

AD-A184 743

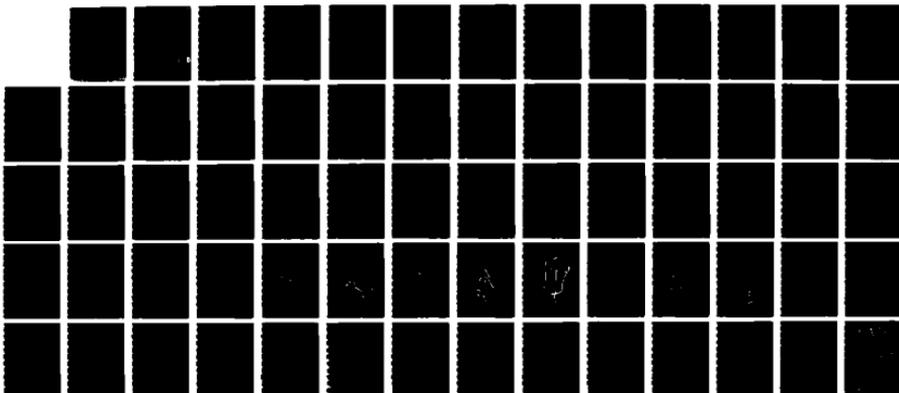
SUSTAINMENT IN A SECONDARY THEATER: AN ANALYSIS OF THE
EFFECT OF TRANSPOR (U) ARMY COMMAND AND GENERAL STAFF
COLL FORT LEAVENWORTH KS SCHOO P L IDIART 04 MAY 87

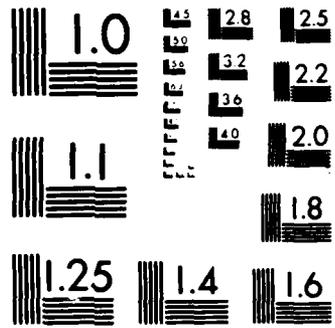
1/1

UNCLASSIFIED

F/G 15/6

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

2

AD-A184 743

DTIC FILE COPY

SUSTAINMENT IN A SECONDARY THEATER:
An Analysis of the Effect of Transportation on Campaign Execution in
North Africa, 1941-1942, and Its Relevance to Southwest Asia.

by

Major Philip L. Idiart
Field Artillery

School of Advanced Military Studies
U.S. Army Command and General Staff College
Fort Leavenworth, Kansas

4 May 1987

DTIC
ELECTE
SEP 25 1987
S D
E

Approved for public release; distribution is unlimited.

87-3043

87 9 18 019

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE		4. PERFORMING ORGANIZATION REPORT NUMBER(S)	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION School of Advanced Military Studies, USAC&GSC	6b. OFFICE SYMBOL (if applicable) ATZL-SWV	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code)		7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Sustainment in a Secondary Theater: An Analysis of the Effect of Transportation on Campaign Execution in North Africa 1941-1942 and Its Relevance to Southwest Asia (U)			
12. PERSONAL AUTHOR(S) MAJ Philip L. Idiart, USA			
13a. TYPE OF REPORT Monograph	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) 870504	15. PAGE COUNT 61
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	Southwest Asia	
		Operational Sustainment	
		Transportation	
		North African Campaign	
		Logistics	
		Interdiction	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This monograph discusses operational sustainment in a secondary theater of war. Essentially, this study asks, given horizontal escalation in a global conflict where Central Europe is the primary theater, what is the effect of operational sustainment, specifically transportation, upon campaign execution in a secondary theater of war. This monograph is a historical analysis of the German World War II experience in the North African campaign. German operational sustainment, specifically theater infrastructure, sustainment base, lines of communication, transportation and interdiction are examined based on the available historical records and contemporary literature to isolate those essential sustainment conditions that impacted upon operational execution. Having determined these, those elements that influenced execution are then isolated and a set of relevant principles that impact on campaign execution are derived. Subsequently, the World War II secondary theater in North Africa is contrasted with a hypothetical yet potential secondary theater of war in Southwest (continued on other side of form)			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL MAJ Philip L. Idiart		22b. TELEPHONE (Include Area Code) (913) 684-2138	22c. OFFICE SYMBOL ATZL-SWV

UNCLASSIFIED

Continuation of DD form 1473, block 19.

Asia. Afterwhich, these sustainment effects are then compared with the evolving battlefield since World War II to determine the effect this has on the historically derived principles. Finally, the conclusions of this analysis are compared to current sustainment doctrine to determine operational and sustainment implications for Southwest Asia.

Among the conclusions drawn from this analysis as to the effect of transportation upon campaign execution are: First, as supply is dependent upon transport, transport shortfalls or failures hastened by extended depth and interdiction will precipitate one's culminating point. Second and most importantly, in an overseas theater of significant depth where mobility is paramount, transport becomes a decisive point at the operational level. Finally, this study concludes that current AirLand Battle doctrine concerning operational sustainment, transportation and culminating points is both adequate and sound.

UNCLASSIFIED



Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input checked="" type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

SCHOOL OF ADVANCED MILITARY STUDIES
MONOGRAPH APPROVAL

Name of Student: Philip L. Idiart, Major, Field Artillery

Title of Monograph: SUSTAINMENT IN A SECONDARY THEATER: An Analysis of the Effect of Transportation on Campaign Execution in North Africa 1941-1942 and Its Relevance to Southwest Asia.

Approved by:

James J. Schneider Monograph Director
James J. Schneider, M.A.

Richard Hart Sinnreich Director, School of Advanced Military Studies
Colonel Richard Hart Sinnreich, M.A.

Philip J. Brookes Director, Graduate Degree Programs
Philip J. Brookes, Ph.D.

Accepted this 17th day of May, 1987.

APPROVED FOR PUBLIC RELEASE:
DISTRIBUTION UNLIMITED.

ABSTRACT

SUSTAINMENT IN A SECONDARY THEATER: AN ANALYSIS OF THE EFFECT OF TRANSPORTATION ON CAMPAIGN EXECUTION IN NORTH AFRICA, 1941-1942, AND ITS RELEVANCE TO SOUTHWEST ASIA, by Major Philip L. Idiart, USA, 61 pages.

This monograph discusses operational sustainment in a secondary theater of war. Essentially, this study asks, given horizontal escalation in a global conflict where Central Europe is the primary theater, what is the effect of operational sustainment, specifically transportation, upon campaign execution in a secondary theater of war.

This monograph is a historical analysis of the German World War II experience in the North African campaign. German operational sustainment, specifically theater infrastructure, sustainment base, lines of communication, transportation and interdiction are examined based on the available historical records and contemporary literature to isolate those essential sustainment conditions that impacted upon operational execution. Having determined these, those elements that influenced execution are then isolated and a set of relevant principles that impact on campaign execution are derived. Subsequently, the World War II secondary theater in North Africa is contrasted with a hypothetical yet potential secondary theater of war in Southwest Asia. After which, these sustainment effects are then compared with the evolving battlefield since World War II to determine the effect this has on the historically derived principles. Finally, the conclusions of this analysis are compared to current sustainment doctrine to determine operational and sustainment implications for Southwest Asia.

Among the conclusions drawn from this analysis as to the effect of transportation upon campaign execution are: First, as supply is dependent upon transport, transport shortfalls or failures hastened by extended depth and interdiction will precipitate one's culminating point. Second and most importantly, in an overseas theater of significant depth where mobility is paramount, transport becomes a decisive point at the operational level. Finally, this study concludes that current AirLand Battle doctrine concerning operational sustainment, transportation and culminating points is both adequate and sound.

TABLE OF CONTENTS

	<u>Page</u>
Approval Page	i
Abstract	ii
Section I: Introduction	1
Sustainment and the Operational Level of War	3
Section II: The North African Campaign, 1941-1942	7
Strategic Situation	7
Rommel's First Offensive	8
British Counteroffensive	12
Rommel's Second Offensive	14
Section III: German Operational Sustainment	19
Theater Infrastructure	20
Theater Sustainment Base	21
Lines of Communication	22
Transportation	23
Interdiction	26
Summary	28
Section IV: Transportation — A Contemporary Analysis	30
Southwest Asian Theater of War	30
Airland Battle Battleground	33
Summary	34
Section V: Conclusions and Implications	35
Maps:	
A. North Africa -- The Strategic Situation	38
B. Cyrenaica Raid	39
C. Operation Battleaxe	40
D. Operation Crusader I	41
E. Operation Crusader II	42
F. Operation Crusader III	43
G. Rommel's Retreat	44
H. Rommel's Second Advance	45
I. Gazala Line	46
J. Gazala Line	47
K. Alam Halfa	48
L. North Africa — Lines of Communications	49
Endnotes	50
Bibliography	58

I. INTRODUCTION

Throughout military history, logistics has influenced and in some cases determined not only the course of battles, operations and campaigns, but the outcome as well. Numerous historians such as Martin van Creveld, Ronald Lewin and Martin Blumenson have recently noted and examined the importance of logistics to operations. Blumenson in a recent article noted, "It is perhaps a law of warfare that armies usually fight with inadequate supplies. The tyranny of logistics denies units what they deem to be enough resources to engage in battle or a campaign."¹ Although it has influenced the conduct of war throughout history, the importance of logistics to success in battle has significantly increased in the late 19th and 20th centuries. With the ever-increasing size, technological sophistication and complexity of armies and battlefields, the role and importance of logistics has similarly broadened. Logistics influences in varying degree all theaters of war. However, its effect is especially significant in secondary theaters of war where economy of forces and resources is practiced in order to concentrate in the primary theater of war. Considering this and the ever-increasing impact of technology today, the importance of sustainment in secondary theaters of war is even more significant today than previously.

Potential confrontation between the Warsaw Pact and NATO suggests that conventional combat in the future will most likely occur in Central Europe. However, conflicting US and Soviet interests in the Middle East also suggest Southwest Asia as a potential combat theater. Furthermore, the likelihood of horizontal escalation promises that Southwest Asia will be a secondary theater of war while Central Europe remains the primary theater of war. As such,

Southwest Asia promises to challenge operational planners and practitioners as its inhospitable environment, austere sustainment infrastructure, minimal host nation support and secondary resource priority will dramatically influence the conduct of the campaign and operations. Considering these conditions, an important question must be posed. Given horizontal escalation in a global conflict where Central Europe is the primary theater, what is the effect of operational sustainment, specifically transportation, upon campaign execution in a secondary theater of war? In an attempt to answer this question, this paper will examine in detail the concept of transportation and its effect upon campaign execution -- what it has meant historically and what it means today.

In his book On War, Clausewitz reminds us that "historical examples clarify everything and also provide the best kinds of proof in the empirical sciences. This is particularly true in the art of war."² Clausewitz goes on to state that there are four levels of historical analysis characterized by the different uses of historical examples. First, historical examples may simply explain an idea. Secondly, they may serve to demonstrate the application of an idea. Third, one can appeal to historical facts to support a statement. Finally, the detailed presentation of an historical event, and the combination of several events, makes it possible to deduce a conclusion wherein the proof is in the evidence itself.³ Therefore, a detailed analysis and presentation of historical examples of major operations and battles where transportation affected their execution should allow us to isolate those conditions affecting campaign execution.

Given that World War II provides the most commonly known examples of high intensity operations, we need to determine which campaigns of that conflict

would provide us the most relevant examples for analysis. As the North African campaign was essentially a secondary theater conducted principally in an austere desert environment, historical analysis of the German experience would be most relevant to Southwest Asia today.⁴ This study examines the German experiences during Rommel's first offensive to include Operation Battleaxe, the subsequent British counter-offensive beginning with Operation Crusader, Rommel's second offensive ending in the battle of Alam Halfa and finally Rommel's operational defeat during Operation Lightfoot -- the second battle of El Alamein. These historical examples are then analyzed to uncover those essential sustainment conditions that impacted upon Axis operational execution. Having determined these, elements that influenced execution are then isolated and a set of relevant principles that impact on campaign execution are derived. We will then contrast the World War II secondary theater in North Africa with a hypothetical yet potential secondary theater of war in Southwest Asia. Having done so, we will then compare these sustainment efforts with the evolving battlefield since World War II to determine what effect this has on the historically derived principles. Finally, the conclusions of this analysis will be compared to current doctrine to determine operational and sustainment implications for Southwest Asia.

SUSTAINMENT AND THE OPERATIONAL LEVEL OF WAR

To further narrow the scope of this paper and to provide a common understanding, some explanation of terms is required. First, we will examine what is meant by the terms logistics and sustainment at the operational level; what they are theoretically and doctrinally; and why they are important. Having done so, we will continue by clarifying what is meant by

transportation. Finally, we will define what is meant by distribution.

Historian Martin van Creveld defines logistics as the practical art of moving armies and keeping them supplied.⁵ This definition provides us a startpoint, but let us examine it further. Logistics in a theoretical sense encompasses all activities to bring an army to battle. As such, it concerns itself with maintenance, supply, lines of communications and bases of operation. In The Art of War, Jomini defined logistics as:

...the art of moving armies. It comprises the order and details of marches and camps, and of quartering and supplying troops; in a word it is the execution of strategic and tactical enterprises. Logistics comprises the means and arrangements which work out the plans of strategy and tactics.⁶

Elaborating further, Jomini wrote that logistics involved providing for the successive arrival of convoy of supplies and the establishment and organization of lines of operations and supplies.⁷ Having examined the theoretical definition of logistics, let us now proceed to its doctrinal definition.

FM 100-16 Support Operations: Echelons Above Corps defines operational logistics as an essential military operation which takes the means of war from the heart of the nation to the battle area in the right quantity at the right time. Explaining further FM 100-16 adds, "it includes the reception of material, port handling, storage, transportation, maintenance, disposal of property, and related training."⁸ This definition provides us a startpoint. However, it does not take the operational level of war for its perspective. Rather its focus is on describing the organization and functions of combat

service support (CSS) operations. Brian Davenport in his monograph, "Operational Sustainment: Defining the Realm of the Possible," points out that the critical shortfall of this manual is its failure to address theater support within the operational level context of campaigns or major operations.⁹ Therefore, we must still ask what is sustainment at the operational level of war. FM 100-5, Operations which established the operational level of war in our AirLand Battle doctrine provides us a more useful definition. It states:

Operational sustainment comprises those logistical and support activities required to sustain campaigns and major operations. Operational sustainment extends from the theater sustainment base or bases which link strategic to theater support functions, to the forward₁₀ CSS units and facilities organic to major tactical units.

However, if this definition is to be of any utility, let us further narrow its focus. Operational sustainment is essentially sustainment from the theater of operations sustainment base(s) into the forward area of operations. Practically speaking, operational sustainment occurs from the TAACOM to the COSCOM. Having established a working definition of operational sustainment, let us now examine why it is important.

