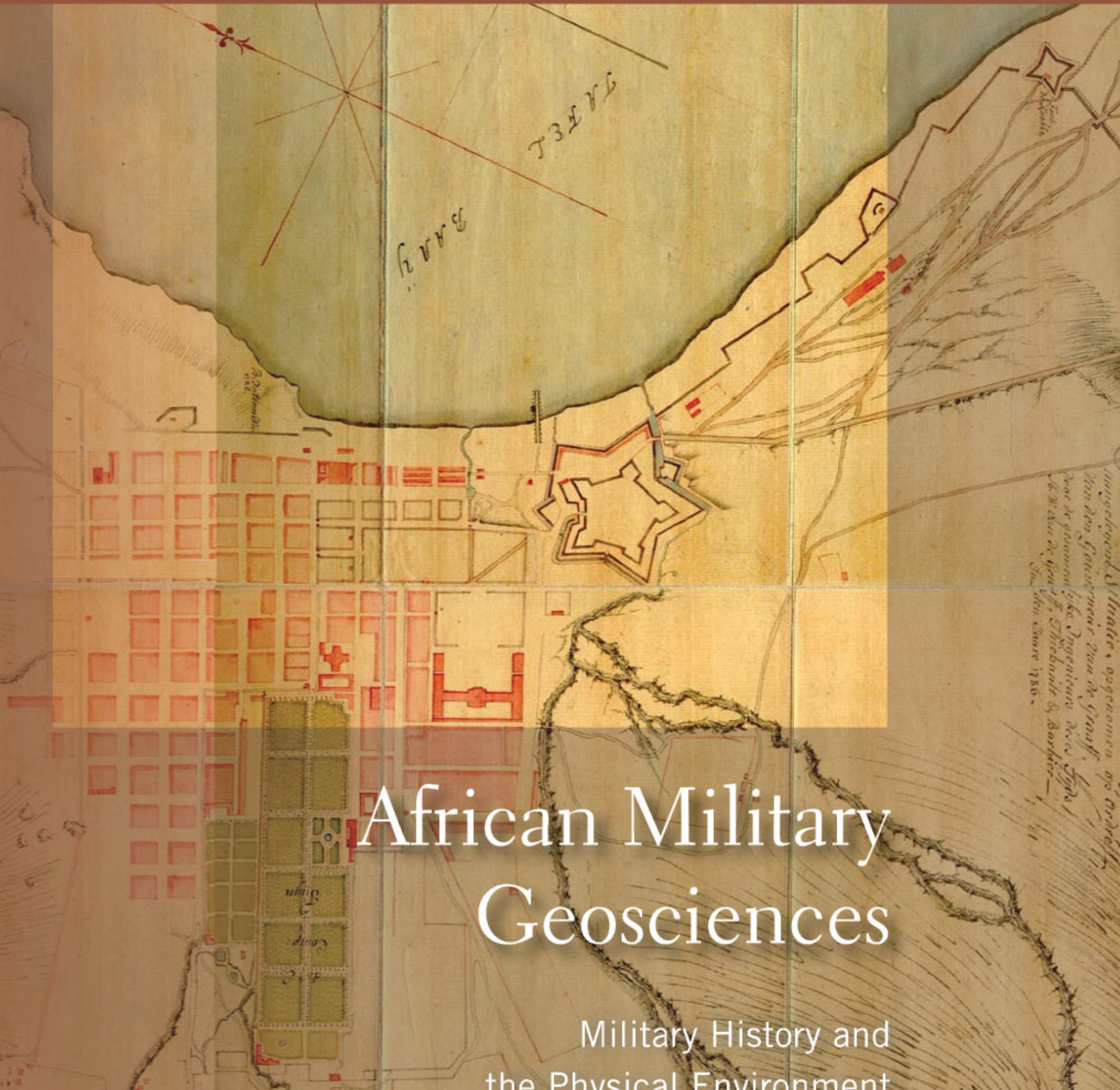
AFRICAN MILITARY STUDIES • Volume 1



African Military Geosciences

Military History and the Physical Environment

Jacques Bezuidenhout & Hennie Smit
Editors

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FOREWORD

African Military Studies

Series Editor

Ian van der Waag, Stellenbosch University

African Military Studies is an exciting, new series of books on war, conflict and armed forces in Africa. Covering the whole span of African history, and the full conflict continuum, the series seeks to encourage works on the drivers of armed conflict, the ways in which societies and armed forces prepare for and conduct war, the development of technology, strategy, tactics, and logistics in the African battlespace, and the impact of warfare on African societies. *African Military Studies* presents the latest research and accepts high-quality monographs, collections of essays, conference proceedings, and annotated military and historical texts. It is a library for the academic specialist, for the policymaker, and for the practitioner with "boots on the ground".

Volume Editors

Jacques Bezuidenhout & Hennie Smit, Stellenbosch University

The editors want to thank all the authors for their contributions towards this book, as well as their efforts to ensure that publication timelines were kept. We would also like to extend our sincere gratitude to the anonymous external reviewers for their thoughtful, insightful and critical scholarly evaluation of the manuscript. The comments and suggestions emanating from the double-blind peer review mechanism was an indispensable part of the process to guarantee the academic quality and integrity of the publication. In the final instance, we want to express our heartfelt gratefulness to Emily Vosloo from AFRICAN SUN MeDIA who patiently guided us through the publication process. May all who read the book find what they were looking for in a book of this nature.

INTRODUCTION

African Military Geoscience: Military History and the Physical Environment

Traditionally, military activities strongly depend on the physical environment of the operational theatre where a conflict transpires. The field of military geosciences study the relationship between these different physical environments and the associated offensive and defensive military tactics and strategies. Military geoscientific studies are mostly undertaken from either a geological or geographical perspective. Although there are some underlying relation between these perspectives, the theoretical approaches typically differs. The differences in these approaches, and the manner in which they guide the study of the impact of the physical environment in military historical geoscientific studies, are presented in the chapters of this book.

