



Calhoun: The NPS Institutional Archive
DSpace Repository

Theses and Dissertations

1. Thesis and Dissertation Collection, all items

2003-06

High altitude warfare: the Kargil Conflict and the future

Acosta, Marcus P.

Monterey, California. Naval Postgraduate School

<http://hdl.handle.net/10945/1043>

Downloaded from NPS Archive: Calhoun



Calhoun is a project of the Dudley Knox Library at NPS, furthering the precepts and goals of open government and government transparency. All information contained herein has been approved for release by the NPS Public Affairs Officer.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

<http://www.nps.edu/library>

NAVAL POSTGRADUATE SCHOOL Monterey, California



THESIS

**HIGH ALTITUDE WARFARE: THE KARGIL CONFLICT
AND THE FUTURE**

by

Marcus P. Acosta

June 2003

Thesis Advisor:
Second Reader:

Peter Lavoy
Douglas Porch

Approved for public release, distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE June 2003	3. REPORT TYPE AND DATES COVERED Master's Thesis	
4. TITLE AND SUBTITLE: High Altitude Warfare: The Kargil Conflict and the Future			5. FUNDING NUMBERS	
6. AUTHOR(S) Marcus P. Acosta, CPT, U.S. Army				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release: distribution is unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (maximum 200 words)				
<p>The unique combination of thin air, freezing temperatures, and mountainous terrain that forms the high altitude environment has resisted advances in military technology for centuries. The emergence of precision warfare has altered the nature of warfare on most of the world's surface, yet has not significantly changed the conduct of ground combat at high altitude. The tactics that lead to victory on the high altitude battlefield have remained constant over time. This thesis examines the impact of the high altitude environment on soldiers, their weapons, and military operations, and identifies the lessons of the 1999 Kargil Conflict that are relevant to future high altitude combat.</p> <p>Combat at altitudes approaching 18,000 feet (5,485 m) above sea level between India and Pakistan at Kargil illustrates the timeless nature of high altitude warfare. U.S. combat experiences in the mountains of Afghanistan in 2002 parallel those of the combatants at Kargil despite the overwhelming technological advantage of U.S. forces. Trained and well-equipped light infantry is the only force capable of decisive maneuver in mountainous terrain. Heavy volumes of responsive firepower, in concert with bold maneuver, determine victory. Artillery, rather than air power, remains the preferred source of firepower to support ground maneuver.</p>				
14. SUBJECT TERMS India, Pakistan, Kargil, Afghanistan, High Altitude Warfare			15. NUMBER OF PAGES 103	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for Public Release, Distribution is Unlimited

HIGH ALTITUDE WARFARE: THE KARGIL CONFLICT AND THE FUTURE

Marcus P. Acosta
Captain, United States Army
B.S., United States Military Academy, 1994

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF ARTS IN NATIONAL SECURITY AFFAIRS

from the

NAVAL POSTGRADUATE SCHOOL
June 2003

Author: Marcus P. Acosta

Approved by: Peter Lavoy
Thesis Advisor

Douglas Porch
Second Reader

James J. Wirtz
Chairman, Department of National Security Affairs

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

The unique combination of thin air, freezing temperatures, and mountainous terrain that forms the high altitude environment has resisted advances in military technology for centuries. The emergence of precision warfare has altered the nature of warfare on most of the world's surface, yet has not significantly changed the conduct of ground combat at high altitude. The tactics that lead to victory on the high altitude battlefield have remained constant over time. This thesis examines the impact of the high altitude environment on soldiers, their weapons, and military operations, and identifies the lessons of the 1999 Kargil Conflict that are relevant to future high altitude combat.

Combat at altitudes approaching 18,000 feet (5,485 m) above sea level between India and Pakistan at Kargil illustrates the timeless nature of high altitude warfare. U.S. combat experiences in the mountains of Afghanistan in 2002 parallel those of the combatants at Kargil despite the overwhelming technological advantage of U.S. forces. Trained and well-equipped light infantry is the only force capable of decisive maneuver in mountainous terrain. Heavy volumes of responsive firepower, in concert with bold maneuver, determine victory. Artillery, rather than air power, remains the preferred source of firepower to support ground maneuver.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	INTRODUCTION.....	1
B.	THE HIMALAYAN BATTLEFIELD	3
C.	THE 1999 KARGIL CONFLICT	6
1.	Background	7
2.	The Northern Light Infantry	8
3.	The Indian Response.....	8
D.	ORGANIZATION	10
II.	THE HIGH ALTITUDE BATTLEFIELD.....	11
A.	INTRODUCTION.....	11
B.	THIN AIR – THE UNIQUE CONDITION OF HIGH ALTITUDE.....	12
1.	Altitude Illness.....	12
2.	Acclimatization.....	14
3.	Effects on Weapons and Aircraft	15
C.	COLD WEATHER.....	17
D.	THE ETERNAL MOUNTAINS.....	18
1.	Terrain and the Soldier	19
2.	Effects on Weapons and Aircraft	20
E.	THE OPERATIONAL ART OF HIGH ALTITUDE WARFARE	21
1.	Maneuver	22
2.	Firepower.....	24
3.	Holding the High Ground	25
F.	CONCLUSION	26
III.	THE NORTHERN LIGHT INFANTRY AT KARGIL	27
A.	INTRODUCTION.....	27
B.	THE NORTHERN LIGHT INFANTRY	28
C.	INFILTRATION IN THE HIGH MOUNTAINS	29
D.	THE ENVIRONMENT’S TOLL.....	32
E.	ASYMMETRIC WARFARE.....	33
F.	GROUND COMBAT AT HIGH ALTITUDE	34
1.	Balancing the Close Fight.....	35
2.	Holding Ground in the Mountains	36
G.	TIGER HILL.....	38
H.	CONCLUSION	41
IV.	THE INDIAN OFFENSIVE	43
A.	INTRODUCTION.....	43
B.	RAPID DEPLOYMENT TO HIGH ALTITUDE.....	44
C.	DEFEAT ON TOLOLING	47
D.	TURNING THE TIDE: OFFENSIVE TACTICS	50
1.	The Capture of Tololing	50
2.	Victory at Tiger Hill.....	52

3.	Attack on “Balal Post”	53
4.	Mountaineering Under Fire	54
E.	THE DOMINANCE OF ARTILLERY	55
F.	AIR POWER	58
1.	Helicopters at High Altitude	59
2.	Strike Missions	60
G.	CONCLUSION	63
V.	CONCLUSION	65
A.	INTRODUCTION.....	65
B.	AFGHANISTAN	65
1.	Ground Combat in the Shah-i-Kot Valley.....	66
2.	The Apache in the Mountains.....	68
3.	Air Power and Precision in Operation Anaconda	70
C.	FINDINGS	72
D.	IMPLICATIONS	74
E.	FINAL WORDS	75
	APPENDIX. ARRAY OF FORCES DURING THE KARGIL CONFLICT.....	77
	BIBLIOGRAPHY	79
	INITIAL DISTRIBUTION LIST	85

LIST OF FIGURES

Figure 1.	Kashmir and the Northern Areas. (From: < http://www.lib.utexas.edu/maps/kashmir.html > (February 2003))	4
Figure 2.	The Srinagar-Leh Highway. (After: Rahul Bedi, “India Strikes Back at Intruders,” <i>Jane’s Defence Weekly</i> (9 June 1999), 66).....	5
Figure 3.	NLI infiltration routes across the LOC. (From: Gurmeet Kanwal, Colonel, Indian Army, <i>Heroes of Kargil</i> (Delhi: Army Headquarters, 2002), 2)	30
Figure 4.	Tiger Hill and Western Ridge, approaching from the south. (After: Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 117)	39
Figure 5.	Overhead view of the Tiger Hill complex. (After: Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 94).....	39
Figure 6.	Overhead view of the Tololing complex. (After: Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 94).....	48
Figure 7.	Operation Anaconda. (From: < http://www.csmonitor.com/2002/0314/p06s01-wosc.html > (May 2003))....	67

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1.	2 RAJ RIF Acclimatization Program. (From: Amarinder Singh, <i>A Ridge Too Far: War in the Kargil Heights 1999</i> , 195).....	51
----------	---	----

THIS PAGE INTENTIONALLY LEFT BLANK

ABBREVIATIONS

AAC	Army Aviation Corps
AGL	Automatic Grenade Launcher
AGPL	Actual Ground Position Line
AMS	Acute Mountain Sickness
BDA	Battle Damage Assessment
CAS	Close Air Support
CEP	Circular Error Probable
CG	Commanding General
CI	Counter-insurgency
CJTF	Combined Joint Task Force
DMPI	Desired Mean Point of Impact
DPICM	Dual-purpose Improved Conventional Munition
ETAC	Enlisted Terminal Attack Controller
FAC	Forward Air Controller
FCNA	Forces Command Northern Areas
GARH RIF	Garhwal Rifles
GPS	Global Positioning System
GR	Gorkha Rifles
HACE	High Altitude Cerebral Edema
HAL	Hindustan Aeronautics Limited
HAPE	High Altitude Pulmonary Edema
HAWS	High Altitude Warfare School
HE	High Explosive
HMG	Heavy Machine Gun
IAF	Indian Air Force
IFG	Indian Field Gun
INS	Inertial Navigation System
JAK LI	Jammu and Kashmir Light Infantry

JDAM	Joint Direct Attack Munition
Km	Kilometers
LOC	Line of Control
LGM	Laser-guided Munitions
LTC	Lieutenant Colonel
LZ	Landing Zone
MG	Major General
MiG	Aviatsionnyi Nauchno-Promyshlennyi Kompleks MiG (MiG Aviation Scientific-Industrial Complex)
Mm	millimeter
MmHG	millimeters of mercury
MMG	Medium Machine Gun
NCO	Non-commissioned Officer
NLI	Northern Light Infantry
NPS	Naval Postgraduate School
NWFP	Northwest Frontier Province
PAF	Pakistan Air Force
PGM	Precision-guided Munitions
PLA	People's Liberation Army of China
POK	Pakistan Occupied Kashmir
RAJPUT	Rajputana
RAJ RIF	Rajputana Rifles
RPG	Rocket Propelled Grenade
R&O	Reconnaissance and Observation
SAM	Surface-to-air missile
SOF	Special Operations Forces
SSG	Special Services Group
USAF	United States Air Force
WASO	Winter Air Surveillance Operations

ACKNOWLEDGMENTS

The author would like to thank Dr. Peter Lavoy for his guidance and patience during the research and completion of this thesis. A special thanks also goes to Dr. Douglas Porch, John H. Gill, Surinder Rana and Feroz Khan, who offered valuable expertise, insight and assistance to this study. I would also like to express my gratitude to my wife Janeen for her love and support.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. INTRODUCTION

The towering peaks of the Himalayan Mountains have challenged man's ability to survive in extreme conditions for centuries. Waging war at high altitude has proven to be a more daunting task. The high altitude environment has posed the same unique challenges to soldiers throughout history, from Alexander the Great's Himalayan expedition in the fourth century B.C. to the Indo-Pakistan Kargil Conflict in 1999.¹ Thin air is the only condition exclusive to high altitude; in the Himalayas, it combines with freezing temperatures and mountainous terrain to create an inhospitable environment. How does this environment affect soldiers, their weapons, and military operations? How did the high altitude battlefield affect combat during the Kargil Conflict? This thesis answers these questions and explores implications relevant to future high altitude combat.

In the summer of 1999, Pakistan and India engaged in high altitude combat in Kargil, a region in the disputed state of Kashmir. Pakistani forces occupied peaks in Indian-held territory, dominating the lone road that connected India to the remote reaches of the Kashmir state. The Indian Army faced the formidable task of defeating an enemy entrenched atop commanding heights. A campaign that lasted seventy-four days and cost each side more than a thousand casualties concluded with India in control of the peaks around Kargil. The high altitude environment determined the nature of the conflict and shaped the conduct of the campaign.

The combination of thin air, cold weather and rugged mountains has dramatic effects on men and their equipment. Reduced oxygen leads to a variety of physiological changes and illnesses, some of which can prove fatal. Low air pressure alters the accuracy and range of both weaponry and aircraft. Cold weather incapacitates soldiers and degrades equipment. Mountainous terrain makes all aspects of warfare more

¹ High altitude is generally defined as those areas 8,000 to 14,000 feet (2,440-4,270 m) above sea level where a reduction in human performance is common. Very high altitude, from 14,000 to 18,000 feet (4,270-5,490 m), causes severe effects on performance. Humans can function for only short periods of time at extreme altitude, beyond 18,000 feet (5,490 m). Technical Note 9402, *Medical Problems in High Mountain Environments* (Natick, Mass.: U.S. Army Research Institute of Environmental Medicine, February 1994), 5.

difficult. Steep gradients make movement slow and hazardous. High peaks and ridgelines expose men to the elements as well as plunging and often unseen enemy fire. These characteristics create an unforgiving battlefield, in which the environment can prove as deadly as the enemy.

The Himalayan topography and atmosphere set the parameters of the military operations of both armies at Kargil. Prolonged exposure to the elements degraded soldiers' ability to fight, especially those who were ill equipped and inadequately trained. Mountaineering expertise and well-conditioned soldiers proved essential for success. Possession of the high ground provided an early advantage, yet did not ensure victory. After initial setbacks, Indian firepower and maneuver, the integration of massed artillery and overwhelming force, overcame Pakistani forces atop commanding heights. Indian air power, although psychologically devastating and effective against fixed targets, did not provide reliable and consistent close support. In the end, fierce close combat between infantry units decided the outcome of the battle.

The Kargil Conflict illustrates the timeless challenges posed by combat at high altitude. Tactics proven in earlier mountain wars succeeded at Kargil. Successful Indian offensive tactics mirror those used by both the Gebirgsjaeger of the German Army in the Rhodope Mountains of Greece and the U.S. Army's 10th Mountain Division in the Apennines of Italy during the Second World War. Fire and maneuver, provided by artillery and small well-trained infantry units, decided the battle. Tactics that failed in previous wars did not succeed at Kargil. Pakistani forces exposed atop the ridgelines at Kargil succumbed to massive firepower and bold maneuver, as fortified Greek positions had fallen to overwhelming German fire.

This thesis assesses the high altitude environment's impact on military operations using scientific and medical data. Several historical examples illustrate the timeless attributes of military victory on the high altitude, as well as mountain, battlefield. I analyze the Kargil Conflict using Indian after action reviews and battlefield accounts. I also measure the Kargil experience against U.S. military doctrine, and draw comparisons to U.S. military operations in the mountains of Afghanistan in 2002.

The implications for future high altitude combat are clear. Well-trained and equipped light infantry is the only force capable of decisive maneuver in rugged mountain terrain. Artillery, rather than air power, remains the preferred source of firepower to support ground maneuver. Close air support cannot be relied upon as the sole source of fire to support maneuver on the high altitude battlefield. Critical mistakes in adapting to high altitude and mountain terrain will continue to prove costly. Inadequate artillery support plagued U.S. Army operations in the mountains of Afghanistan in 2002, just as it hindered initial Indian offensives at Kargil. Advances in military technology have not made these lessons obsolete.

B. THE HIMALAYAN BATTLEFIELD

Kashmir occupies the distant north of the country of India. Pakistan and India have contested for control of the majority Muslim region in two wars, the first in 1947 and a second in 1965. The 1972 Simla Agreement following the third Indo-Pakistan war over Bangladesh created the Line of Control (LOC) that divides Kashmir into Pakistani and Indian-held portions. India controls the eastern half of the state, which consists of Jammu, the Kashmir Valley and Ladakh; Pakistan controls the west, which it calls “Azad” (Free) Kashmir, and the Northern Areas (see Figure 1).²

² “Azad” (Free) Kashmir and the Northern Areas are autonomous regions administered by the government of Pakistan. India refers to “Azad” Kashmir as Pakistan Occupied Kashmir (POK). Ashok Kalyan Verma, Major General, Indian Army (Retired), *Kargil: Blood on the Snow* (Delhi: Manohar, 2002), 46.



Figure 1. Kashmir and the Northern Areas. (From: <http://www.lib.utexas.edu/maps/kashmir.html>) (February 2003))

Ladakh is the northern section of the state, and shares borders with China and Pakistan. It is divided into two districts, Kargil and Leh. The main land approach to Ladakh is the 434-kilometer (km) Srinagar-Leh Highway, which is also known as National Highway 1A. The highway connects Srinagar, the state's summer capital in the heart of the Kashmir Valley, to the remote town of Leh, the largest town in Ladakh (see Figure 2). The Srinagar-Leh Highway is Ladakh's only link to the Kashmir Valley, making the region susceptible to isolation. It is most vulnerable near the town of Kargil. The road passes close to the LOC in the Kargil district, and winds through the critical Zoji-La Pass, the gateway to Ladakh and a chokepoint at an altitude of 11,600 feet (3,535 m) near the town of Dras.

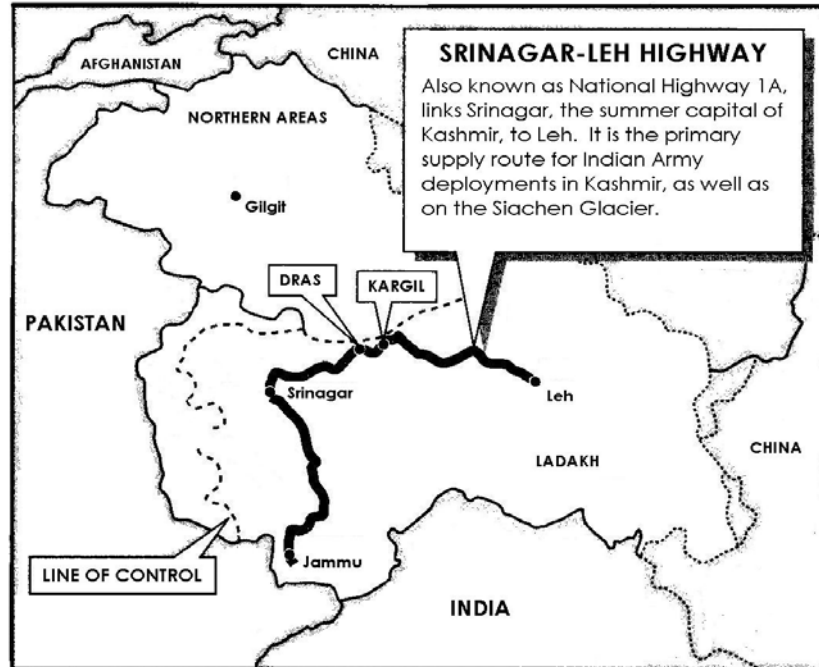


Figure 2. The Srinagar-Leh Highway. (After: Rahul Bedi, “India Strikes Back at Intruders,” *Jane’s Defence Weekly* (9 June 1999), 66)

Mountain ranges divide Ladakh and dominate its landscape. The Great Himalayan Range separates Ladakh from the Kashmir Valley. Three other major ranges, the Zaskar, Ladakh and the Karakoram, also pass through the region. The peaks in the Kargil district rise to altitudes between 16,000 feet (4,880 m) and 18,000 feet (5,485 m) above sea level. The treeless ridgelines are vast and barren, made up of loose rocks.

Ladakh lies in the shadow of the Great Himalayan Range that shields the region from the monsoon rains that flood most Indian states to the south. It is an arid land that receives as little as two inches of rainfall a year. The scarcity of water creates a desolate landscape with sparse vegetation. High peaks, whose snow melts quickly in the early summer months, are the only source of water.

High altitude produces extremely low temperatures across the region. As a general rule, the temperature drops one degree centigrade for each 100-meter increase in elevation.³ The town of Dras is typically referred to as the second coldest inhabited place

³ *Medical Problems in High Mountain Environments*, 26.

in the world, with winter temperatures dropping to -60° C.⁴ Temperatures in Kargil reach -30° C in the winter, and rise above freezing during the summer months. Wind speeds on the peaks and ridgelines are high and create low wind chill. The stark landscape, combined with arctic temperatures, has caused travelers to refer to the region as a “cold desert.”⁵

High elevation creates a unique atmosphere in the mountains around Kargil. Ultraviolet light increases rapidly with rise in elevation. The radiation level is 55 percent higher than at sea level, and can cause severe sunburn and snow blindness.⁶ The barometric pressure is half that at sea level. The partial pressure of oxygen falls as well, producing arid air that holds little water vapor.⁷ The high altitude atmosphere makes Ladakh an inhospitable and sparsely populated land, yet one that Pakistan has sought to control since its founding in 1947.

C. THE 1999 KARGIL CONFLICT

Only a small circle of senior Pakistani leaders know whether the incursion that began in early 1999 was a strategy designed to force international intervention in Kashmir, or if it was simply the result of local commanders’ initiative to seize terrain along the LOC unoccupied by Indian forces.⁸ Although the strategic objective may not have been grand in scope, the operation offered Pakistan an opportunity to alter the situation on the ground in Kashmir. Occupation of several critical peaks would threaten the Srinagar-Leh Highway and isolate Leh, India's base of operations in Ladakh.

⁴ Prasun K. Sengupta, “Mountain Warfare: The Kargil Experience,” *Asian Defence Journal*, Vol. 10 (October 1999), 46.

⁵ Ibid.

⁶ The radiation level at 14,000 feet (4,270 m) is 55 percent higher than at sea level. *Medical Problems in High Mountain Environments*, 27.

⁷ Ibid 4.

⁸ Some observers believe that the operation had the sanction of the highest levels of Pakistan military authority, and that General Pervez Musharraf, Chief of the Army Staff, and Lieutenant General Mohammed Aziz, Chief of General Staff, developed the operation and supervised its execution. Others counter that the operation was a local initiative, coordinated at division level and lower, designed to occupy terrain that created a tactical advantage within the sector. Most sources on both the reason for the incursion and events that took place during the conflict are of Indian origin, with the exception of an interview between Feroz Khan, Brigadier, Pakistan Army (Retired) and the author, 28 February 2003. Brigadier Khan commanded 5 NLI in the early 1990’s, serving along the LOC in Turtok and the Neelum Valley opposite Kargil.

Pakistani planners gambled that possession of the formidable heights would dissuade India from launching an offensive to retake the lost ground.

1. Background

A light force initiated covert infiltration across the LOC into the peaks around Kargil in the spring of 1999. The Northern Light Infantry (NLI), composed of local men accustomed to working in the mountains, provided the majority of the 1,700-man force. Highly trained Special Services Group (SSG) soldiers reportedly accompanied the small infantry units. At least eighteen artillery batteries reportedly supported the operation, most from across the LOC in Pakistani territory.⁹

Pakistani soldiers infiltrated by both foot and helicopter. They built fortified positions and occupied abandoned Indian outposts. They brought substantial firepower, including light cannon, mortars, and surface-to-air missiles (SAM). The NLI occupied outposts along a total frontage of about 150-km, at heights approaching 18,000 feet (5,485 m) above sea level. Their positions included the strategic Tololing-Tiger Hill complex in Dras that dominates the Srinagar-Leh Highway near the Zoji-La Pass.

The operation caught the Indian military by surprise. The Indian Army normally stretched the battalions of 121 Infantry Brigade along the 168-km LOC in the Kargil sector for routine security operations.¹⁰ The battalions occupied outposts on several key avenues of approach. Soldiers conducted regular patrols and manned isolated posts, but left approximately 80-km of unmanned gaps. Patrols and outposts failed to detect the NLI soldiers throughout the spring. A group of shepherds discovered the intruders in early May, and the full extent of the Pakistani incursion became evident within a matter of days.¹¹

After weeks of uncertainty and deliberation, the Indian government issued orders to its armed forces at the end of May. The Indian government ordered the armed forces to evict the Pakistani forces and restore the original LOC. The Indian Army developed

⁹ *The Kargil Review Committee Report* (Delhi: Sage Publications, 2000), 95.

¹⁰ 121 Infantry Brigade contained five battalions in the summer of 1999. *Ibid* 85.

¹¹ Rahul Bedi, "Paying to Keep the High Ground," *Jane's Intelligence Review*, Vol. 11, No.10 (October 1999), 29.