Simply, an army's ability to transport and distribute material and supplies to major operational units can make the decisive difference in the failure or success of major operations or campaigns. Our doctrinal capstone manual, FM 100-5, Operations recognizes this by stressing that "today the US Army's ability to sustain its operations is more important as an element of combat power than ever before."¹¹ Elaborating further, it states that

"sustainment is equally vital to success at both the operational and tactical levels of war. Campaigns will often be limited in their design and execution by the support structure and resources of a theater of war."¹²

Having examined the nature and importance of logistics and operational sustainment in the doctrinal and theoretical sense, let us now proceed further to narrow the focus of this paper by defining what is meant by transportation and distribution. FM 100-10, Combat Service Support defines transportation as:

Those services related to the movement of personnel and material to meet the Army's requirements and commitments. Without adequate transportation, the successful support of combat operations is impossible. It is the means of distributing supplies, evacuating damaged equipment, and moving personnel to where they are needed.¹³

For the purpose of this study, this definition serves as startpoint. However, we need to expand this definition to include not only transportation means and assets, but also systems as well. By this means, we will include in our definition the establishment, adjustment and management of lines of support and communications, and the transshipment of material and supplies at terminal nodes. Thus, for the purpose of clarity in this paper, transportation at the operational level of war consists of those services, assets and systems involved in the movement of supplies and material to support major operations and campaigns. Hence, operational transportation involves the movement of material and supply from the theater of war through the theater of operations to the tactical support bases. Finally, let us examine what is meant by the term distribution. FM 100-16 defines it as:

The functional phase of logistics that embraces the dispensing of materials, supplies, equipment, products or services, according to need, requisition, orders, plans, etc. It includes the authorized delivery of such things.¹⁴

II. THE NORTH AFRICAN CAMPAIGN, 1941-1942

Prior to the Second World War, the Mediterranean was a mixture of competing French, Italian and British interests. Further, both Italy and Britain had conflicting interests in North Africa. Consequently, Italy's invasion of Ethiopia in 1935 caused grave concern for the Egyptians who feared further Italian expansion. With the Suez Canal and ultimately Mideast oil at stake, British attention soon turned to North Africa.¹ Thus, the stage was set for a clash between Italy and Britain in the Mediterranean.

THE STRATEGIC SITUATION (Map A)

Following the outbreak of the war, the Italian strategic aim in this arena was dominance on the continent of Africa. Observing the direction of the German campaign in Western Europe, Italy declared war on France and England on 11 June 1940. With France defeated and England fighting for its very existence, it seemed an opportune moment for Mussolini to make some quick conquests of his own, specifically to seize British interests in the Mediterranean area.² By contrast, British strategic aims were defense of the home islands, preservation of the integrity of British territory and the defense of vital interests. To achieve these aims, British intent was to hold against the Germans while concentrating to defeat the Italians.³

In August 1940, Mussolini ordered Marshal Graziani to advance into Egypt. A month later, the Italian 10th Army crossed the frontier and contacted the British. However, Graziani soon stopped his forces at Sidi Barrani short of the British main body at Mersa Matruh.⁴ While the Italians garrisoned Sidi Barrani, General Wavell planned a counteroffensive. On 9 December 1940, the Western Desert Force struck the Italians and in the ensuing battle precipitated their withdrawal. In the subsequent pursuit, the British quickly pushed the Italians some 500 miles back to Beda Fomm. Initially the Germans had no intention of becoming involved in Italy's North African campaign. However, the Italian reversal concerned Hitler. Although he felt that even the loss of North Africa was militarily tolerable to the Axis, Hitler feared the political implications of such a development.⁵ Thus, he found it necessary to come to their relief and a Sperrverband (blocking detachment) was sent to North Africa to stem the British advance.⁶

ROMMEL'S FIRST OFFENSIVE

When the first German elements arrived at Tripoli in February 1941, the operational aim was essentially to defend Tripolitania. According to then Lieutenant Colonel Westphal, "the intention was merely to hold an expanded bridgehead, a ring around Tripoli."⁷ However, Rommel as commander of the Deutsches Afrika Korps (DAK) had different and broader aims. After his arrival in theater, he immediately directed reconnaissance elements to the east in search of better defensive terrain. Following the initial clash between British and German reconnaissance elements on 24 February, Rommel directed elements of the 5th Light Division to continue their movement eastward. In little more than a month, Rommel's eastward reconnaissance not

only extended the defensive line more than 300 miles east of Tripoli, the Axis theater sustainment base, but also extended his line of communications (LOC) as well.⁸ What began initially as a reconnaissance — a look around the corner — soon turned into a series of probing attacks.⁹

On 23 March, reconnaissance elements of DAK were ordered to probe the British positions at El Agheila. Upon finding them a hollow shell, Rommel boldly ordered the 3d Reconnaissance Battalion to attack the next day. This attack in turn precipitated a British withdrawal to Mersa el Brega. Rommel sensed that the British had severely thinned their defenses.¹⁰ Contrary to a standing directive to remain on the defensive, Rommel instead initiated an attack by elements of the 5th Light Division toward Mersa el Brega.¹¹ Consequently, Rommel began his first offensive to drive the supply and equipment constrained British forces eastward across Cyrenaica. The British, already overextended with their armored vehicles badly in need of overhaul, were pushed past the ports of Derna and Tobruk and eventually to the Egyptian Frontier.¹²

The attack on 31 March transitioned quickly into a pursuit as the thin British defenses disintegrated. Immediately, Rommel's operational aim shifted to securing not only Benghazi but also all of Cyrenaica as the Benghazi area could not be held by itself.¹³ Thus began the so-called "Cyrenaica Raid" (Map B). In rapid succession, DAK captured Mersa el Brega (31 March), Agedabia and the port of Zuetina (2 April), Benghazi (3 April), El Mechili and Derna (8 April), and finally reached Tobruk on 11 April.¹⁴ As the British continued their retreat, Rommel completed the encirclement of Tobruk and penetrated inside the Egyptian frontier to Sollum. Hence, the

breakthrough at Mersa el Brega had precipitated a week long 500 mile British retreat. Although the German-Italian pursuit successfully pushed the British back inside Egypt, it failed to achieve a decisive victory while adding 700 miles to the already extended LOC.¹⁵ Thereby, Rommel began to hasten his offensive culminating point.

Arriving at Tobruk, Rommel launched a series of unsuccessful attacks to capture the port. Having failed to seize it quickly and with his forces nearing culmination, Rommel paused to gather strength and plan for Tobruk's capture. His focus now on Tobruk, Rommel directed the establishment of defenses at Sollum, Bardia and Halfaya Pass to prevent Tobruk's relief. Rommel needed the port of Tobruk for several reasons. First, the Italian transport fleet made little use of Benghazi and his LOC was overextended some 1000 miles back to Tripoli.¹⁶ As a result, he needed an intermediate sustainment base. Moreover, Tobruk as a port was the best harbor in Cyrenaica, perhaps in all of North Africa. Tobruk also blocked a 22 mile stretch of the coastal highway, the only high speed avenue of approach and major LOC to the Egyptian border. As a result, Tobruk thus forced Axis supply convoys onto a 50 mile inland detour along a desert track where the desert sand made the trip extremely difficult. Finally, with Tobruk in British hands, Rommel dared not resume his offensive as the Australian garrison could sever his LOC at any time.¹⁷ Thus, the Axis operational aim, driven by the problems of supply, became the seizure of Tobruk. By contrast the British aim was to hold and deny the Germans the port. Further, Wavell needed to tie down Axis forces for two months to allow reinforcements to be brought in to augment the defenses of Egypt.¹⁸

While elements of DAK were overextended inside Egypt and with Rommel's attention focused on Tobruk, Wavell set in motion a counterattack. As the 15th Panzer Division would arrive soon in theater, the British could not wait. As a result, Operation Brevity, a limited spoiling attack designed to secure jumping-off positions for the major counteroffensive to follow in the summer, was launched prematurely on 15 May.¹⁹ While the Germans were weak at Halfaya Pass and the Axis armor was close to Tobruk, Wavell's plan called for an attack along three axes: one toward Sidi Azeiz, one toward Capuzzo and the third for Halfaya Pass.²⁰ Although the British seized Capuzzo and Halfaya Pass quickly, their separate and uncoordinated advance permitted Rommel to mass his armor and counterattack each column separately. Realizing the importance of Halfaya Pass, Rommel dispatched a strong German force that drove the British out of the pass. This final engagement signified the abortive conclusion of Operation Brevity.

Following the unsuccessful Operation Brevity, Wavell, under extreme political pressure from Churchill, launched Operation Battleaxe (Map C) on 15 June. The operational concept was fundamentally the same as Brevity but on a larger scale. Essentially, the intent was to defeat the Axis forces at the frontier, relieve Tobruk then exploit to Derna and El Mechili to complete the destruction of the Axis forces and thereby gain a decisive victory in North Africa.²¹ By contrast, the German defensive plan hinged on a strong defense of the critical passes, Halfaya and Sollum. Earlier during the ill-fated Operation Brevity, Rommel had grasped the significance of this key terrain to his position at Tobruk.²² Accordingly these passes, especially Halfaya, had been converted into almost impregnable positions.

The ensuing three-day battle was not a success for the British. Air reconnaissance reports and radio intercepts alerted the Germans. Stopping one British advance at Halfaya, Rommel massed his armor -- 5th Light and 15th Panzer Divisions -- into one center of gravity to strike the British armor south of Fort Capuzzo. Afterwards the 5th Light Division was to move toward Halfaya Pass to sever the British LOC and line of retreat. Although successful in stopping the offensive and precipitating the British withdrawal, Rommel failed to trap the British force and complete its destruction.²³ Thus ended a phase in the campaign where both combatants reached operational culmination. During the ensuing operational pause which lasted three months, the British changed commanders while both sides sought to improve their logistical posture for future operations.²⁴

THE BRITISH COUNTEROFFENSIVE

Throughout this operational pause, Axis planning was conditioned by the problems of supply.²⁵ Rommel was concerned that the interdiction of his sea lines of communication (SLOCs) and LOC would allow the British build-up to overwhelm him eventually by its sheer weight. Moreover, to continue the offensive into Egypt, he needed the port facilities at Tobruk and to eliminate the British forces in his rear. Accordingly, Rommel sought and received permission to eliminate Tobruk.²⁶ As a result, Tobruk became Rommel's primary objective which was to be stormed at the end of November.

While Panzer Gruppe Afrika gathered its strength for the planned seizure of Tobruk, Auchinleck launched Operation Crusader (Map D) on 18 November. Its operational aim was the destruction of Axis armor and secondarily, the relief

of Tobruk. To accomplish these aims, Auchinleck directed XXX Corps to swing around the Axis southern flank to Gabr Saleh where he assumed Rommel would mass his armor for the climactic battle.²⁷ Concurrently, XIII Corps would assault the Axis line in the north to tie down forces. XXX Corps would then link up with XIII Corps and both would relieve Tobruk before the final clearance of Cyrenaica.²⁸

Initially the British attack did not divert Rommel's attention from Tobruk. However, convinced finally that the British were involved in a serious offensive, Rommel shelved his plan for Tobruk and turned his attention to this threat. As the battle unfolded, the desert terrain south of Tobruk -- Sidi Rezegh -- became the decisive point of the operation. In the ensuing three days, the British fed their armored brigades piecemeal into this cauldron where the massed armor of DAK under Cruewell destroyed them (Map E). By 23 November -- Totensonntag -- virtually every British formation had taken heavy punishment with Rommel the tactical victor.²⁹ Gauging his opponent's frame of mind, Rommel took his remaining armor and went all out for the Egyptian border on 24 November in his famous "dash to the wire" (Map F).³⁰ Rommel's aim was to threaten the enemy rear and force Cunningham to give up the offensive and withdraw. Although his penetration -- some 15 miles inside Egypt -- shook Cunningham, Rommel's attempt to concentrate on the frontier failed to shake Auchinleck. Instead the British forces now in Rommel's rear did not withdraw but continued their attack. On 26 November, XIII Corps' New Zealand Division broke through to Tobruk. With the relief of Tobruk, Rommel saw no immediate hope in seizing the port and so fell back to Sidi Rezegh.

Returning to Sidi Rezegh, Rommel and his fuel-starved armor became embroiled in a battle that would last 10 more days. Although he succeeded in laying siege to Tobruk again on 30 November, the tempo of operations and degradation of his sustainment only hastened his culmination. Moreover, Axis sustainment was exacerbated by the air interdiction of LOCs and ports and attacks upon supply columns by British armored cars.³¹ Because of these raiding activities, Axis resupply and transport was restricted to the hours of darkness. This led to a fifty percent reduction in sustainment capability. By 6 December, Rommel had finally reached his culminating point and the Axis forces began their withdrawal to Gazala where the Italians were strengthening its existing defenses. On 15 December, the British attacked these defenses precipitating a further Axis withdrawal the next day (Map G). Despite the British pursuit, the Axis withdrawal was orderly. Through successive and skillful delaying actions, Rommel managed to avoid encirclement and further damage while exhausting his pursuers. On 10 January 1942 Rommel reached El Agheila where a coherent defensive line was established.

ROMMEL'S SECOND OFFENSIVE

With his LOC shortened and forces resupplied, Rommel was ready to strike again. Catching the British 8th Army overextended and deployed with its divisions beyond supporting distance of each other, the newly formed Panzer Armeel Afrika attacked Mersa el Brega on 21 January 1942 (Map H).³² As in the previous year, the assault transitioned quickly into a pursuit as the attack rolled the 8th Army back. In rapid succession, Rommel recaptured Agedabia and Beda Fomm (22 January), Msus (25 January) and Benghazi (29 January) as the British withdrew before him. On 30 January, Ritchie ordered

the 8th Army to fall back to a defensive line at Gazala to cover Tobruk.³³ By 6 February, Panzer Armee Afrika recaptured Derna and El Mechili and pushed the British — badly hurting for want of supplies — back to Gazala. Here, throughout the rest of the winter, an operational pause ensued.³⁴ However brilliant the advance was, Rommel had again overextended his LOC from Tripoli by 500 miles.

In late May, Rommel was ready to resume the offensive. To attack the British defensive line at Gazala (Map I), his plan called for Group Cruewell — X and XXI Corps (4 Italian infantry divisions) — to conduct feints in the north to tie down and deceive British forces while the DAK with the 90th Light, and the attached Ariete and Trieste divisions enveloped the British southern flank around Bir Hacheim with a thrust north deep into the British rear.³⁵ Fundamentally the plan hinged on the rapid elimination of Bir Hacheim along with a preconceived reaction by British armor.³⁶

The attack that began on 26 May made excellent initial progress. However, heavy resistance and attrition stopped the Axis advance by the third day. As a result, Rommel concluded that his forces must be redeployed and on 29 May he ordered their withdrawal to a position west of Knightsbridge. After organizing a defense of a now-consolidated penetration, the Axis forces focused their efforts on the 150th Brigade box and by 2 June had destroyed it. With Rommel on the defensive, British armor assaulted the Axis position. However, for the next 10 days the 8th Army suffered heavy tank losses as Ritchie committed his armor brigades piecemeal into the cauldron.³⁷ While the British hammered his position, Rommel assaulted Bir Hacheim with the 90th Light and Trieste divisions. Under extreme pressure for 10 days, the

defenders at Bir Hacheim broke out and withdrew on the night of 10-11 June. With this position cleared and his armor resupplied, Rommel attacked out of the cauldron moving north along the Gazala line, subduing the remaining defensive boxes one by one (Map J).³⁸ By 15 June, Axis armor had reached the coast and precipitated a British withdrawal the next day.