The ever-present relationship between warfare and the physical environment is well established. Throughout history, key elements of geology and geography have served as decisive factors in the conduct and outcome of military operations at the strategic, operational and tactical levels of war. In each area of military operations, a number of physical characteristics, unique to that area, combine to create a distinctive operational environment. The elements that render an operational environment unique provide a useful background for the study of the historical impact of climate and terrain on warfare.

The physical environment likewise shaped the course of wars in Africa. The continent is well known for its large variation in physical environments. This makes it an ideal theatre for investigating the impact of different environments on military activities. Despite this, the interrelationship between the physical environment and military operations in Africa is not well studied. This publication aims to address this disparity. The first chapter investigates the interaction between geography and military operations within southern Africa. Four very different physical environments are described and specific battles are discussed in order to illustrate the development of military organisations and tactics suitable to operations in each zone. These environments include coastal zones, deserts, tropical jungles and savannahs at high altitude. All the conflicts in this chapter date to the pre-colonial and colonial eras, and focus mainly on military operations during conventional and semi-conventional warfare. Subsequent chapters are arranged in chronological order.

The second chapter studies the impact of geology on coastal naval operations against the physical backdrop of Saldanha Bay, on the south-west coast of South Africa. The geology in and around the bay influenced the erosional patterns, creating an ideal natural deepwater harbour with various maritime and naval attributes. These natural characteristics also rendered it of great military strategic importance in times of war. Various navies used the bay during the age of sail, and it was even the scene of minor naval skirmishes. However, it was never fully developed as a port due to a shortage of fresh water. This all changed during the Second World War, when a freshwater pipeline was built to the Saldanha Bay area, so that the naval and military potential could be fully exploited. Chapter 7 discusses the unique physical features of the area surrounding the bay and how its military strategic potential was exploited during this war. The chapter further indicates how the geography of the area impacted on the planning and development of the Second World War harbour defences of Saldanha Bay.

Chapter 3 discusses the invasion of the Dutch settlement at the Cape on 11 *Jun*e 1795 by a British fleet. The settlement was small, but the formidable geographical features of the Cape Peninsula turned the balance of power in favour of the Dutch defenders. Despite the advantages offered by the geographical realities, the Cape was conquered by the British on 16 September 1795. This chapter explores the geographical realities of 1795, and the failure of the Cape defenders to use the favourable geography to maximum effect. Similarities between historical events at the Cape and in Saldanha Bay exist, such as the importance of safe anchorage and the operational support between naval and land forces. In both instances, the geographical realities played an unmistakable part in the unfolding of events during the period under discussion. Due to the close proximity of Saldanha Bay to the Cape, the bay area also saw some military action during the 1795 campaign.

The next four chapters of the book deal with the impact of geology and geography on military operations in Africa during the Second World War. They focus mainly on East and North Africa, where the Italian and German armies confronted the Allies. The deployment of South African troops to the East African theatre during 1940 afforded the Union Defence Force (UDF) the opportunity to test its military capabilities under operational conditions against the Italian forces in Abyssinia (Ethiopia) and Somaliland (Somalia). Chapter 4 shows that the East African operational environment, best described as complex and hybrid, distinctly influenced the operational deployment of the UDF throughout the campaign. From the extensive deserts of the Northern Frontier District to the coastal plains of Somaliland and the mountainous bastions of central and northern Abyssinia, the East African climate and terrain served as crucial determinants during the planning and execution of the South African and Allied military operations throughout the campaign.

Large parts of Africa were relatively unexplored and poorly mapped before the start of the Second World War; as a result, the war effort of both the Axis and Allied forces in East and North Africa was supported by geological units. Chapter 5 discusses the 42nd Geological Section of the South African Engineer Corps that supported British forces during the East African campaign. Geological and geophysical surveys helped to open up routes for the successful advance of British troops into the Italian-occupied countries of Abyssinia and Somaliland. The Geological Section was also involved in well-drilling in order to develop water supplies in North Africa, the Middle East, and some of the islands in the Mediterranean.

Geology is a major determining factor when military operations are conducted in desert environments. The German forces were well aware of this before and during their invasion of North Africa, and supported their effort with various geological expeditions. Chapter 6 looks at the work of *Wehrgeologenstelle 12*, the military geology team that aided and supported General Erwin Rommel's forces during the Western Desert campaign. They prepared information on off-road trafficability and the location of potable water, and performed geological investigations to find locations for the positioning of defences. Maps for assessing off-road trafficability of northern Libya were provided to the German military in support of operations in that theatre of war.

The concluding chapter investigates the Cuvelai-Etosha Basin that connects southern Angola and northern Namibia. This was essentially the theatre of the 1966-1989 war for Namibian independence. The Cuvelai-Etosha Basin is characterised by a gentle topography covered with savannah vegetation. During the rainy season, much of the area is transformed into a deltaic marsh, which makes it difficult to navigate by vehicle. Knowledge and understanding of the operational environment are essential components of military operations, and this chapter demonstrates the importance and influence of geography on conflict.

African Military Geosciences: Military History and the Physical Environment illustrates the inescapable effects of geology and geography on selected military operations conducted on the African continent over a period spanning more than five centuries. Lessons learned in the study of these activities are essentially timeless; they are as relevant today, and will be in future, as during the past 500 years. The chapters in this book investigate warfare on the African continent – military actions and a military environment that have not been addressed adequately, or at all, in previous similar compilations. It should therefore be of great interest to the international military geosciences community. Furthermore, it contains chapters dealing with naval warfare, a subject rarely addressed in Military Geology and Geography research. It will make a significant contribution to the literature on the subject, and should provide a basis for future research.