Operation Vijay (Victory) based on three successive objectives: contain the existing enemy pockets to prevent further build-up of forces; evict the enemy forces; finally, Indian Army units would occupy key terrain along the LOC.¹²

2. The Northern Light Infantry

The NLI excelled at several aspects of high mountain warfare and gained an early advantage. Soldiers traveled in small groups, employing skilled mountaineers and mule teams. Pakistan Army helicopters ferried troops and equipment, and were rarely spotted by Indian patrols. Soldiers and mules carried disassembled light artillery pieces across the LOC. Pakistani guns harassed Indian troop movements along the Srinagar-Leh Highway and successfully shattered initial Indian assaults. Dispersed and concealed SAMs destroyed an Indian helicopter and two ground attack aircraft early in the campaign.

Prolonged exposure to the high altitude environment gradually eroded the NLI's ability to fight and survive. Soldiers remained in positions for long periods of time, exposed to thin air and cold weather. Tactical mistakes in mountain terrain negated initial success. Holding the high ground did not ensure victory. Linear defenses consisting of undermanned positions sat exposed to massive Indian artillery barrages. The NLI lacked adequate materials to construct positions in the austere environment. Overhead cover typically collapsed under artillery fire, killing the inhabitants. Tactical mistakes combined with failure to adapt to the environment shifted the advantage to the Indian forces.

3. The Indian Response

The Indian military rushed forces to the region once it finally realized the scope of Pakistan's incursion. By the end of May 1999, the Indian Army had amassed a force of nineteen infantry battalions and several artillery regiments in the Kargil sector (see

¹² Vinod Anand, "India's Military Response to the Kargil Aggression," *Strategic Analysis*, Vol. 23.7 (October 1999) at <http://www.ciaonet.org/olf/sa/sa_99anv05.html> (April 2002).

Appendix. Array of Forces During the Kargil Conflict).¹³ Initial offensive operations failed despite an overwhelming force advantage. Indian planners underestimated the size and tenacity of their foe, and poorly planned assaults produced staggering casualties. Soldiers involved in the initial actions were neither equipped nor prepared for high altitude combat. Battalions launched uphill assaults without sufficient artillery and close air support. Indian infantrymen advanced up steep gradients. Assaults faded as men succumbed to exhaustion and enemy fire.

The Indian Air Force's (IAF) efforts, Operation Safed Sagar (White Sea), produced mixed results. Thin air diminished weapon accuracy and hindered aircraft performance. Adverse weather and the heightened SAM threat hampered the IAF's attempts at close air support (CAS). Aircraft proved unreliable in rapidly changing weather, and a lack of pilot training for CAS in the mountains further diminished the IAF's ability to provide firepower in coordination with ground maneuver. The IAF eventually adapted and enjoyed some success, primarily against fixed targets. The introduction of laser-guided munitions (LGM) increased accuracy and contributed to the fight on Tiger Hill. IAF pressure on NLI soldiers had a significant psychological effect. Unconventional techniques, such as using aerial munitions to create avalanches over trails, isolated Pakistani defensive positions and destroyed supply sites.

The Indian Army modified its offensive tactics and exploited NLI errors. Massive artillery barrages preceded infantry assaults. Suppressive fire, provided primarily by artillery and mortars, set the conditions for successful attacks. Battalions advanced along the most inaccessible routes. Daring maneuver along a difficult axis of attack created the crucial element of surprise. Indian soldiers climbed vertical cliffs throughout the night, attacking the Pakistani positions at dawn. Once at the objective, victory depended on combat at close quarters.

The Indian armed forces prevailed, driving the NLI from all of its positions by the end of July. India lost 474 soldiers killed in action and 1,109 wounded; Indian analysts estimated that Pakistan suffered approximately 700 casualties.¹⁴ Pakistan claimed

¹³ Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999* (Delhi: Tulika, 2001), 62.

¹⁴ Ashok Kalyan Verma, Major General, Indian Army (Retired), *Kargil: Blood on the Snow*, 126.

throughout the operation that mujahadeen militants beyond the government's control planned and executed the incursion.¹⁵ Captured documents, prisoners of war, and the bodies of Pakistan Army officers killed in action seemed to prove otherwise. Faced with mounting evidence, in late July Pakistan officially acknowledged that soldiers had been "martyred in the adventure."¹⁶

D. ORGANIZATION

This thesis has five chapters. Chapter I introduces the case study and provides a brief background of the 1999 Kargil Conflict and the geography of the region. Chapter II describes the characteristics of the high altitude environment. It assesses the impact of thin air, cold weather and mountainous terrain on soldiers and weaponry. Historical examples illustrate the effects of the high altitude environment on the conduct of military operations, as well as the tactics that either failed or succeeded in previous high mountain wars.

Chapter III provides an analysis of the NLI operations during the Kargil Conflict. The NLI's early tactical victories are studied, as well as the subsequent errors and detrimental effects of high altitude that erased initial success. Chapter IV offers an analysis of the Indian Army's rapid deployment to Kargil and the offensive operations that followed. The chapter evaluates the role that the environment played in the Indian military's initial setbacks, as well as the adaptation of both ground and air operations that led to victory. Chapter V concludes with a study of U.S. combat operations in Afghanistan in 2002, and identifies several similarities with Indian operations at Kargil. The thesis concludes with a summary of the lessons of high altitude ground combat demonstrated by both the Kargil Conflict and U.S. operations in Afghanistan, as well as the implications for future high mountain warfare.

¹⁵ Ashok Krishna, Major General, Indian Army (Retired), "Appendix 12, Pakistan Prime Minister Nawaz Sharif's Address to the Nation, 12 July 1999," *Kargil: The Tables Turned*, Ed. Major General Ashok Krishna and P.R. Chari (Delhi: Manohar, 2001), 325.

¹⁶ Quote taken from Pakistan Information Minister Mushahid Hussain. Prasun K. Sengupta, "Mountain Warfare and Tri Service Operations," *Asian Defence Journal*, Vol. 11 (November 1999), 28.

II. THE HIGH ALTITUDE BATTLEFIELD

A. INTRODUCTION

Thin air, cold weather and rugged mountains pose a significant challenge to man's ability to survive at high altitude. These characteristics create a unique and unforgiving battlefield, in which the environment can prove as deadly as the enemy. This chapter describes the high altitude environment's effect on soldiers, weapons, and military operations. In addition, it offers several examples from previous wars that provide lessons regarding the strategy and tactics best suited for high altitude combat.

The high altitude environment significantly affects soldiers and the tools of war. Reduced oxygen causes a wide range of physiological effects and illnesses. The atmosphere inflicts casualties and degrades soldiers' ability to carry out and sustain military operations. The process of acclimatization allows men to adapt to the environment and retain the capacity to perform. In addition to its effect on men, low air pressure alters the accuracy and performance of both weapons and aircraft. Cold weather incapacitates men and equipment. Mountainous terrain makes all aspects of warfare more difficult, and places limits on ground maneuver.

Like warfare on any field, high altitude combat is decided by the application of firepower and maneuver. Wars fought atop the earth's highest plateaus and among its many mountain chains illustrate the most effective methods of fire and maneuver. Combat ranging from the German and U.S. Army in the mountains of Europe during the Second World War to the Soviet Army in Afghanistan suggests that well-trained light infantry units best execute maneuver. An unexpected and difficult approach by small elements produces tactical surprise, which is essential against a foe atop high ground. Artillery is the preferred source of firepower primarily because of its reliability and ability to mass overwhelming fire. Failure to adapt to the environment and recognize the unique characteristics of war at high altitude leads to military failure.

B. THIN AIR – THE UNIQUE CONDITION OF HIGH ALTITUDE

The phenomenon of thin air, caused by low barometric pressure, is the only environmental condition unique to high terrestrial altitude. It imposes several physical stresses on men. The barometric pressure at 16,000 feet (4,880 m) is half its value at sea level.¹⁷ The partial pressure of oxygen falls as well, producing arid air that holds significantly less water vapor and reducing the amount of oxygen available to human tissue.¹⁸ Hypoxia, the reduction of oxygen supply to tissue, occurs at elevations above 5,000 feet (1,524 m).¹⁹ Hypoxia can lead to several illnesses, some of which can prove fatal, as well as less severe physiological effects. The most common altitude illness is acute mountain sickness (AMS).

1. Altitude Illness

Rapid ascent to elevations beyond 8,000 feet (2,446 m) above sea level generally causes AMS.²⁰ Headache and nausea are the most common symptoms. Most men afflicted with AMS suffer muscular weakness, fatigue and appetite loss as well. Symptoms appear within twenty-four hours, and usually dissipate within four to seven days.²¹ A high carbohydrate diet reduces AMS symptoms, and medication can also be helpful in tempering its symptoms.²² The only sure treatment for AMS is descent to a lower elevation.

High altitude pulmonary edema (HAPE) and cerebral edema (HACE) are more severe syndromes that occur when soldiers rapidly ascend beyond 8,000 feet (2,438 m) above sea level. HAPE, fluid accumulation in the lungs, is the most common cause of death among altitude illnesses. It manifests as a dry cough and labored breathing.

¹⁷ *Medical Problems in High Mountain Environments*, 4.

¹⁸ At 14,765 feet (4,500 m) the partial pressure of oxygen is 40 percent less than at sea level. A. Roberto Frisancho, *Human Adaptation and Accommodation* (Ann Arbor: University of Michigan Press, 1993), 221.

¹⁹ *Medical Problems in High Mountain Environments*, 5.

²⁰ Rapid ascent is within twenty-four hours. Up to 20 percent of soldiers will develop AMS at 8,000 feet (2,446 m). All soldiers will experience AMS beyond 17,500 feet (5,333 m). *Ibid* 10.

²¹ Robert Karniol, "Fighting on the Roof of the World," *Jane's Defence Weekly*, Vol. 30, No. 22 (2 December 1998), 30.

²² Acetazolamide lessens the impact of AMS. *Medical Problems in High Mountain Environments*, 12.

Cyanosis, in which the extremities turn blue in color, occurs as the illness worsens. HACE, swelling of the brain, is more severe and less common. Once symptoms manifest, both HAPE and HACE can progress to coma and death in less than twelve hours. Immediate descent is the best treatment for both illnesses; acclimatization is the most effective means of prevention.²³

High altitude initiates a variety of less severe illnesses and physiological effects. Sub-acute mountain sickness occurs in most soldiers deployed at altitudes above 12,000 feet (3,600 m) for extended periods of time.²⁴ Symptoms include sleep disturbance, fatigue and loss of appetite. The resulting low caloric intake can cause drastic weight loss. Researchers participating in Mount Everest expeditions, which subjected men to altitudes approaching 21,000 feet (6,400 m), found that trained men lost a pound (.45 kilograms) per week; men who were poorly acclimated lost almost 3 pounds (1.3 kilograms) per week.²⁵ Soldiers must consume at least 4,500 calories and 10 or more quarts of water per day to prevent weight loss and dehydration.²⁶ In addition to the loss of body mass, soldiers lose their ability to work at high altitudes. Aerobic capacity decreases 10 percent for each 3,000 feet (914 m) gain in elevation above 5,000 feet (1,524 m).²⁷ Even the most physically fit men exhibit muscular weakness and a loss of neuromuscular control above 14,765 feet (4,500 m).²⁸

Illness combines with other physiological changes to restrict soldiers' ability to function at high altitudes. The atmosphere affects vision in several ways. Soldiers lose much of their natural night vision above 8,000 feet (2,400 m); retinal hemorrhaging, bleeding from blood vessels in the eyes, affects over half of all soldiers at 18,000 feet (5,486 m).²⁹ The drastic increase in ultraviolet light can cause snow blindness and severe

²³ The medication nifedipine can help treat and prevent HAPE as well. Ibid 18.

²⁴ U.S. Army Field Manual 3-97.6, *Mountain Operations* (Washington, DC: U.S. Government Printing Office, 28 November 2000), 1-12.

²⁵ A. Roberto Frisancho, *Human Adaptation and Accommodation*, 228.

²⁶ FM 3-97.6, *Mountain Operations*, 5-7.

²⁷ *Medical Problems in High Mountain Environments*, 37.

²⁸ A. Roberto Frisancho, *Human Adaptation and Accommodation*, 227.

²⁹ *Medical Problems in High Mountain Environments*, 23.

sunburn.³⁰ The time it takes for wounds to heal increases because of the lack of oxygen in body tissues. The effects combine to make the environment a potent adversary; acclimatization is one way to reduce its impact.

2. Acclimatization

Acclimatization is the physiological adaptation to low air pressure at high altitude. The body compensates for reduced oxygen supply by increasing the efficiency of oxygen delivery to tissue. Acclimatization, once achieved, enables the soldier to attain maximum physical performance. A physically fit man can typically acclimate to a high altitude environment in ten days.³¹ Soldiers maintain a high rate of performance as long as they remain at altitude. A soldier's ability to adapt to high altitude depends largely on his physical fitness and age; older and unfit soldiers have a difficult time tolerating the environment.³² Acclimatization is not possible at altitudes beyond 18,000 feet (5,490 m).

Staged or graded ascents are the most effective methods of acclimatization. Rapid ascent causes a variety of incapacitating illnesses, some of which can lead to death. Soldiers who conduct a staged ascent climb to intermediate altitudes and remain for several days until ascending higher. Graded ascent limits daily altitude gains and focuses on sleep altitude. Most armies practice a combination of the two methods. Both the Indian and Pakistan Army have extensive experience with acclimatization programs. They have faced each other on the Siachen Glacier, the world's highest battlefield, since 1984. The Siachen Glacier sits on the "Roof of the World," the Great Karakoram Range. The nearby Saltoro Ridge holds three passes that access the glacier. The Saltoro's peaks range from 9,100 feet (2,800 m) to 17,500 feet (5,300 m) elevation.³³

³⁰ Ultraviolet light increases by over 50 percent at 14,000 feet (4,250 m) above sea level. Ibid 26.

³¹ Up to 80 percent of the respiratory component of acclimatization occurs in a week to 10 days for most soldiers operating from 8,000 to 18,000 feet (2,440 to 5,490 m). Ibid 7.

³² A. Roberto Frisancho, *Human Adaptation and Accommodation*, 238.

³³ The Indian Army seized two of the passes in the spring of 1984; Pakistan seized the third soon after. A Pakistani attack to dislodge the Indian forces on the two passes failed. Each nation posted a brigade on the glacier, and a stalemate has ensued, with the two sides engaging in routine artillery duels. Rupal S. Khosa, "The Siachen Glacier Dispute: Imbroglia on the Roof of the World," *Contemporary South Asia*, Vol. 8, No. 2 (1999), 195.

The regular rotation of soldiers to a high altitude environment forced each army to develop and maintain routine acclimatization programs. Pakistan's program begins with a staged ascent and ends with a graded climb. Soldiers ascend to 10,000 feet (3,050 m), where they remain for one week; they climb to 13,000 feet (3,960 m) the following week. From that point forward, soldiers rest one night for each 1,000 feet (305 m) climb in elevation.³⁴ The graded climb places limits on sleeping altitude, allowing partial acclimatization to occur daily. Soldiers who develop AMS descend to base altitude and repeat the process; soldiers who develop HAPE or HACE are reassigned.

The physical and psychological stresses of high altitude degrade all soldiers over time, even those who are acclimated. Most soldiers stationed on the Siachen Glacier develop "Siachen Syndrome," a combination of AMS and psychological fatigue, after even short periods of duty on the glacier.³⁵ Soldiers who must rapidly deploy to a high altitude environment do not have the benefit of an acclimatization program. Rapid deployment proved devastating for the Indian Army during the 1962 Sino-Indian War. The Indian Army suffered more casualties due to altitude illness than enemy fire. By some estimates, as much as 15 percent of the force developed HAPE.³⁶ India rapidly deployed soldiers to elevations approaching 18,000 feet (5,490 m) from units spread throughout the country at lower elevations. China deployed acclimated soldiers from its garrison at 15,000 feet (4,570 m) in Tibet.³⁷

3. Effects on Weapons and Aircraft

Low barometric pressure affects the tools of war with a severity that equals its impact on man. Thin air at high altitudes alters the trajectory of all projectiles that move through the atmosphere. Projectiles are more efficient in low air pressure because of the

³⁴ Acclimatization schedule detail provided by Major Hassan Iqbal, 322 Brigade medical officer, in Robert Karniol, "Fighting on the Roof of the World," 31.

³⁵ The Indian Army estimates that the "Siachen Syndrome" affects approximately 60 percent of soldiers assigned to duty on the glacier. Raspal S. Khosa, "The Siachen Glacier Dispute: Imbroglio on the Roof of the World," 197.

³⁶ Charles Houston, M.D., *Going Higher: Oxygen, Man and Mountains* (Seattle, Wash.: The Mountaineers, 1998), 180.

³⁷ For a discussion of the People's Liberation Army (PLA) of China's advantage over Indian forces during the 1962 war see Gerald Segal, *Defending China* (London: Oxford University Press, 1990), 140-157.

reduction in drag. The increase in efficiency causes bullets to strike higher on the target at high altitude than at sea level. At an elevation of 10,000 feet (3,050 m), a round fired at a target at a distance of 1,000 meters will impact almost 70 inches higher than at sea level.³⁸ The range of artillery shells increases as well, yet accuracy and predictability suffer. High angle munitions, such as mortar rounds, are especially erratic.³⁹ Artillery units stationed atop the Siachen Glacier have learned from experience that firing tables developed at sea level are of no use at high altitude.⁴⁰ Aircraft performance is equally unpredictable.

Aircraft engines produce less power at high altitudes, reducing maneuverability and limiting load capacity. In addition to a reduction in engine power, helicopters lose rotor efficiency in low air pressure. Hovering is difficult and risky, and most helicopters are unable to lift normal loads at altitudes above 13,000 feet (3,965 m).⁴¹ Most attack helicopters are too heavy to fly at high altitude. The physical limitations of the high altitude environment prohibit most helicopter operations, yet both Pakistan and India have successfully used light helicopters with exceptionally high service ceilings. Both the Indian and Pakistan Army used light helicopters during offensive operations on the Siachen Glacier in 1984, and continue to use them for routine duty on the glacier at altitudes approaching 24,600 feet (7,500 m).⁴² An Indian Army Aviation Corps (AAC) pilot compared the difference between landing at sea level and on the glacier to “the same as walking on ground and trying to walk on water.”⁴³

³⁸ U.S. Army Field Manual 23-10, *Sniper Training* (Washington, D.C.: U.S. Government Printing Office, 17 August 1994), 3-27.

³⁹ Ali Ghazanfar and Hassan Akhtar Ghani, “Siachen – The World's Highest Battlefield,” *Military Technology*, Vol. 22, No. 3 (March 1998), 17.

⁴⁰ Pravin Sawhney, “Himalayan Conflict Forges Artillery Doctrine,” *Jane's International Defense Review* (March 1999), 57.

⁴¹ Lester W. Grau, Lieutenant Colonel, U.S. Army (Retired), and Hernan Vazquez, Lieutenant Colonel, Argentine Army, “Ground Combat at High Altitude,” *Military Review*, Vol. 82, No. 1 (January-February 2002), 22.

⁴² The Aerospatiale Lama is a light single-engine helicopter; Hindustan Aeronautics Limited (HAL) produces a version of the aircraft (Cheetah) in India. Rupal S. Khosa, “The Siachen Glacier Dispute: Imbroglio on the Roof of the World,” 195.

⁴³ Chindu Sreedharan, “Flying in the Face of Danger,” *Rediff* (June 1999) at <<http://www.bharat-rakshak.com/LAND-FORCES/Army/Articles/Article9.html>> (August 2002).

Fixed wing aircraft suffer similar limitations. The drag reduction caused by low air pressure alters the aerodynamics of high performance aircraft. Thin air forces a greater turning radius and increases the height lost in a pullout following a dive. The lost height forces the pilot to initiate the pullout higher, or earlier, than at sea level. Pilots must increase the weapon release height to make up for the change.⁴⁴ Aerial-delivered munitions can be wildly inaccurate if pilots are not trained to expect variations in performance. Low air pressure affects aerial weapon trajectory as well, causing even precision-guided munitions (PGM) to perform significantly different than sea-level specifications predict.⁴⁵

C. COLD WEATHER

Frigid weather is common to most of the world's high mountain ranges. A climb in altitude generates freezing temperatures that drop one degree centigrade for each 100-meter increase in elevation.⁴⁶ Snow and freezing temperatures degrade weapons and ballistic performance. Cold weather causes incapacitating injuries, and has wreaked havoc on armies in past winter warfare. German soldiers endured as much as four feet of snow and freezing temperatures while fighting in Russia during the Second World War. By January 1942, the German Army suffered 100,000 frostbite cases with over 14,000 requiring amputation; the 6th Panzer Division lost 800 men a day to frostbite during the month of January.⁴⁷

Cold weather affects soldiers in a variety of ways. Freezing temperatures reduce human performance and cause an initial physiological shock. The human body can adapt to subzero temperatures; tolerance to cold stress is influenced by age and physical fitness, as well as the amount of insulation provided by both subcutaneous fat and external layers of clothing.⁴⁸ Injuries pose a significant threat to soldiers exposed to cold weather for

⁴⁴ Prasun K. Sengupta, "Mountain Warfare and Tri Service Operations," 26.

⁴⁵ Anil R. Pustam, "Mountain Air Support Demands Special Equipment and Training," *United States Naval Institute Proceedings*, Vol. 126, No. 9 (September 2000), 71.

⁴⁶ *Medical Problems in High Mountain Environments*, 26.

⁴⁷ Allen F. Chew, *Leavenworth Paper No. 5: Fighting the Russians in Winter* (Fort Leavenworth, Kansas: Combat Studies Institute, 1981), 40.

⁴⁸ A. Roberto Frisancho, *Human Adaptation and Accommodation*, 97.

long periods. Frostbite and hypothermia are common injuries that typically require treatment and evacuation. Proper equipment, such as extreme cold weather gear, is essential for survival. Shelter is a necessity. The 6th Panzer Division created craters with explosives and cut trees for continuous fires; shelter and heat reduced frostbite cases from 800 to 4 a day.⁴⁹

Cold weather affects weapon performance as well. Cyclic weapons perform poorly due to lubricant freezing and metal brittleness.⁵⁰ A weapon fired in subzero temperatures crystallizes water vapor in the air, creating ice fog that hangs over the weapon and vapor trails that follow the round and obscures the gunner's vision.⁵¹ Frigid air reduces the range of projectiles and affects the burst characteristics of artillery projectiles. Deep snow absorbs most of the impact burst of artillery rounds. Mortars are significantly affected; a cold tube can prevent the propellant from completely burning, causing the round to lose range.⁵²

D. THE ETERNAL MOUNTAINS

In addition to the atmosphere, armies that wage war at high altitude must contend with the rugged and imposing terrain of the mountains. Peaks and ridgelines expose soldiers to severe weather and restrict movement. Rocky terrain degrades equipment and men alike, and makes all aspects of warfare more difficult. Terrain folds hide enemy forces from aerial and ground observation, and mask the effects of firepower. Mountains increase the requirements necessary to support soldiers and makes logistics more difficult. The limited availability of trafficable roads makes mountain warfare the domain of the light infantry.

⁴⁹ Allen F. Chew, *Leavenworth Paper No. 5: Fighting the Russians in Winter*, 40.

⁵⁰ Ali Ghazanfar and Hassan Akhtar Ghani, "Siachen – The World's Highest Battlefield," 17.

⁵¹ U.S. Army Field Manual 31-70 *Basic Cold Weather Manual* (Washington, D.C.: U.S. Government Printing Office, 12 April 1968), 165.

⁵² Cold mortar rounds fired in a cold tube, below -40° F, will lose as much as 20 percent of tabulated range due to incomplete propellant burning. U.S. Army Field Manual 9-207 *Operation and Maintenance of Ordnance Material in Cold Weather* (Washington, D.C.: U.S. Government Printing Office, 20 March 1998), 4-14.