Determined not to be stopped by a threat to his flank, Rommel focused his attention on Bardia and Tobruk. On 18 June, the port was once more under Axis siege and the 90th Light Division captured Bardia the next day.³⁹ On 21 June, the British forces in Tobruk surrendered and with its capture, Rommel won a tremendous prize. Although the campaign had expended the last of the Axis strength, the capture of vast supply stocks permitted Rommel to postpone his offensive culminating point and continue the offensive.⁴⁰

As the British withdrew first to Mersa Matruh then to El Alamein, Panzer Armee Afrika continued its pursuit. However, after relieving Ritchie and assuming personal command, Auchinleck turned the 8th Army around and established a determined defense at El Alamein. Upon reaching the British defense on 30 June, Rommel planned for an attack the next day. Rommel directed 90th Light division with Kampfgruppe Briel to penetrate the British defenses between El Alamein and Dier el Abyad, then swing north to sever the coastal road. Concurrently, DAK followed by the Italian XX Corps would penetrate, then swing south thrusting into the British XIII Corps rear.⁴¹ With the British southern flank tied to the El Quattara depression and their determined resistance, Rommel's forces were unable to penetrate the defense. After reverting to the defensive for 4 days, Rommel launched a new attack on 8 July. Rommel directed DAK to penetrate the New Zealand Division's defenses,

then to exploit to the delta.⁴² However, by a deft combination of offensive and defensive tactics Auchinleck kept the Axis forces at bay.⁴³ Consequently, Panzer Armee Afrika throughout the month of July hammered unsuccessfully at the British line.

Exhausted by his unsuccessful assaults and the interdiction of his SLOCs, ports and overextended LOC, Rommel paused to gather his remaining strength for a final assault at the end of August.⁴⁴ Meanwhile, the British command structure changed and their forces continued a build-up of men and material. On 12 August, Alexander relieved Auchinleck while Montgomery assumed command of the 8th Army. Since the British defense grew stronger each passing day while the Axis forces grew weaker due to interdiction, an offensive had to be launched no later than 31 August.⁴⁵ Essentially, Rommel's plan was a repetition of the one he employed at Gazala. In the north, the Italian X and XXI Corps with the 164th German Infantry Division attached would attack to tie-down enemy forces while Rommel's schwerpunkt — DAK with 90th Light, Ariete and Littorio Armored divisions attached — thrust east around the the British flank.⁴⁶

On the night of 30 August, Rommel launched his last attempt to smash the 8th Army and break through to Cario and Alexandria (Map K). Crucial to the operation was the availability of fuel and oil. However, continued interdiction of their SLOCs, ports and LOC exacerbated Axis supply and transport.⁴⁷ Although the Axis forces made initial progress, fuel became so scarce on 1 September that only 15th Panzer Division continued the attack.⁴⁸ As a result, Rommel modified his plan and directed his attack at a dominating terrain feature, Alam Halfa ridge. However, Montgomery

anticipated this shift and positioned his armor accordingly. Hence, Rommel merely sent DAK on a death-ride against the strongest position of the British defense.⁴⁹ His fuel and ammunition stocks nearly depleted, foiled by British anticipation and overwhelmed by the resistance encountered, Rommel abandoned his costly offensive.⁵⁰

Returning to his original startline, Rommel realized as did Montgomery, that Alam Halfa signaled the irrevocable transfer of the initiative to the British.⁵¹ As such, the Axis forces reverted to the defensive and awaited the inevitable British offensive. As an operational pause ensued, Montgomery continued his build-up of men and material to launch Operation Lightfoot, planned for 23 October. Fundamentally, the British plan was a simple one. Taking advantage of a 3:1 superiority in men and material, Montgomery directed XIII Corps to conduct diversionary attacks in the south to fix Rommel's attention while XXX Corps with 4 infantry divisions followed by X Corps -- 3 armored divisions -- conducted the main attack in the north between Tell el Eisa and Miteiriya Ridge.⁵² By contrast, Rommel's plan hinged on corseting the Italian infantry divisions with German formations behind extensive minefields. To the rear of this defensive line, Rommel grouped the Littorio Armored Division with the 15th Panzer Division in the north and the Ariete Armored Division with the 21st Panzer Division in the south as his counterattack forces.⁵³ However, his supply situation was desperate. For the battle, Panzer Armee Afrika was down to 3 issues of fuel -- one of which was at Benghazi -- and 8-10 issues of ammunition.⁵⁴

Following an extensive artillery preparation, the British offensive began on the night of 23-24 October. Until the end of the month, the 8th Army

hammered at the Axis defenses while the RAF attacked Axis forces, fuel and ammunition dumps, supply columns and the ports behind the front. Although Rommel held the British at bay, continued attrition and interdiction exhausted the Axis forces and supply stocks. After committing X Corps, Montgomery broke the Axis defense on 2 November. Two days later, the 8th Army completed its breakthrough precipitating the Panzer Armees withdrawal on 4 November.⁵⁵

The following day, Montgomery committed the X Corps in the pursuit of Axis forces. Thus, began the decisive Axis retreat that did not end until 4 February 1943 at the Mareth line — some 1350 miles away.

III. GERMAN OPERATIONAL SUSTAINMENT

The desert: a tactician's paradise but a quartermaster's hell.¹

General von Ravenstein
Commander, 21st Pz Div

In studying Rommel's campaigns in North Africa, historians have suggested various reasons for his ultimate defeat. However some observers, to include Rommel himself, have attributed supply failure as the principal cause for his failure.² After the war, Field Marshal Kesselring wrote, "In the final analysis, everything to include the possession of Africa, depended upon supply."³ In his study of the Axis supply failure, historian van Creveld argued that the problem of supplying an Axis force for an advance into the Middle East was insoluble,⁴ citing transportation shortfalls as the primary reason. Perhaps the best testimony came from Rommel's ex-chief of staff. After the war, Westphal offered the following reasons for the supply failure:

... namely that the supply line had become intolerably long. As a war harbor, Tobruk had only a very small unloading capacity, so that we were still chiefly dependent on Benghazi, indeed also on Tripoli. There was no railway line available; therefore, transport had to be by lorry. Lorries were, however, in extremely short supply. Even if they traveled 40 mile per hour, the return journey for a column from Benghazi to Alamein took 7 days and double the time from Tripoli.⁵

With these points in mind, let us explore why sustainment, and specifically transportation, failed. To do so, we will examine those conditions that impact on operational sustainment and transportation. These are: infrastructure, sustainment base, lines of communication, intertheater and intratheater transportation and finally, the impact of interdiction upon transportation. Having determined our framework for analysis, let us examine the theater infrastructure.

THEATER INFRASTRUCTURE

The difficulty in establishing a theater sustainment base will depend significantly upon the extent and nature of the civil and military infrastructure within a theater.⁶ Nowhere was this truer than in North Africa. As a theater of operations, North Africa was characterized by its vast expanses, inhospitable terrain and austere infrastructure. Moreover, indigenous resources were virtually nonexistent. Its vast distances and desolate terrain rendered supply fundamental. Hence, everything required to sustain combat -- men, material, fuel and ammunition -- was transported into the theater of operations and then carried forward to the front. Thus the transport of supply became indispensable. However, the austere infrastructure in Tripolitania and Cyrenaica, specifically the inadequate port facilities and limited road and rail networks dramatically affected transportation.

North Africa as an overseas theater of operations depended heavily on sea transport for men, material and supply from the strategic sustainment base. This being the case, the availability and adequacy of port facilities to transfer supplies was critical. However, there existed only a few ports of any value within the theater. These were Tripoli, Benghazi, Bardia, Derna and Tobruk. Of these ports, only Tripoli, Benghazi and Tobruk were successfully and successively employed.⁷ As a port, Tripoli was capable of handling 45,000 tons of cargo monthly. By contrast, Benghazi as a port was capable of processing 81,000 tons monthly, whereas Tobruk's capacity was only 45,000 tons monthly.⁸ Aside from limited ports, Axis sustainment was further constrained throughout the campaign by the limited road network in Lybia. Essentially, there existed only a single major paved road -- the Via Balbia -- that spanned the theater of operations to serve as an LOC. Moreover, as an LOC the Via Balbia was plagued by constant disrepair, frequent flooding and interdiction. This situation was further exacerbated by the total lack of rail within the theater. Consequently, the lack of rail transport required the Germans and Italians to transport all supplies by truck or coastal shipping. It was not until Axis operations advanced well into Egypt that rail became available to supplement the LOC. However, as this Spartan infrastructure affected transportation, the location of the Axis theater sustainment base influenced transportation as well.

THEATER SUSTAINMENT BASE

The location of the theater support base is critical to the conduct of the campaign, since a malpositioned support base may adversely influence the course of operations and perhaps the entire campaign. Although access to

sealift, transshipment facilities and multiple LOCs are indispensable, thus location must provide the operational commander the greatest possible freedom of action.⁹ Such was the case for the British forces, but not for the Axis. Prior to the outbreak of the war, the British had planned, surveyed and begun the construction of major logistic facilities in Egypt capable of serving the Mediterranean fleet and a large army with a supporting air force.¹⁰ With this in mind, the British possessed a sustainment base of considerable size in Egypt. By contrast, Italian logistic facilities were more limited and the Axis forces were entirely dependent on sea transport even for their most elementary requirements.¹¹ Following their retreat from Cyrenaica, the Italians were reduced to a single port, Tripoli, for unloading supplies. Consequently, when Rommel arrived in North Africa, the Axis forces possessed only a single support base. Because Rommel had inadequate port facilities in his theater support base, he was unable to maintain adequate stocks in the forward areas. Although Tripoli provided easy access to the SLOCs, its transshipment capability was limited. Despite its capability of handling 45,000 tons monthly, the Axis forces in February 1941 required 70,000 tons of supplies per month.¹² Further, the port was located some 300 miles from the forces at Sirte. As the campaign unfolded, Rommel required and added the ports of Benghazi and Tobruk as intermediate support bases. However, the impact of Tripoli as a support base upon transportation was not as significant as the ever-extending LOC.

LINES OF COMMUNICATION (Map L)

The North African campaign illustrates the importance of lines of communication to campaign execution.¹³ Due to the very nature of the

infrastructure, Axis sustainment was limited to a single LOC — Via Balbia — throughout the campaign. Further, operations conducted over North Africa's vast expanses continually extended and strained this logistic tether. In February 1941, the front was stabilized at Sirte which was 300 miles from the Axis support base. Even by German doctrinal standards the Axis LOC was already overextended some 100 miles since 200 miles was considered the limit for effective transport by motor vehicle.¹⁴ As Rommel began his offensive, his LOC was already considerably overextended (see figure 1). As the campaign unfolded, only the capture and use of Benghazi and Tobruk as intermediate support bases eased the overstrained LOC and transport system. As Benghazi and Tobruk became intermediate support bases, SLOCs originating from Italy were similarly extended. In isolation, this overextension of the LOC and SLOCs was not as significant as its effect on Axis transport vehicles and shipping.

	AXIS SUSTAINMENT BASES		
	<u>Tripoli</u>	<u>Benghazi</u>	<u>Tobruk</u>
Sirte	300	-	-
El Agheila	470	-	-
Benghazi	700	-	-
Gazala	900	280	-
Tobruk	1000	300	-
Sollum	1100	400	100
El Alamein	1350	800	350

figure 1: LOC distances¹⁵

TRANSPORTATION

Initially, Axis transport, both motor vehicle and shipping was sufficient

to meet requirements. During the period February-May 1941, the Italian merchant fleet succeeded in transporting 325,000 tons of supply and material against a monthly requirement of 70,000 tons.¹⁶ With the front at Sirte, and then at El Agheila, motor transport supply remained feasible. However, as the depth of operations increased motor transport became strained. In November 1941, this situation was exacerbated further. With forces at Tobruk, Sollum and Halfaya Pass, Rommel extended his LOC to dangerous lengths. Of course, Rommel realized this and demanded additional motor transport and pressed the Italians to make greater use of Benghazi.¹⁷ However, Rommel failed to seize Tobruk and the Italians were reluctant to use Benghazi as their larger ships had difficulty in entering the harbor. Moreover, the sea route to Benghazi was longer and more vulnerable, and the Italians possessed insufficient fuel for the extra escorts required. Finally, the port itself was badly damaged.¹⁸ Its port capacity was reduced to 24,000 tons per month due to air attacks during February-March 1941. Consequently, the Italians directed the bulk of their shipping to Tripoli. With Benghazi rendered useless, Rommel was forced to use coastal shipping to supplement his motor transport. Although coastal shipping was capable of transporting 29,000 tons per month in May 1941, its vulnerability to interdiction soon reduced this capacity to 15,000 tons.¹⁹ Hence, motor transport continued to be strained.

As we have just seen, Axis operational sustainment and transport depended principally on the use of motor vehicles. From the time of Operation Crusader in November 1941 until the second battle of El Alamein, the effectiveness of Axis motor transport was degraded for a number of reasons. It was chiefly the overall result of insufficient coastal shipping, the Italian reluctance to

utilize Benghazi and Tobruk fully, insufficient rail and rolling stock, British sea and air interdiction and insufficient numbers of transport vehicles. At the same time Panzer Group Afrika lost half of its motor transport in Operation Crusader.²⁰ However, the impact of this shortfall was not readily apparent as the Axis withdrawal shortened the LOC. Consequently, when the second offensive unfolded, the shortfall in transport vehicles became increasingly apparent as the operation wore on. Alone, this shortfall may have precipitated Rommel's offensive culminating point earlier if it had not been for the seizure of vast stocks of trucks and fuel stocks with the capture of Tobruk. In their advance to El Alamein, Panzer Armee Afrika captured some 3900 trucks and 1900 tons of urgently needed fuel.²¹ As historian I. S. O. Playfair observed, it was the captured stocks that took the army to Alamein.²² However, even the captured use of vehicles to supplement his motor transport failed to provide a final solution. With 85% of all Axis motor transport consisting of captured British and American vehicles, the lack of repair parts coupled with the overextended LOC -- 1350 miles to Tripoli -- resulted in only 65% of these vehicles available for use.²³ To ease this shortfall and shorten the LOC, Rommel continued to press the Italians to increase the use of Benghazi and Tobruk. However, continued sea and air interdiction forced the Italians to use primarily Tripoli.²⁴ By the battle of Alam Halfa in August-September 1942, the Axis transport crisis had become critical. To illustrate this situation, David A. Wood demonstrates that Rommel's daily transport requirement was 2,264,500 ton-miles, yet his daily transport capability was only 1,344,000 ton-miles. This 920,500 ton-mile translated into a daily shortfall of 892 tons.²⁵ The criticality of this shortfall becomes apparent when contrasted with the daily requirement of 350 tons for an Axis armored division. Moreover, stocks

of 5000 tons of fuel at Benghazi and 7000 tons of ammunition at Tobruk while Panzer Arme Afirka lacked fuel and ammunition at El Alamein provides further evidence of the magnitude of the transport failure.²⁶ Of the situation, Field Marshal Kesselring noted that in Rommel's rear area fuel was freely issued in any amount to columns on the road and that only at the front, where it was most important, was it lacking.²⁷ Having examined the magnitude of the transport failure, let us now turn our attention to the impact and effect of British interdiction of Axis transportation.