The Editors

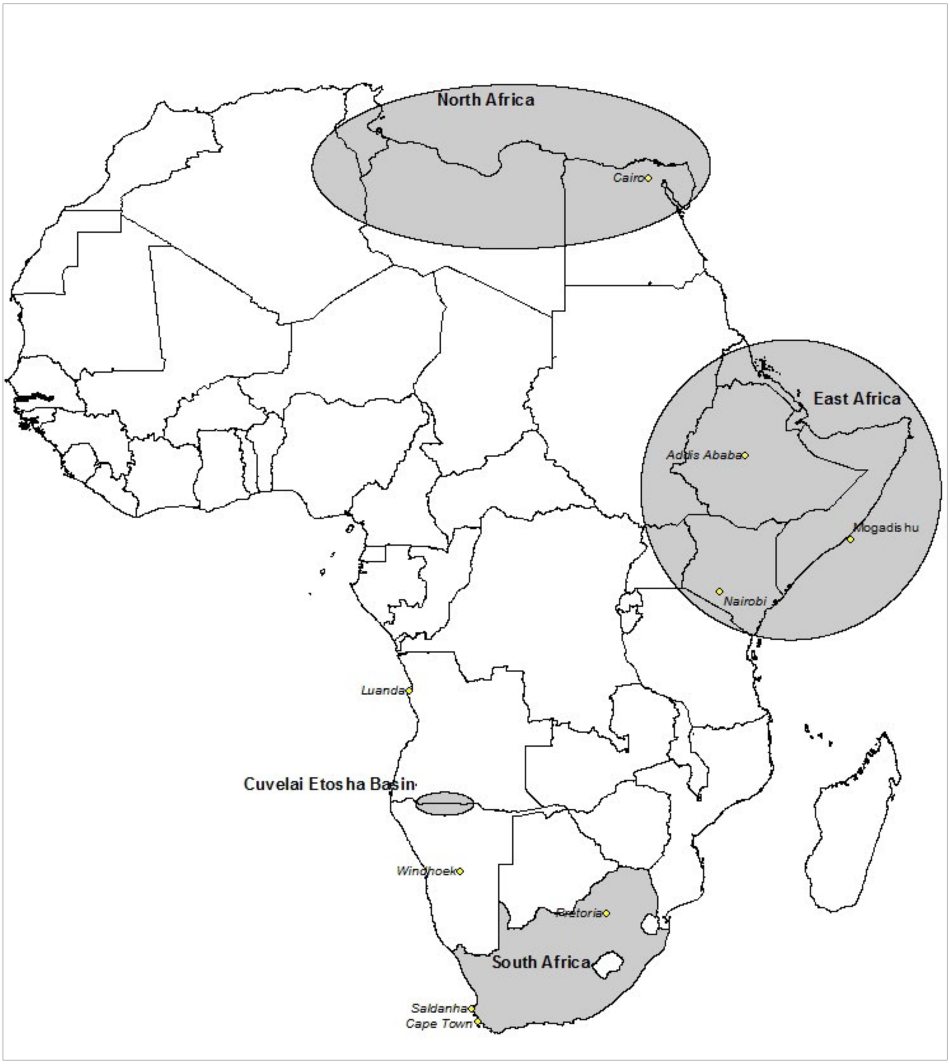

Figure A Map of the areas covered by the eight chapters in *African Military Geoscience: Military History and the Physical Environment*

Source: Map by B. Mtshawu

CHAPTER 1

The influence of terrain and climate on military operations in South Africa

Ian van der Waag

Introduction

The study of the military history of Africa and its relationship to the physical environment is in its infancy. Here, as elsewhere, warfare formed part of longer term patterns of behaviour with deep roots in social structure and the physical environment. The physical environment, attitudes and perceptions, and technological innovation combined to form the conditions of conflict and shape the nature of the warfighting. This chapter considers this interface between geography and military planning and operations, and the study of military history within the southern African context. The value geographic knowledge holds for military commanders – something that is often ignored, and with disastrous results – is discussed with a focus on the ways in which water, or water scarcity, impact upon military planning, strategy and tactics. A four-zone typology for politics and warfare in southern Africa is proposed. The four-zones or environments are described and, using specific battles and battle spaces as illustration, the ways in which spaces shaped patterns of human settlement, the development of military organisations, and the conduct of military operations during the pre-colonial and colonial eras are considered.

Ian van der Waag, Department of Military History, Faculty of Military Science
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Reconnoitring the landscape

The central theme of this chapter is the spatial patterns of military activity during the past 1 000 years of southern African history. Three factors have determined these patterns: the physical environment or total physical setting in which military activity took place; the attitudes, perceptions and forms of social and military organisation of the people who occupied that environment; and, lastly, the technologies developed and military innovations made by their armed forces. These three factors – place, people and technology – interact in a variety of ways. Some environments encourage, others permit; and yet others restrict military activity. Conversely, as technologies improve, man comes to dominate his environment, which might be tamed and shaped according to military planning and the pursuit of desired military and security outcomes. Perceptions and attitudes, although ever-present variables, are fickle and unpredictable, and, unsurprisingly, the relationship of armed forces with the environment, modified constantly through technological innovation and social and military change, has been immensely complex.[1]

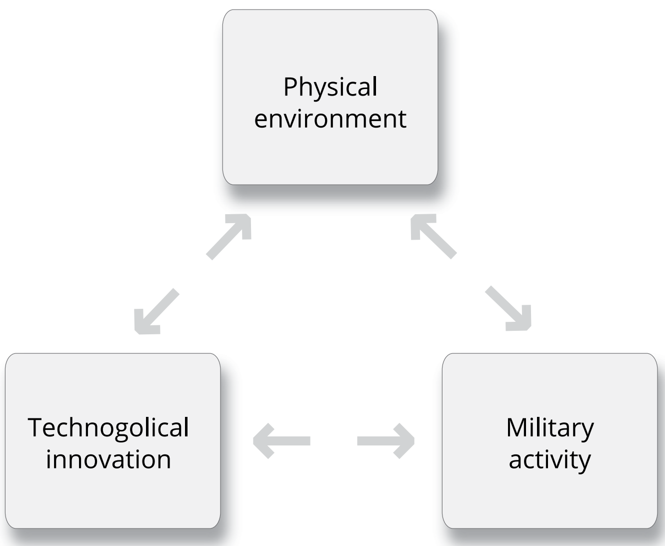

Figure 1.1 The relationship between the physical environment, military activity, and technological innovation
Source: Developed from N.J.G. Pounds, *An Historical Geography of Europe*, p. 1