1. Terrain and the Soldier

Mountains impede both foot and vehicular movement. Rocky, narrow roads make travel a dangerous endeavor. Foot movement is considerably limited, and calculated in time, not distance. Most armies estimate one hour of time for every four kilometers of horizontal movement on a flat surface. Uneven terrain generally adds at least one hour for every 300 meters of ascent or 600 meters of descent.⁵³ The Pakistan Army estimates that a light unit requires up to six full days to travel twenty-five kilometers in high mountains.⁵⁴ Movement is slow and treacherous, especially at night. A soldier's load further reduces his mobility in the mountains. Armies must strike a difficult balance between combat readiness and mobility. Heavy loads and inadequate equipment tied Soviet infantrymen to their armored personnel carriers, reducing their effectiveness as dismounted infantry and making them vulnerable to mujahadeen ambushes in Afghanistan.⁵⁵

The experience of the Gebirgsjaeger, the German Army's renowned mountain fighters, in both Greece and Italy during the Second World War illustrates the difficulty of maneuver in the mountains. The Jaeger carried a light assault kit during the attack, which allowed them to scale vertical terrain quickly and gain momentum. The assault kit contained a ground sheet and blanket, two days' rations, and ammunition. They did not wear helmets or carry bayonets during the attack, considering the items to be unnecessary weight. During regular foot movement, however, the Jaeger carried a tremendous load. The average rucksack weighed 120 pounds (22 kilograms), and each man's complete load with ammunition and weapon typically exceeded 165 pounds (75 kilograms).⁵⁶ Even with such a heavy burden on the backs of its soldiers, the Jaeger relied heavily on the most reliable means of transportation in mountains, the mule.

⁵³ William M. Menning, Lieutenant Colonel, U.S. Army, "Moving in the Mountains," *Infantry*, Vol. 82, No. 1 (January-February 1992), 36.

⁵⁴ Ali Ghazanfar and Hassan Akhtar Ghani, "Siachen – The World's Highest Battlefield," 16.

⁵⁵ Mohammad Yahya Nawroz, General, Army of Afghanistan (Retired), and Lester W. Grau, Lieutenant Colonel, U.S. Army (Retired), "The Soviet War in Afghanistan: History and Harbinger of Future War?" from *Foreign Military Studies Office*, Fort Leavenworth, Kansas (1995) at <<http://call.army.mil/fms/fmsopubs/issues/waraf.htm>> (January 2003).

⁵⁶ Barry Gregory, *Mountain and Arctic Warfare: From Alexander to Afghanistan* (London: Stephens, 1989), 172.

Mules and porters are the primary means of logistics above 13,000 feet (3,960 m). They can travel on trails and mountain roads where vehicles cannot pass. At high altitude, American mules can carry 20 percent of their body weight (200 pounds) up to 20 miles a day. For their benefit as load bearers, mules require substantial amounts of food and water.⁵⁷ The Jaeger used mules extensively, with each division supported by over 3,500 mules.⁵⁸ Human porters provide dependable carrying capacity at high altitude, but rely on excess manpower, which is not always available. The Jaeger typically employed up to half of each battalion in action as porters, primarily transporting ammunition and explosive charges.⁵⁹

2. Effects on Weapons and Aircraft

Mountains alter the effects of weapon systems and impose limitations on their use. Splintering and ricochet enhances the effectiveness of small arms fire and high explosive shells alike.⁶⁰ Target engagement changes because of the difficulty of estimating range in mountains. Targets seem farther away to soldiers firing downhill, which typically causes them to fire high. Similarly, targets appear closer to soldiers firing uphill, which may cause them to fire low. Machine guns can rarely achieve grazing fire due to drastic changes in elevation, and their effects are usually confined to the beaten zone, the area of impact created by plunging fire. Hand grenades can be effective, but are dangerous due to rollback.

Artillery suffers significant limitations in a mountainous environment. Movement of guns is restricted because of high gradients and hazardous mountain roads. Suitable positions are usually very small, accommodating only one gun.⁶¹ High angle fire is

⁵⁷ American mules require ten pounds of grain, fourteen pounds of hay, thirty liters of water and an ounce of salt daily. Lester W. Grau, Lieutenant Colonel, U.S. Army (Retired), and Hernan Vazquez, Lieutenant Colonel, Argentine Army, "Ground Combat at High Altitude," 30.

⁵⁸ Barry Gregory, *Mountain and Arctic Warfare: From Alexander to Afghanistan*, 173.

⁵⁹ James Lucas, *Hitler's Mountain Troops* (London: Arms and Armour Press, 1992), 51.

⁶⁰ High explosive (HE) shells with impact fuse and dual-purpose improved conventional munitions (DPICM) are effective on rocky ground. FM 3-97.6, *Mountain Operations*, 3-5.

⁶¹ Lester W. Grau, Lieutenant Colonel, U.S. Army (Retired), and Hernan Vazquez, Lieutenant Colonel, Argentine Army, "Ground Combat at High Altitude," 28.

necessary to clear high mountain crests. Displacing guns in high mountains typically requires mule transport, making repositioning a slow and tedious process.⁶²

Mountains also affect air operations, imposing limits on both helicopter and fixed wing flight. Low ceilings, fog and changing winds make mountain flying a dangerous task. Terrain canalizes air avenues of approach, limiting ingress and egress routes and increasing aircraft vulnerability. Terrain suitable for helicopter landing zones is difficult to find. Target acquisition and engagement is more difficult in uneven terrain, where enemy positions are easily hidden. Aircraft are more vulnerable to enemy ground fire, especially SAMs, which can be concealed in terrain folds. The Soviet military lost more than one hundred ground-attack aircraft and three hundred helicopters to well-hidden mujahadeen missile and anti-aircraft gun teams during ten years of combat in the mountains of Afghanistan.⁶³

E. THE OPERATIONAL ART OF HIGH ALTITUDE WARFARE

Reduced mobility in restrictive terrain is the critical characteristic of mountain warfare; the unique atmosphere creates additional constraints on military operations. Strategists must consider both of these factors when contemplating warfare in high mountains. A strategy that calls for the occupation of high altitude terrain, and defense of static positions, has seldom succeeded in high mountain wars. At first glance, the possession of the high ground seems to offer an almost overwhelming advantage. Yet possession of the high ground does not always yield an operational advantage; high mountains exact a price on a fixed force, exposing it to severe weather as well as enemy observation and fire. The attrition caused by exposure to enemy firepower and the environment has led to the defeat of mountain fortifications in past wars, most notably the Greek Army's Metaxas line in the Second World War.

Bypassing the mountains and securing routes of access is not always a viable choice, especially in the case of India and Pakistan, in which the area of dispute consists

⁶² A light artillery battery may require up to sixty mules for transport. Barry Gregory, *Mountain and Arctic Warfare: From Alexander to Afghanistan*, 174.

⁶³ Mohammad Yahya Nawroz, General, Army of Afghanistan (Retired), and Lester W. Grau, Lieutenant Colonel, U.S. Army (Retired), "The Soviet War in Afghanistan: History and Harbinger of Future War?"

mainly of high mountain terrain, the mere possession of which constitutes victory. Therefore, an army faced with a foe atop dominating heights may have no choice but to take the hill. For the force tasked with dislodging an enemy atop high mountains, victory relies on the difficult task of integrating firepower and maneuver, as it does in warfare on any battlefield. But high mountains significantly alter the conditions of combat, the systems that are best suited for delivery of firepower, and the tactics that enable successful maneuver. Victorious armies have historically focused offensive operations on isolating enemy positions by gaining control of surrounding heights and passes, the key terrain that dominates a mountainous region. Isolation further exacerbates the effects of the environment, degrading the enemy forces' ability and will to fight. Applying overwhelming firepower to fix the isolated force, in concert with maneuver, leads to the enemy's defeat.

1. Maneuver

Mountainous terrain makes dismounted infantry the primary combatant on the high altitude battlefield. The scarcity of trafficable roads and narrow mountain passes relegates armor and tracked vehicles to a limited role and increases their vulnerability to a lightly armed enemy. Well-placed mujahadeen ambushes on rugged and narrow roads destroyed more than one thousand Soviet armored personnel carriers and more than eleven thousand trucks during a decade of war in Afghanistan.⁶⁴ The lack of trafficable roads makes logistical support difficult. Cross-country movement is equally demanding. Soldiers must be trained mountaineers in order to conduct, as well as support, military operations.

Trained mountaineers allow an army to execute bold maneuver over the most difficult and unlikely terrain, the key to successful offensive operations in the mountains. Maneuver in the mountains therefore places a premium on the ability to install and use ropes to scale vertical cliffs. From 1942 to 1944, the U.S. Army's 10th Mountain Division trained at Camp Hale, Colorado, in elevations that approached 12,000 feet

⁶⁴ Ibid.

(3,660 m) and winter temperatures that dropped to -20° C.⁶⁵ Soldiers received extensive training in mountaineering skills and cold weather survival. They arrived in Italy in December 1944 as perhaps the most skilled mountaineers on the peninsula.

The 10th Mountain Division employed small, skilled units against static German positions atop high ground. The 10th Mountain entered battle against German fortifications in the Apennines, at heights reaching 5,000 feet (1,500 m). German positions included Mount Belvedere, which had beaten back three Allied attacks and appeared impregnable.⁶⁶ The 10th Mountain commander, Brigadier General George P. Hays, ordered the 86th Infantry Regiment to seize Riva Ridge, a rocky, perpendicular slope, as a foothold to launch an attack on Mount Belvedere. According to General Hays, “the Germans would never believe that anyone could scale it.”⁶⁷ On the night of 18 February 1945, the men of the 1st Battalion, 86th Infantry Regiment installed ropes and scaled the 1,500-foot vertical cliff under cover of darkness, surprised the German defenders at dawn and seized the ridge.

The 10th Mountain Division’s operations in Italy exhibit the tactics that succeed against mountain positions. Maneuver must be on an unexpected axis of advance; small units that execute multidirectional attacks can achieve tactical surprise, critical to success against heights. The German Army’s own Field Service Regulation of 1933, written after extensive combat experience in the mountains of Europe during World War I, clearly stated the methods that achieve victory in the mountains:

In restricted terrain the attacker often needs only a local and limited superiority in numbers and battle means. Apparently strong heights and rocky positions ... can be made to fall if we succeed in enveloping, or turning these positions.⁶⁸

⁶⁵ Tom Jenkins, “The Assault on Riva Ridge,” *American History* (December 2001), 48.

⁶⁶ The 10th Mountain Division’s actions against Riva Ridge and Mount Belvedere were part of Operation Encore, an allied offensive in February 1945 that sought the capture of key terrain to set the stage for a larger spring offensive. For further reading see Dwight Oland, *North Apennines: The U.S. Army Campaigns of World War II*, U.S. Army Center of Military History Publication 72-34 at <<http://www.army.mil/cmh-pg/brochures/nap/72-34.htm>> (April 2003).

⁶⁷ Barry Gregory, *Mountain and Arctic Warfare: From Alexander to Afghanistan*, 231.

⁶⁸ John F. Antal, Colonel, U.S. Army, “Busting Through,” *Military Review*, Vol. 80, No. 1 (January-February 2000), 30.

2. Firepower

Daring maneuver can only be successfully when it is supported by overwhelming firepower. Artillery is the most effective and reliable method of delivery on the high altitude battlefield, because of its ability to concentrate sustained fire in varied terrain and harsh weather. Artillery compensates for the loss of mobility and accuracy by offering concentrated and relentless fire, a capability unmatched by any other platform on the high altitude battlefield, including air power. Organic artillery emerged as an indispensable component of forces built to fight in mountains. Each Jaeger battalion carried its own internal light howitzers as well as mortars of varying caliber.⁶⁹ Each regiment contained a mountain howitzer battery. Most of the guns were light artillery of First World War vintage, which proved to be highly mobile and effective.

The Jaeger became masters of integrating firepower and maneuver to destroy mountain defensive positions. In April 1941, the 5th Gebirgs Division launched the first successful attack on permanent mountain fortifications by a light infantry force in the history of warfare.⁷⁰ The series of concrete bunkers that formed the Metaxas Line stretched across the Rhodope Mountains in Macedonia. The mountains reached an altitude of 6,500 feet (2,000 m) with little vegetation on the highest ridges and deep, narrow valleys. The Greek Army considered the line to be impregnable.⁷¹

The Jaeger initiated the assault with overwhelming fire support, firing heavy, long-range artillery from the valley floor. They dismantled and carried mountain artillery guns to the high slopes by pack mule. Ju-87 Stuka dive-bombers attacked the pillboxes, but had difficulty acquiring the targets and did not destroy them. Small infantry units pressed the attack, using mortars and heavy machine gun fire to suppress the bunkers. Jaeger dragged light artillery pieces within close range of the bunkers to provide direct fire. The overwhelming suppressive fire of Stuka, mortars, and artillery allowed small

⁶⁹ Each company had three light mortars and two 8-cm mortars. The machine gun company had twelve heavy machine guns and four 12-cm mortars. The heavy weapons company had four light machine guns and two 7.5-cm howitzers. Barry Gregory, *Mountain and Arctic Warfare: From Alexander to Afghanistan*, 173.

⁷⁰ James Lucas, *Hitler's Mountain Troops*, 61.

⁷¹ *Ibid* 49.

groups of Jaeger to maneuver and destroy the bunkers by assault.⁷² The Metaxas Line fell after four days of intense combat.

3. Holding the High Ground

The Greek Army's failure to maintain the Metaxas Line provides a compelling example of the difficulty a static defender faces in a mountainous environment. The high ground does not guarantee victory. History provides examples of techniques that allow the defender to use the terrain to his advantage and defeat a foe that has superior firepower. Defenders can use the reverse slope to protect soldiers from the effects of enemy firepower. The reverse slope is the mountainside that descends away from the enemy. Defending forces use the topographical crest to shield the defensive positions from observation and the effect of overwhelming firepower. Armies have used this technique with great effect in previous mountain wars.

The People's Liberation Army (PLA) of China used the reverse slope defense during the Korean War to offset the U.S. Army's overwhelming advantage in firepower. Chinese forces called the technique "front light, rear heavy," and it halted numerous allied advances in the snow-covered mountains of Korea.⁷³ The Japanese Army used ridgelines to mask the effects of U.S. firepower in the Philippines during the Second World War. On Lane's Ridge, in the mountains near Luzon, Japanese infantry units defended in depth; elements of the U.S. 6th Infantry Division encountered over fifty-five fortified positions on the reverse slope of the ridgeline.⁷⁴ Japanese battalions stopped entire U.S. divisions and inflicted heavy casualties. Using the terrain to mask the effects of firepower requires a large force due to the extension of the battlefield's depth. This requirement eliminates light, irregular forces from using the reverse slope technique as a general framework covering a large piece of terrain. However, units lacking manpower

⁷² Ibid 53.

⁷³ A detailed description of the PLA's defensive techniques can be found in Scott R. McMichael, Major, U.S. Army, *A Historical Perspective on Light Infantry* (Ft. Leavenworth, Kansas: Combat Studies Institute, 1987), 51-91.

⁷⁴ *Light Infantry in Action* at <http://call.army.mil/products/ctc_bull/1-88/chpt3.htm> (December 2002).

and heavy weapons can use terrain locally, in battle positions, to protect soldiers from the effects of enemy fire.

F. CONCLUSION

The successful integration of firepower and maneuver determine victory on the battlefield. The high altitude environment alters the playing field, significantly changing the manner in which armies conduct military operations. The atmosphere and terrain combine to degrade man and equipment alike, setting constraints on military planners and reducing available options. Static forces fare worse than those that are on the offensive. Although the high ground affords command of large expanses of land, it also exposes men to the elements and the full brunt of massed enemy fire.

Artillery has emerged over the course of man's experience with war at high altitude as the most reliable means of firepower delivery. Although it is limited in mobility and suffers erratic ballistic effects, light artillery has proven to be a decisive and devastating force in mountain warfare. The campaigns of the 10th Mountain Division and 5th Gebirgs Division displayed the effective marriage of overwhelming artillery support with bold maneuver in difficult terrain. Trained light infantry, operating in small units, best performs the bold maneuver essential to gaining tactical surprise.

Prior to the 1999 Kargil Conflict, the question of air power's effectiveness on the high altitude battlefield had not been decisively answered. Aircraft suffer multiple performance shortcomings in rarified air, as do artillery and all weapon systems designed for use at sea level. The Soviet Union lost staggering numbers of high performance aircraft, as well as helicopter gunships, to mobile missile teams hidden among the Hindu Kush Mountains of Afghanistan. The Kargil Conflict matched a modern air force and army against an irregular force entrenched atop imposing mountains. The high altitude battlefield would degrade and limit both combatants, but exposure to the Himalayan environment would prove far more devastating to the NLI.

III. THE NORTHERN LIGHT INFANTRY AT KARGIL

A. INTRODUCTION

After a bold and successful insertion in the spring of 1999, Pakistani forces occupied commanding heights in Indian-held Kashmir and gained an initial tactical advantage. Pakistani soldiers seized peaks that dominated the Indian towns of Dras, Kargil, and the strategic Srinagar-Leh Highway, threatening India's ability to reach its units deployed in Ladakh and on the Siachen Glacier. But initial success did not translate into military victory. India chose to retake the ground by force, and entered into a massive military campaign against the small band of raiders. After seventy-four days of combat, the Pakistanis retreated back across the Line of Control (LOC). How did the high altitude environment affect Pakistan's military operations?

The high altitude environment complemented Pakistani military capabilities in the campaign's early stages. Difficult terrain provided infiltration routes for a light infantry force. The atmosphere and terrain enhanced the effects of Pakistani air defenses, reducing India's asymmetric advantage of air power. Well-placed artillery and heavy weapons balanced Indian superiority on the ground as well, defeating poorly planned assaults. A limited arsenal atop decisive terrain yielded initial success, but it could not withstand critical miscalculations, the destructive nature of the environment, and an adaptive Indian military.

Pakistan did not provide the manpower and logistical effort necessary to retain a high altitude belt of terrain. A light infantry force that could slip past Indian border security could not hold terrain against a combined ground and air offensive. An inadequate logistical effort exposed men to the environment's impact with little means of protection. Unable to rotate to lower altitudes, pockets of soldiers remained across the LOC for extended periods. The thin air and frigid conditions of the Kargil battlefield gradually eroded the Pakistani soldiers' health and combat effectiveness. Weary men in static positions lost their fighting edge due to over-exposure, inadequate shelter, and malnutrition.

Military leaders exacerbated the environment's effects by committing numerous tactical mistakes in the unforgiving mountain terrain. Dispersed outposts, which were not part of a coherent defensive scheme that provided mutual support among positions, proved vulnerable to Indian firepower and maneuver. Defenses afforded little depth and no flexibility, with small units assigned to retain areas too large for their manpower and firepower capabilities. Most individual positions occupied the forward slope, which exposed soldiers to Indian fire. The Indian Army eventually exploited these mistakes and forced a Pakistani withdrawal.

B. THE NORTHERN LIGHT INFANTRY

The desolate and rugged Northern Areas sit across the LOC from Kargil. It is an autonomous region that is home to a Pakistan Army divisional headquarters, Forces Command Northern Areas (FCNA). The headquarters commands three Pakistan Army brigades that are posted in the Northern Areas and responsible for maintaining security along the LOC. The brigades routinely contained regular army battalions as well as battalions of the Northern Light Infantry (NLI), whose soldiers would bear the burden of seizing terrain across the LOC.⁷⁵

The NLI traces its lineage to scout units raised by the colonial British Army to patrol the Himalayan frontier. In 1973 Pakistan reorganized three of these formations, the Karakoram, Northern and Gilgit Scouts, into the NLI. The organization posted a headquarters at Bunji, in the Northern Areas, from which commanders supervised the unit's primary task, border defense. Over the years the NLI expanded training to include specialized missions such as mountain and arctic warfare. The soldiers are local men, accustomed to the difficult terrain and high altitude atmosphere. In 1999 the NLI's officers were assigned from regular Pakistan Army infantry units, and routinely trained at the army's elite schools, including a world-class mountaineering school in the Northern Areas.⁷⁶

⁷⁵ Prior to the Kargil Conflict the FCNA shared command of the NLI with the Ministry of the Interior.

⁷⁶ Pakistan conducts high altitude training in three to four month courses near the town of Astor in the Northern Areas. The training is extensive and produces proficient mountaineers who are generally assigned to units, including the NLI, as instructors. Robert Karniol, "Fighting on the Roof of the World," 30.

NLI battalions resemble Western light infantry battalions in size and structure, each holding approximately 600 men. An NLI battalion consists of four rifle companies, each consisting of three platoons and a heavy weapons section. Platoons have three sections and two light machine guns. Each company has two 60-mm mortars. The light infantry battalions have few organic combined arms assets. The headquarters contains an 81-mm mortar platoon with four tubes and an air defense section with four 12.7-mm machine guns. Each battalion has an animal transport section, an essential source of mobility in the mountains.⁷⁷

Outside observers do not know the exact organization of the force that crossed the LOC. Captured Pakistani soldiers and documents identified elements of the 4, 5, 6 and 12 NLI battalions.⁷⁸ A battalion of the Special Service Group (SSG), elite commandos trained in advanced mountaineering, and elements of the Frontier Corps of the Northwest Frontier Province (NWFP), the Chitral and Bajaur Scouts, augmented the NLI forces as well.⁷⁹ Civilian militants, also known as mujahadeen, from the Northern Areas may have occupied outposts and engaged in combat. The scope of mujahadeen involvement has been a continuing source of debate. The Pakistani government initially claimed that uncontrollable bands of mujahadeen were responsible for the entire operation.⁸⁰ Whatever the exact composition, Indian intelligence sources estimated that the total force numbered approximately 1,700 men.⁸¹

C. INFILTRATION IN THE HIGH MOUNTAINS

The force conducted a phased infiltration, crossing the LOC in several different areas (see Figure 3). Infiltration is a difficult and risky task, made more so by rugged mountain terrain and high altitude. Few lanes exist for movement along the LOC. Indian outposts on high ground observe large expanses of terrain. Small units risk rapid

⁷⁷ NLI task organization from Ashok Krishna, Major General, Indian Army (Retired), "Appendix 5, Pakistan's Northern Light Infantry," 297.

⁷⁸ Ashok Krishna, Major General, Indian Army (Retired), "The Kargil War," 100.

⁷⁹ Ibid.

⁸⁰ Ashok Krishna, Major General, Indian Army (Retired), "Appendix 12, Pakistan Prime Minister Nawaz Sharif's Address to the Nation, 12 July 1999," 325.

⁸¹ Ashok Krishna, Major General, Indian Army (Retired), "The Kargil War," 102.

isolation if detected. Movement is slow and dangerous. Despite the challenges, the NLI used difficult terrain and severe weather to its advantage. Soldiers traveled on hazardous peaks and ridgelines, as well as large expanses of ground that went unobserved by Indian patrols and outposts.

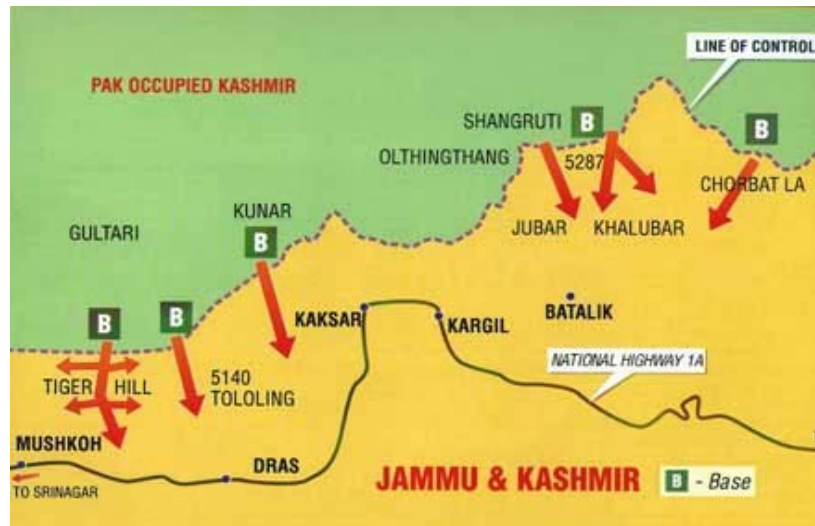


Figure 3. NLI infiltration routes across the LOC. (From: Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil* (Delhi: Army Headquarters, 2002), 2)

The groups infiltrated across the LOC over the course of several months in the spring of 1999.⁸² The NLI traveled in small formations of approximately thirty soldiers each. Soldiers walked on ridgelines through gaps in Indian coverage created by the abandonment of outposts during the winter months. They used mule teams and helicopters to carry equipment across the LOC. Indian patrols spotted several Puma and Lama helicopters, which are capable of operating at extremely high altitudes, carrying loads of supplies across the LOC.⁸³ NLI soldiers dismantled heavy equipment, including artillery pieces, for shipment into the area of operations by helicopter. Pakistani helicopter pilots displayed their skill at high altitude, using “innovative techniques” to fly

⁸² *The Kargil Review Committee Report*, 88.