INTERDICTION

North Africa illustrates the importance of uninterrupted sustainment throughout all phases of the campaign. In concert with the Axis transport shortfall, British sea and air interdiction of Axis SLOCs and LOC played a decisive role in the interruption of sustainment. British ULTRA intercepts provided the means with which to develop an effective interdiction plan.²⁸ The interdiction of the SLOCs had two principal effects. First, successful shipping strikes during the period September-December 1941 and August-November 1942 denied the Axis forces urgently needed supplies. With a monthly requirement of 100,000-116,000 tons of supply, British interdiction resulted in a shortfall of about 50,000 tons per month during this period (see figure 2).²⁹ Of particular note is the British interdiction performance during Operation Crusader, the battle of Alam Halfa and the second battle of El Alamein where an average of 44% of enemy tonnage was sunk. Secondly, as the SLOCs to Benghazi and Tobruk were more vulnerable to Malta-based warships and aircraft and land-based aircraft in Egypt, interdiction forced the Italian merchant fleet to utilize Tripoli. In turn, the diversion of shipping to

<u>Month</u>	<u>Tonnage Disembarked</u>	<u>Tonnage Lost</u>	<u>Tonnage Lost (%)</u>
Jun 41	125,076	5,695	4.4
Jul 41	62,700	15,190	19.5
Aug 41	83,900	13,090	13.5
Sep 41	67,400	26,210	28.0
Oct 41	73,600	18,400	20.0
Nov 41	30,000	48,950	62.0
Dec 41	39,000	8,560	18.0
Jan 42	66,000	-	less than 1.0
Feb- Mar 42	107,000	10,590	9.0
Apr 42	150,000	-	less than 1.0
May 42	86,000	6,470	7.0
Jun 42	32,300	9,130	22.0
Jul 42	91,500	5,830	6.0
Aug 42	51,600	25,360	33.8
Sep 42	77,200	19,300	20.0
Oct 42	46,000	36,140	44.0
Nov 42	94,000	20,630	18.0

figure 2: Interdiction and SLOC performance³⁰

Tripoli only exacerbated the already overextended LOC. However, as significant as their SLOC interdiction, British air interdiction of port facilities further contributed to the Axis transport and supply problem.

In addition to the Italian merchant fleet, Axis ports of discharge became the second of three decisive points that the British attacked to unhinge the enemy center of gravity. Relying chiefly on air interdiction, the RAF habitually attacked Benghazi, Tobruk, Derna and Bardia. As such, air attack precluded Axis use of the smaller ports of Derna and Bardia. Moreover, the air interdiction of Tobruk and Benghazi caused such damage that these ports were significantly degraded. Damage to Tobruk reduced its daily capacity from 1500 tons to only 600 tons and Benghazi was similarly reduced to 800 tons as opposed to its capacity of 2700 tons.³¹ As bottlenecks ensued the cargo

ships waiting to unload their stocks remained vulnerable to further interdiction. Consequently, this interdiction diverted Italian cargo ships in some cases to Benghazi, as well as toward Tripoli.

As interdiction increased the vulnerability of the LOC, the supply columns became a third decisive point. Throughout Operation Crusader and the battles of Alam Halfa and El Alamein, marauding British armored cars and light tanks and constant air interdiction created havoc among Axis transport. Inflicting such heavy damage, air interdiction reduced Axis movement to the hours of darkness. As the RAF was now concentrated in Egypt, even resupply at night became precarious. During July 1942, Rommel observed, "It is hardly possible to supply the army at night, as the roads are almost completely denied by enemy air activity."³² Aside the 35% non-availability rate previously cited, continued air attack of the LOC resulted in a daily loss rate of 30 vehicles.³³

Having examined the infrastructure, sustainment base, lines of communication, transportation and interdiction upon Axis sustainment, let us summarize our findings.

SUMMARY

The North Africa campaign provides us many insights into operations within a secondary and austere theater. To summarize why the German-Italian campaign failed, we can note four principal reasons. First and foremost, the foundations of strategy and operational art are closely tied to logistics. North Africa was a theater of operations in a secondary theater of war.

Moreover, it did not have resourcing priority. Consequently, limited resources necessitate limited operational aims. If operational aims and the depth of the operations exceed the depth of resources, then resources must be increased -- contrary to the strategic concept -- or an immense degree of risk accepted. Rommel's aims in the campaign and the depth of his operations consistently exceeded his sustainment capability. Secondly as demonstrated in North Africa, austere operational sustainment and limited resourcing are inherent in a secondary theater. Accordingly if aims exceed the means, sustainment shortfalls will hasten and precipitate the operational offensive culminating point. Third and critical to an overseas and austere theater, sustainment is chiefly dependent on transport. As Winston Churchill noted in 1899, "supply and transport stand or fall together; history depends on both."³⁴ As demonstrated in our analysis, such was the case in North Africa. The ineffectiveness of the SLOCs linking the theater of war sustainment base to the theater of operations contributed significantly to the Axis failure. Hence, the management, control and protection of SLOCs had a major impact on the effectiveness of operational sustainment. Furthermore, as in the case of the SLOCs, the management, control and protection of LOCs within the theater of operations impact upon operational sustainment. Finally and most significant was the synergistic effect of interdiction upon transportation assets, systems and transshipment nodes. In summation operational aims beyond the depth of sustainment resourcing and transport created preconditions such that transport became a decisive point and interdiction the means to unhinge the operational center of gravity.

Considering these conditions, let us summarize the effect of sustainment and look specifically at the impact of transportation upon campaign execution

in a secondary theater of war. First, as supply is dependent upon transport, transport shortfalls or failures will hasten, if not precipitate one's culminating point. Secondly, and most importantly, in an overseas theater of significant depth where mobility is paramount, transport becomes a decisive point at the operational level. Winston Churchill summarized this more eloquently when he noted, "victory is the beautiful, bright-colored flower. Transport is the stem without which it could never blossom."³⁵

IV. TRANSPORTATION -- A CONTEMPORARY ANALYSIS

If our historically derived imperatives demonstrating the effect of transportation upon campaign execution are to have any relevance to contemporary application in a potential Southwest Asia theater of war, we must contrast the two theaters and examine the AirLand battlefield where campaigns will be waged.

SOUTHWEST ASIAN THEATER OF WAR

To contrast Southwest Asia as a theater of war with the World War II theater in North Africa, certain assumptions must be made. First, like the Mediterranean theater of war, Southwest Asia is presumably a secondary theater of war compared to the primary Central European theater. Further, Iran is the primary theater of operations within the Southwest Asia theater as North Africa was the primary theater of operations within the Mediterranean. Having determined our parameters, let us contrast Iran to North Africa as theaters of operations.

At first glance several similarities and parallels come to mind. Geographically, both theaters are principally austere and vast desert environments. However, unlike North Africa, Iran is predominantly a mountainous country where only its desert central plateau closely resembles North Africa. Further, operations in North Africa were conducted along its coast whereas operations in Iran are likely to be inland. Hence, LOCs will diverge from the coast rather than parallel it. However, the operational depth of Iran suggests that offensive operations conducted there will stretch and tax LOCs to the breaking point. Having quickly examined the geography, let us now turn our attention to the infrastructure and the theater sustainment base.

As in North Africa, Iran possesses limited infrastructure. Apart from Bandar Abbas which has a daily capacity of 15,000 tons, most ports along the gulf are more limited and as such will most likely require logistics-over-the-shore (LOTS) to supplement them. Further, as with the Via Balbia in North Africa, paved road surfaces moving inland are also in disrepair. Further, rail in Iran is also limited and in the same state of disrepair as its roads. Considering the infrastructure, the most likely location for a theater support base would be Bandar Abbas due to its access to sealift, airlift and LOCs. Finally, as in North Africa, Iran will be an immature overseas theater and will depend chiefly upon sea and airlift for everything required to conduct combat. This leads us to the forces which will conduct these combat operations.

Given that Central Europe will require priority of forces and resources, for Southwest Asia a 2 corps - 5 division force is possible, but a single

corps of 3 divisions is more likely. Opposing this force will be, for the sake of this analysis, 1-2 Soviet armies of perhaps 6-10 divisions. However, similar to the British in North Africa, Soviet forces will enjoy certain inherent advantages. First, Soviet forces will have shorter LOCs compared to the extended SLOCs and ALOCs of US forces. Secondly, the Soviet sustainment bases will be more extensive than the initial theater sustainment base that US forces must build up. Thirdly, Soviet forces would likely operate on interior lines. Given these conditions, US forces like the Axis forces in North Africa will be vulnerable to the interdiction of their sustainment.

To illustrate the potential effect of interdiction, let us examine the logistical requirement of a US force. Current logistic planning factors identify a daily requirement of 5740 tons to support a 3 division force and 10,990 tons to support a 2 corps, 5 division force.¹ These figures translate into a monthly requirement of 172,110 and 329,000 tons respectively, of which the port of Bandar Abbas can supply 450,000 tons. Further, to transport this tonnage to the forward tactical formations in one line haul per day, 11 and 21 truck companies would be required respectively. However, one must consider the impact of interdiction on the port, LOCs and SLOCs.

In the case of North Africa, both Benghazi and Tobruk were reduced to a third of their capacity. Given technological advances in munitions and their delivery systems, a similar reduction at Bandar Abbas is not unlikely. Accordingly, its capacity could be reduced to 150,000 tons and sustainment shortfalls would follow. Interdiction of the LOCs by air or special operations forces (SOFs) as in North Africa would also exacerbate operational sustainment. Additionally, if LOC interdiction successfully reduced transport

to the hours of darkness, the capability of truck companies to transport supplies 420 miles -- one day's line haul -- would be cut in half. Finally, as the British benefited from ULTRA intercepts, Soviet intelligence satellites as well as other SIGINT and ELINT systems promise that SLOCs will be monitored and most likely interdicted. Having contrasted the two theaters, let us now turn our attention to the AirLand battlefield where campaigns will be conducted.

THE AIRLAND BATTLEFIELD

According to FM 100-5, Operations, the future battlefield is likely to be chaotic, intense and highly destructive. Increased lethality coupled with the rapid massing of forces afforded by technological advancements in weapons, acquisition and mobility systems promises that units that are acquired and located will be defeated. Further, lethality and electronic jamming developments promise to disrupt command, control and communications (C³) equipment thereby greatly increasing friction and uncertainty. Moreover, the attack of command control nodes along with casualties among leaders will result in a confused and disordered environment. This potential battlefield will also be characterized as nonlinear. Rapid movement to concentrate or disperse promises that units will become islands of conflict as engagements and battles degenerate. The use of unconventional and special operating forces coupled with the tremendous mobility of conventional forces and fluid nature of combat will add to this condition. Further, this battlefield will likely see the employment of nuclear and chemical weapons adding to its chaos and destructiveness. As mobile units fight throughout their depth, lines of communication will become overextended and vulnerable to interdiction. The

prevalence of obstacles encountered throughout the battlefield will also impede the movement of logistics. Consequently, this battlefield will be characterized by its austere logistic support.²

SUMMARY

Having contrasted the two theaters and examined the AirLand battlefield where campaigns will be conducted, we note several similarities between the two theaters and between the AirLand battlefield and that of 1940-43 North Africa. Both theaters are similar geographically as well as in their infrastructure. Further, the size and depth of a Southwest Asian theater, specifically Iran, promises to influence operational sustainment as North Africa did in World War II. Finally, as North Africa was chiefly depended on SLOCS, Southwest Asia also will be dependent on sea and airlift. If we contrast operations in North Africa with the Airland battlefield, we also note similarities. Axis operations in North Africa were on many occasions nonlinear and the tempo characterized as fluid. Further, the North African campaign witnessed integrated sea, air and land operations. The battles and operations during the summer-fall of 1942 typified AirLand operations. The use of Long-Range Desert Groups and SAS forces with marauding armored vehicles added depth to the battle. With regard to transportation, shortfalls hastened by extended depth and interdiction will precipitate one's culminating point. Secondly, and most importantly in an overseas theater of significant depth, transport becomes a decisive point at the operational level.

V. CONCLUSIONS AND IMPLICATIONS

From our historical and contemporary analysis, we have seen the importance of operational sustainment and specifically transportation to campaign execution. Essentially, in planning and executing a campaign, maneuvering operational/tactical units X number of miles to secure an operational objective requires Y number of tons of supply and Z number of transportation assets. Clearly, the North African campaign demonstrated the effect of sustainment and transportation upon campaign execution when supply and transport cannot support the depth of operational objectives. Moreover, we concluded that transportation shortfalls hastened by extended depth will precipitate one's culminating point and more importantly in an austere and immature theater, as most likely will be the case in Southwest Asia, that transport becomes a decisive point. Considering these findings, let us contrast our conclusions to doctrine.

Current logistic doctrine as espoused by FM 100-16 Support Operations: Echelons Above Corps is inadequate for a number of reasons. First, it fails to address theater sustainment within the operational level context of campaigns and major operations. Secondly, although it states that austerity will be rule of logistics, the central framework of this doctrinal manual revolves principally around a mature theater where third party or host nation (HN) support is possible. More significantly, it assumes the availability of a somewhat extensive theater infrastructure. Therefore, we must question the applicability of this doctrine to an austere theater. Thirdly, with respect to the criticality of transportation, FM 100-16 only recognizes the vulnerability of ports to enemy interdiction. However, it fails to caution

the reader as to the effect of transport interdiction upon operations and campaigns. Rather, it stresses the importance of our ability to conduct LOTS.¹ Moreover, it evades the impact of transport shortfalls -- likely in an austere theater -- by stressing transport will be accomplished by host nation rail and highway support to the maximum possible extent.² Elaborating further, it adds:

During the early stages of hostilities the HN provides the bulk of the transportation services in the COMMZ except for the movement control and Army airlift. As the theater matures, US military transportation is deployed to augment HN or third country support. It is essential that prior arrangements be made to ensure compatibility between HN and US equipment for discharge of supplies and equipment. Terminal transfer services will be provided by HN or third country support to transfer cargo between transport nodes at sea, rail, highway and inland water terminals.³

Consequently, we question the relevance of a doctrine that stresses extensively the use of HN support in an immature and austere theater such as Southwest Asia. Clearly, North Africa has shown us the consequence of limited infrastructure, particularly limited rail and host nation support. Although FM 100-16 proves inadequate with respect to the significance of transportation, FM 100-5, Operations on the other hand offers logistic and operational planners and practitioners many valuable insights.