A considerable body of literature has developed on the relationship between the environment, peoples more widely, and the diffusion of technologies. The term "frontier", usefully defined by Howard Lamar and Leonard Thompson as 'a territory or zone of interpenetration between two previously distinct societies', has, for example, been used by historians to explain some of these processes.[2] Fernand Braudel, French historian of the *Annales* School, went much further. For Braudel there are perhaps 'a hundred frontiers, not one, some political, some economic, and some cultural.'[3] His first book, on *The Mediterranean and the Mediterranean World in the Age of Philip II* (1949 in French), was his most influential. In it, Braudel argued for three levels of time. The first is environmental or geographic time (the *longue durée*), where change is almost imperceptibly slow, with repetition and cycles. While change on this timescale may be slow, it is also irresistible. The longer term social, economic and cultural history, focussing on discussions of economy and of social groupings, empires, and civilisations, is Braudel's second level of time. While change at this level is much more rapid than that of the environment, it may still take several hundred years to detect patterns. The third level (*histoire événementielle*) is the time of short duration – the time of politics, events, and of individual people who might be identified by name. He expounded on the *longue durée* in his final book, *L'Identité de la France* (*The Identity of France*), which was published posthumously in 1986. France, he argued, was 'the product not of its politics or economics, but rather of its geography and culture' and, therefore, time and place had to be integrated into the broad sweep of history. His concern remained with centuries and millennia rather than specific events, years and decades.[4]

This debate resonates within the domain of military history. Most notable among scholars in the field is perhaps John Keegan, the eminent British military historian who drew together some of these arguments in his *History of Warfare* (1993). In this well-informed and broad sweep of global military history, Keegan addresses wide-ranging aspects – stone, flesh, iron, fire – and places these within the framework of the history of warfare. Alongside the chapters he included four interludes, the first of which addresses the 'limitations on warmaking.' Keegan follows something of a Braudelian line. These limitations, he argues, are imposed in part by legal and moral restraints. Yet, by far the most important constraints belong to the domain of the physical environment, or what the Soviet General Staff called "permanently operating factors". Beyond human jurisdiction, these factors include weather, climate, terrain and vegetation, and serve to 'affect, inhibit, or sometimes altogether prohibit the operations of war.'[5] These "permanent" factors affect other, "contingent" factors – such as difficulties in the raising, supplying, training and quartering of armies – and combine to constrain the scale, intensity, and duration of combat. Growing prosperity and technological innovation may reduce, or perhaps even largely overcome, some of these limitations. Nevertheless, concludes Keegan, no single limitation 'can be said to have been eliminated altogether.'[6]

Keegan's thesis is controversial. His argument that the "permanent" and "contingent" factors impose severe restrictions on the nature and scope of offensive or defensive operations – to the extent that 'most of the globe's dry land has no military history'[7] – has drawn critical comment. John Thornton, for example, has taken him to task for oversimplifying the complexities of African warfare and succumbing to a greater problem of African invisibility in world and comparative history.[8] Keegan's map, which divides the world into "military" and "non-military" zones, is unfortunate. Yet, what is clear (and what Thornton himself develops further) is that some environments – desert, rain forest, mountain ranges – remain inhospitable, often lacking good water resources and good road and rail networks, which severely limits strategic and tactical options. In many cases, warfighting in these areas may be limited to skirmishes between small groups of well-equipped soldiers.[9] Keegan's point, that the physical environment might increase the likelihood of strife or impose limitations through vegetation, the physical environment and, most importantly, the presence or absence of water, is well made.

The physical and historical geography of South Africa illustrates these arguments. Situated at the southern extremity of the African continent, South Africa stretches from Cape Agulhas northwards to the Limpopo River and covers a total surface area of some 1 223 000 square kilometres. This is larger than the combined land surface of the United Kingdom, France and Germany. The country has seven ecosystems, ranging from subtropical for most of the country to the Mediterranean climes of the Western Cape. Physically, the country takes the form of an upturned saucer: a large plateau enclosed by an escarpment, quite precipitous in places, that separates the Highveld from an often broad coastal plain. There is a rich diversity in the landscape: fertile valleys and fine beaches, but also vast arid and semi-arid areas, beneath which lie some of the oldest archaeological and human fossil sites in the world as well as great quantities of precious and semi-precious stones and precious metals.[10]

The provenance of this mineral wealth is ancient. The heart of the country overlies the Kaapvaal Craton, which dates back some 3,7 billion years, to the Achaean era. This is perhaps the most ancient of continental crusts. The craton, or "Golden Arc", was once a large inland lake and stretches from Johannesburg to Welkom. Silt and deposits from at least six rivers brought alluvial minerals that settled in the area to form rich deposits. Jan Smuts, in reference to this mineral wealth, once said: 'God emptied his pockets over this southern continent, and scattered on our land not just gold and other mineral wealth but beauty and something to appeal to the human spirit.'[11] The trove of gold, diamonds, platinum, coal, and many other metals and minerals, the richest discovered in any one country, transformed South Africa from a collection of small, colonial states into the largest industrialised powerhouse on the African continent.[12] The ownership and control of these precious metals and minerals, and the strategic value they accorded, first to Kruger's Republic, then to Britain, and in the twentieth century to an independent South Africa, was the cause for military conflict. Transvaal gold and a devastating total war fought at the end of the nineteenth century, introduced the boundaries of modern South Africa. The forging of a South African nation would, however, wait another hundred years.[13] Importantly, however, these conflicts, or wars of South African unification, were unevenly distributed across the terrain of modern South Africa. In fact, as figure 1.2 shows, most of the warfighting occurred in the eastern half of the country. This raises many important questions regarding the relationship between armed forces and the physical environment in southern Africa.