⁸³ An Indian Army patrol spotted seven Pakistani helicopters with slingloads in Turtok in late April. The French Aerospatiale Puma is a medium-sized, twin-engine transport helicopter with a service ceiling of 19,680 feet (6,000 meters); the Aerospatiale Lama is a light single-engine helicopter with a service ceiling of 17,715 feet (5,400 meters), although the Pakistan Army reportedly flies it at 24,600 feet (7,500 meters) on the Siachen Glacier. *Ibid* 99.

“along mountain peaks, careful not to be visible against the horizon.”⁸⁴ Mules and porters pulled ammunition, heavy weapons, and light artillery as well.

The NLI sought to avoid contact with the five battalions of the Indian Army’s 121 Brigade that patrolled the LOC in Kargil. The brigade’s patrol and outpost plan created 80-km of uncovered gaps during the winter, when Indian outposts went unoccupied due to severe weather and hazardous conditions.⁸⁵ Indian patrols focused on the streambeds that offered easier and faster avenues of approach, which are commonly called nullahs. Indian patrols generally avoided the rugged terrain and high winds on the ridgelines. Indian Army helicopters augmented the ground surveillance effort, conducting periodic aerial patrols throughout the winter.⁸⁶ Snow-blindness limited the effectiveness of the air patrols, which focused primarily on the valley floors. Winter Air Surveillance Operation (WASO) flights and Indian patrols failed to detect the NLI groups as they moved across the LOC. Indian units reported sporadic activity and sightings, but commanders did not suspect a large-scale incursion.

The NLI occupied approximately 130 posts in Indian-held Kashmir, creating a total frontage of about 150-km that varied in depth from 4 to 8-km across the LOC. A force of more than 500 Pakistanis occupied Mushkoh Valley and Dras, establishing positions on Tiger Hill and Tololing that commanded the Srinagar-Leh Highway. A smaller group of approximately 100 Pakistanis occupied positions 4-km deep in Kaksar, near the town of Kargil. Further north, more than 250 Pakistanis moved into Batalik and Turtok, on the southern edge of the Siachen Glacier (see Appendix. Array of Forces During the Kargil Conflict).⁸⁷ The NLI had seized the initiative with a successful insertion, and occupied dominating heights along the LOC. The Pakistani soldiers faced the uncertainty of a massive Indian offensive to drive them off the peaks. But the men

⁸⁴ Quote taken from an unnamed Indian Army officer commenting on Pakistan pilot proficiency. Rahul Bedi, “Paying to Keep the High Ground,” 27.

⁸⁵ Gaps in Indian coverage varied from 36-km in the Mushkoh Valley to 9-km in Kaksar. Ashok Kalyan Verma, Major General, Indian Army (Retired), *Kargil: Blood on the Snow*, 86.

⁸⁶ Indian Army helicopters conducted six Winter Air Surveillance Operation (WASO) flights during the winter of 1999. *The Kargil Review Committee Report*, 88.

⁸⁷ Estimates of group sizes from Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 102.

faced a certain and immediate threat, the debilitating effect of the high altitude environment.

D. THE ENVIRONMENT'S TOLL

Exposure to high altitude, cold weather and rugged terrain hindered several aspects of Pakistani operations. Soldiers suffered substantial non-battle casualties before the Indian offensive began in late May. Captured NLI soldiers and documents revealed that avalanches and severe blizzards in February and March inflicted numerous casualties.⁸⁸ NLI soldiers attempted to build permanent positions with few available resources. They carried fiberglass huts, snow tents and other permanent shelters. They dug low trenches and constructed sangars on rocky slopes.⁸⁹ They built makeshift overhead cover for protection from the elements as well as indirect fire. These efforts failed. Cement did not set properly because water froze immediately at nightfall. Sangars constructed of loosely fitted boulders collapsed on their inhabitants under fire.

Prolonged exposure to high altitude degraded the health of all soldiers on the battlefield at Kargil, including the indigenous men of the NLI. The NLI recruited the majority of its manpower from the Northern Areas, and most of its soldiers had grown up climbing the peaks around Gilgit.⁹⁰ NLI soldiers were routinely stationed along the LOC and had probably acclimatized to the environment. Many of the NLI's officers were not native to the region and probably bore the brunt of illness caused by the extended deployment at high altitude. A former NLI commander noted that the drastic change in elevation made eating and sleeping nearly impossible for the Pakistan Army officers assigned to outposts, even if acclimatization had occurred.⁹¹ Both officers and soldiers undoubtedly suffered because of the continuous nature of the deployment. Ideally, soldiers in outposts rotate to lower altitudes every ten to fourteen days to minimize exposure. A captured 5 NLI officer's diary describes his company as containing seventy-

⁸⁸ *The Kargil Review Committee Report*, 228.

⁸⁹ Sangars are aboveground fighting positions built by piling stones and other building material above ground in rocky terrain where digging is impossible.

⁹⁰ 55 percent of NLI soldiers were from Gilgit in the Northern Areas. Ashok Krishna, Major General, Indian Army (Retired), "Appendix 5, Pakistan's Northern Light Infantry," 297.

⁹¹ Interview between Brigadier Feroz Khan and the author, 28 February 2003.

one man when it crossed the LOC.⁹² He evacuated twenty-five men due to illness before the Indian offensive began, and did not receive replacements.

Pakistan failed to sustain the NLI soldiers, compounding the effects of the environment. The occupied sector expanded beyond the capability of its logistical base. The band of NLI and civilian militants proved too small to occupy positions and act as fighting porters, responsible for their own logistical support. Regular army battalions that remained in the Northern Areas did not improvise new lines of communication as the IAF eliminated existing ones. The destruction of critical supply sites, such as Muntho Dalo, by the IAF effectively isolated many forward positions. NLI soldiers survived on captured Indian rations when their supplies ran low, and many reportedly subsisted on a diet of sugar during the operation's last days.⁹³ But as the high altitude environment steadily degraded the NLI's ability to fight and survive, it also played a critical role in reducing India's overwhelming military advantage.

E. ASYMMETRIC WARFARE

Air power provided the Indian armed forces with an asymmetric advantage over the vulnerable NLI ground force.⁹⁴ The Indian Air Force (IAF) engaged NLI ground forces absent the threat of interdiction by Pakistani air power. However, the high altitude environment, coupled with the NLI's skillful employment of surface-to-air weapons, diminished India's asymmetric advantage and exposed vulnerabilities. The IAF's primary attack helicopter, the Russian-made Mi-25, was too heavy to fly at high altitude. Thin air reduced the accuracy of aerial weaponry. Irregular and jagged terrain concealed Pakistani surface-to-air missiles (SAMs).

The NLI deployed significant air defense weapons to counter IAF aircraft. Elements of four missile and two gun batteries reportedly crossed the LOC with the

⁹² Ravi Rikhye, "The Northern Light Infantry in the Kargil Operations, 1999." *Bharat Rakshak Monitor* Vol. 3, No. 6 (May-June 2001) at <<http://www.bharat-rakshak.com/MONITOR/ISSUE3-6/rikhye.html>> (April 2002).

⁹³ Ibid.

⁹⁴ A discussion of the concept of positive asymmetry afforded by technology or methods available to only one combatant in a conflict can be found in Steven Metz and Douglas V. Johnston II, *Asymmetry and U.S. Military Strategy: Definition, Background, and Strategic Concepts* (Carlisle: U.S. Army War College Strategic Studies Institute, 2001).

NLI.⁹⁵ Mobile teams hid in terrain folds and massed on peaks near defensive positions. The NLI position on Tololing alone fired twenty-five SAMs during the campaign, and Indian officials estimated that the Pakistani soldiers carried more than one hundred missiles to their outposts.⁹⁶ The soldiers used the weapon systems effectively, and scored early hits that dramatically reduced the IAF's combat role.

Pakistani SAMs limited the IAF's willingness to support Indian ground maneuver with the full complement of its capability and firepower. Stinger missile teams destroyed an IAF MiG-21 and an Mi-17 attack helicopter during the initial days of air strikes. The IAF's response to the early losses significantly lessened its impact on the battlefield. The IAF command suspended attack helicopter operations and imposed safe height restrictions on ground attack aircraft.⁹⁷ The height restrictions placed aircraft out of reach of SAMs but also removed a large component of potential Indian firepower. For the rest of the campaign, IAF aircraft would not fly at low altitudes to provide accurate fire for ground maneuver, focusing instead on supply sites and other fixed targets behind NLI positions. The combination of NLI ground weapons, the high altitude atmosphere, and mountainous terrain placed limits on India's air power. But the NLI faced a far superior Indian ground force as well.

F. GROUND COMBAT AT HIGH ALTITUDE

The characteristics of the high altitude battlefield provided the NLI with an opportunity to lessen the disparity in firepower and force on the ground. The compartmented mountain terrain made the concentration of firepower difficult, diluting India's ability to mass the effects of both fire and force. Terrain canalized the movement of large infantry formations, which allowed the smaller NLI force to inflict heavy casualties on its superior adversary. The NLI skillfully applied limited resources in the early stages of the campaign, restricting the Indian military's ability to maneuver and deliver direct fire. It did not, however, possess the manpower required to hold a wide

⁹⁵ The majority of Pakistani SAMs were U.S.-made FIM-92A Stingers. Indian Army units captured a number of Chinese-made Anza Mark-II missiles as well. Amarinder Singh, *A Ridge too Far: War in the Kargil Heights 1999*, 42.

⁹⁶ Prasun K. Sengupta, "Mountain Warfare and Tri Service Operations," 25.

⁹⁷ Rahul Bedi, "Paying to Keep the High Ground," 31.

expanse of mountainous terrain for an indefinite period of time. Insufficient forces negated the NLI's ability to adapt to the enemy, and removed the possibility of using the terrain to protect its overmatched force.

1. Balancing the Close Fight

The NLI went into action with its full complement of heavy weapons. Contending with an unrecoverable loss in aerobic capacity, soldiers managed to haul several heavy machine guns (HMG) and automatic grenade launchers (AGL) across the LOC.⁹⁸ The Russian-made arms exceed sixty-five pounds in weight, and carrying their ammunition and accessories requires a team of soldiers or mules in mountainous terrain.⁹⁹ The weapons can deliver devastating fire on advancing infantry or low-flying aircraft, but their size and weight make repositioning a time-consuming and difficult task. The NLI's heavy weapons covered uphill approaches with direct fire and halted Indian assaults. The NLI augmented this lethal capability with ample artillery support.

A combination of Pakistan Army artillery and well-placed NLI indirect fire assets provided significant firepower to the NLI outposts. The NLI's array of organic mortars, capable of high-angle fire, provided responsive firepower as well. Twenty artillery batteries reportedly provided direct support to the NLI. Most of these batteries occupied positions in the Shingo Valley in the Northern Areas and shelled Indian targets in Dras.¹⁰⁰ The NLI transported at least one of its three organic artillery batteries and several 120-mm mortar platoons across the LOC. A detachment of three 105-mm guns at Point 4388, between Dras and the Mushkoh Valley, supported NLI positions on Tiger Hill and placed effective fire on the highway for two months.¹⁰¹ A mortar firing position that occupied a nearby nullah, or streambed, provided heavy volumes of fire as well.

⁹⁸ At 14,000 feet (4,250 m) above sea level, the average altitude along the LOC, the soldiers suffered a minimum of 30 percent unrecoverable reduction in aerobic capacity. This is unaffected by acclimatization. *Medical Problems in High Mountain Environments*, 34.

⁹⁹ The 12.7-mm HMG weighs 75 pounds (34 kilograms) without its tripod and ammunition; the AGS-17 AGL weighs 66 pounds (30 kilograms), with each drum of ammunition weighing 32 pounds (15 kilograms). Mohammed Yahya Nawroz, General (Retired), Army of Afghanistan, and Lester W. Grau, Lieutenant Colonel, U.S. Army (Retired), "The Soviet War in Afghanistan: History and Harbinger of Future War?"

¹⁰⁰ Brian Cloughley, *A History of the Pakistan Army*, (Delhi: Oxford University Press, 2002), 376.

¹⁰¹ Rahul Bedi, "Paying to Keep the High Ground," 28.

Three 120-mm and two 81-mm mortars stopped Indian assaults on the Tiger Hill complex for several weeks.¹⁰² Well-developed mule tracks and wire communications connected the positions, which sat in nullahs protected by steep mountainsides. Coordinated indirect fire confused Indian offensives and inflicted heavy casualties.

NLI guns that crossed the LOC kept the Indian Army off balance during initial attacks, engaging at short distances in indirect, high-angle mode. Massed Indian troops provided the primary target, making the concentration of fire more necessary than accuracy. Axes of advance offered little cover and concealment, and NLI mortars and artillery typically fired on the Indian soldiers throughout the entire length of their approach. Doctors attributed over half of the Indian casualties evacuated to the military hospital at Leh to indirect fire.¹⁰³ NLI artillery frustrated troop movements on the Srinagar-Leh Highway and destroyed the Indian Army's ammunition dump in the town of Kargil. The firepower provided by NLI artillery and mortars thwarted initial Indian Army assaults, but it would not be enough for the undermanned force to hold its mountain outposts.

2. Holding Ground in the Mountains

The NLI engaged in an area defense to retain the occupied heights. An overall defensive plan would have permitted the occupants of dispersed positions to fire into shared engagement areas and protect each other. But no such larger defensive scheme materialized. Occupied sectors consisted of a series of scattered outposts on ridgelines and peaks. Due to limited manpower, NLI soldiers occupied static positions that lacked depth and allowed for little tactical flexibility. Limited security forces, in the form of patrols and ambushes, occupied nullahs and other avenues of approach. Pakistan failed to provide the manpower necessary to hold terrain in the difficult environment. This failure prevented the NLI from implementing mountain warfare tactics proven in previous wars.

¹⁰² An Indian raid destroyed a Pakistani heavy mortar platoon firing position in the Safaid Nullah and Point 4388. Amarinder Singh, *A Ridge too Far: War in the Kargil Heights 1999*, 195.

¹⁰³ Ashok Kalyan Verma, Major General, Indian Army (Retired), *Kargil: Blood on the Snow*, 108.

Lightly armed defenders can use mountainous terrain to mask their positions from enemy observation and direct fire. This method, known as the reverse slope defense, offered the NLI its best chance for success in the mountainous terrain along the LOC. The reverse slope defense gains effectiveness when adjacent positions provide interlocking fires, creating an engagement area on the forward slope. Observation posts forward of the topographical crest watch the engagement area and call for indirect fire. The reverse slope method has clear advantages. It creates tactical surprise and protects forces from direct and indirect fire. It allows the defender to mass weapons effects on the reverse military crest. But it has disadvantages as well. Observation is restricted, and the topographical crest limits the range of direct fire weapons. The enemy attacks downhill, a significant advantage in the thin air at high altitude.

The NLI's tactical situation favored use of terrain to protect its soldiers, but it did not possess the manpower necessary to implement it. The reverse slope method gives the defender the advantage when the forward slope is exposed to enemy fire originating beyond the range of the defender's weapons. Direct fire from Indian long-range artillery destroyed many NLI positions on the forward slope. Those positions that were not destroyed suffered under continuous suppressive fire, unable to engage advancing Indian infantry. The NLI had no weapon to reduce the Indian Army's standoff advantage.

In addition to poor placement and insufficient manning, the NLI's outposts suffered from several unique characteristics of defending a static position on the high altitude battlefield. Towering heights along the LOC offered Pakistani positions nearly unlimited observation of the Indian Army's approach, yet the difficulty of estimating range in the mountains diminished that advantage. Indian soldiers reported that the NLI exhibited poor fire discipline, engaging targets at excessive distances and unnecessarily revealing their location.¹⁰⁴ Ice fog and vapor trails, created by weapons fired in the cold air, hung over static NLI positions and gave away their location. NLI defenders developed engagement areas that contained large areas of dead space unaffected by direct

¹⁰⁴ S.S. Chandel, Brigadier, Indian Army (Retired), "Infantry Assaults in High Altitude," *Institute of Peace and Conflict Studies* No. 240 (13 August 1999) at <<http://www.ipcs.org/issues/articles/240-mi-chandel.htm>> (May 2002).

fire. Indian soldiers closed to within twenty yards of NLI bunkers before being engaged with effective fire, despite the presence of night vision devices in most NLI positions.¹⁰⁵

In most battles along the LOC, NLI tenacity and firepower stopped the Indian Army's first attempts to dislodge them. Over time, the Indian Army adapted its tactics to the landscape. Indian Army units eventually overcame their initial failures and exploited NLI tactical errors. Indian units isolated the lightly held positions by force. Indian infantry battalions penetrated linear defenses and attacked assailable flanks. The NLI's limited manpower made recovery from its initial tactical mistakes impossible. NLI forces had no choice but to withdraw once they were surrounded or cut in half. This sequence of events occurred in the battle for Tiger Hill.

G. TIGER HILL

Tiger Hill stands 16,700 feet (5,062 m) high and overlooks Dras. It is a massive terrain feature, approximately one kilometer wide at its base. A high ridgeline, called the Western Ridge, extends to the west and contains several prominent features: India Gate, two rock structures that look similar to a gate; a large rock pile known as the Helmet; Rocky Knob; and Rhino Horn (see Figure 4). Several peaks to the south of Tiger Hill provide observation of the surrounding valleys and ridgelines. Point 4460 is one kilometer south of Tiger Hill, within supporting range of the NLI's direct fire weapons. The Tingel Nullah divides the complex, and Hill 4875 and Point 4540 sit on its far side opposite Tiger Hill (see Figure 5).

¹⁰⁵ Ibid.

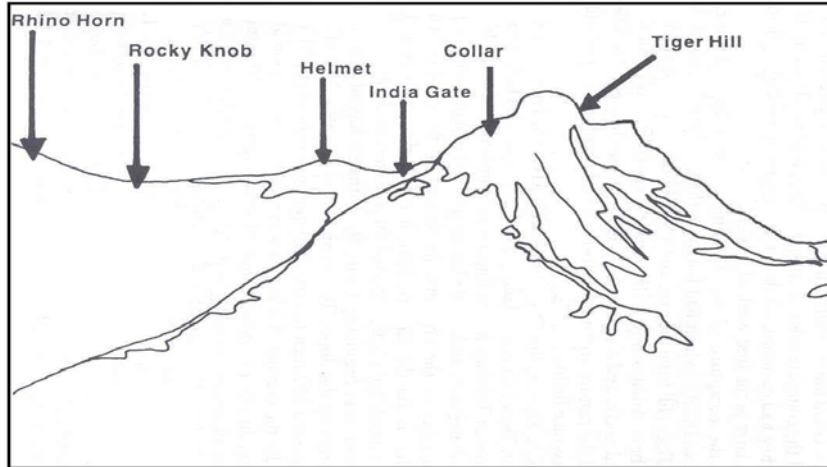


Figure 4. Tiger Hill and Western Ridge, approaching from the south. (After: Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 117)

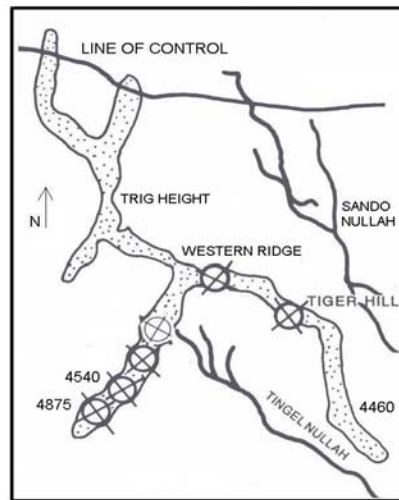


Figure 5. Overhead view of the Tiger Hill complex. (After: Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 94)

The Indian Army estimated that an element of around one hundred men, roughly equivalent in size to an NLI rifle company, defended Tiger Hill and the Western Ridge.¹⁰⁶ The commander dispersed his forces into section positions that each contained eight to ten soldiers. Four sections occupied the hilltop. The remainder of the group occupied trenches on Western Ridge, with a section at India Gate, Helmet and Rhino Horn. The commander placed his headquarters with a group of around twenty soldiers at

¹⁰⁶ Amarinder Singh, *A Ridge too Far: War in the Kargil Heights 1999*, 87.

the Rocky Knob, which fired across the front line of positions, creating an engagement area with interlocking fire. A medium machine gun (MMG) watched the forward slope of Western Ridge. An anti-personnel minefield blocked the approach from Point 4540. A 12.7-mm gun atop Trig Height, a peak that is two-kilometers northwest of Tiger Hill, provided additional heavy weapon support. The artillery battery on Point 4388, as well as the nearby mortar position, fired into the engagement area as well.¹⁰⁷

The NLI's linear positions on Western Ridge and Tiger Hill provided little depth to its array of outposts. Forward security forces could have added depth to the linear defense, but the NLI did not deploy them in significant numbers. Indian forces occupied Point 4460 against light resistance in late May, providing a significant base of fire for maneuver onto Tiger Hill. The NLI also abandoned Point 4540. Forces in a security zone could have slowed the Indian advance, and hindered their attempts to reposition forces on the few narrow and exposed areas that suit foot movement. The NLI lost the initiative by surrendering control of these critical features and allowing the Indian Army to build combat power.

The NLI soldiers on Tiger Hill managed to hold the Indian forces at bay for nearly a month despite their small numbers and tactical mistakes. NLI soldiers skillfully camouflaged their positions, causing the Indian Army to underestimate their strength. Physically unprepared and poorly equipped soldiers of India's 1 Naga and 8 Sikh conducted ill-conceived assaults against Tiger Hill in May.¹⁰⁸ NLI fire support inflicted heavy Indian casualties.¹⁰⁹ The Indian assaults failed, and the units surrounded Tiger Hill and dug in. The NLI launched a series of counterattacks, but the thinly spread forces lacked the combat power to push the Indian battalions off the hill. NLI soldiers even resorted to rolling boulders downhill on the Indian forces.¹¹⁰

Exposure to massive Indian firepower and an inadequate force commitment emerged as critical tactical errors. NLI sections occupied positions on the front slope of

¹⁰⁷ NLI disposition on Tiger Hill provided by Indian Army participants in the battle. Ibid 87.

¹⁰⁸ The full titles of the Indian Army battalions involved in the battle are 1st Battalion, Naga Regiment and 8th Battalion, Sikh Regiment. The battalions are referred to as 1 Naga and 8 Sikh, respectively.

¹⁰⁹ By early July, 1 Naga had suffered 80 casualties; 8 Sikh, 62. Ibid 56.

¹¹⁰ Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, (Delhi: Books Today, 2000), 133.

Western Ridge and the hilltop. Only one section occupied Tiger Hill's reverse slope. The configuration exposed the vast majority of the soldiers to overwhelming Indian direct and indirect fire. A massive artillery barrage, with as many as 1,200 rounds impacting every 5 minutes, preceded the final assault that forced an NLI retreat.¹¹¹ The Indian Army found an assailable flank and launched a successful attack on Tiger Hilltop from the east. Simultaneously, a small Indian raiding party penetrated the thin line of defense on the Western Ridge, splitting the position in half. Despite brave but small counterattacks, the NLI could not push the Indian raiding party off the ridgeline. Faced with certain defeat, the NLI abandoned its positions atop Tiger Hill on 8 July, leaving thirty-two dead soldiers behind.