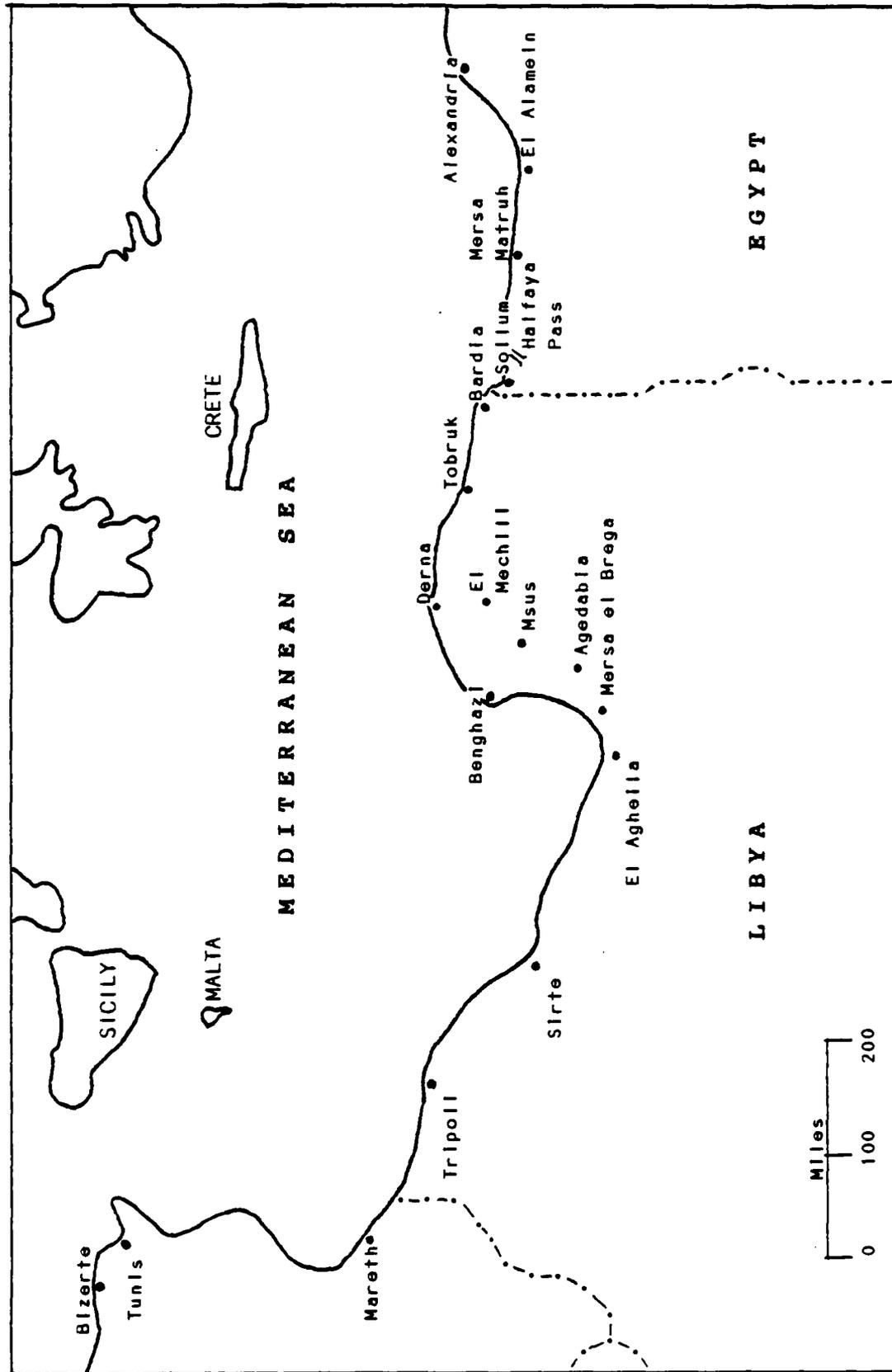
With respect to operational sustainment, FM 100-5 regards transportation as both a major sustainment system and as a key sustainment function. Further it not only recognizes austerity but stresses that austere logistics will be the central characteristic of the AirLand battlefield. Consequently, it addresses several critical areas and their impact with respect to transportation. Unlike FM 100-16, FM 100-5 recognizes that the continuity of

sustainment is provided chiefly by LOCs. Elaborating further, it emphasizes and cautions that the number, location and quality of LOCs may well determine the very structure and tempo of the campaign.⁴ With this in mind, it addresses the necessity and importance of altering LOCs, establishing sustainment priorities and forward staging in the event of LOC overextension. With respect to extended LOCs, it states:

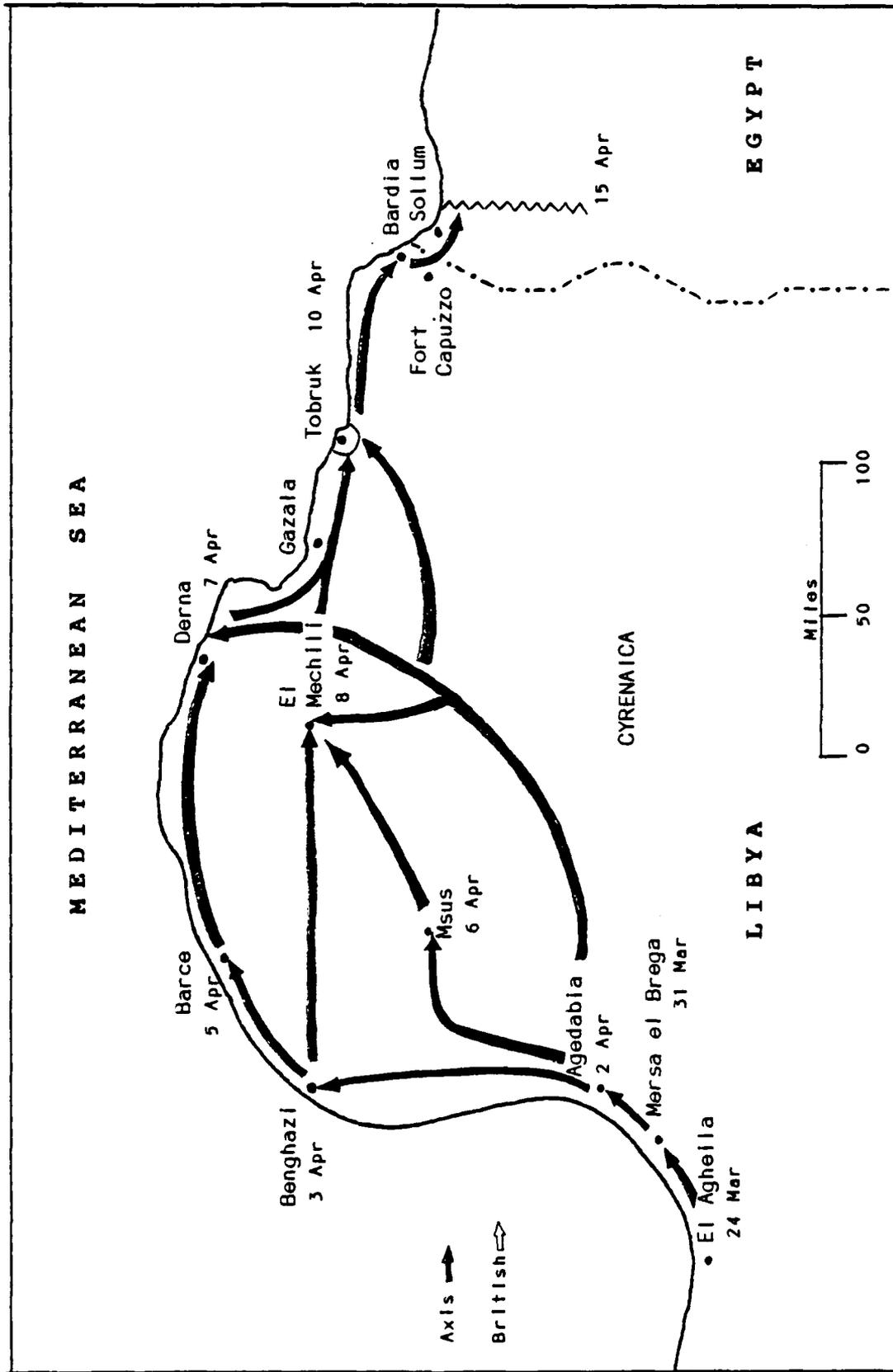
The length of the LOC directly affects combat power. Longer LOC consume more resources themselves, making fewer resources available to combat units. Long LOC are more susceptible to interdiction, need more transportation and maintenance support, and require earlier forecasting of requirements and longer lead time for delivery. Longer LOC also require more engineer effort, traffic control, and protection. The operational commander must therefore seek to support each phase of his campaign efficiently, and as⁵ the campaign progresses, adjust his LOC and support bases.

If we contrast this passage to the previous one from FM 100-16, it is clearly evident that the authors of FM 100-5 recognized the logistic lessons of the North African campaign.

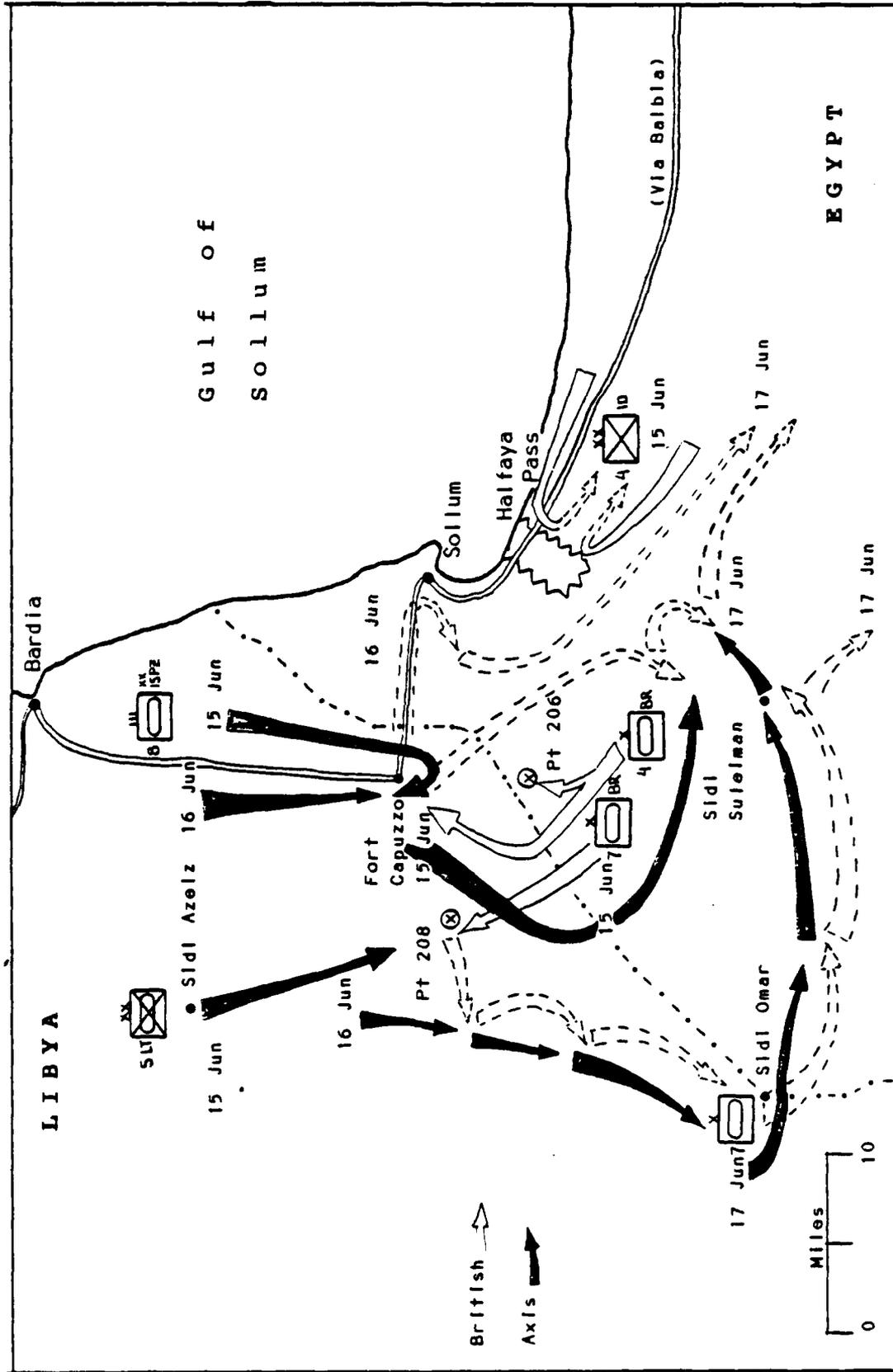
In summation, this study concludes that current logistic doctrine as espoused by FM 100-16 with respect to transportation at the operational level of war is inadequate. By contrast, operational sustainment doctrine as articulated in FM 100-5 is both sound and adequate. Historical evidence presented in this study does substantiate the manual's doctrinal discussion that transport shortfalls hastened by depth or interdiction will precipitate culmination.