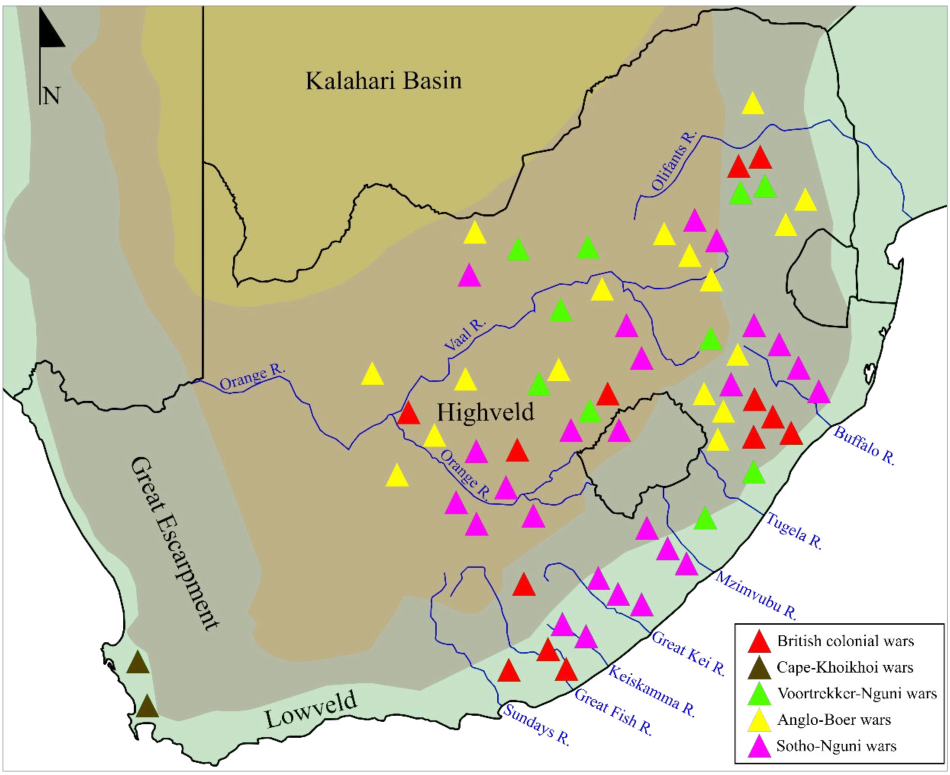

Figure 1.2 The physical features of the landscape and zones of conflict[14]
Source: Drawn by E.P. Kleynhans, 2018

The nature and importance of geographic knowledge

The physical geography of South Africa was, of course, not always an open book. The logic of waterways and river systems is often difficult to understand. There were no maps as such for South Africa during the pre-colonial period. Much as was the case in North America, 'tribal neighbours were more often enemies than friends, inclined to take and torture an interloper rather than help him on his way.'[15] Nevertheless, for trade, and during periods of upheaval and migration, Africans carried the physical patterns of the landscape in their heads and, no doubt, marked specific trails with motifs on trees and rocks, having learned something of the terrain from the tracks beaten by larger game. Although this did not amount to a "key" to the subcontinent, Africans knew the shape of the environment they inhabited.[16] However, there were no known maps for any part of southern Africa when the Portuguese, and later the Dutch, began their early surveys.

Reports of copper and later gold in the interior spurred exploration in the seventeenth and eighteenth centuries. However, until at least the mid-nineteenth century, the vision of the travellers, adventurers, and scientists remained patchy and superficial. They knew of the Indian Ocean and the coastal plains of the modern Eastern Cape and KwaZulu-Natal, which had first been probed by the Portuguese in the late fifteenth century, and then by the Dutch, the French and later the British in the ensuing centuries. But they had little idea of the existence of the Drakensberg, no comprehension of the river systems of the Highveld, no knowledge of the vast central plateau and its well-watered eastern zone, and certainly no apprehension of the existence or extent of the vast interior of the subcontinent. The task, no simple venture, would only be completed in the twentieth century.

The explorers and adventurers who travelled southern Africa came and went. Some were men of means. Some were government-funded. Some were sponsored by geographic societies. Some, like Simon van der Stel (1639-1712), set out in search of mineral wealth. All professed a desire to contribute in some way to the expansion of scientific knowledge, the description of fauna and flora, and, in a paternalistic fashion, of the local, African peoples. Some, like William Burchell (1781-1863), who focussed on the natural history of the region, held narrow interests. Others, like John Barrow (1764-1848) and Karl Lichtenstein (1780-1857), travellers who left accounts showing their wider concerns, held more diverse interests.[17] Published works by generalists and specialists alike proliferated during the nineteenth century. George Thompson (1796-1889), who explored the Cape Colony and its eastern and northern frontiers during the 1820s, noted in the preface to his *Travels and Adventures* that because 'southern Africa has been traversed during the last fifty years by so many travellers, whose works are familiar to the public [...] that it is a common notion in England that there is nothing relating to that country of any general interest which is not already sufficiently known.'[18] Not subscribing to this view, Thompson told his readers that the majority of travellers who had penetrated the hinterland were natural scientists aiming to search out the plant and animal life of the subcontinent.[19] But, since the day of Barrow and Burchell and the others, greater attention was given to geography, agriculture, and commercial networks. These aspects spoke to the strategic value of an area.

