanation of these and other benefits of ballistic missile ownership and indigenous production, see Andrew W. Hull, "Motivations for Producing Ballistic Missiles and Satellite Launch Vehicles," *Jane's Intelligence Review*, vol. 5, no. 2, February 1993, pp. 86-89; John R. Harvey, "Regional Ballistic Missiles and Advanced Strike Aircraft: Comparing Military Effectiveness," *International Security*, vol. 17, no. 2, Fall 1992, p. 77; Navias, *Going Ballistic*, p. 10; Bruce E. Arlinghaus, "Social versus Military Development: Positive and Normative Dimensions," in James Everett Katz, *Arms Production in Developing Countries* (Lexington, Mass.: D.C. Heath and Company, 1984), pp. 39-50; and Michael Brzoska and Thomas Ohlson, eds., *Arms Production in the Third World*, Stockholm International Peace Research Institute, (London: Taylor and Francis, 1986).

While prestige may motivate some nations to acquire ballistic missiles, their popularity among developing nations stems as much from their deterrent value as from any other factor. The deterrent value of ballistic missiles, especially when armed with unconventional warheads, far exceeds that of combat aircraft. All the Middle East nations that possess missiles do so in part due to their deterrent value. Iraqi dictator Saddam Hussein explicitly referred to the deterrent value of ballistic missiles when he commented that peace was possible only when both the Arabs and Israelis each had "one missile, so neither can use it." For more on the deterrent value of ballistic missiles, see Navias, *Going Ballistic*, p. 48.

36. Several analysts have opinions as to what the actual crossover point is between aircraft and ballistic missiles. John Harvey, in "Regional Ballistic Missiles and Advanced Strike Aircraft" (pp. 41-83), uses nine percent. Steve Fetter, in "Ballastic Missiles and Weapons of Mass Destruction: What is the Threat? What Should Be Done?" *(International Security*, vol. 16, no. 1, Summer 1991, pp. 5-42), claims that 35 percent is enough for single-stage missiles, while 25 percent suffices for two-stage missiles. Finally, Uzi Rubin in "Iraq and the Ballistic Missile Scare" *(Bulletin of the Atomic Scientists*, October 1990, cited in Navias, *Going Ballistic,* p. 12) argues for 50 percent.

37. Navias, *Ballistic Missile Proliferation in the Third World,* pp. 29-31; System Planning Corporation, *Ballistic Missile Proliferation*, p. 55; Lennox, "Missile Race Continues," pp. 18-21; and "World Missiles," *Defense and Foreign Affairs Strategic Policy*, March 1991, p. 23.

38. Primary tactical effects are those that occur directly from a missile attack or threat of such an attack. Secondary effects are those tactical effects that devolve indirectly from a friendly response to the political and strategic use of ballistic missiles by enemy forces.

39. Louis C. Wagner, Jr., "Theater Missile Defense," *Army*, vol. 44, no. 11, November 1994, p. 26; U.S. Army Air Defense Artillery School, "Draft Concept for Integrated Air Defense Artillery Operations" (Fort Bliss, Tex.: Combat Developments Directorate, 13 June 1994), p. 23.

40. Michael W. Ellis and Jeffrey Record, "Theater Ballistic Missile Defense and U.S. Contingency Operations," *Parameters*, vol. 22, no. 1, Spring 1992, p. 20; Rick Atkinson, *Crusade: The Untold Story of the Persian Gulf War* (New York: Houghton Mifflin, 1993), pp. 256-257.

41. *Ibid.*, p. 18.

42. The issue of a North Korean missile attack and the potential for the ballistic missile intimidation of Japan were discussed by the author and Lieutenant Colonel Keith

McNamara, Assistant Director of Combat Developments, U.S. Army Air Defense Artillery School, Fort Bliss, Texas, during a meeting at Fort Leavenworth, Kansas in August 1994.

43. *Ibid.*, conversation with Lieutenant Colonel McNamara. The Patriot battalion was the 2-7 ADA stationed at Fort Bliss, Texas. That battalion is part of an all-Patriot air defense brigade charged with providing tactical ballistic missile protection to echelon-above-corps (EAC) units. One of the Patriot batteries that deployed to Korea was positioned outside of Osan Air Base. The other locations were not disclosed to the author.

44. Gulf War Collection, SSG AAR 3-042, SG Historian Group VII Corps, (S/Unclass) Part 3, Chronology and Documentation, Volume 4, Documentation: Tab B, VII (U.S.) Corps Operations Order (OPORD) 1990-2 (Operation Desert Sabre), Annex M (Air Defense), (U) (hereafter cited as GWC Operation Desert Saber), p. 3. The task force designation was TF 8-43 ADA. It consisted of a four-battery Patriot battalion and two Hawk batteries.

45. Lieutenant General Funk made these comments in response to a question the author asked him during a briefing at the School of Advanced Military Studies, Fort Leavenworth, Kansas on 13 October 1994.

46. U.S. Congress. House. Committee on Armed Services, Subcommittee on Oversight and Investigations, *Report on Intelligence Successes and Failures in Operations Desert Shield/Storm*, 103d Cong., 1st Sess., August 16, 1993, Committee Print 5, p. 11.

47. In a meeting with Colonel Joseph Garrett, Commander of the 11th Air Defense Artillery Brigade, and Lieutenant Colonel Jeff Gault, Deputy Commander, prior to the movement of XVIII Corps west, Lieutenant General Yeosock called King Khalid Military City and Logistics Base Bravo his operational center of gravity. Lieutenant Colonel Gault related these comments to the author during a meeting at Fort Leavenworth, Kansas on 13 August 1994.

48. On 6 October 1994 at Fort Leavenworth, Kansas, the author questioned General Franks on how the threat of a ballistic missile attack complicated his planning during Operation Desert Storm. He commented that he was particularly concerned with chemical rounds landing on his forces while they were breaching Iraqi positions and potentially caught up in a minefield. He also mentioned that he felt tactical ballistic missiles were particularly dangerous during early entry operations. He concluded by stating that the Army must always possess its own means of self-defense against ballistic missiles.

49. GWC (Operation Desert Saber), p. A-7.

50. Major Michael Alexander made these observations to the author on 16 November 1994 at Fort Leavenworth, Kansas. Major Alexander was a Headquarters Company commander in the 2d Brigade, 1st Infantry Division during Operation Desert Storm.

51. This paragraph is based on comments by Major Alexander to the author on 16 November 1994.

52. Data on the population size and density of Seoul obtained from *The World Almanac*, (New York: Pharos Books, 1992, p. 881). Incidentally, Pusan, while having a smaller total population (five million) has almost twice the population density (92,735) as Seoul. An attack on Pusan during any phase of the war risks closing its main arteries for the duration of the conflict. The comment by a North Korean diplomat is attributed to Park Young Su. It was made at Panmunjom in March 1994. Quoted in *ADA* (Air Defense Artillery), July-August 1994, p. 1.