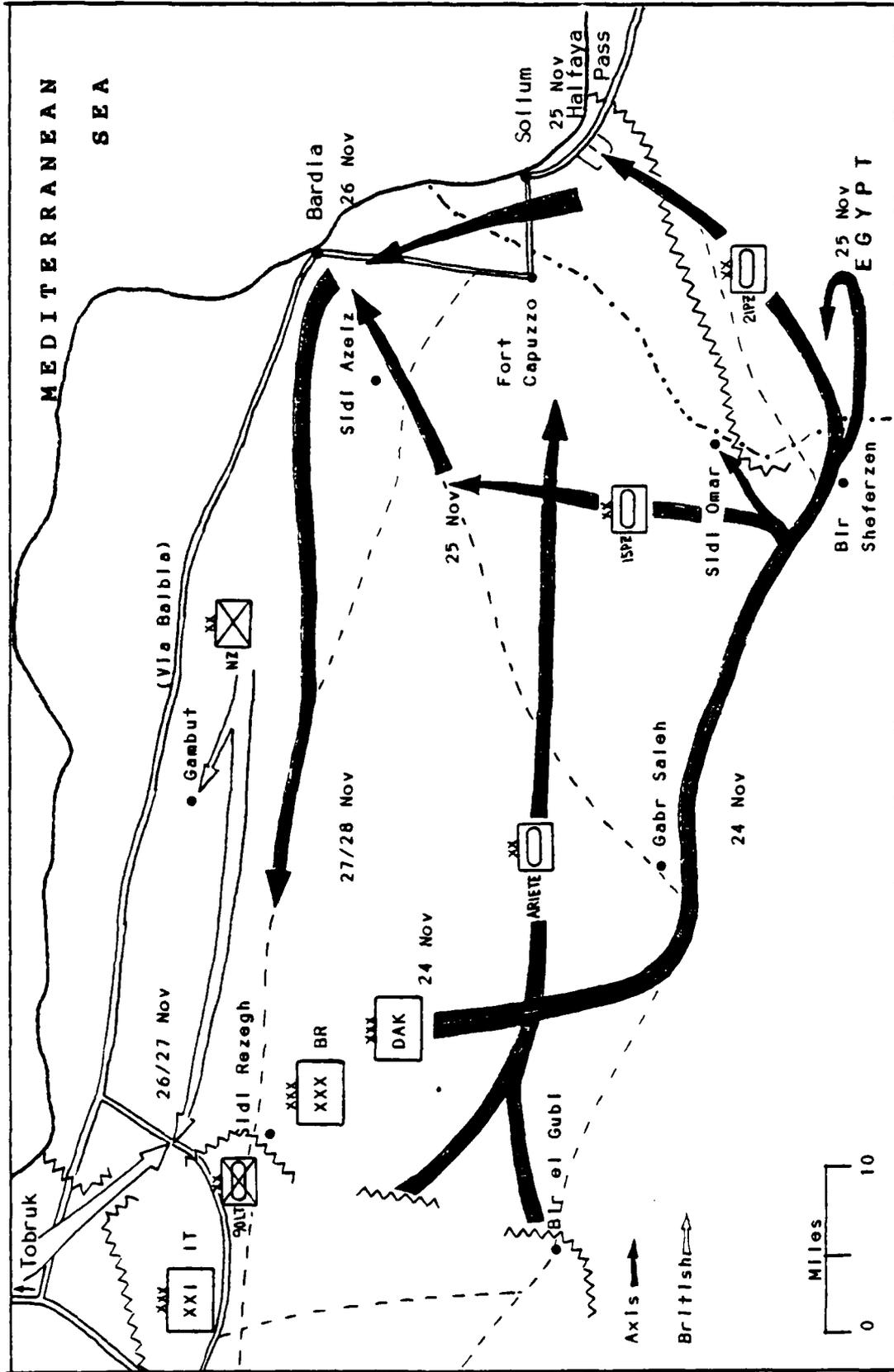
MAP A - THE STRATEGIC SETTING



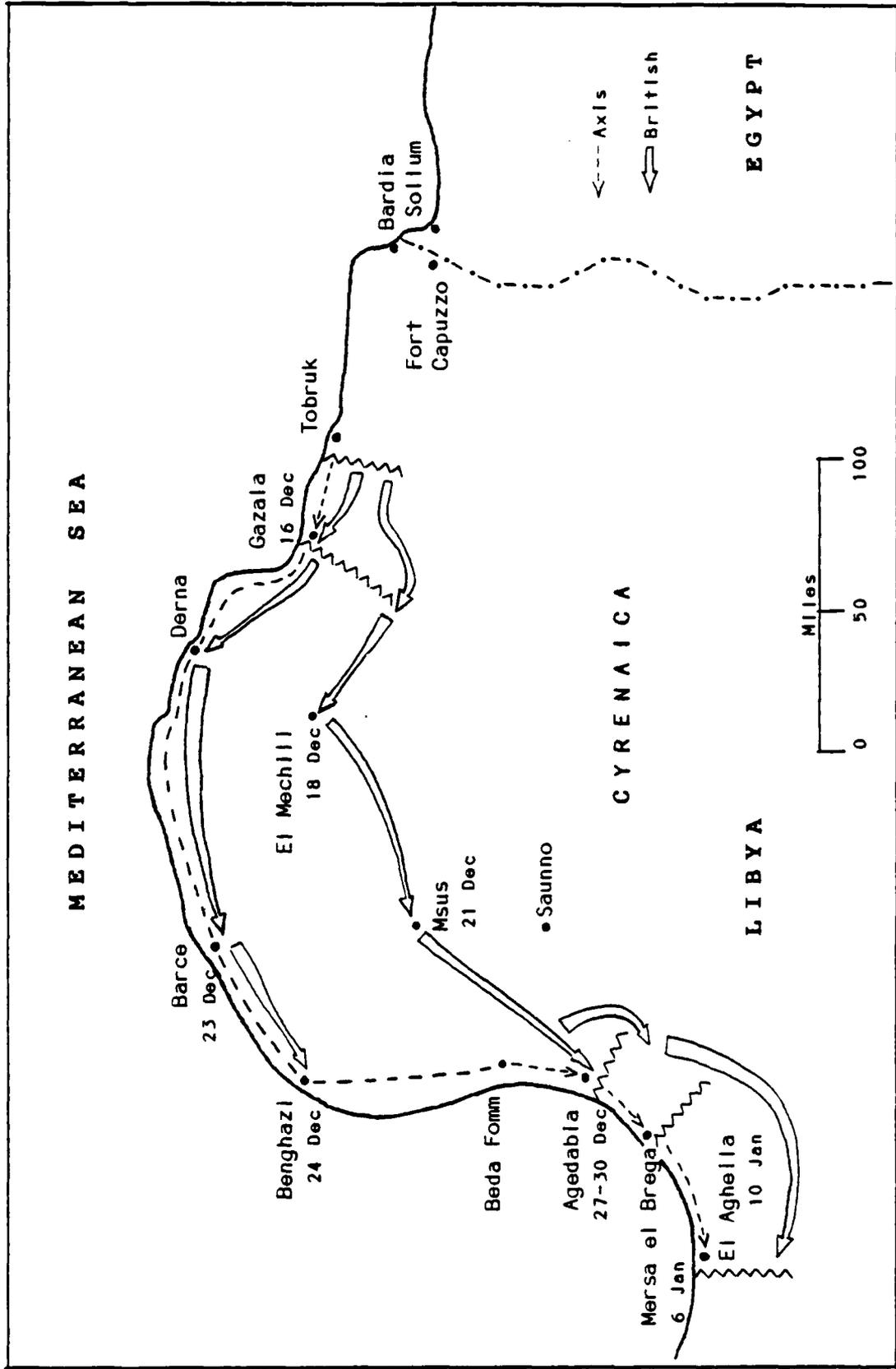
MAP B - THE RAID ACROSS CYRENAICA, 31 March - 15 April 1941



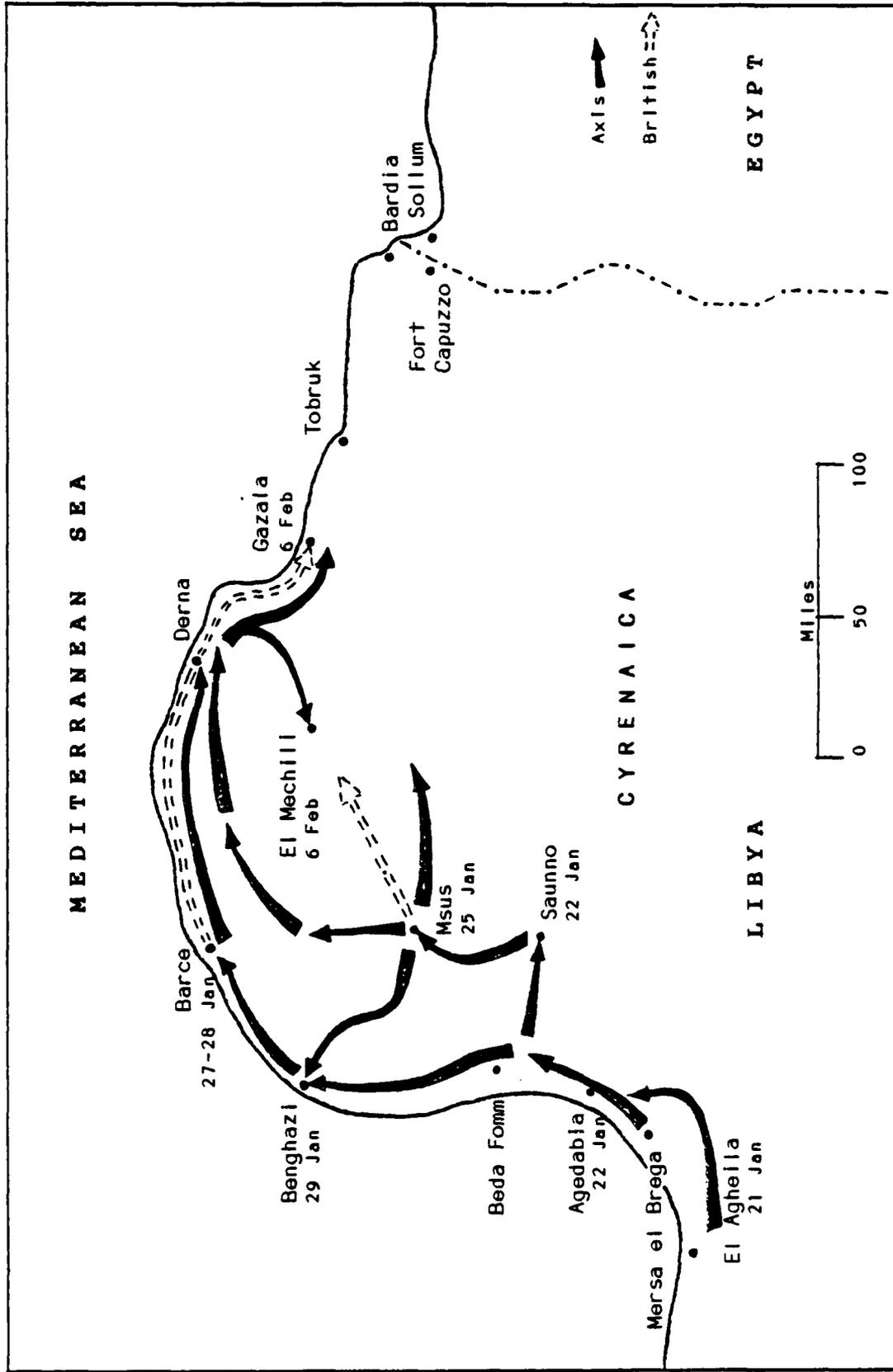
MAP C -- OPERATION BATTLEAXE, 15-17 June 1941



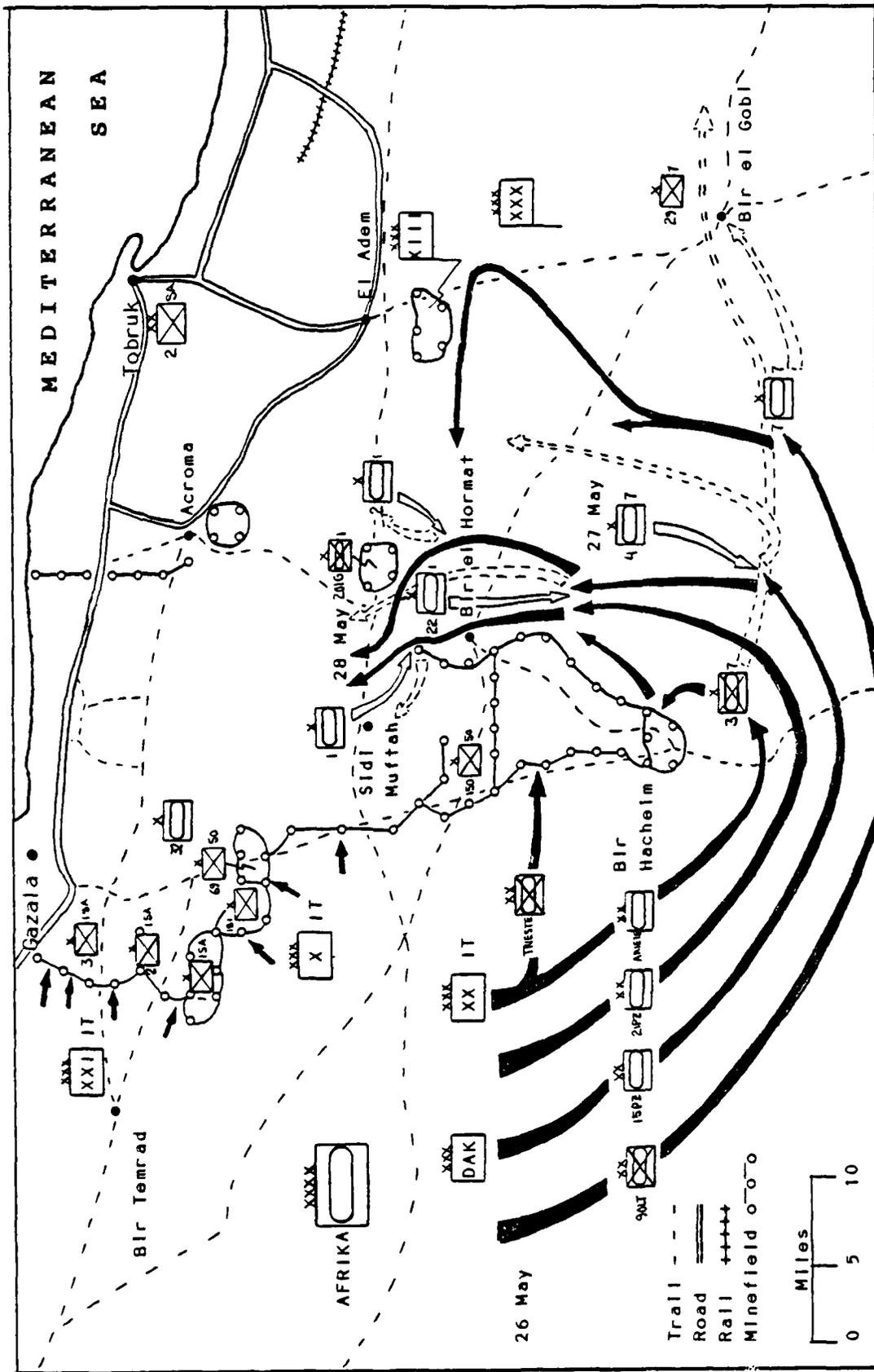
MAP F - OPERATION CRUSADER, 24-30 November 1941



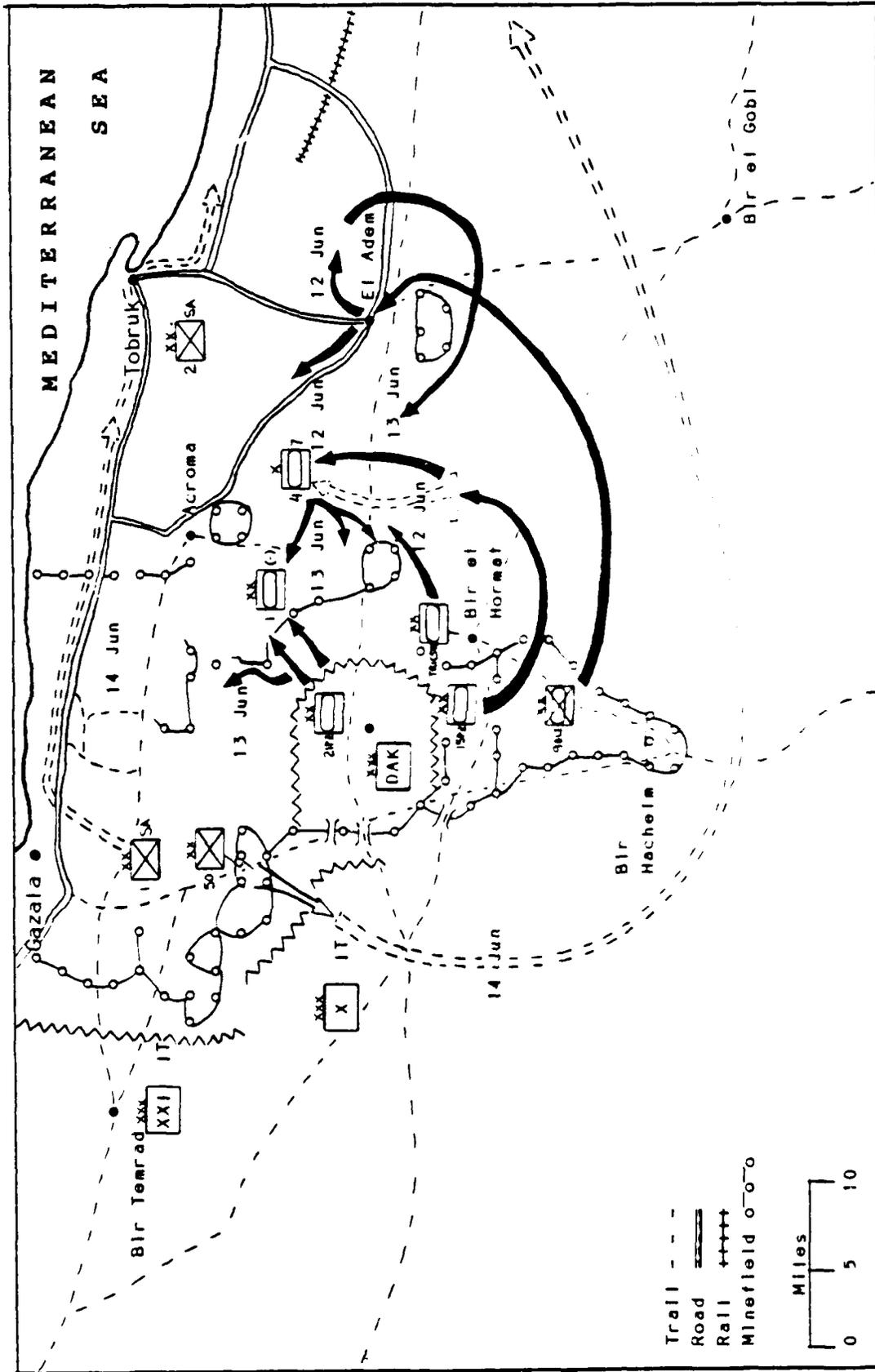
MAP G - ROMEL'S RETREAT, 6 December 1941 - 10 January 1942