H. CONCLUSION

The NLI demonstrated that holding the high ground does not necessarily ensure victory on the high altitude battlefield. Even the existence of well-trained, indigenous men could not ultimately make the difference between victory and defeat. The NLI masterfully infiltrated over seemingly impossible terrain and occupied commanding heights. Outposts tucked into folds in rugged terrain limited the Indian military's ability to focus its overwhelming firepower. Indirect fire assets harassed Indian troop movements and defeated initial attacks. The combination of NLI missile teams and thin air deterred the IAF and mitigated the NLI's asymmetric disadvantage. The NLI's objective, to retain the heights, seemed tenable after India's unsuccessful attacks in late May, with 1,700 soldiers firmly entrenched atop Himalayan peaks.

The NLI used the high mountain terrain to its advantage in the initial stages of the battle, yet could not escape its detrimental effects. Although the environment provided some benefits to the overmatched NLI force, the effects of high altitude gradually eroded the NLI's ability to fight and survive. Illness, caused by thin air and severe temperatures, rendered many units combat ineffective. Soldiers remained on outposts indefinitely, and most went without food or water during the final days of the battle. Inclement weather and barren terrain made defensive preparation an arduous task. Inadequate manpower

¹¹¹ Gurmeet Kanwal, Colonel, Indian Army, "Pakistan's Military Defeat," *Kargil 1999: Pakistan's Fourth War for Kashmir*, Ed. Jasjit Singh (Delhi: Knowledge World, 1999), 148.

and logistical support added to the misery of the men who occupied the outposts. With supplies running low and the environment reducing its ability to fight, the NLI's firm grip on the high ground became its only hope for victory. Tactical errors, amplified by the unforgiving mountainous terrain, erased that advantage as well.

The Indian Army exploited the NLI's inability to adapt the full scope of its military operation to the environment. Pakistan did not provide the logistic support necessary for the NLI soldiers to survive, let alone sustain military operations, at high altitude. The force commitment did not match the objective, and the undermanned NLI force could not defend the full reach of its territorial gains. A small and agile force designed to avoid detection could not withstand the combined effects of the environment and the Indian offensive. Linear defenses, dispersed across peaks outside of supporting distance, offered little chance of success. Indian assaults isolated the outposts and defeated them piecemeal. The NLI exposed its soldiers to massive fire on the forward slope. The harsh environment and a determined Indian Army ensured that the NLI would not recover from its tactical mistakes.

IV. THE INDIAN OFFENSIVE

A. INTRODUCTION

Facing an unforeseen turn of events on the LOC, India chose to mount a military campaign to drive the Pakistani invaders off the mountains around Kargil. The Indian Armed Forces quickly mobilized in Kargil and began the arduous task of clearing the heights.¹¹² The effects of rapid deployment to the high altitude environment, coupled with tactics that did not fit the mountainous landscape, stalled India's initial efforts. Adaptation to the harsh environment and the entrenched enemy force was essential to achieving victory. Both the Indian Army and Air Force (IAF) gradually altered their approach to warfare at high altitude and ultimately drove the Pakistani forces back across the LOC. How did the high altitude environment affect Indian military operations, and what modifications led to victory?

The Indian campaign started slowly in the final days of May 1999, following the decision to use military force to evict the Pakistani intruders and restore the LOC.¹¹³ The Indian Army simply underestimated the Pakistani force dug in atop the peaks at Kargil. Initial assaults failed. Soldiers rushed to the theater from low elevations arrived unacclimatized and ill equipped for the environment. Infantry battalions launched uphill attacks without adequate artillery support. The absence of crucial suppressive fire made Indian infantrymen vulnerable to withering fire from an enemy atop commanding heights. The Indian Air Force's (IAF) air campaign suffered early losses as well, as it discovered its training and equipment lacking in the high altitude atmosphere. After losing three IAF aircraft to enemy fire in the first week of operations, the IAF imposed height limits on its aircraft that reduced their ability to deliver effective close air support (CAS) to maneuver units.¹¹⁴ The early rounds of fighting had not gone well for the Indian forces, and change was necessary to break the stalemate on the LOC.

¹¹² XV Corps commanded 3 Infantry Division, whose 121 Brigade had responsibility for the LOC in Kargil, and 8 Mountain Division, whose four brigades deployed from the Kashmir Valley. Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999*, 68.

¹¹³ The Indian Armed Forces, including aircraft, were not allowed to cross the LOC to avoid escalation of the conflict. Vinod Anand, "India's Military Response to the Kargil Aggression."

¹¹⁴ A common definition of close air support (CAS) is "air action by fixed- and rotary-wing aircraft against hostile targets that are in close proximity to friendly forces and that require detailed integration of

The Indian Army modified its methods and achieved victory. Units initiated acclimatization and training programs. Commanders developed techniques for high altitude assault that featured small groups scaling vertical terrain. Most importantly, the Indian Army coordinated overwhelming firepower with daring maneuver. Massive artillery fire preceded all attacks. The IAF innovated despite the limitations imposed by its command and the environment, successfully destroying Pakistani lines of supply. Indian aircraft provided a psychological advantage and isolated Pakistani positions; however, air power did not provide effective close support to maneuver forces. The combination of firepower, most of it provided by massed artillery, and bold, vertical maneuver eventually overcame Pakistani forces. The suppressive fire of artillery emerged as a critical complement to ground maneuver, and overshadowed the IAF's ability to provide CAS. Adaptation succeeded, and by the end of July 1999 the Indian military had driven all Pakistani forces back across the LOC.

B. RAPID DEPLOYMENT TO HIGH ALTITUDE

Most of the Indian Army forces that deployed to Kargil were initially unprepared for the rigors of high altitude warfare. 8 Mountain Division deployed from the Kashmir Valley, where it was conducting counter-insurgency (CI) operations, to Dras in a matter of weeks. Several of its infantry units were thrown into the battle with only a few days of preparation and given little time to acclimatize to the drastic change in altitude. In the words of 56 Mountain Brigade commander, Brigadier Amar Aul, his brigade arrived in Kargil “without any acclimatization and therefore was not in a fit state to carry out operations.”¹¹⁵ Units designed to operate in the Himalayan environment, as well as those that were posted either along the LOC or on the Siachen Glacier, quickly adjusted to the altitude and terrain.

The Indian Army battalions that initiated operations were primarily local units whose soldiers were accustomed to high altitude. These units adapted quickly and helped

each air mission with the fire and movement of those forces.” Joint Publication 1-02 *Department of Defense Dictionary of Military and Associated Terms* (Washington, D.C.: U.S. Government Printing Office, 12 April 2001), 90.

¹¹⁵ Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 48.

to contain the Pakistani forces in the campaign's initial stages in early May. Elements of the Ladakh Scouts, a local paramilitary force, augmented units in Batalik in May and provided immediate mountaineering expertise.¹¹⁶ In addition to the Scouts, elements of 11 Gorkha Rifles (1/11 GR) assumed an immediate combat role, arriving from recent duty on the Siachen Glacier. Most of the units that deployed into combat operations in Dras under 8 Mountain Division, however, did not have the benefit of specialized training or recent experience at high altitude. These battalions would suffer from the effects of rapid deployment to the high altitude battlefield.

The effects of rapid deployment from sea level to high altitudes contributed to the Indian Army's initial failures. Soldiers that deployed from the Kashmir Valley were physically unprepared for the high altitude environment. Units were accustomed to sweltering mid-May temperatures at an elevation of 2,000 feet (600 m) in the valley, and faced a drastic change in both temperature and altitude in a matter of hours. Indian Army doctrine calls for gradual increases in elevation over the course of a twelve-day acclimatization process.¹¹⁷ Few would receive the required time.

Soldiers suffered from the effects of rapid altitude gain immediately. 1 Naga climbed 14,000 feet (4,260 m) in elevation in two days, occupying positions at an altitude of 16,000 feet (4,880 m) upon arrival into the sector.¹¹⁸ 8 Sikh departed the Kashmir Valley on the morning of 14 May and reached the Zoji-La Pass at nightfall. The next day they occupied positions near Dras at 15,000 feet (4,570 m) without time to acclimatize or acquire appropriate clothing and equipment. The soldiers immediately suffered severe AMS symptoms. Within two weeks, a senior non-commissioned officer (NCO) in 8 Sikh died of HAPE.¹¹⁹

¹¹⁶ The Ladakh Scouts were accepted as a regiment of the Indian Army following the Kargil Conflict. Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil*, 55.

¹¹⁷ The minimum acceptable time for acclimatization is six days at 9,000 feet (2,750 m), three days at 12,000 feet (3,650 m), and another three days at 15,000 feet (4,570 m). Ashok Krishna, Major General, Indian Army (Retired), "The Kargil War," 110.

¹¹⁸ The commander of 1 Naga, Colonel D.A. Patil, recognized that he was given no time to acclimate. "On May 12, the unit had not even started acclimatizing when it was asked to deploy." Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 25.

¹¹⁹ Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999*, 112.

Frigid weather exacerbated the effects of thin air. Temperatures that plummeted as low as -11° C at night became a significant threat to soldiers arriving in Kargil. Defense Minister George Fernandes observed “unimaginable” conditions during a visit with Indian troops in May.¹²⁰ Most soldiers did not have any type of shelter or extreme cold weather clothing to protect them from the elements. 18 Grenadiers arrived without sleeping bags.¹²¹ The army hauled reserve stocks of glacial clothing from the Siachen Glacier to Kargil to try to make up for the severe shortages, but could not outfit every man.¹²² As a result, cold weather produced casualties throughout the campaign. Some Indian reports estimate that 26 percent of the Indian soldiers evacuated to the Military Hospital at Leh suffered cold weather injuries, primarily frostbite and chilblains.¹²³

In addition to the debilitating effects of the environment, a shortage of trained mountaineers hampered initial attacks. Most of the infantrymen who deployed to the area did not possess the advanced mountaineering skills required to maneuver among the steep cliffs of Kargil. 121 Brigade received several battalions in the early stages of the campaign that lacked the training to move in mountainous terrain. The commander requested the deployment of instructors from the High Altitude Warfare School (HAWS) located in Sonamarg, near Srinagar.¹²⁴ The instructors spent the month of June training teams of soldiers from several battalions on the difficult skills of rock climbing and rope fixing.¹²⁵ Meanwhile, soldiers from the battalions continued combat operations, despite a lack of skill in traversing the vertical cliffs.

The rugged and isolated terrain of Kargil limited the Indian Army’s logistic capability as well, slowing initial deployments and making supply a difficult endeavor.

¹²⁰ Mohammed Ahmedullah, “India's Kashmir Offensive May Accelerate Army Modernisation Plans,” *Military Technology*, Vol. 23, No. 7 (July 1999), 37.

¹²¹ Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 54.

¹²² *The Kargil Review Committee Report*, 231.

¹²³ Ashok Kalyan Verma, Major General, Indian Army (Retired), *Kargil: Blood on the Snow*, 108.

¹²⁴ HAWS was the only school of its kind for Indian military personnel prior to the Kargil Conflict. In 2000 the Indian Army created the High Altitude Commando School, the highest of its kind in the world at 15,000 feet (4,570 m). The school is located in Tawang, Arunachal Pradesh, near the border with China. N.A. Gokhale, “High School,” *Outlook India* (3 April 2000) at <<http://www.bharat-rakshak.com/LAND-FORCES/Army/Articles/Article15.html>> (May 2002).

¹²⁵ The battalions included 28 Rajputana Rifles (28 RAJ RIF), 14 Jammu and Kashmir Light Infantry (14 JAK LI) and 10 Garhwal Rifles (10 GARH RIF). Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999*, 59.

Soldiers often went without food for more than twenty-four hours during the first weeks of the campaign. Adding to the logistical requirements, natural water sources disappeared quickly in mid-June when the snow melted. The inability to transport sufficient quantities of water into the area forced many Indian units to restrict consumption to one liter per day, and many soldiers ate ice to quench their thirst.¹²⁶ Mules and porters formed a continuous line of supply between infantry units and their supply trains, which were typically separated by an eight to ten hour climb.¹²⁷ The army organized the citizens of Ladakh into porter companies to make up for the manpower shortage. The Indian Army estimated that at least one male member of every household served as a porter.¹²⁸ The detrimental effects of the environment would be compounded by significant tactical errors that figured prominently in the Indian Army's dismal performance in its first assault on Tololing.

C. DEFEAT ON TOLOLING

56 Mountain Brigade arrived in the Dras sector in mid-May and immediately began planning the clearance of the Tololing complex, a critical objective that Indian Army officials viewed as the most strategic terrain in Dras.¹²⁹ Pakistani positions atop Tololing, as well as an adjoining ridgeline known as Point 5140, formed the deepest incursion into Indian territory and allowed the NLI to target indirect fire onto the Srinagar-Leh Highway (see Figure 6). Indian Army leaders also hoped Tololing would be a foothold from which they could launch subsequent attacks on other enemy positions on the surrounding peaks. But the Pakistani positions would not fall quickly. The first Indian attacks on Tololing failed, as unprepared infantry battalions conducted uphill assaults during daylight. Maneuver, without the support of sufficient firepower, proved incapable of retaking the heights.

¹²⁶ Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 89.

¹²⁷ Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil*, 149.

¹²⁸ 3 and 8 Division raised porter companies from the local populace, and many citizens donated their mules and donkeys, which were heartier and more sure-footed in the mountains than the army's service mules. Ibid 150.

¹²⁹ Ashok Krishna, Major General, Indian Army (Retired), "The Kargil War," 112.

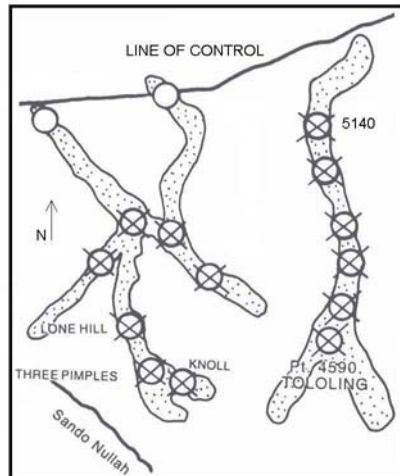


Figure 6. Overhead view of the Tololing complex. (After: Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 94)

56 Mountain Brigade committed two infantry battalions, 18 Grenadiers and 1 Naga, to the capture of the Tololing complex. 18 Grenadiers, commanded by Colonel Khushal Thakur, would capture Tololing Top and 1 Naga, under Colonel D.A. Patil, would capture Point 5140. The brigade’s five artillery batteries would support both attacks. However, the plan did not call for heavy artillery fire preceding or accompanying the infantry assaults, which were to be made up steep, unprotected terrain in full view of Pakistani positions. Initial intelligence estimated that the position contained ten enemy soldiers with small arms.¹³⁰ As the battle unfolded, it became apparent that the Pakistani position was far more substantial, equipped with heavy machine guns, mortars, and automatic grenade launchers.¹³¹

The brigade initiated the attack on the Tololing complex on the night of 22 May. The two columns of 18 Grenadiers advanced along an open avenue of approach that afforded no cover from Pakistani fire. Pakistani positions were well fortified and withstood light and sporadic Indian artillery fire.¹³² Indian Mi-17s, armed with machine

¹³⁰ L.N. Subramanian, “A Ridge Too Far: The Battle for Tololing,” *Bharat Rakshak Monitor* Vol. 3, No. 6 (May-June 2001) at <<http://www.bharat-rakshak.com/MONITOR/ISSUE3-6/Ins.html>> (April 2002).

¹³¹ Once the fight began, Indian Army officials increased their estimate to forty-five enemy soldiers armed with 12.7-mm machine guns, 81-mm mortars and 30-mm AGS-17 Plamya automatic grenade launchers. Prasun K. Sengupta, “Mountain Warfare: The Kargil Experience,” 44.

¹³² Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 42.

guns, did not provide effective fire support. In contrast, the NLI delivered heavy volumes of mortar and artillery fire upon 18 Grenadier's columns. Movement was slow and painful, as men crawled up rocky cliffs under intense fire. It would have taken at least eleven hours for an acclimatized soldier to climb to the top of Tololing without the presence of enemy fire.¹³³ After a week of inching forward, heavy fire stopped both columns' advance.¹³⁴ A final assault in early June ended in disaster, with the deaths of the second in command of the regiment, Lieutenant Colonel (LTC) Vishwanathan, and sixteen grenadiers. After eight days in contact, the Grenadiers had suffered more than one hundred fifty casualties and had failed to take Tololing.

1 Naga fared little better in its attack on Point 5140, the highest enemy position in the Tololing complex. The battalion ascended under cover of night, but the unacclimatized soldiers moved forward slowly on a 6,500-foot (2,500 m) climb. Soldiers advanced on all fours, digging footholds with entrenching tools. The battalion did not reach the summit before dawn. At daylight, Pakistani positions engaged 1 Naga with heavy fire, halting the advance.

The Indian Army's initial campaigns failed because planners did not adapt military operations to the high altitude battlefield. Most units attacked during daylight, vulnerable to enemy observation and intense fire. Unacclimatized soldiers struggled to advance over difficult terrain. Most importantly, battalions did not have the support of overwhelming firepower essential to overcoming the NLI's terrain advantage. 18 Grenadiers and 1 Naga went into the attack with only five artillery batteries in support, which could not provide the volume of fire required to either suppress or destroy the Pakistani positions. Close air support did not materialize. Indian attacks on nearby Tiger Hill, the most dominating feature in Dras, met the same fate. By early June the Indian Army's campaign had stalled, unable to achieve its initial objectives. The Indian Army was losing the fight against both the environment and the NLI, and a change in methods would be essential to prevent defeat.

¹³³ Ashok Krishna, Major General, Indian Army (Retired), "The Kargil War," 112.

¹³⁴ One column made it to within 30 meters, and the other remained over 600 meters away from the top. 18 Grenadiers suffered 34 killed in action and over 100 wounded. Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999*, 65.

D. TURNING THE TIDE: OFFENSIVE TACTICS

Units that deployed to Kargil in early May suffered several disadvantages. Soldiers arrived ill equipped for survival in the harsh Himalayan landscape, much less up to the task of defeating a determined foe atop the heights. Units that began to arrive in June adapted to the environment and applied the tactical lessons of the early failures. Initial operations illustrated that massive firepower was essential to permit the infantry to scale the heights. The army massed artillery regiments in Kargil, and infantry battalions retooled their approach to high altitude tactics. The experience of 2 Rajputana Rifles (2 RAJ RIF) provides an example of a unit that made the right adjustments, and whose victory provided a turning point in the conflict.

1. The Capture of Tololing

2 RAJ RIF, commanded by Lieutenant Colonel (LTC) M.B. Ravindranath, prepared his unit for ground combat at high altitude and won a series of impressive victories. 2 RAJ RIF deployed to Sonamarg from the Kashmir Valley, where it was conducting CI operations. The battalion remained in Sonamarg for a few days before departing for the combat zone in Dras. At Sonamarg LTC Ravindranath initiated planning, forming teams of senior leaders charged with creating a mountain assault doctrine, an acclimatization program, and a logistic support plan.¹³⁵ These efforts proved to be the determining factor in the battalion's success. The battalion requisitioned large quantities of cold weather gear, and limited soldiers' load to a light assault kit during the attack.¹³⁶ The acclimatization program, condensed to eight days from the army standard of twelve, resulted in no high altitude illnesses in the battalion throughout the operation (see Table 1). The most significant product of the battalions' preparation was its approach to high altitude tactics, which it would test on Tololing.

¹³⁵ Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 75.

¹³⁶ The assault kit weighed 30 pounds (15 kilograms) and contained rations, a sleeping bag and ammunition. Ibid.

Days	Activity
1-2	Normal road walks with no change in elevation
3-4	Gradual climbing
5-6	Climbing without loads to 15,000 feet
7-8	Climbing to 15,000 feet with full battle load

Table 1. 2 RAJ RIF Acclimatization Program. (From: Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999*, 195)

LTC Ravindranath reported to 56 Mountain Brigade on 3 June and received the order to seize Tololing. 18 Grenadiers, still sitting under fire around the peaks and unable to advance, would support 2 RAJ RIF's attack with suppressive fire. Twenty artillery batteries totaling over 120 guns would support the operation as well. After a thorough reconnaissance, LTC Ravindranath identified two avenues of approach to the Pakistani positions, over which he could launch multi-directional attacks and achieve surprise.¹³⁷ He established ammunition and water supply points on each axis. The battalion ferried equipment forward along the approach for two days before the assault. Mules carried the battalion's machine guns, mortars and ammunition up only a third of the route. Porters had to take over at that point, making a treacherous seven-hour uphill climb. The altitude and terrain restricted porters to making only one trip per day, and forced Ravindranath to use as many as sixty porters continually on each axis. The task of transporting water alone required twenty men daily.

On the night of 12 June, a massive six-hour bombardment by all twenty artillery batteries preceded the assault. The companies moved quickly on both axes of advance. Fire by 18 Grenadiers and the artillery batteries allowed Ravindranath's troops to seize their initial objectives in a matter of hours. The artillery barrage continued unabated until soldiers reached to within 200 meters of their objectives; at that point, 18 Grenadiers picked up a heavy volume of fire that effectively suppressed the Pakistani positions. By early morning the battalion had captured Tololing Top and beaten back several desperate Pakistani counterattacks.¹³⁸ Point 5140 fell a week later, on 20 June, following another

¹³⁷ Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 76.

¹³⁸ Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil*, 17.

multi-directional attack supported by the full complement of twenty artillery batteries. 2 RAJ RIF had given the Indian Army its first major victory in the war, and provided the foothold to move forward to other objectives, primarily the commanding heights of Tiger Hill.

2. Victory at Tiger Hill

Following the decisive victory on Tololing the Indian Army seized the initiative and began the methodical clearance of the peaks around Kargil. The army launched attacks throughout the sector, from Tiger Hill in Dras to the glaciated landscape of the southern Siachen Glacier. The attacks followed the same successful pattern that had been established on Tololing. Infantry battalions advanced on unexpected, and therefore difficult, avenues of approach, supported by overwhelming artillery fire. Multi-directional attacks produced the element of surprise. Daring nighttime maneuver over steep terrain, in coordination with massive firepower, broke NLI defenses in all areas.

8 Sikh had attempted to scale the heights of Tiger Hill in late May, only to be repulsed by heavy artillery and small arms fire.¹³⁹ Poorly coordinated assaults initiated without adequate artillery support failed under heavy fire from an entrenched enemy. Unable to press the attack, the soldiers dug in and surrounded the hill. 192 Mountain Brigade assumed command of the operations at Tiger Hill in late June, and received 18 Grenadiers, fresh from participating in the victory at Tololing. 18 Grenadiers picked up the assault, supported by the concentrated fire of twenty-two artillery batteries and 8 Sikh. In freezing rain on the night of 3 July, 18 Grenadiers launched an assault on the 16,700-foot (5,062 m) Tiger Top that began with a twelve-hour, vertical climb using fixed ropes.

18 Grenadiers achieved surprise and made initial gains, yet the assault stalled near the top under heavy resistance. Sensing the loss of initiative, Major Ravinder Singh of 8 Sikh launched a daring attack. He and a detachment of fifty-two soldiers climbed up the side of the adjoining Western Ridge, splitting the Pakistani defense on the night of 5 July.

¹³⁹ Both 8 Sikh and 18 Grenadiers were transferred from 56 Mountain Brigade to 192 Mountain Brigade for operations on Tiger Hill.

The group held off several counterattacks. Most of the Sikh soldiers attacked without cold weather gear, and many of the wounded died from exposure.¹⁴⁰ After three more days of heavy fighting, the bold plan paid off, and 18 Grenadiers resumed the attack on an NLI force facing attack from two directions. 18 Grenadiers seized Tiger Hill Top on the morning of 8 July. Daring maneuver on an unexpected approach, in coordination with overwhelming firepower, had ended the stalemate on Tiger Hill.

3. Attack on “Balal Post”

The southern Siachen Glacier area, north of the Shyok River, had been the scene of continuous activity since the battle for the Salto Ridge began in 1984. Combat action in the area, which came to be known as “Sub-sector Haneef,” was technically not part of Operation Vijay, yet one daring Indian attack stands as an amazing example of the benefit of mountaineering expertise.¹⁴¹ Pakistani soldiers occupied a feature that they called “Balal Post,” which at 19,000 feet (5,770 m) is one of the highest points on the Actual Ground Position Line (AGPL), the boundary that divides the Siachen Glacier. 27 Rajputana (RAJPUT), in the process of induction into the sector, received the order to seize “Balal Post.”