British travel writer, Jan Morris (born 1926) has described the British Empire of the late nineteenth century as a vast 'development agency', an international structure geared to the distribution of 'technical knowledge around the world, and [the erection of] what economists were later to call the infra-structure of industrial progress – roads, railways, ports, posts and telegraphs.'[20] This is a rather flattering image of empire, but one that draws interest in the context of this chapter. The Empire was mapped, much of it for the first time, often by soldiers, sometimes by private enterprise. The Royal Geographical Society brought military men and privately-funded explorers together and linked them to government officials and agencies. Imperial defence and strategy remained the primary drive for the surveying and charting of imperial territories, with an emphasis on areas identified for pacification or further expansion.[21]

The result was a rather patchy system that neglected much of South Africa. When formed in 1912, the Union Defence Forces (UDF) lacked maps in respect of more than half of the surface of the country. With few exceptions, there weren't any maps of the South African coast suitable for operations, and the only good military maps were for the 'old trouble spots', including the eastern Orange Free State, Basutoland, and the Kalahari south of the Orange River to latitude 31 degrees.[22] As F.S. Malan, a member of the Botha cabinet, noted during the unrest in the Transkei in November 1914, knowledge of the terrain and good infrastructure allowed 'the timely concentration of the district's troops and the conduct of politics of investigation and diplomacy.'[23] Much trouble was taken in the ensuing years to fill the cartographic gaps. In January 1923, the HMSAS *Protea* surveyed St Helena Bay, which was then identified as the most likely beachhead for a German invasion force.[24] Further north, in 1921, Major J.G.W. Leipoldt, a surveyor by profession, had charted the headwaters of the Okavango and Kwande rivers and the Lunge-Vungo River to within 160 kilometres of the Northern Rhodesian frontier, as well as parts of the Zambezi River basin. These surveys, although commissioned by the Department of Agriculture, were vitally important to the UDF and planning for potential war against the Portuguese colonies.[25] Military men, seeking adventure during times of peace, played key roles as scientists and mapmakers, sometimes consolidating the work of others, occasionally striking out, as Leipoldt did.[26]

In the story of the contacts between Europe and Africa, and among Africans themselves, there are numerous examples of formal military campaigns. Yet far more frequent was the low-level warfare that occurred continuously between communities as part of the constant birth, growth and disintegration of social and political entities. For most Africans, and the later Afro-Europeans, warfare was a way of life and, defining social role and function, formed part of longer term patterns of behaviour with deep roots in social structure and ecology. Climate and, by implication, natural disaster added to the conditions that both created and inhibited war. Long cycles of wet and dry weather, with years of plenty and of drought, was highly destabilising and triggered migrations that fed the slave trade and enhanced both the appeal of the social bandit and power of the warlord. Terrain and climate, as John Thornton has argued convincingly, therefore created or prevented conflict in regions where nature increased the likelihood of strife (through an abundance of water for example) or imposed limitations through vegetation, the physical environment and disease, as well as lack of water.[27]

Geography and the physical environment impacted greatly on the conduct of operations. This impact varied from terrain that supported large-scale operations to landscapes that limited operations or even prevented large-scale operations entirely. Knowledge of both the climate and terrain was (and still is) crucial for the conduct of successful operations – something many somewhat myopic European commanders learned to their detriment, suffering defeat or losing large proportions of their forces to tropical diseases and the hot and humid African climes. In 1872, on the eve of his departure for Ashanti, Garnet Wolseley, one of the more far-sighted of Victoria's generals, issued a pamphlet on jungle warfare and the health risks imposed by exposure to excessive humidity and the monsoons to his troops; and on their voyage out, his staff and he studied meticulously both the nature of the Ashanti army and, as importantly, the nature of the terrain on which they would engage.[28]

Most nineteenth-century commanders did not plan with Wolseley's thoroughness, and all were blinkered by the lack of published knowledge. This the Duke of Devonshire (1808-1891), an original founder of the Royal

Agricultural Society and a trustee of the British Museum, acknowledged when in 1877 he warned of Britain's deplorable knowledge of the physical geography of regions in her national interest.[29] Such concerns, together with the growing body of personal accounts, gave rise to several publications on a variety of related topics, from the conduct of colonial operations to the impact of geography on imperial military planning.[30] The classic primer for colonial warfare was Colonel C.E. Callwell's *Small Wars: Their principles and practice,* which was first published by the War Office in 1896 and reprinted several times until 1914.[31] Europeans possessed both the technological edge and substantial knowledge of their African opponents, yet victory in small wars, as Callwell and others knew, was far from automatic. Superior technology provided European forces with a tactical advantage in battle, but, as was all too often the case, African opponents enjoyed a strategic advantage and could control the pace of war by maximising their knowledge of the terrain and climate, refusing battle, and adopting guerrilla strategies.[32] The counter-guerrilla operations European powers adopted in response demanded increasingly accurate knowledge of the nature of the opposing African forces, as well as more detailed information about the terrain on which those forces would be encountered. This gave rise to works such as *The Native Tribes of the Transvaal* (1905)[33] and Captain D.H. Cole's *Imperial Military Geography*, which appeared for the first time in January 1924.[34] Cole's tome was expanded in July of that year and saw nine revised editions to the eve of the Second World War. *Imperial Military Geography*, the first volume to treat imperial geography globally, provided the British colonial administrator and his military counterpart with a 398-page introduction to 'the resources of the various parts of the Empire as well as a guide for further reading. Power, they realised, subsists on knowledge production.