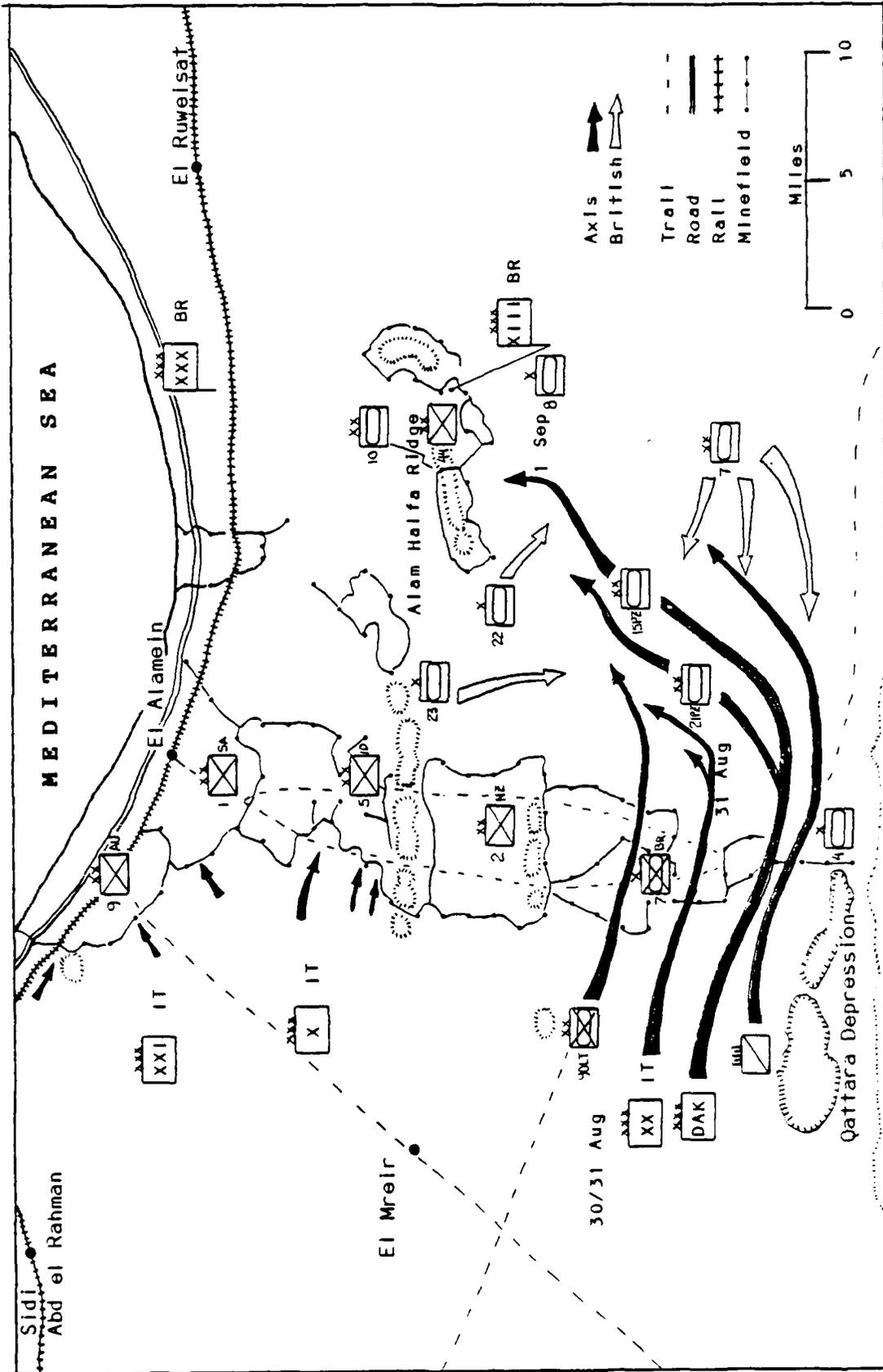
MAP H - ROMEL'S SECOND ADVANCE, 21 January - 6 February 1942



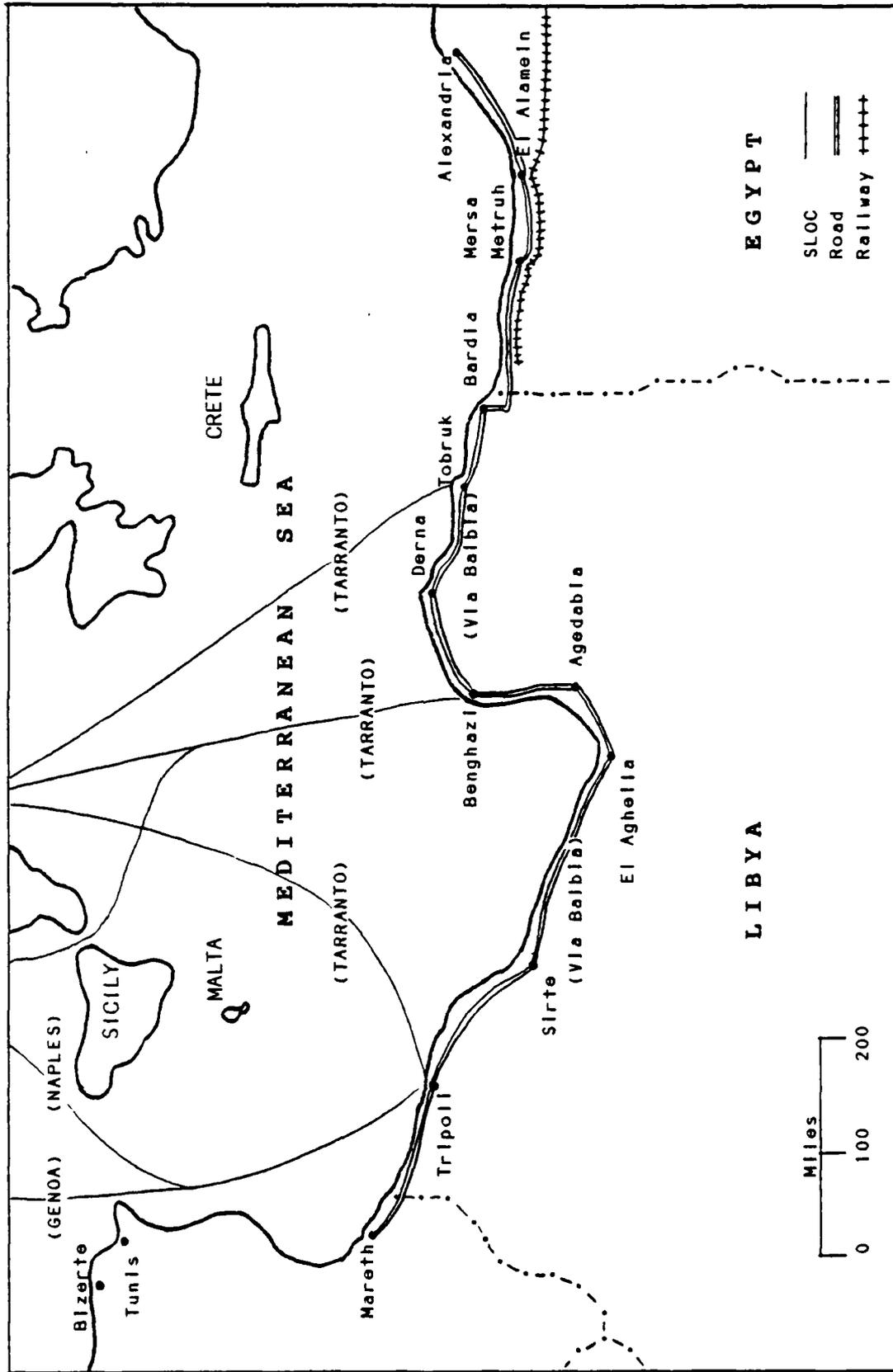
MAP I - GAZALA LINE, 26-28 May 1942



MAP J - GAZALA LINE, 12-15 June 1942



MAP K - THE BATTLE OF ALAM HALFA, 30 August - 1 September 1942



MAP L - LINES OF COMMUNICATION

ENDNOTES

Section I:

1. Martin Blumenson, "Constants in Warfare: The Relevance of Kasserine Pass," Army (March 1987), p. 52.
2. Carl von Clausewitz, On War, (Princeton, 1976), p. 170.
3. Ibid, p. 171.
4. North Africa as a secondary theater varied with the time frame of the campaign as well as the perspective of the Allies and the Axis. Throughout the campaign, the Italians viewed it as a primary theater of operations within a primary theater of war -- the Mediterranean. For the Germans the Mediterranean was their only active theater of war until Operation Barbarossa. Further, North Africa as a primary theater of operations fluctuated as the Germans also conducted operations in Greece, Crete and Yugoslavia. However, from June 1941 on, the Germans definitely considered the Mediterranean a secondary theater of war to the Eastern Front. By contrast, North Africa for the British was one of many theaters of operations -- East Africa, Palestine, Syria, Greece and Iraq -- within their primary theater of war. Initially, East Africa was the primary theater. After the Italian excursion into Egypt, North Africa became the primary theater of operations and remained so until the German intervention in Greece. For the purpose of this paper, we will use the German perspective. It is recognized that North Africa was the only active theater of operations within a Mediterranean theater of war. However, after June 1941 the Mediterranean became a secondary theater of war contrasted to the Eastern theater of war. As such, we will assume North Africa to be a secondary theater for the purpose of this study.
5. Martin van Creveld, Supplying War: Logistics from Wallenstein to Patton, (London, 1977), p. 1.
6. Baron de Jomini, The Art of War, (Philadelphia, 1862), p. 62.
7. Ibid, p. 233.
8. US Army, FM 100-16, Support Operations: Echelons Above Corps, (Washington, DC, 1985), p. Glossary-16.
9. Brian W. Davenport, "Operational Sustainment: Defining the Realm of the Possible," (Fort Leavenworth, 1986), p. 2.
10. US Army, FM 100-5, Operations, (Washington, DC, 1986), p. 65.
11. Ibid, p. 59.
12. Ibid, p. 59.
13. US Army, FM 100-10, Combat Service Support, (Washington, DC, 1983), p. 8-2.

14. US Army, FM 100-16, p. Glossary-8.

Section II:

1. Thomas E. Griess, The Second World War: Europe and the Mediterranean, (Wayne, 1984), p. 163.

2. Richard Collier, The War in the Desert, (Alexandria, 1977), p. 8. As Italy already held Lybia, Eritrea, Italian Somaliland and Ethiopia, Collier suggests that Mussolini's intent was to triple his empire in Africa.

3. Griess, p. 163 and James L. Stokesbury, A Short History of World War II, (New York, 1980), pp. 137, 139.

4. Griess, p. 165.

5. Martin van Creveld, "Rommel's Supply Problems, 1941-42," Journal of the Royal United Services Institute of Defense Studies, (September 1974), p. 67. See also Siegfried Westphal, "Notes on the Campaign in North Africa," Journal of the Royal United Services Institute for Defense Studies, (February 1960), p. 71.

6. Ibid, p. 67.

7. Westphal, p. 73.

8. T. L. McMahon, "Operational Principles: The Operational Art of Erwin Rommel and Bernard Montgomery," (Fort Leavenworth, 1985), pp. 38-39. See also van Creveld, Supplying War, p. 184. According to van Creveld, the Germans considered 200 miles as the transportation limit for effective supply by motor transport.

9. Kazimierz Glabitz, "Rommel versus Montgomery," Military Review, (March 1951), p. 74. See also Donald E. Kirkland, "Rommel's Desert Campaign, February 1941 - September 1942: A Study in Operational Weakness," (Fort Leavenworth, 1986), p. 5.

10. At this time, the primary British theater of operations had switched from North Africa to Greece. In reaction to the German intervention in the Balkans, Wavell transferred forces from North Africa to Greece. As such, the British aim was to conduct an economy of force defense in North Africa.

11. Erwin Rommel, Rommel Paper, (New York, 1982), pp. 105-106. According to Rommel, on 19 March 1941, General Brauchitsch (chief OKW) informed him that there was no intention of striking a decisive blow in Africa. However, Brauchitsch's directive to Rommel allowed for a limited attack as far as El Agheila. But there was to be no general offensive. In either case, Rommel was to do nothing until May 1941, nor could he expect any reinforcements.

12. Ward A. Miller, "The 9th Australian Division Versus the Africa Corps: An infantry Division Against Tanks -- Tobruk, Libya, 1941," (Fort Leavenworth, 1986), p. 6.

13. Rommel, p. 106. See also Collier, p. 63.
14. McMahon, pp. 39-40.
15. David Irving, The Trail of the Fox, (New York, 1978), p. 94. See also van Creveld, Supplying War, p. 186.
16. Rommel, p. 134. Discussing his poor supply situation, Rommel complained that the Italian failure to use Benghazi fully placed a tremendous strain on the Axis road transport. See also Irving, p. 94. Despite the proximity of Benghazi to the front over Tripoli, Irving states that the Italians refused to send their supply ships as the sea route was longer and the danger of British interdiction greater.
17. Miller, p. 6. See also Irving, p. 84 and F. W. von Mellethin, Panzer Battles, (New York, 1956), p. 67.
18. Ibid, p. 6.
19. I. S. O. Playfair, The Mediterranean and Middle East, Volume II, (London, 1956), p. 160. See also Collier, p. 70 and Kenneth J. Macksey, Afrika Korps, (New York, 1968), p. 27.
20. Collier, p. 70. Rommel considered that without possession of Halfaya Pass, his tenure of the positions outside Tobruk were at risk. Therefore, the pass had to be retaken and permanently held. See also Macksey, p. 27.
21. Rommel, p. 141 and Playfair, p. 163. See also Griess, p. 166.
22. Ibid, pp. 136-137. See also Macksey, p. 35. According to Rommel, the Halfaya and Sollum passes were points of great strategic importance for these passes were the only places between the coast and Habat where it was possible to cross the escarpment. In any offense from Egypt; therefore, possession of these were bound to be of utmost value to the British as they offered a comparatively safe route for their supplies.
23. Ibid, pp. 141-148. See also Macksey, pp. 35-37.
24. von Mellethin, p. 67. According to von Mellethin all German planning during the late summer and fall of 1941 was conditioned by the problems of supply.
25. Ibid, p. 67.
26. R. E. Rogge, "Crusader -- Slow Step to Victory," Armor (July-August 1984), p. 38 and Macksey, p. 43. To illustrate the effectiveness of British interdiction of his SLOCs, an entire convoy of 5 merchant ships totaling some 39,000 tons was sunk the night of 8-9 November 1941 by Force K and Malta based aircraft. See von Mellethin, p. 68 and van Creveld Supplying War, p. 190.
27. Ibid, p. 39.
28. Ibid, p. 39.

29. Collier, p. 85.
30. Rogge, p. 41.
31. Rommel, p. 169. See also Macksey, p. 56 and van Creveld, Supply War, p. 190. To highlight the effect of the interdiction of Rommel's LOC, British aircraft and marauding armored cars inflicted such heavy losses on the Axis supply columns traveling the LOC that transport capacity was reduced by half as movement was restricted to night-time only.
32. Collier, p. 89 and Griess, p. 167.
33. Macksey, p. 67.
34. Collier, p. 89.
35. Sherwood S. Cordier, "Rommel's Greatest Triumph -- The Gazala Campaign," Armor (May-June 1963), p. 69 and Macksey, p. 71.
36. Macksey, p. 73.
37. Cordier, p. 61. See also Griess, p. 169.
38. Collier, p. 91.
39. Macksey, p. 83.
40. Rommel, p. 233. See also Collier, p. 92 and van Creveld, Supplying War, p. 196. According to Rommel, "In winning our victory at Tobruk we too, had expended the last of our strength, for the weeks of very heavy fighting against an enemy superior in both men and material had left their mark on my forces. Now; however, with the vast booty that had fallen to us, including ammunition, petrol, food and war material of all kinds; a build-up for a further offensive was possible." According to van Creveld and Collier, this booty included 2000 vehicles, 1400 tons of fuel -- enough to fill-up his panzers for the drive to Egypt, 5000 tons of general supplies and large quantities of ammunition.
41. Correlli Barnett, The Desert Generals, (Bloomington, 1982), pp. 200-201. See also Sherwood S. Cordier, "Auchinleck Halts the Axis Tide," Armor (January-February 1965), p. 35.
42. Ibid, p. 212.
43. Collier, p. 93.
44. Rommel, p. 243. See also Griess, p. 167.
45. I. S. O. Playfair, The Mediterranean and Middle East, Volume III, (London, 1960), p. 381. As his prospects of reinforcement were slight, Rommel calculated that he must either attack prior to the end of August -- before the British could benefit from Allied convoys expected to arrive in early September -- or give up the initiative altogether.