The battalion commander, Colonel K.H. Singh, divided an attack force into four elements: an eight-man assault team; a seven-man rope-fixing party, composed of two High Altitude Warfare School (HAWS) trainers and five Ladakh Scouts; a twelve-man fire support party with heavy and medium machine guns; and a reorganization party containing twenty-one men.¹⁴² The rope-fixing team required four full days to install the thirty ropes necessary to reach the last ridgeline before the summit.¹⁴³ On 27 June, Major N.S. Cheema led the group on a 1,800-foot near-vertical climb to the top of the “Balal

¹⁴⁰ 8 Sikh suffered 32 casualties during the 58-hour engagement. Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999*, 93.

¹⁴¹ The sector was named in honor of Captain Haneef Uddin, 11 Rajputana Rifles (11 RAJ RIF), who was killed in action in the area in May 1999. Ashok Kalyan Verma, Major General, Indian Army (Retired), *Kargil: Blood on the Snow*, 122.

¹⁴² Ibid 123.

¹⁴³ Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil*, 118.

Post” that required thirty fixed ropes and achieved complete surprise. The assault force quickly swept the objective, defeating a squad of NLI soldiers, and occupied the position.

4. Mountaineering Under Fire

As the battles on Tololing, Tiger Hill and “Balal Post” had shown, unexpected directions of attack are typically near-vertical cliffs on the high altitude battlefield. Early attacks illustrated the futility of advancing against Pakistani positions on open avenues of approach during daylight. Success required coordinated assaults from different and unanticipated directions. The element of surprise proved essential to defeating an adversary atop heights, and made night movement a necessity. Indian Army doctrine that set a 9:1 force ratio against defensive positions at high altitude proved to be accurate.¹⁴⁴ According to an unidentified Indian Army major, “a single night-time operation may see as many as a thousand men moving against a single post occupied by only ten people.”¹⁴⁵ The high altitude environment made the assault difficult for Indian soldiers, yet also yielded certain advantages. Mountaineering at night, usually under fire, proved to be a difficult and time-consuming task, with each climber requiring five additional men to secure his ropes. But nighttime also gave the Indians an advantage. The night sky silhouetted Pakistani positions.¹⁴⁶ Poorly placed Pakistani machine guns left large areas of uneven terrain not covered by direct fire.

Indian infantry battalions eventually developed effective tactics for offensive operations at high altitude. Units bypassed Pakistani positions, cutting off supply routes. The IAF’s air campaign against Pakistani supply lines further isolated the enemy pockets. Once isolated, the Indian Army wore down the defenders with overwhelming firepower, primarily a combination of direct fire and artillery. Artillery proved to be the most effective and reliable source of suppressive fire. Indian infantry battalions conducted multi-directional attacks after extensive artillery preparation. The ability to traverse steep terrain allowed infantry formations to envelope Pakistani positions, attacking an

¹⁴⁴ Vinod Anand, “India’s Military Response to the Kargil Aggression.”

¹⁴⁵ Mohammed Ahmedullah, “India’s Kashmir Offensive May Accelerate Army Modernisation Plans,” 37.

¹⁴⁶ Ashok Kalyan Verma, Major General, Indian Army (Retired), *Kargil: Blood on the Snow*, 110.

assailable flank rather than engaging in murderous frontal assaults against heavy fire. Soldiers typically climbed near-perpendicular cliffs throughout the night, attacking the Pakistani positions at first light. Once at the objective, combat was typically at close quarters. Every aspect of the attack depended on outstanding small unit leadership. Mountaineering training, as well as capable force multipliers such as HAWS instructors and Ladakh Scouts, proved to be essential elements of success. Daring maneuver, however, would not have been successful without overwhelming firepower, and the main source of that was artillery.

E. THE DOMINANCE OF ARTILLERY

Artillery emerged as the primary source of firepower on the high altitude battlefield. Massive artillery barrages provided the cover of suppressive fire under which Indian infantry advanced. Indian batteries engaged in both direct and indirect fire, and produced devastating effects. Without artillery fire, Indian infantry stood no chance of taking the heights, as they were vulnerable to Pakistani forces firing freely down upon them while they made the slow and difficult trek up the slope. Recognizing this need after early setbacks, the Indian Army deployed fifteen artillery regiments containing over three hundred artillery pieces to the theater. Indian artillery fired more than 250,000 rounds over the course of the campaign.¹⁴⁷

The limitations imposed by the high altitude battlefield hampered India's artillery efforts. Firing positions were difficult to find and occupy. Heavy artillery pieces were cumbersome and hard to move, especially on rugged trails. Mortars expended their supply of ammunition quickly, and relied heavily on porters and infantrymen to carry extra rounds. Projectiles behaved erratically in the air, requiring trial-by-error registering of guns to determine the deviations in distance. Difficulty in estimating ground maneuver time in the mountainous terrain rendered time-synchronized fire plans ineffective as well.¹⁴⁸ These obstacles, however, did not prevent artillery from proving itself as an indispensable complement to ground maneuver in the mountains.

¹⁴⁷ Prasun K. Sengupta, "Mountain Warfare: The Kargil Experience," 44.

¹⁴⁸ Pravin Sawhney, "Himalayan Conflict Forges Artillery Doctrine," 57.

The Indian Army utilized a wide variety of artillery pieces and mortars in Kargil. Light and agile weapon systems that could be transported on trails by mule teams or porters provided reliable support to infantry battalions. Several batteries of vintage 130-mm M-46 field guns, as well as 105-mm Indian Field Guns (IFG), fired in coordination with ground assaults. The lightweight Russian-designed M-46, which had been in service with the Indian Army for decades, once again proved its worth on the battlefield.¹⁴⁹ Its ability to fire rapidly at low angles made it an indispensable source of close range fire support, and harkened back to the German mountain guns that devastated Greek defenses with direct fire during the Second World War.¹⁵⁰ The high-angle fire of 120-mm heavy mortars, as well as light mortars carried by the infantry battalions, delivered responsive and accurate firepower. Artillery regiments used combinations of these weapon systems to provide sustained artillery barrages in support of ground maneuver. No single artillery piece proved more valuable than the Bofors FH-77B 155-mm howitzer.

The controversial Bofors FH-77B emerged as the Indian Army's most reliable and lethal artillery piece on the high altitude battlefield of Kargil.¹⁵¹ Its long-range, heavy caliber shell readily destroyed poorly constructed fighting positions. Indian batteries reported that the 24-km maximum range at sea level extended beyond 40-km in the thin air of Kargil.¹⁵² The concentrated fire of multiple batteries overcame the loss in accuracy that accompanied the increase in range. One of the howitzer's most important features became its ability to execute high-angle fire. The tube could be elevated to angles over 70°, making it capable of shooting over the high mountain crests of Kargil. Infantry battalions grew to rely on the devastating fire of the Bofors, so much so that Major General (MG) Mohinder Puri, commander of 8 Mountain Division, commented,

¹⁴⁹ The M-46 had seen long service on the Siachen Glacier, and had won acclaim for its lethality during the 1971 Indo-Pakistan War. It was originally designed as an anti-tank weapon, which accounts for its low angle of fire. Gurmeet Kanwal, Colonel, Indian Army, "Pakistan's Military Defeat," 128.

¹⁵⁰ German techniques for combined arms warfare in mountains are cited in Chapter II from James Lucas, *Hitler's Mountain Troops*.

¹⁵¹ The Indian government purchased over four hundred of the Swedish-made Bofors FH-77B artillery pieces in 1988 and originally planned to build the guns under license; allegations that Bofors had bribed Indian politicians with over \$50 million led to a ban on Bofors weapons, which was not lifted until the weapons displayed their effectiveness at Kargil. Mohammed Ahmedullah, "India's Kashmir Offensive May Accelerate Army Modernisation Plans," 38.

¹⁵² Prasun K. Sengupta, "Mountain Warfare: The Kargil Experience," 46.

“the infantry started taking Bofors as their section weapon.”¹⁵³ The Indian Army deployed over 130 Bofors guns to Kargil, and most of them came under the command of one of the army’s most innovative leaders, Brigadier Lakhinder Singh.

Singh earned the nickname “Enraged Bull of Dras” for his technique of applying overwhelming firepower in support of infantry maneuver, which he compared to using a “sledgehammer to shell a peanut.”¹⁵⁴ As commander of 8 Mountain Division's Artillery Brigade at Dras, he played a pivotal role in the conflict’s most important battles. Singh lined all the guns in his batteries and concentrated direct fire on Pakistani positions. He first used the technique during the assaults on Tololing in early June, firing over one hundred guns at Point 5140.¹⁵⁵ The ferocity of his direct fire on Point 4875 in the Tiger Hill complex caused the Indian Army to rename the point “Gun Hill.”¹⁵⁶ Brigadier Singh’s batteries fired 9,000 rounds on Tiger Hill during a single day of the attack.¹⁵⁷

Artillery became the most reliable and effective method of firepower at Kargil, determining the success of infantry assaults by providing time and space for maneuver. MG Puri credited his division’s victories to “the preponderance of the artillery fire” provided by Singh’s batteries.¹⁵⁸ Pakistani soldiers feared it as well. An NLI soldier atop Tiger Hill reported in an intercepted radio transmission that “hell has fallen on us” when Indian artillery fire commenced.¹⁵⁹ Direct fire produced the most significant results, destroying Pakistani positions on the forward slopes. Artillery demonstrated its value on the high altitude battlefield, creating conditions that allowed Indian infantry to advance and take the heights. Air power, on the other hand, established a less conclusive record of performance during the Kargil Conflict.

¹⁵³ Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil*, 37.

¹⁵⁴ Prasun K. Sengupta, “Mountain Warfare: The Kargil Experience,” 46.

¹⁵⁵ L.N. Subramanian, “A Ridge Too Far: The Battle for Tololing.”

¹⁵⁶ Gurmeet Kanwal, Colonel, Indian Army, “Pakistan's Military Defeat,” 156.

¹⁵⁷ Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil*, 128.

¹⁵⁸ Prasun K. Sengupta, “Mountain Warfare: The Kargil Experience,” 46.

¹⁵⁹ Ibid.

F. AIR POWER

The Indian Air Force (IAF) initiated operations in Kargil reluctantly. Self-imposed restrictions in response to early aircraft losses, coupled with the effects of the environment, reduced the effectiveness of air power. Attack helicopters played virtually no role, too heavy or vulnerable to fly at high altitudes. Fixed wing aircraft flew far above target areas to avoid surface-to-air missiles (SAMs). The increase in release altitude added to the inaccuracy of aerial-delivered munitions, reducing the effectiveness of close air support (CAS) to infantry units. The IAF's contribution grew as the campaign wore on, and aircraft armed with laser-guided munitions (LGM) eventually destroyed virtually all of the Pakistani supply lines and played a major role in the battle for Tiger Hill. Yet despite these successes, and the psychological impact of aerial firepower on Pakistani morale, the IAF did not provide reliable close support to ground maneuver.

The Indian military campaign began with significant disagreement among the services. IAF doctrine placed air superiority, destruction of the enemy's air power, as its first priority in an offensive operation.¹⁶⁰ The army, on the other hand, emphasized the urgent need for CAS, citing the absence of an immediate Pakistani air threat in Kargil as justification.¹⁶¹ The IAF reportedly attempted to avoid involvement in the conflict altogether, claiming inexperience in mountain warfare and unfamiliarity with the terrain, as well as the risk associated with the heightened SAM threat in the mountains.¹⁶² The prohibition on crossing the LOC further limited the IAF's ability to respond in accordance with its doctrine, eliminating the capacity to interdict lines of communication deep within Pakistani territory.

The IAF eventually relented and initiated its air campaign, Operation Safed Sagar (White Sea), on 26 May 1999. The Western Air Command deployed eight squadrons, which operated approximately sixty aircraft from the Srinagar air base and the Avantipur

¹⁶⁰ Vinod Anand, "Evolution of a Joint Doctrine for Indian Armed Forces," *Strategic Analysis* Vol. XXIV No. 4 (July 2000) at <http://www.ciaonet.org/olj/sa_jul00anv01.html> (April 2002).

¹⁶¹ Pakistan Air Force (PAF) F-16 fighters were spotted 15-km from the LOC in Pakistani territory, and did not engage IAF aircraft during air operations. D.N. Ganesh, "Indian Air Force in Action," *Kargil 1999: Pakistan's Fourth War for Kashmir*, Ed. Jasjit Singh (Delhi: Knowledge World, 1999), 186.

¹⁶² Rahul Bedi, "Paying to Keep the High Ground," 31.

airfield near Kargil. Most of the fleet of ground attack aircraft were Russian-made and included MiG-21, MiG-23 and MiG-27s. A squadron of Mirage 2000 aircraft, which were of French origin and more advanced than the Russian-made jets, deployed to the airbases as well. In addition to fixed wing aircraft, the IAF deployed several Mi-17 helicopters, which could provide both lift and ground attack with a machine gun and rocket pods.¹⁶³

1. Helicopters at High Altitude

The IAF and Army Aviation Corps (AAC) helicopter fleets made significant contributions as transport platforms, performing 2,185 sorties during Operation Safed Sagar, most of them in a support role.¹⁶⁴ Transport helicopters carried more than 900 casualties and 300 tons of supplies.¹⁶⁵ Two of the AAC's Reconnaissance and Observation (R&O) squadrons employed their reliable HAL Cheetah helicopters as Forward Air Controllers (FAC) to direct artillery fire onto enemy targets, a task that required them to fly as high as 23,000 feet (7,010 m).¹⁶⁶ Larger Mi-17 helicopters contributed in a support role, with a high service ceiling of approximately 18,380 feet (5,600 m).¹⁶⁷ They would not, however, perform well in the ground attack role.

The IAF's fleet of attack helicopters proved lacking in operational capability at high altitude. Heavily armed Mi-25 attack helicopters were unable to fly at high altitude because of their excessive weight, and were not deployed to Kargil. The IAF attempted to conduct CAS with Mi-17s armed with rocket pods and machine guns. During the first two days of air operations Mi-17s conducted strikes on several Pakistani positions in Dras. On 28 May a Pakistani shoulder-fired missile destroyed one of the Indian Mi-17s

¹⁶³ Descriptions of the various types of aircraft provided in Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999*, 57.

¹⁶⁴ Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil*, 139.

¹⁶⁵ D.N. Ganesh, "Indian Air Force in Action," *Kargil 1999: Pakistan's Fourth War for Kashmir*, 183.

¹⁶⁶ One R&O squadron supported each of the two divisions in Kargil. Gurmeet Kanwal, Colonel, Indian Army, *Heroes of Kargil*, 139.

¹⁶⁷ *Jane's Aircraft – Rotary Wing*, at <<http://www4.janes.com>> (May 2002).

near Tololing, killing its four-man crew. In response the IAF suspended attack helicopter operations.¹⁶⁸

The decision to cease attack helicopter operations proved controversial. Senior IAF officers complained that the Mi-17s could provide responsive firepower, and that operations should have continued despite the SAM risk.¹⁶⁹ The density of Pakistani SAMs, as well as the ease of concealment in irregular mountain terrain, made attack helicopter operations a risky endeavor. Even without the SAM threat, IAF attack helicopters were not effective at high altitude. Indian Army soldiers observed that the few Mi-17 CAS missions carried out were ineffective, most likely due to “running gunfire” techniques necessitated by the SAM threat and the difficulty of hovering in thin air.¹⁷⁰ The IAF restrictions on attack helicopters would not be as controversial as the impact of fixed wing aircraft in the ground support role.

2. Strike Missions

Analysis of CAS missions during Operation Safed Sagar is difficult due to the lack of publicly available information on battle damage assessment (BDA), and therefore depends primarily on the eyewitness accounts of both IAF and Indian Army personnel. These viewpoints may be affected by service bias. However, given the information available, it is apparent that air operations did not have the intended impact. The IAF was not fully prepared to provide close air support (CAS) on the high altitude battlefield, and the reaction to early losses diminished its effectiveness. Innovative methods achieved success against fixed targets but did not deliver effective CAS to ground maneuver forces.

The loss of three aircraft, including the Mi-17, in the first three days of Operation Safed Sagar shocked the IAF and forced an immediate evaluation of tactics.¹⁷¹ On 27

¹⁶⁸ Rahul Bedi, “Paying to Keep the High Ground,” 31.

¹⁶⁹ Ibid.

¹⁷⁰ Soldiers of 18 Grenadiers commented on the ineffectiveness of the Mi-17s on Tololing. Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 50.

¹⁷¹ Mohammed Ahmedullah, “India's Kashmir Offensive May Accelerate Army Modernisation Plans,” 37.

May, the second day of air strikes, an IAF MiG-27 crashed due to engine failure. A Pakistani SAM downed a MiG-21 later the same day, during the recovery operation, killing the pilot. In response the IAF imposed limits on weapons release altitude that placed most aircraft at 30,000 feet (9,140 m) to avoid the Pakistani SAM threat.¹⁷² While the IAF continued to provide CAS, it shifted the focus of operations to fixed targets, such as supply sites, and initiated night combat operations for the first time in its history.¹⁷³

The high altitude atmosphere severely degraded the accuracy of aerial munitions. Most of the ordnance dropped by IAF aircraft during more than 550 strike missions was not precision-guided. Army reports claim that of over eighty CAS missions in the month of June, only twelve projectiles landed near the target, with no direct hits.¹⁷⁴ Introduction of the Mirage 2000, which was capable of delivering 1,000-pound bombs with laser-guidance kits, improved accuracy against fixed targets.¹⁷⁵ Mirage aircraft attacked twenty-five ground targets, including the two main Pakistani supply sites, Mantho Dalo in Batalik and Point 4388 in Dras.¹⁷⁶ Mirage aircraft flew CAS missions in support of the attack on Tiger Hill as well, destroying an NLI battalion headquarters and causing considerable damage to enemy forces.¹⁷⁷

Reports indicate that the IAF had conducted little CAS training in the high altitude environment prior to Operation Safed Sagar. The IAF operated an air-ground firing range in Ladakh, but training was infrequent and typically did not focus on integration with the army.¹⁷⁸ The two services lacked interoperable equipment, and as

¹⁷² Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 133.

¹⁷³ Vinod Anand, “India’s Military Response to the Kargil Aggression.”

¹⁷⁴ Amarinder Singh, *A Ridge Too Far: War in the Kargil Heights 1999*, 72.

¹⁷⁵ A laser-guided bomb requires the target to be illuminated with a laser designator by personnel either on the ground or in the aircraft. It is not an all-weather weapon, because clouds, smoke, dust, and high winds can affect the laser seeker and alter the munition’s flight. In fair weather, the LGM typically has a circular error probable (CEP) of about ten meters, which means that half of all bombs will fall within ten meters of the target. Glenn W. Goodman Jr., “Terminal Accuracy,” *Armed Forces Journal International* (October 2002), 66.

¹⁷⁶ Prasun K. Sengupta, “Mountain Warfare and Tri Service Operations,” 25.

¹⁷⁷ A message from the Indian Army headquarters to the IAF praised the “Mirage boys with their precision laser guided bombs” as a “tremendous success,” and as a result of the air effort “the enemy is on the run” at Tiger Hill. D.N. Ganesh, “Indian Air Force in Action,” 184.

¹⁷⁸ Anil R. Pustam, “Mountain Air Support Demands Special Equipment and Training,” 71.

one senior IAF officer put it, the IAF had not equipped or “trained itself for close support tasks with the army.”¹⁷⁹ The need to both find and attack targets in mountainous terrain, relying primarily on information from ground forces, made CAS all the more difficult. Army officials reportedly called off several CAS missions early in the campaign because the inaccurate strikes were threatening Indian troops on the attack.¹⁸⁰

Unpredictable weather, equipment shortcomings, and altitude restrictions reduced the effectiveness of the CAS effort and heightened tensions between the services. Army officers contend that they often halted advancing columns to wait for IAF missions that were ultimately ineffective.¹⁸¹ The IAF’s MiG fleet lacked electronic countermeasures to defeat SAMs, and displayed poor low-speed aerodynamics, which hindered their ability to operate in the environment and deliver accurate strikes.¹⁸² Brigadier Aul, commander of 56 Mountain Brigade, attributed the failings of CAS to the pilots’ unwillingness to “take reasonable risks,” adhering to safe height restrictions.¹⁸³

The prohibition on crossing the LOC affected the IAF’s ability to engage fixed targets as well. Many Pakistani supply sites were located across the LOC in the Northern Areas and were therefore off-limits. The increased turning radius caused by the high altitude atmosphere placed many targets in Kargil off-limits, because the LOC could not be crossed.¹⁸⁴ The IAF compensated by developing innovative techniques to degrade NLI logistics. Aircraft utilized carefully aimed projectiles to initiate landslides and avalanches, covering Pakistani supply lines.¹⁸⁵

The IAF eventually adapted to both the environment and its own constraints. MiG-21 pilots overcame the lack of navigational equipment, using a stopwatch and a

¹⁷⁹ Joint operations suffered from the mismatch of service targeting systems. The army used a digital command, control, communications and intelligence system; the IAF's Air Defense Ground Environment System was not digital. Calculation errors added to the accuracy problems. Rahul Bedi, “Paying to Keep the High Ground,” 31.

¹⁸⁰ Ibid.

¹⁸¹ Ibid.

¹⁸² Anil R. Pustam, “Mountain Air Support Demands Special Equipment and Training,” 71.

¹⁸³ Harinder Baweja, *A Soldier's Diary: Kargil, The Inside Story*, 68.

¹⁸⁴ Ashok Krishna, Major General, Indian Army (Retired), “The Kargil War,” 133.

¹⁸⁵ Prasun K. Sengupta, “Mountain Warfare and Tri Service Operations,” 26.

global positioning system (GPS) receiver to navigate and acquire targets at night.¹⁸⁶ The Mirage 2000 produced the most successful performance, and became the workhorse of Operation Safed Sagar. Air Chief Marshall Ajay Yashwant Tipnis observed that the Mirage 2000 proved itself as a “superior aircraft.”¹⁸⁷

Operation Safed Sagar succeeded against fixed targets, and had an undeniable psychological effect on both the NLI and the Indian soldiers below. Senior leaders of both services praised the Mirage and innovation as the saviors of the air campaign. Army Chief General V.P. Malik qualified the air effort as “not effective against enemy posts” but “innovating and ... ever willing.”¹⁸⁸ The IAF achieved remarkable successes, yet CAS strikes did not provide reliable and consistent firepower to ground forces. The cumulative effect of the high altitude environment, a heightened SAM threat, and equipment and training deficiencies diminished the effectiveness of CAS as a source of responsive fire in support of ground maneuver.

G. CONCLUSION

The Indian Armed Forces were caught off guard and unprepared for the Pakistani intrusion. Initial operations revealed significant deficiencies in the ability to wage war at high altitude on short notice. Units arrived on the battlefield without the benefit of acclimatization, and without the essential gear required to survive in the frigid environment. Tactical errors added to these deficiencies, and resulted in assaults that stalled against a determined foe atop commanding heights. Indian infantrymen went on the attack, typically frontal assaults, without adequate firepower provided by either artillery or air power. Pakistani defenders, undeterred by the light volume of fire on their positions, stopped Indian attacks with heavy fire. A rapid deployment that afforded little time for much needed preparation, as well as an underestimation of the enemy, led to poorly coordinated and unsuccessful attacks.

¹⁸⁶ D.N. Ganesh, “Indian Air Force in Action,” 186.

¹⁸⁷ Prasun K. Sengupta, “Mountain Warfare and Tri Service Operations,” 25.

¹⁸⁸ Rahul Bedi, “Paying to Keep the High Ground,” 31.

The Indian Army adapted to the environment and gained the initiative. Commanders, when time permitted, initiated condensed acclimatization and training programs. Infantry battalions enveloped Pakistani positions, choosing the most difficult avenues of approach at night to gain surprise. Assaults were slow and methodical, yet succeeded when supported by overwhelming firepower. The Indian Army deployed tremendous amounts of artillery assets, and preceded each assault with an overwhelming barrage. Artillery established itself as the weapon of choice in the high mountains.