The impact of climate on military operations became a primary concern for Victorians. The lack of forethought regarding weather, and of rainfall more especially, was noted to have defeated armies. In Africa, climate and its associated diseases killed more men than did gunfire, necessitating 'constant and increasingly efficacious measures on the part of army commanders to counteract them.' Cole identified three ways in which climate influences warfare. Firstly, it influenced the health and efficiency of the troops. European troops were susceptible to tropical diseases, including malaria and yellow fever, which, along with heat and humidity and the lack of a good water supply, impaired their physical condition and military efficiency. The colonies were synonymous with death, and Africa was characterised in both memoirs and fiction as 'the white man's grave.'[35] The gathering pace of advances in medical knowledge and infrastructure development, which resulted in improved hygiene and sanitation, more appropriate clothing and better provisioning, and the increased use of pipelines to secure reliable water supplies, eventually countered such notions.[36]

Secondly, Cole highlighted the impact of climate on movement, whether by land, sea or air. Movement overland in undeveloped tropical countries depended greatly on tracks, which, for portions of the year, became roaring torrents or quagmires impassable to horses and gun carriages. Gradually European soldiers mastered African rivers and overcame the effects of the rains. Gunboats were placed on the Nile and the Lakes of East Africa;[37] and the railway locomotive, utilising water in another form for propulsion, provided increased circulation of a more sophisticated range of provisions.[38] Yet technology went only so far, and even Jan Smuts, an Afro-European master at manoeuvre warfare, had to rest his East African troops during the 1916 rainy season.[39]

The third impact of climate is on production. Some regions can support large field armies, while others, for want of water and arable land, necessitate sophisticated logistic arrangements whereby every morsel of food and can of water has to be conveyed to the front. Climate (and most particularly the availability of water) therefore also determines whether a place has value as a base of supply for a campaign in another theatre.[40]

A commander, about to operate in a region, must therefore ask a variety of critical questions, which range from the expected temperatures and the impacts of humidity on efficiency to whether there are any periods of the year when movement may be impeded by an abundance or lack of water. In order to answer these questions, every commander ought to have sufficient information about the climate (and geography more generally) of the theatre of operations, and arguably most of all information on temperature, wind systems, rainfall and humidity.[41] Yet, until recent times, the information available to military commanders was often limited to general rainfall statistics. The South African commanders who planned the German South West and East African campaigns of the First World War, for example, had scant knowledge of the water sources in either German colony.[42] Recognising the problem, Smuts tasked his intelligence officer, Major Johann Leipoldt, with gleaning this information from captured German documentation and creating a reliable rainfall and water resource database. This work was extended after the First World War to other areas of strategic interest to South Africa. As we have noted, Leipoldt, a surveyor by profession, also journeyed to the source of the Cunene in 1920, where he tested the water capacity of the Etosha Pan and the Cunene River and examined the western scheme of the headwaters of the Okavango ("Cubango" on the Angolan side of the border) and Cuando rivers, and the Lungue-Bungo River.[43] This was followed in 1921 by a survey of the Kalahari water supply and a study of the Okavango and Nkarikari rivers.[44] Suitably qualified, and no doubt seeking a post-war role for himself in the Union Defence Force, Leipoldt argued in 1921 for the creation of a Survey Corps for the UDF. This never materialised, and, disappointed, he resigned from the UDF in 1923. His dream was partly realised when the 1st Field Survey Company was established as a Citizen Force unit of the South African Engineer Corps with effect from 1 April 1938, staffed by personnel from Trigonometrical Survey offices across the country.[45]

Water and the levels of war

Water influences operations at practically every level of war. Cole identified five strategic frontiers, all of which are associated with water: the sea, swamps and rivers relate to an abundance of water; deserts to a dearth of water; and mountain ranges to watersheds (table 1.1). Zones of low habitation, such as arid and semi-arid regions, mountain ranges, swamps, tropical forests and jungle, and, of course, the sea itself, provide strategic strength and limit the defence to a few vital points.

Table 1.1 Natural frontiers hold strategic advantage

Strategic frontiers	Defensive value	Offensive value
Sea	Prevention of overland invasion	Projection of sea power by a maritime nation
Rivers	Obstacles if across the path of advance	Opens options if parallel to the advance
Mountain ranges, deserts, swamps	Refuges for the tactically weak	Safe bases for raiders

Source: Developed from ideas contained in D.H. Cole, *Imperial Military Geography: General Characteristics of the Empire in Relation to Defence*, London: Sifton Praed, p. 192

The land frontier of South Africa, formed for the most part by the arid and semi-arid regions of the Kalahari and Namib, provide considerable protection against invasion from the north. This natural barrier largely limited an invader's path to the Lebombo bottlenecks between the arid region on the one side, and the sea on the other. The battlefields of many centuries that dot modern-day KwaZulu-Natal and the eastern Highveld bear witness to the defensive power exercised by the Kalahari.

Such a barrier, protected by the absence of supplies and particularly of water, compels any army moving across the region to keep to definite and easily anticipated routes.[46] Here the South African invasion of German South West Africa in 1915 is another good illustration. The South Africans, facing the Namib Desert, were confined to a choice of three approach routes at most, and once their decision was made, they could not shift the point of attack, due to a complete lack of lateral communications.[47] However, recent developments in engineering lessened the protective power of the Namib: Railways were constructed from the coast along the three lines of advance, enabling the South African forces to keep in touch with their base and obtain supplies. Pipelines for the transmission of water or fuel, roads and motor transport, and the use of wire netting laid on the sand as a car track reduced the difficulties of movement; while aircraft allowed for easier and more effective reconnaissance.[48] Yet, even with modern engineering skill and in the face of an inferior retreating force, the heat and a lack of adequate water supplies, confinement to one or a few definite lines of advance, and the blocking of rails by sand combined to make operations a matter of time and considerable difficulty.[49]

Deserts, which per definition lack water resources, pose the greatest of military obstacles, but not by any means the only ones. Regions of water abundance, such as *swamps*, marshes and good rivers also provide barriers to penetration. As Colonel Hugh Wyndham, South Africa's first intelligence chief, noted to his mother in 1916, excessive flooding made it impossible to relieve the British forces in Mesopotamia, and Smuts, at the same time, was also delayed by the rainy season in East Africa; therefore, on two fronts an abundance of rainwater brought 'a muddled position'.[50] Swamps, Cole thought, were more difficult to cross than a moderate range of mountains; and, it would appear, they were an even greater obstacle to the use of tanks than are deserts, mountains or even rivers. But, as Lord Cobham noted during the East African campaign of the Great War, marshes could have an offensive military value: 'It looks at last as if we are just seeing the last of the Boshes in Africa. Only 1 000 left in E. Africa, & they are cooped up in a marsh where they will die of fever in 3 weeks. Let them – if we attack them we shall lose 20 good men, worth more than 1 000 scoundrels.'[51]