46. Sherwood S. Cordier, "Alam Halfa -- Last Chance in North Africa," Military Review (November 1970), p. 68.

47. Playfair, p. 382. As supply stocks were so low, Rommel in a report to Comando Supremo dated 22 August 1942, stated that if Panzer Arme Afrika were to attack, it required immediate shipments of 6000 tons of fuel and 2500 tons of ammunition to arrive 25-30 August.

48. Cordier, p. 69. See also Alan Kinghorn, "The Turn of the Tide in North Africa," Armor (July-August 1967), p. 45.

49. Macksey, p. 107

50. Cordier, p. 74

51. Macksey, p. 113.

52. Barnett, p. 270. See also Macksey, p. 113.

53. Macksey, p. 113.

54. van Creveld, "Rommel's Supply Problems," p. 72. According to van Creveld, an issue of fuel -- verbrauchssatze -- represented the amount required to drive 100 kilometers and one issue of ammunition -- ausstattungen -- was that amount required for one days combat. See also Rommel, pp. 304-305. According to Rommel, experience had shown that the Panzer Arme consumed one issue of fuel each day in combat. Accordingly, the possession of only 3 issues of fuel distressed Rommel. Moreover, he felt that the Panzer Arme was crippled and could not react to the enemy.

55. Barrett, p. 285. Following the initial British breakthrough on 2 November, Rommel wanted to withdraw his forces to preclude their ultimate destruction. However, Hitler issued Rommel a stand and fight directive the next day. After the 8th Army completed its breakthrough by X Corps with its 3 armored divisions on 4 November, Rommel requested and received permission to withdraw.

Section III:

1. James Lucas, Panzer Army Africa, (San Rafael, 1977), p. 17.

2. Davenport, p. 18. See also Rommel, pp. 244, 328.

3. Albert Kesselring, "Kesselring's View of the African War, Part I," Donald S. Detwelier, editor, World War II German Military Studies, Volume 14, (New York, 1979), p. 15.

4. van Creveld, Supplying War, p. 201.

5. Westphal, p. 78.

6. US Army, FM 100-5, p. 64.

7. Glabisz, p. 77.
8. van Creveld, Supplying War, pp. 184, 187 and Irving, p. 94. According to van Creveld, Tripoli was the largest of the Lybian ports, capable of processing 5 cargo ships or 4 troop transports simultaneously and handling 45,000 tons of cargo monthly. Benghazi was capable of processing 2700 tons a day and Tobruk was capable of 1500 tons a day. Assuming a 30 day month, these figures translate into a monthly capacity of 81,000 tons and 45,000 tons respectively.
9. US Army, FM 100-5, p. 65.
10. Griess, p. 163 and van Creveld, Supply War, p. 182. See also Pitt, Western Desert 1941, p. 7.
11. van Creveld, Supply War, p. 182.
12. Ibid, pp. 184, 186. There appears to be a contradiction of figures in van Creveld's thesis. According to van Creveld, Tripoli's capability was 45,000 tons; however, he also states that in February 1941, the total supply requirement of the Axis forces in Libya was 70,000 tons per month. He further states that during the 4 month period February-May 1941, that the Axis forces received a total of 325,000 tons of supply or a monthly average of 81,250 tons. As such, this monthly average exceeds the port's capability almost two-fold.
13. US Army, FM 100-5, p. 65.
14. van Creveld, Supplying War, p. 184.
15. van Creveld, "Rommel's Supply Problems," pp. 70 and 72. See also von Mellethin, p. 67.
16. van Creveld, Supplying War, p. 186.
17. Playfair, The Mediterranean and Middle East, Volume II, p. 282.
18. Ibid, p. 282.
19. Ibid, p. 157. See also van Creveld, "Rommel's Supply Problems," pp. 68-69.
20. van Creveld, Supplying War, p. 190.
21. Irving, pp. 157 and 197; Lucas, p. 91; Lewin, p. 141; and van Creveld, Supplying War, p. 196. In their advance, Panzer Armees Afrika capture 600 trucks at Msus (25 January 1942); 1300 trucks north of Benghazi vicinity Coefia (27 January); 2000 vehicles and 1400 tons of fuel at Tobruk (22 June); and 500 tons of fuel at Capuzzo (22 June).
22. Playfair, The Mediterranean and Middle East, Volume III, p. 331.
23. Rommel, p. 266 and van Creveld, Supplying War, p. 190.

24. Playfair, pp. 190 and 331.

25. David A. Wood, "El Alamein -- A Study in Logistics," Unpublished Study, (Fort Leavenworth, 1986), p. 8. Using a ton-mile analysis (a transportation planning figure that measures transportation capacity by simply multiplying the tonnage to be moved by the distance it must travel), Wood's analysis provides the best framework to illustrate the Axis shortfall. Comparing port capacity, LOC length and availability/capacity of motor transport with the monthly supply requirement of 60,000 tons or 2000 tons per day, the author demonstrates a transport shortfall of 920,500 ton-miles or 892 tons of supply. Given an availability of 1600 2-ton trucks with a daily transport capability of 3200 tons and transport limited to 35mph for 12 hours per day due to road condition and air interdiction, able to travel 420 miles each day:

Transport requirement:

<u>From</u>	<u>LOC Length</u>	<u>Requirement</u>	=	
Tripoli	1350 miles	650 tons	=	442,000
Benghazi	680 miles	1350 tons	=	1,822,500
		2000 tons		<u>2,264,000 ton-miles</u>

Transport capacity: 3200 tons x 420 miles = 1,344,000 ton-miles

26. Irving, pp. 238-239.

27. Kesselring, "Final Comments on the Campaign in North Africa, 1941-1943," Historical Report MS # C-075, (Werle, 1949), p. 46.

28. Ronald Lewin, Ultra Goes to War, (New York, 1978), pp. 196-197. According to the author, the British were able to monitor the flow of supplies to Rommel across the Mediterranean by sea or air. As such, the British knew convoy routes, destination and the type and quantity of cargo carried. Further, Ultra permitted the British to keep abreast of Rommel's logistic state to include his fuel stocks.

29. Irving, p. 94 and van Creveld, Supplying War, p. 194. According to van Creveld, the Axis requirement was 100,000 tons. By contrast, Irving lists requirements as 24,000 tons for DAK, 20,000 tons for future operations, 9000 tons for the Luftwaffe, and 63,000 tons for the Italian forces in theater or a total monthly requirement of 116,000 tons.

30. Playfair, The Mediterranean and Middle East, Volume II, p. 281 and Volume III, pp. 107, 158, 163, 189 and 327.

31. van Creveld, Supplying War, p. 187.

32. Pitt, Year of Alamein, 1942, p. 145.

33. Playfair, The Mediterranean and Middle East, Volume III, p. 339.

34. Robert Debs Heinl, Jr, Dictionary of Military and Naval Quotations, (Annapolis, 1965), p. 175.

35. Ibid, p. 330.

Section IV:

1. US Army, Student Text 101-1: Organizational and Tactical Reference Data for the Army in the Field, (Fort Leavenworth, 1986), pp. 5-8, 5-14, 5-22, 5-27, 7-10 and 7-15. See also US Army, Student Text 101-2: Planning Factors, (Fort Leavenworth, 1985), p. 2-9.
2. US Army, FM 100-5, pp. 2-4.

Section V:

1. US Army, FM 100-16, p. 6-74.
2. Ibid, p. 6-74.
3. Ibid, p. 6-75.
4. US Army, FM 100-5, p. 61.
5. Ibid, p. 66.

BIBLIOGRAPHY:

BOOKS AND THESES:

- Barnett, Correlli. The Desert Generals. Bloomington: Indiana University Press, 1982.
- von Clausewitz, Carl On War. Translated by Michael Howard and Peter Paret. Princeton: Princeton University Press, 1976.
- Collier, Richard. The War in the Desert. Alexandria: Time-Life Books, 1977.
- Coggins, Jack. The Campaigns in North Africa. New York: Doubleday & Co, 1980.
- van Creveld, Martin. Supply War: Logistics from Wallenstein to Patton. London: Cambridge University Press, 1977.
- Davenport, Brian W. "Operational Sustainment: Defining the Realm of the Possible." Research Monograph. Fort Leavenworth: School of Advanced Military Studies, U.S. Army Command and General Staff College, 1986.
- Feige, Richard. "The Relationships Between Operations and Supply in Africa." Detweiler, Donald S. ed. World War II German Military Studies, Volume 14. New York: Garland Publishing, Inc., 1979.
- Great Britain. War Office. The Eighth Army, September 1941 to January 1943. London: H. M. Stationery Office, 1944.
- Griess, Thomas E. The Second World War: Europe and the Mediterranean. Wayne: Avery Publishing Group, 1984.
- _____. Atlas for the Second World War: Europe and the Mediterranean. Wayne: Avery Publishing Group, 1985.
- Gross, David F. "Logistics Implications of the Operational-Level Offensive." MMAS Thesis. Fort Leavenworth: U.S. Army Command and General Staff College, 1984.
- Irving, David. The Trail of the Fox. New York: Thomas Congdon books, 1977.
- Kesselring, Albert. "Kesselring's View of the African War, Part I." Detwiler, Donald S. ed. World War II German Military Studies, Volume 14. New York: Garland Publishing, Inc., 1979.
- Kirkland, Donald E. "Rommel's Desert Campaign, February 1941 - September 1942: A Study in Operational Level Weakness." Research Monograph. Fort Leavenworth: School of Advanced Military Studies, U.S. Army Command and General Staff College, 1986.
- Lewin, Ronald. Rommel as Military Commander. New York: D. Van Nostrand, 1968.

- _____. The Life and Death of the Afrika Korps. New York: Quadrangle/New York Times Book Co, 1977.
- _____. Ultra Goes to War. New York: Pocket Books, 1978.
- Lucas, James. Panzer Army Africa. San Rafael: Presidio Press, 1977.
- Macksey, Kenneth J. Afrika Korps. New York: Ballantine Books, 1968.
- _____. Rommel's Battles and Campaigns. New York: Mayflower Books, 1979.
- McMahon, T. L. "Operational Principles: The Operational Art of Erwin Rommel and Bernard Montgomery." MMAS Thesis. Fort Leavenworth: U.S. Army Command and Staff College, 1985.
- von Mellenthin, F. W. Panzer Battles. New York: Ballantine Books, 1984.
- Messenger, Charles. The Unknown Alamein. London: Ian Allan Ltd., 1982.
- Miller, Ward A. "The 9th Australian Division Versus the Africa Corps: An Infantry Division Against Tanks -- Tobruk, Libya, 1941." Fort Leavenworth: Combat Studies Institute, U.S. Army Command and General Staff College, 1986.
- Mitcham, Samuel W. Jr. Rommel's Desert War: The Life and Death of the Afrika Korps. New York: Stein and Day, 1982.
- Nichols, Howard V. "Operational Level Logistics: An Examination of U.S. Army Logistics Doctrine for the Operational Level of War." MMAS Thesis. Fort Leavenworth: U.S. Army Command and General Staff College, 1984.
- Pitt, Barrie. The Crucible of War: Western Desert 1941. London: Jonathan Cape, 1980.
- _____. The Crucible of War: Year of Alamein 1942. London: Jonathan Cape, 1982.
- Playfair, I. S. O. The Mediterranean and Middle East, Volume II: The Germans Come to the Help of Their Ally. London: Her Majesty's Stationary Office, 1956.
- _____. The Mediterranean and Middle East, Volume III: British Fortunes Reach Their Lowest Ebb. London: Her Majesty's Stationary Office, 1960.
- Rommel, Erwin. The Rommel Papers. Edited by B. H. Liddell-Hart. New York: De Capo Press, 1982.
- Stokesbury, James L. A Short History of World War II. New York: Willaim Marrow and Company, Inc., 1980.
- Wood, David A. "El Alamein -- A Study in Logistics." Student Research Paper. Fort Leavenworth: Combat Studies Institute, U.S. Army Command and Staff College, 1986.

Young, Desmond. Rommel: The Desert Fox. New York: Harper and Row, 1950.

PERIODICALS:

Addington, Larry H. "Operation Sunflower: Rommel vs the General Staff." Military Affairs 31 (Fall 1967): 120-130.

Barclay, C. N. "Crusader 1941." Army Quarterly [Great Britain] 82 (July 1961): 192-196.

Blumenson, Martin. "Constants in Warfare: The Relevance of Kasserine Pass." Army 37 (March 1987): 50-59.

van Creveld, Martin. "Rommel's Supply Problems 1941-42." Journal of the Royal United Services Institute for Defense Studies 119 (September 1974): 67-73.

Cordier, Sherwood S. "Rommel's Greatest Triumph -- The Gazala Campaign." Armor 72 (May-June 1963): 58-63.

_____. "Auchinleck Halts the Axis Tide." Armor 74 (January-February 1965): 34-41.

_____. "Alam Halfa -- Last Chance in North Africa." Military Review 50 (November 1970): 62-74.

Cullen, James F. "The First Battle of Sidi Rezegh." Armor 73 (September-October 1964): 48-51.

Glabisz, Kazimierz. "Rommel vs Montgomery." Military Review 30 (March 1951): 73-79.

Kinghorn, Alan. "The Turn of the Tide in North Africa." Armor 76 (July-August 1967): 42-47.

Luttwak, Edward N. "The Operational Level of War." International Security 5 (Winter 1980-81): 61-79.

O'Ballance, Edgar. "The Greatest Military Leaders: Rommel the Desert Fox." Asian Defense Journal 1 (January 1986): 77-78.

Patton, George S. "Operation Crusader." Armor 67 (May-June 1958): 6-19.

Rogge, R. E. "Crusader: Slow Step to Victory." Armor 93 (July-August 1984): 36-43.

Stark, Warner. "The German Africa Corps." Military Review 45 (July 1965): 91-97.

Taylor, John M. "North Africa Campaign: Logistic Lessons Learned." Military Review 68 (October 1983): 46-55.

Westphal, Siegfried. "Notes on the Campaign in North Africa." Journal of the Royal United Services Institute for Defense Studies 105 (February 1960): 70-81.

FIELD MANUALS:

Field Manual 90-3, Desert Operations. Washington, DC: Department of the Army.

Field Manual 100-5, Operations. Washington, DC: Department of the Army, 1986.

Field Manual 100-10, Combat Service Support. Washington, DC: Department of the Army, 1983.

Field Manual 100-16, Echelons Above Corps. Washington, DC: Department of the Army, 1985.

GOVERNMENT REPORTS:

Kesselring, Albert. "Final Comments on the Campaign in North Africa, 1941-1943." Historical Report MS # C-075. Werl: Historical Division, European Command, 1949.

END

10-87

DTIC