Several factors prevented the IAF from providing timely and reliable close support to ground maneuver. Restrictions imposed following early aircraft losses added to the detrimental effects of the high altitude atmosphere. CAS missions became hindrances to ground maneuver on several occasions, and delayed ground operations with inaccurate strikes. The IAF adapted by targeting Pakistani supply lines and isolating their forward positions. Mirage aircraft reduced NLI positions on Tiger Hill, destroying the enemy's battalion headquarters. The service contributed to the campaign, yet its ability to provide CAS in the high altitude environment proved to be a shortcoming.

The Indian Army weathered early setbacks and achieved victory on the high altitude battlefield. Massive artillery fire, combined with daring maneuver, overcame the challenge of defeating an enemy atop commanding heights. Air power could not deliver consistent and reliable firepower to support ground maneuver. Laser-guided munitions (LGM) improved accuracy, yet the heightened risk and atmospheric effects prevented the IAF from providing the volume of fire necessary to suppress Pakistani positions. Would these conclusions be relevant in future high altitude warfare? Could a technologically advanced U.S. military, with satellite-guided precision munitions and advanced weapons platforms superior to those of India, overcome the effects of the high altitude atmosphere and mountain terrain? These questions would be answered three years later, when the United States would test its ability to wage mountain warfare in Afghanistan.

V. CONCLUSION

A. INTRODUCTION

U.S. experiences in combat in the mountains of Afghanistan in 2002 parallel those of Indian forces at Kargil, despite the U.S. military's significant advantage in weapons technology. U.S. ground forces entered combat without the supporting fire of artillery, relying primarily on air power to provide the firepower necessary to support maneuver. An irregular enemy in dispersed positions, with the support of mortar and artillery fire, provided unexpectedly stiff resistance against U.S. forces. Heavy attack helicopters proved vulnerable to ground fire and suffered from an inability to hover in thin air. U.S. air power dropped a significant amount of ordnance on well-hidden al Qaeda positions protected by mountainous terrain. Yet close air support, similar to the IAF's experience at Kargil, could not provide the volume of fire necessary to support ground maneuver against a determined enemy. Unlike the Indian Army at Kargil, U.S. infantry would not have the benefit of massed artillery fire.

B. AFGHANISTAN

In October 2001 the United States initiated offensive operations against the Taliban regime in Afghanistan and the al Qaeda terrorist network that it harbored. An aerial bombardment campaign, in coordination with ground combat by Afghan forces augmented by U.S. Special Operations Forces (SOF) teams, culminated in the defeat of the Taliban in early December.¹⁸⁹ Large pockets of al Qaeda remained in the mountains of eastern Afghanistan after the fall of the Taliban. U.S. forces identified significant al Qaeda activity in the Shah-i-Kot valley, southeast of Gardez in the Paktia province, in the spring of 2002. In March allied forces initiated a ground and air assault, Operation

¹⁸⁹ U.S. air power in coordination with ground maneuver by the Northern Alliance, Afghan forces allied with the United States, defeated Taliban and al Qaeda forces in a series of battles in open terrain in November and December 2001. Battles typically ended in breakthrough of Taliban defenses, such as Bai Beche in November, or mass surrender following a siege, such as the surrender of 5,000 Taliban fighters at Konduz in late November. Al Qaeda remnants remained in the country after the Taliban leadership fled following the fall of Kandahar in December. A sixteen-day battle in the White Mountains near Tora Bora ended inconclusively, with sizable al Qaeda elements fleeing across the border into Pakistan. Stephen Biddle, *Afghanistan and the Future of Warfare: Implications for Army and Defense Policy* (Carlisle Barracks: U.S. Army War College Strategic Studies Institute, 2002), 11.

Anaconda, against a large al Qaeda group located in the Shah-I-Kot valley, the highest battlefield in U.S. history.

Eastern Afghanistan and Ladakh share several similar characteristics, with one notable exception. The mountains that encircle the Shah-i-Kot valley reach 12,500 feet (3,800 m), some 4,200 feet (1,280 m) less than the elevation of Tiger Hill and most battles at Kargil. Despite the difference in altitude, the atmosphere at 12,500 feet (3,800 m) exhibits similar qualities as the rarified air above the LOC in Kashmir. Barometric pressure at 12,500 feet (3,800 m) is approximately two-thirds of its value at sea level.¹⁹⁰ Temperatures in eastern Afghanistan in early March 2002 dropped to -10° C at night, and snow fell as U.S. forces initiated the battle. The barren and rocky landscape resembles that of Ladakh as well.

1. Ground Combat in the Shah-i-Kot Valley

In early March, a U.S. infantry force of approximately 1,200 men, supported by a like number of Afghan allies and significant U.S. air power, launched Operation Anaconda against an al Qaeda force estimated at 1,000 fighters (see Figure 7). The plan called for an Afghan and SOF attack from Gardez into the western portion of the valley; commanders hoped that the assault would force the enemy to flee to the east into blocking positions established by U.S. infantry forces on the eastern edge of the valley.¹⁹¹ Al Qaeda forces offered stiff resistance, and instead of fleeing to the east, held their ground and repelled the allied Afghan assault, forcing the column to withdraw back to Gardez. U.S. soldiers who flew into their blocking positions by helicopter expected light resistance, but instead received heavy fire from machine guns, mortars, and howitzers on the landing zones (LZ). A seventeen-day battle ensued, in which eight U.S.

¹⁹⁰ Barometric pressure is approximately 500 mmHG at 12,500 feet (3,800 m), compared to 760 mmHG at sea level. *Medical Problems in High Mountain Environments*, 5.

¹⁹¹ Elements of the 101st Airborne Division (Air Assault) and 10th Mountain Division formed the majority of Combined Joint Task Force (CJTF) Mountain. An overview of the operation, as well as a detailed account of the events on Takur Ghar Mountain, can be found in *Executive Summary of the Battle of Takur Ghar*, U.S. Department of Defense (24 May 2002) at <<http://www.defenselink.mil/news/May2002/d20020524takurghar.pdf>> (May 2003).

soldiers were killed and seventy-six wounded in action; up to half of the al Qaeda forces on the field may have been killed as well.¹⁹²

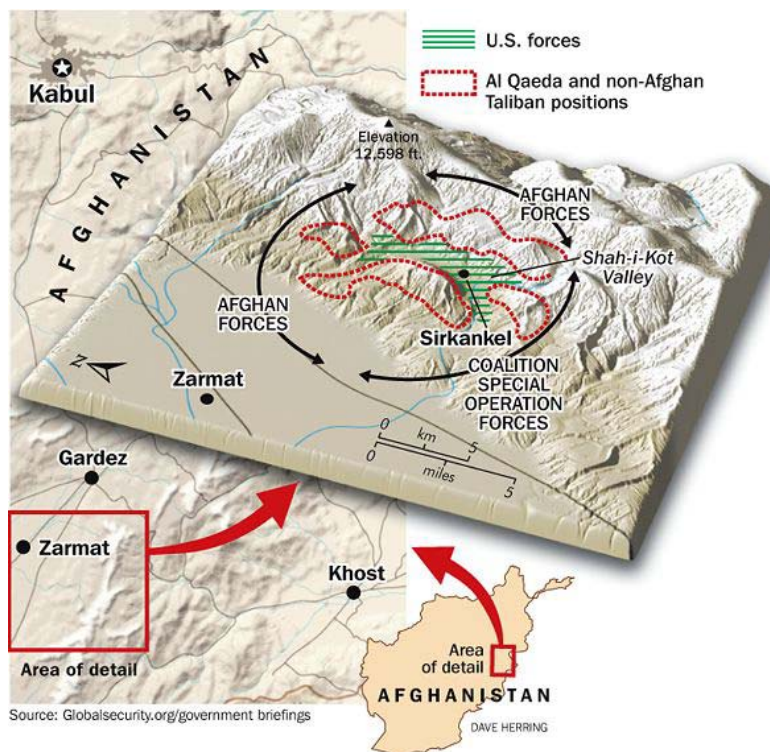


Figure 7. Operation Anaconda. (From: <http://www.csmonitor.com/2002/0314/p06s01-wosc.html>) (May 2003))

U.S. forces underestimated the enemy, repeating the Indian Army’s miscalculations in the initial stages of Operation Vijay. Soldiers flew into the valley at dawn, instead of under the cover of darkness, because commanders assumed that the threat posed by flying in the mountains at night was greater than the risk of enemy fire. Senior U.S. officers expected a seventy-two hour battle against light resistance, and “didn’t want to go in with a whole lot of firepower.”¹⁹³ As a result, many U.S. infantry companies went into battle without their most responsive fire support assets, mortars.¹⁹⁴

¹⁹² Some officials estimate that up to 450 al Qaeda fighters were killed in action during Operation Anaconda, but exact casualty figures are not known. Gerry J. Gilmore, “Anaconda Is Success; Enemy Killed Unknown, Say Officials,” *Armed Forces Press Service News Articles* (15 March 2002) at http://www.defenselink.mil/n03152002_200203154.htm) (May 2003).

¹⁹³ Quote from U.S. Army Major Dennis Yates, fire support officer for the 3rd Brigade, 101st Airborne Division. Elaine M. Grossman, “Left in the Dark for Most Anaconda Planning, Air Force Opens New Probe,” *Inside the Pentagon* (3 October 2002) at <http://ebird.dtic.mil/Oct2002/e20021003left.htm>) (October 2002).

¹⁹⁴ Of the 34 mortars available to 3rd Brigade, 101st Airborne Division, 26 were employed in direct

The infantry battalions also entered combat without their 105-mm artillery batteries. Senior commanders believed that the difficulty in airlifting and transporting artillery pieces in rugged terrain and thin air exceeded the potential benefit.¹⁹⁵

Al Qaeda mortar and howitzer fire caused the majority of casualties in the first two days of Operation Anaconda.¹⁹⁶ U.S. forces would eventually destroy five D-30 howitzers that fired on helicopter landing zones.¹⁹⁷ Mortars provided the only immediate form of suppression for U.S. forces without artillery support. Artillery had proven to be an indispensable source of firepower in the mountains of Kargil, setting the stage for successful maneuver with relentless bombardment of Pakistani positions. U.S. forces under fire in the Shah-i-Kot valley had no comparable element to call on for fire support. They would instead turn to close air support (CAS) provided by fixed wing aircraft and attack helicopters.

2. The Apache in the Mountains

U.S. helicopters suffered from environmental limitations similar to those faced by Indian aircraft at Kargil. Just as Indian Army Aviation Corps (AAC) helicopters provided invaluable transport capability to the Indian Army, the CH-47D Chinook proved to be a crucial source of mobility and heavy lift for U.S. forces in the mountains of Afghanistan.¹⁹⁸ Unlike Indian forces at Kargil, the U.S. military would be able to employ its heavy attack helicopter, the AH-64A Apache. Altitudes approaching 18,000

support of operations in the Shah-i-Kot Valley, with the other systems remaining at Bagram and Kandahar. Christopher F. Bentley, Lieutenant Colonel, U.S. Army, "Afghanistan: Joint and Coalition Fire Support in Operation Anaconda," *Field Artillery* (September-October 2002), 13.

¹⁹⁵ According to Major General (MG) Franklin L. Hagenbeck, Commanding General (CG) of the 10th Mountain Division and Coalition Joint Task Force (CJTF) Mountain, if he "had 105s, because of the terrain and lack of road system, [he] would not have brought them in on the first day." Robert H. McElroy, "Afghanistan: Fire Support for Operation Anaconda," *Field Artillery* (September-October 2002), 6.

¹⁹⁶ Enemy indirect fire caused 28 of 36 casualties in the first two days of operations. Eric Shinseki, General, U.S. Army, "Hearing on the Cancellation of the Crusader Program," testimony before the Senate Armed Services Committee, 16 May 2002.

¹⁹⁷ The D-30 is a 122-mm towed howitzer with a maximum range of fifteen-kilometers. Robert H. McElroy, "Afghanistan: Fire Support for Operation Anaconda," 9.

¹⁹⁸ The single-engine UH-60 Blackhawk helicopter was not used to transport troops because of limitations on lift capability. U.S. forces relied on the twin-engine CH-47D Chinook for transport, which could carry 15,000-pounds at 9,000 feet (2,750 m). Frank Colucci, "Helicopters for a Long War," *Vertiflite* Vol. 48, No. 4 (Fall 2002), 23.

feet (5,485 m) at Kargil had prevented the IAF from using the Mi-25 attack helicopter, forcing Indian forces to rely on the lighter Mi-17.

Seven AH-64A Apache attack helicopters escorted the CH-47D Chinooks that ferried soldiers and supplies to the landing zones (LZ), and remained on station to provide CAS for the infantry. The Apaches had difficulty hovering in the rarified air, and had to rely on “running gunfire” to engage targets, similar to the Mi-17s employed by the Indian Army in an attack role. The Apache has a distinct advantage over the Mi-17, however, in that the AH-64A possesses an infrared jamming device that defeats SAMs such as the Stinger.¹⁹⁹ At Kargil the Indian Mi-17s had no such device, making them vulnerable to NLI SAMs. But mountainous terrain made the superior Apache equally vulnerable to enemy fire. Al Qaeda positions were well hidden in irregular terrain, similar to the NLI positions at Kargil, forcing the helicopters to fly as close as 200 meters to enemy positions to identify and engage them with fire.²⁰⁰ Most al Qaeda fire against U.S. helicopters consisted of rocket-propelled grenades (RPG) and machine guns, for which there is no countermeasure.²⁰¹

Heavy fire and environmental limitations hampered the Apache’s ability to provide CAS. As one pilot put it, “if you hover, you will die, so move and shoot.”²⁰² Yet the pilots of the 101st Aviation Regiment had not routinely trained for “running gunfire” missions, making much of their fire inaccurate.²⁰³ Mountainous terrain further limited the Apaches’ effectiveness, disrupting line of sight radio communications and making coordination with other aircraft and ground forces difficult. Five of the seven Apaches were eventually disabled by enemy ground fire and forced to withdraw. Four U.S. Marine AH-1W SuperCobra attack helicopters augmented the force, and performed

¹⁹⁹ The AH-64A is equipped with the AN/ALQ-144 infrared jamming device. Michael Puttre, “How’d They Do?,” *Journal of Electronic Defense* Vol. 25, No. 9 (September 2002), 44.

²⁰⁰ Dodge Billingsley, “Choppers in the Coils,” *Journal of Electronic Defense* Vol. 25, No. 9 (September 2002), 38.

²⁰¹ Al Qaeda RPGs brought down two U.S. MH-47E Special Operations Chinook helicopters during Operation Anaconda. Frank Colucci, “Helicopters for a Long War,” 19.

²⁰² Quote from Chief Warrant Officer Rich Chenault, an Apache pilot assigned to the 3rd Battalion, 101st Aviation Regiment. Dodge Billingsley, “Choppers in the Coils.”

²⁰³ Michael Puttre, “How’d They Do?,” 44.

well, ultimately completing 217 sorties in close support of ground forces.²⁰⁴ Yet with the Apaches out of the fight, the four SuperCobras could not respond to all of the requests for supporting fire, and U.S. ground forces would rely on fixed wing aircraft.

3. Air Power and Precision in Operation Anaconda

The demand for firepower increased as ground combat intensified. Artillery did not exist in the theater of operations. Many units had flown into combat without their mortars. Apache pilots had performed courageously, but their aircraft had been knocked out of the fight by heavy enemy fire. A wide range of United States Air Force (USAF) and Navy aircraft responded, and ultimately dropped more than six million pounds of ordnance onto the Shah-i-Kot valley.²⁰⁵ Most of these aircraft employed the Joint Direct Attack Munition (JDAM).

The JDAM is a guidance tail kit that converts unguided free-fall bombs into all-weather precision-guided munitions (PGM). A Global Positioning System (GPS) guidance control unit and inertial navigation system (INS) in the tail section allows the JDAM to navigate to its target after release. It therefore offers a significant advantage over laser-guided munitions (LGM), because clouds, dust and smoke do not affect the JDAM's trajectory as it flies toward the GPS coordinates entered by the aircrew.²⁰⁶ It is most effective against fixed targets, not a mobile enemy, such as al Qaeda mortar teams that can quickly displace and use terrain for protection. All-weather characteristics appear to make the JDAM an ideal weapon for the high altitude environment, where unpredictable changes in precipitation and cloud cover are the norm.

Despite the significant technological advantage afforded by the JDAM, the U.S. air effort encountered many of the same challenges as Indian Air Force (IAF) operations at Kargil. U.S. aircraft faced an enemy in small, mobile teams dispersed in uneven

²⁰⁴ Frank Colucci, "Helicopters for a Long War," 22.

²⁰⁵ USAF F-15E, F-16, B-52 and B-1 aircraft, as well as U.S. Navy F-14 and F-18 aircraft, participated in Operation Anaconda. Elaine M. Grossman, "Left in the Dark for Most Anaconda Planning, Air Force Opens New Probe."

²⁰⁶ The JDAM is slightly less accurate than the LGM, with a circular error probable (CEP) of thirteen meters, compared to ten meters for most LGMs. Another distinct advantage of the JDAM is that it does not require the aircraft to loiter and maintain the sight picture while the munition flies to the target, which is necessary for the LGM. Glenn W. Goodman Jr., "Terminal Accuracy."

terrain. U.S. planners believed that the al Qaeda possessed a significant number of portable SAMs that could be easily hidden in terrain folds.²⁰⁷ Most U.S. aircraft flew at altitudes above 20,000 feet (6,100 m) to avoid the SAM threat, making target acquisition difficult.²⁰⁸ Pilots were also constrained by a small view of target areas from the cockpit, referred to as “about the size of a postage stamp,” and an angle of attack that made target acquisition difficult.²⁰⁹

Immediately following the battle, U.S. Army participants credited CAS with destroying most al Qaeda mortars and howitzers in the first two days of combat.²¹⁰ However, closer inspection revealed that many al Qaeda positions survived extensive air strikes. U.S. aircraft failed to destroy the al Qaeda positions atop Objective Ginger, a mountain at 10,200 feet (3,100 m), despite ten days of continuous bombing. U.S. ground forces eventually discovered an enemy position surrounded by five JDAM craters whose occupants had survived the aerial bombardment.²¹¹ Most enemy forces hid in deep caves during air strikes, and reemerged after the bombing run to continue the fight.²¹² U.S. participants also identified limiting effects of terrain on aerial munitions that are similar to those observed by Indian forces at Kargil:

The hills were just really steep, and really rocky ... if a bomb was a couple of hundred yards off the target on the horizontal, with the vertical interval there going up a mountainside, it could mean that it was off by over 500 yards.²¹³

²⁰⁷ U.S. planners believed that the al Qaeda possessed significant numbers of Russian-made SA-7s, which are low-altitude, man-portable SAMs. Robert H. McElroy, “Afghanistan: Fire Support for Operation Anaconda,” 8.

²⁰⁸ Elaine M. Grossman, “Left in the Dark for Most Anaconda Planning, Air Force Opens New Probe.”

²⁰⁹ Robert H. McElroy, “Afghanistan: Fire Support for Operation Anaconda,” 8.

²¹⁰ Rebecca Grant, “The Clash About CAS,” *Air Force Magazine* Vol. 86, No. 1 (January 2003), 58.

²¹¹ Stephen Biddle, *Afghanistan and the Future of Warfare: Implications for Army and Defense Policy*, 35.

²¹² Dodge Billingsley, “Choppers in the Coils,” 40.

²¹³ Observation made by Major Dennis Yates. Elaine M. Grossman, “Left in the Dark for Most Anaconda Planning, Air Force Opens New Probe.”

C. FINDINGS

Combat in the mountains of Kargil and Afghanistan demonstrates that the nature of warfare at high altitude has not significantly changed, even with the emergence of precision munitions. Mountain warfare is the domain of light infantry. Artillery remains a necessary element of maneuver warfare. Air power alone cannot deliver sufficient firepower to support ground maneuver in the high mountains. The suppressive fire afforded by artillery is more valuable than the precision of aerial munitions on the high altitude battlefield. Advanced precision munitions, such as the JDAM, are effective against unprotected fixed targets in any environment. But in a fluid battle in the rugged terrain of the high mountains, the firepower necessary to support methodical and difficult ground maneuver cannot be provided by close air support alone.

The surge of air assets to critical areas, such as an intense SOF firefight atop Takur Ghar Mountain during Operation Anaconda, can sometimes overcome the limitations of CAS at high altitude. A similar event occurred during the battle for Tiger Hill at Kargil, when Mirage aircraft conducted a series of successful strikes against NLI positions. Yet such occurrences are not the rule, and factors such as the weather, increased ground threat, and survivability of enemy positions in irregular terrain combine to make CAS less than sufficient to act as the lone supporter of ground assault.²¹⁴ The Indian Army relied heavily on massed artillery fire as the campaign at Kargil wore on. The U.S. Army did not have artillery in Afghanistan in March 2002; if it had, there is little doubt that it would have been the weapon of choice in the Shah-i-Kot valley.

In addition to overwhelming firepower, high altitude combat requires extensive preparation. Rehearsals and acclimatization, two essential elements of success on the high altitude battlefield, require time. A short-notice war that demands rapid deployment to high altitude is a difficult and risky endeavor. 1 Naga and 8 Sikh entered combat operations on Tiger Hill without the benefit of time to prepare for the rigors of high

²¹⁴ One factor that affects the responsiveness of CAS, although not addressed here because it is unrelated to the environment, is the time required to request and arm PGMs. MG Hagenbeck observed that it generally required at least 26 minutes from request to weapons release, due to several factors, such as the lack of USAF Enlisted Terminal Attack Controllers (ETAC) in ground units and the lengthy calculation of the Desired Mean Point of Impact (DMPI) required to ensure PGM accuracy. USAF personnel counter that thorough planning for the use of CAS on the part of the ground force, which did not occur prior to Operation Anaconda, could have lessened the response time. Rebecca Grant, "The Clash About CAS," 57.

altitude, and launched poorly planned and costly assaults. 2 RAJ RIF, given time for extensive rehearsals and an acclimatization program, seized Tololing and created a turning point in the conflict.

Only highly trained, physically fit soldiers can perform the demanding maneuver required to achieve victory in the mountains. A team of U.S. Army Rangers in the midst of the most intense firefight of Operation Anaconda conducted a 1,000-foot (300 m) climb on the snow-covered Takur Ghar Mountain without ropes. Most of the men climbed on all fours, carrying up to eighty pounds of gear.²¹⁵ Basic mountaineering skill is a necessity for all soldiers. Advanced mountaineers are force multipliers that dramatically alter the commander's maneuver options. Rope teams consisting of Indian High Altitude Warfare School (HAWS) instructors and Ladakh scouts performed remarkable feats in the Indian Army's most celebrated victories at Kargil.

Daring maneuver by light infantry forces is a necessary component of combat as well. Tactical surprise, which is essential against an enemy that holds the high ground, is typically achieved by night assault along an unexpected approach. But the infantry cannot assault the heights without concentrated supporting fire. Ground maneuver in restrictive terrain against an enemy in protected positions relies heavily on the application of firepower. Aircraft, vulnerable to a heightened ground threat, cannot provide the reliable and relentless fire needed to suppress a determined enemy. Only artillery can provide concentrated fire, which although imprecise, provides the necessary cover for ground assault.

Underestimation of the enemy, and the tactical mistakes that follow, is difficult to overcome in unforgiving mountain terrain. The inability to adapt to the high altitude environment leads to failure as well. Forces can use the imposing terrain of the high altitude battlefield to their advantage. Mountain terrain and the high altitude atmosphere can afford protection or diminish an asymmetrical advantage, restricting the use of advanced weapons platforms like the attack helicopter. The NLI held the initial advantage with concealed positions spread across dominating peaks. Yet limited tactical flexibility and the detrimental effects of the environment granted the Indian Army an

²¹⁵ Bradley Graham, "Ambush at Takur Ghar: Fighting for Survival in the Afghan Snow," *The Washington Post* (25 May 2002) at <<http://ebird.dtic.mil/May2002/s20020528wintry.htm>> (May 2002).

opportunity to regain the initiative. Tactical innovation, as well as the application of overwhelming firepower, allowed the Indian Army to overcome its early failures and achieve victory.

D. IMPLICATIONS

A ground force destined for combat in the high mountains must be tailored to meet the demands of the environment. Logistic support is necessarily difficult and requires more assets than in other less strenuous environments. The force requirement increases accordingly, to both secure and man supply lines and other essential assets, such as artillery batteries. The plight of isolated NLI soldiers at Kargil demonstrates the fate that befalls the force that is not fully supported at high altitude. Similarly, decisive maneuver in the mountains requires a significant infantry force capable of operating in small units. The force must be unencumbered by heavy loads, and capable of traversing the world's most inaccessible terrain.

The full range of firepower, delivered from the air, sea and ground, is necessary to provide overwhelming lethality to the force engaged in combat at high altitude. Aerial munitions are part of the full spectrum of echeloned firepower that should be available to ground forces. Fixed wing aircraft can fulfill an array of roles in combat at high altitude ranging from the destruction of fixed targets to the delivery of emergency close air support. Attack helicopters can provide responsive firepower if pilots are trained to fly in thin air and employ "running gunfire" techniques. Yet air power cannot be relied upon as the sole provider of the responsive, concentrated fire needed to support ground maneuver. Suppressive fire, created by a heavy volume of continuous fire over a wide area, is a necessary complement to ground maneuver, and is best provided by artillery.

Artillery must be available to forces engaged in ground combat, despite the challenges posed by the high mountains. The Indian Army at Kargil demonstrated the overwhelming lethality of artillery. All weather, responsive fire is essential to maneuver warfare on any battlefield, including the high mountains. British and U.S. forces that deployed to Afghanistan after Operation Anaconda brought 105-mm artillery batteries. They successfully transported the artillery pieces by air throughout the country, proving

that they could have been employed during Operation Anaconda if they had been available.²¹⁶

E. FINAL WORDS

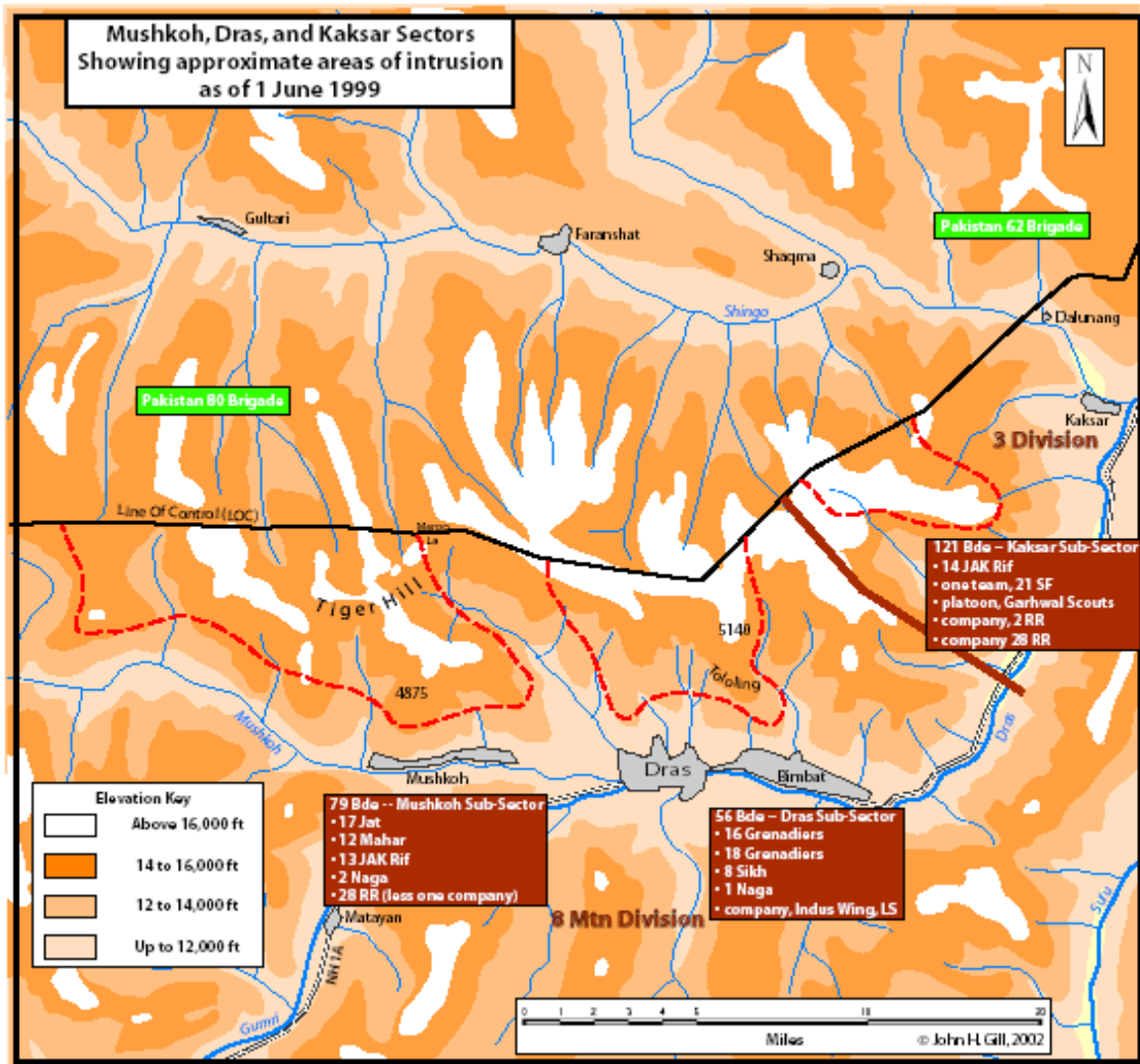
Revolutions in technology drive tactical change. Yet certain regions of the world remain largely unaffected by the full reach of advances in military technology. Thin air, cold weather, and mountainous terrain combine to create a uniquely inhospitable battlefield at high altitude. The elements of military victory at high altitude have not dramatically changed. Overwhelming fire, in concert with bold maneuver, continues to determine victory on the high altitude battlefield. The emergence of precision warfare has yet to dominate combat in the timeless environs of the world's highest mountains.

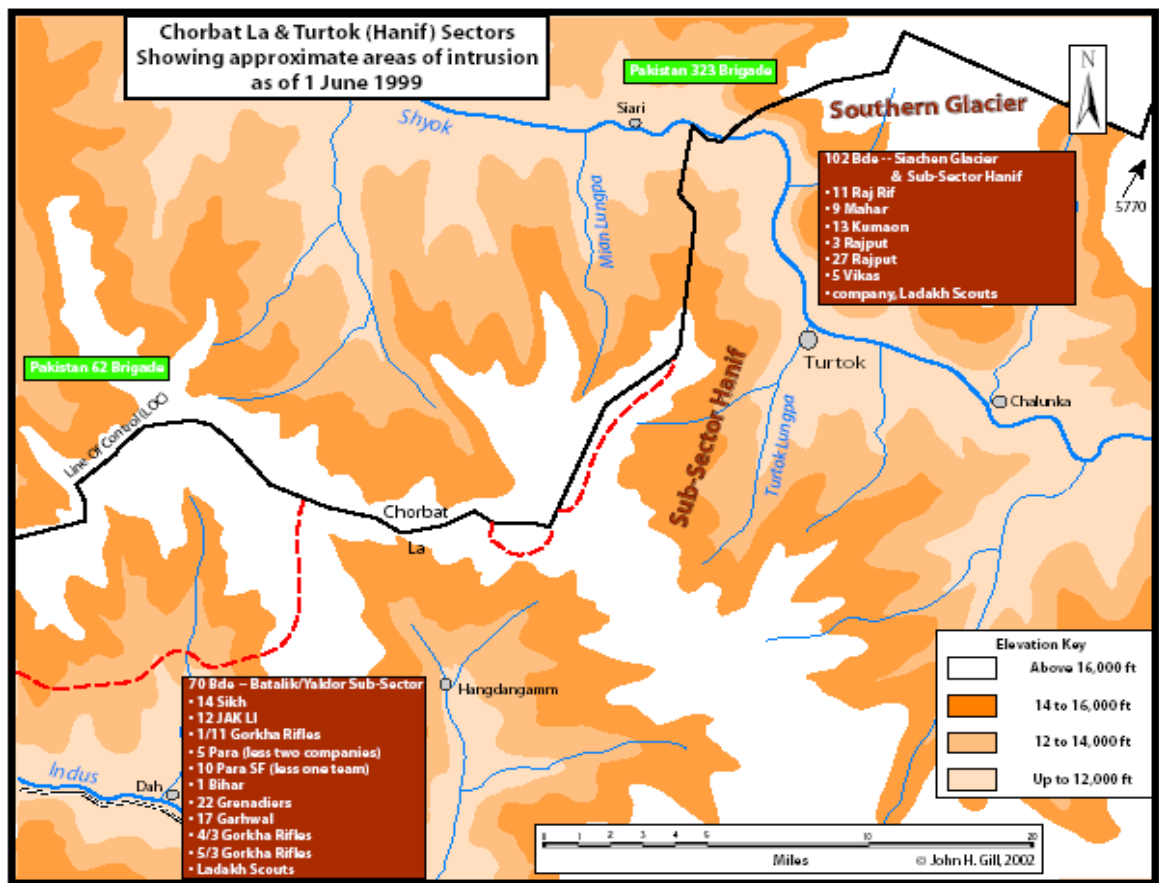
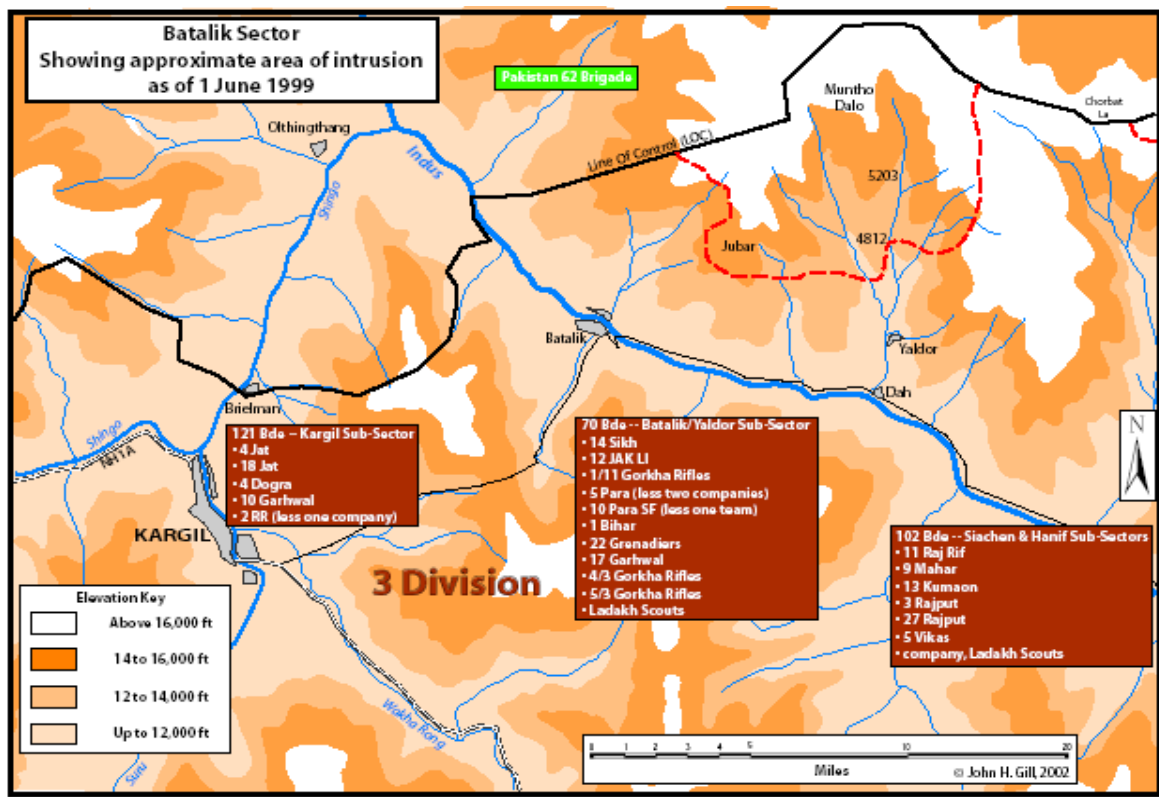
²¹⁶ Robert H. McElroy, "Afghanistan: Fire Support for Operation Anaconda," 8.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX. ARRAY OF FORCES DURING THE KARGIL CONFLICT

This appendix contains maps of NLI incursions in the Mushkoh Valley, Dras and Kaksar sector; Batalik sector; and the Chorbhat La and Turtok sector. The dashed line represents the front line of Pakistani advance across the LOC. Indian Army deployments are listed in the boxes as well. Maps courtesy of John H. Gill, 2002.





BIBLIOGRAPHY

Ahmedullah, Mohammed. "India's Kashmir Offensive May Accelerate Army Modernisation Plans." *Military Technology* Vol. 23 No. 7 (July 1999): 36-38.

Anand, Vinod. "Evolution of a Joint Doctrine for Indian Armed Forces." *Strategic Analysis* Vol. XXIV No. 4 (July 2000) at <http://www.ciaonet.org/olj/sa_jul00anv01.html> (April 2002).

Anand, Vinod. "India's Military Response to the Kargil Aggression." *Strategic Analysis* Vol. XXIII No. 7 (October 1999) at <http://www.ciaonet.org/olj/sa/sa_99anv05.html> (April 2002).

Antal, John F., Colonel, U.S. Army. "Busting Through." *Military Review* Vol. 80 No. 1 (January-February 2000): 28-39.

Baweja, Harinder. *A Soldier's Diary: Kargil, The Inside Story* (Delhi: Books Today, 2000).

Bedi, Rahul. "India Strikes Back at Intruders." *Jane's Defence Weekly* Vol. No. (9 June 1999): 66-69.

Bedi, Rahul. "Paying to Keep the High Ground." *Jane's Intelligence Review* Vol. 11 No. 10 (October 1999): 27-31.

Bentley, Christopher F., Lieutenant Colonel, U.S. Army. "Afghanistan: Joint and Coalition Fire Support in Operation Anaconda." *Field Artillery* (September-October 2002): 10-14.

Biddle, Stephen. *Afghanistan and the Future of Warfare: Implications for Army and Defense Policy* (Carlisle Barracks: U.S. Army War College Strategic Studies Institute, 2002).

Billingsley, Dodge. "Choppers in the Coils." *Journal of Electronic Defense* Vol. 25 No. 9 (September 2002): 38-47.

Chandel, S.S., Brigadier, Indian Army (Retired). "Infantry Assaults in High Altitude." *Institute of Peace and Conflict Studies* No. 240 (13 August 1999) at <<http://www.ipcs.org/issues/articles/240-mi-chandel.htm>> (May 2002).

Chew, Allen F. *Leavenworth Paper No. 5: Fighting the Russians in Winter* (Fort Leavenworth, Kansas: Combat Studies Institute, 1981).

Cloughley, Brian. *A History of the Pakistan Army* (Delhi: Oxford University Press, 2002).

Colucci, Frank. "Helicopters for a Long War." *Vertiflite* Vol. 48 No. 4 (Fall 2002): 18-23.

"The Disputed Area of Kashmir." at <<http://www.lib.utexas.edu/maps/kashmir.html>> (February 2003).

Executive Summary of the Battle of Takur Ghar. U.S. Department of Defense (24 May 2002) at <<http://www.defenselink.mil/news/May2002/d20020524takurghar.pdf> > (May 2003).

Frisancho, A. Roberto. *Human Adaptation and Accommodation* (Ann Arbor: University of Michigan Press, 1993).

Ganesh, D.N. "Indian Air Force in Action." *Kargil 1999: Pakistan's Fourth War for Kashmir*. Ed. Jasjit Singh (Delhi: Knowledge World, 1999): 178-211.

Ghazanfar, Ali, and Hassan Akhtar Ghani. "Siachen – The World's Highest Battlefield." *Military Technology* Vol. 22 No. 3 (March 1998): 15-17.

Gilmore, Gerry J. "Anaconda Is Success; Enemy Killed Unknown, Say Officials." *Armed Forces Press Service News Articles* (15 March 2002) at <http://www.defenselink.mil/n03152002_200203154.htm> (May 2003).

Gokhale, N.A. "High School." *Outlook India* (3 April 2000) at <<http://www.bharat-rakshak.com/LAND-FORCES/Army/Articles/Article15.html>> (May 2002).

Goodman, Glenn W. Jr. "Terminal Accuracy." *Armed Forces Journal International* (October 2002): 64-72.

Graham, Bradley. "Ambush at Takur Ghar: Fighting for Survival in the Afghan Snow." *The Washington Post* (25 May 2002) at <<http://ebird.dtic.mil/May2002/s20020528wintry.htm>> (May 2002).

Grant, Rebecca. "The Clash About CAS." *Air Force Magazine* Vol. 86 No. 1 (January 2003): 54-59.

Grau, Lester W., Lieutenant Colonel, U.S. Army (Retired), and Hernan Vazquez, Lieutenant Colonel, Argentine Army. "Ground Combat at High Altitude." *Military Review* Vol. 82 No. 1 (January-February 2002): 22-31.

Gregory, Barry, *Mountain and Arctic Warfare: From Alexander to Afghanistan* (London: Stephens, 1989).

Grossman, Elaine M. "Left in the Dark for Most Anaconda Planning, Air Force Opens New Probe." *Inside the Pentagon* (3 October 2002) at <<http://ebird.dtic.mil/Oct2002/e20021003left.htm>> (October 2002).

Houston, Charles, M.D. *Going Higher: Oxygen, Man and Mountains* (Seattle, Wash.: The Mountaineers, 1998).

Interview between Feroz Khan, Brigadier, Pakistan Army (Retired) and the author, 28 February 2003.

Jane's Aircraft – Rotary Wing at <<http://www4.janes.com>> (May 2002).

Jenkins, Tom. "The Assault on Riva Ridge." *American History* (December 2001): 46-52.

Joint Publication 1-02 *Department of Defense Dictionary of Military and Associated Terms* (Washington, D.C.: U.S. Government Printing Office, 12 April 2001).

Kanwal, Gurmeet, Colonel, Indian Army. "Pakistan's Military Defeat." *Kargil 1999: Pakistan's Fourth War for Kashmir*. Ed. Jasjit Singh (Delhi: Knowledge World, 1999): 144-177.

Kanwal, Gurmeet, Colonel, Indian Army. *Heroes of Kargil* (Delhi: Army Headquarters, 2002).

Karniol, Robert. "Fighting on the Roof of the World." *Jane's Defence Weekly* Vol. 30 No. 22 (2 December 1998): 27-31.

Khosa, Raspal S. "The Siachen Glacier Dispute: Imbroglia on the Roof of the World." *Contemporary South Asia* Vol. 8, No. 2 (1999): 187-209.

Krishna, Ashok, Major General, Indian Army (Retired). "The Kargil War." *Kargil: The Tables Turned*. Ed. Major General Ashok Krishna and P.R. Chari (Delhi: Manohar, 2001): 77-138.

Krishna, Ashok, Major General, Indian Army (Retired). "Appendix 5, Pakistan's Northern Light Infantry." *Kargil: The Tables Turned*. Ed. Major General Ashok Krishna and P.R. Chari (Delhi: Manohar, 2001): 296-299.

Krishna, Ashok, Major General, Indian Army (Retired). "Appendix 12, Pakistan Prime Minister Nawaz Sharif's Address to the Nation, 12 July 1999." *Kargil: The Tables Turned*. Ed. Major General Ashok Krishna and P.R. Chari (Delhi: Manohar, 2001): 324-329.

Light Infantry in Action at <http://call.army.mil/products/ctc_bull/1-88/chpt3.htm> (December 2002).

Lucas, James. *Hitler's Mountain Troops* (London: Arms and Armour Press, 1992).

McElroy, Robert H. "Afghanistan: Fire Support for Operation Anaconda." *Field Artillery* (September-October 2002): 5-9.

McMichael, Scott R. *A Historical Perspective on Light Infantry* (Ft. Leavenworth, Kansas: Combat Studies Institute, 1987): 51-91.

Menning, William M., Lieutenant Colonel, U.S. Army. "Moving in the Mountains." *Infantry* Vol. 82 No. 1 (January-February 1992): 36-38.

Metz, Steven and Douglas V. Johnston II. *Asymmetry and U.S. Military Strategy: Definition, Background, and Strategic Concepts* (Carlisle: U.S. Army War College Strategic Studies Institute, 2001).

Nawroz, Mohammed Yahya, General, Army of Afghanistan (Retired), and Lester W. Grau, Lieutenant Colonel, U.S. Army (Retired), "The Soviet War in Afghanistan: History and Harbinger of Future War?" from *Foreign Military Studies Office*, Fort Leavenworth, Kansas (1995) at <<http://call.army.mil/fmso/fmsopubs/issues/waraf.htm>> (January 2003).

Oland, Dwight. *North Apennines: The U.S. Army Campaigns of World War II*. U.S. Army Center of Military History Publication 72-34 at <<http://www.army.mil/cmhp/brochures/nap/72-34.htm>> (April 2003).

Pustam, Anil R. "Mountain Air Support Demands Special Equipment and Training." *United States Naval Institute Proceedings* Vol. 126 No. 9 (September 2000): 70-71.

Puttre, Michael. "How'd They Do?" *Journal of Electronic Defense* Vol. 25 No. 9 (September 2002): 44.

Rikhye, Ravi. "The Northern Light Infantry in the Kargil Operations, 1999." *Bharat Rakshak Monitor* Vol. 3 No. 6 (May-June 2001) at <<http://www.bharat-rakshak.com/MONITOR/ISSUE3-6/rikhye.html>> (April 2002).

Sawhney, Pravin. "Himalayan Conflict Forges Artillery Doctrine." *Jane's International Defense Review* (March 1999): 56-59.

Segal, Gerald. *Defending China* (London: Oxford University Press, 1990).

Sengupta, Prasun K. "Mountain Warfare: The Kargil Experience." *Asian Defence Journal* No. 10 (October 1999): 42-46.

Sengupta, Prasun K. "Mountain Warfare and Tri Service Operations." *Asian Defence Journal* No. 11 (November 1999): 24-29.

Shinseki, Eric, General, U.S. Army. "Hearing on the Cancellation of the Crusader Program." Testimony before the Senate Armed Services Committee, 16 May 2002.

Singh, Amarinder. *A Ridge Too Far: War in the Kargil Heights 1999* (Delhi: Tulika, 2001).

Sreedharan, Chindu. "Flying in the Face of Danger." *Rediff* (June 1999) at <<http://www.bharat-rakshak.com/LAND-FORCES/Army/Articles/Article9.html>> (August 2002).

Subramanian, L.N. "A Ridge Too Far: The Battle for Tololing." *Bharat Rakshak Monitor* Vol. 3 No. 6 (May-June 2001) at <<http://www.bharat-rakshak.com/MONITOR/ISSUE3-6/lms.html>> (April 2002).

Technical Note 9402 *Medical Problems in High Mountain Environments* (Natick, Mass.: U.S. Army Research Institute of Environmental Medicine, February 1994).

The Kargil Review Committee Report (Delhi: Sage Publications, 2000).

U.S. Army Field Manual 3-97.6 *Mountain Operations* (Washington, D.C.: U.S. Government Printing Office, 28 November 2000).

U.S. Army Field Manual 23-10 *Sniper Training* (Washington, D.C.: U.S. Government Printing Office, 17 August 1994).

U.S. Army Field Manual 31-70 *Basic Cold Weather Manual* (Washington, D.C.: U.S. Government Printing Office, 12 April 1968).

U.S. Army Field Manual 9-207 *Operation and Maintenance of Ordnance Material in Cold Weather* (Washington, D.C.: U.S. Government Printing Office, 20 March 1998).

Verma, Ashok Kalyan, Major General, Indian Army (Retired). *Kargil: Blood on the Snow* (Delhi: Manohar, 2002).

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
Ft. Belvoir, Virginia
2. Dudley Knox Library
Naval Postgraduate School
Monterey, California
3. Peter R. Lavoy
Naval Postgraduate School
Monterey, California
4. Douglas Porch
Naval Postgraduate School
Monterey, California
5. John H. Gill
National Defense University
Washington, D.C.