Rivers, although visible and easily recognisable, make poor frontiers. They do not separate peoples, but rather form a means of communication and therefore of trade. The valley on both sides tends to become single economic entities and, as a result, nations tend to build themselves around rivers, rather than be separated by them. As military obstacles, they offer defensive lines which have been exploited by all great commanders. However, their use depends on whether they are parallel to the direction of attack or across it. They can therefore either form defensive moats or, parallel to the advance, provide a greater choice of routes, all of which must be watched by the defenders.[52] The defensive or offensive use of a river naturally depends too on the number of tributaries, the possibility of navigation, and the presence of bridges, fords, roads and rail communications. Still, rivers that lie across the direction of attack do not confer the same defensive strength as a moderate mountain range. Moreover, lateral communication by rail and road parallel to a river is normally good, as it tends to follow the valley, and forces can be quickly moved from one point to another to attempt a crossing. Armies, as the Belgian forces in the Congo River Basin showed during the late nineteenth century, are therefore not confined to a few definite (and often ill-suited) roads.

The offensive value of a river is naturally great when it runs along or parallel to the line of advance, especially if navigable. It then relieves the congestion of traffic on the roads and railways. Illustrations are not found in South Africa, although good examples are found elsewhere in Africa: Dodd's Dahomeian campaign and Kitchener's Sudanese expedition are classics.[53] Other important determining factors of the defensive strength of a river are its width, depth and speed, and the height of its banks; whether it is lined by marshes or passes through gorges; bridges, ferries, communications leading to bridgeheads, and so on. Climate, too, is a consideration, for if a river freezes over it may destroy its defensive value; in southern Africa this was, however, never a possibility.[54]

The use of water in another form produced steam power, which was harnessed both for ships and river boats, as well as the rail locomotive. This brought a wider network of penetration, which could now also be achieved more quickly. In southern Africa, due to the absence of good rivers, steam-powered rail was always more important for moving troops and supplies across the subcontinent, supplying and re-supplying them, and (sometimes) providing them with additional firepower. Broadly speaking, European colonisation in Africa was successful because the Europeans had mastered water by the projection of power over the seas and oceans and then into Africa herself, using her river systems – as Kitchener did on the Nile, the French did on the Senegal and the Niger, and the Belgians did on the Congo.

Rivers and *seas* attract and separate people in equal measure, and both provide axes of advance. The sea, having served as a great divider and defensive zone for the British Isles, was transformed by the advent of steam power into a means of uniting regions and continents. It enabled the British and continental powers to move with relative ease to almost any part of the globe. Sea power allowed European states to land troops at undefended or weakly defended points on an enemy's coast, and enabled them to conduct campaigns concurrently in Europe, the Americas, India, and Africa. It made, as Cole noted, 'the enemy's coastline the frontier of Great Britain.'[55] And the same could be said of France, Germany, Belgium and Portugal.

Four environments for politics and warfare

Water not only created opportunities for, and obstacles to, warfare; it also shaped the terrain as well as the nature of the states formed and the armies fielded. The warfare waged, in turn, reflects both the geographies and natures of these states and armed forces.

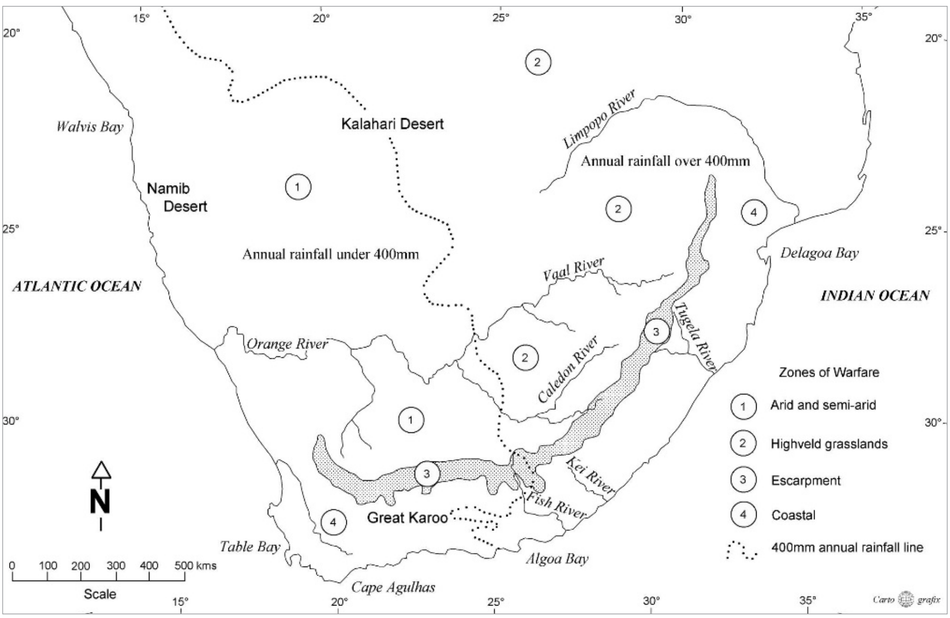

Figure 1.3 South Africa and the four environments for politics and warfare

The general physical features of the South African theatre, as shown in figure 1.3, comprise a coastal plain, an interior plateau (the arid and semi-arid regions in the west and Highveld grasslands in the east), and an escarpment that marks the transition between the two. South Africa's varied geography makes for a diverse climate; mostly semi-arid, but subtropical along the east coast. The Highveld, on account of its altitude and remoteness from the sea, is subject to marked temperature variations between winter and summer. These extremes of heat and cold, and the general tendency of the temperature to rise in summer and fall in winter, are shown in table 1.2. Cautious commanders, throughout South African history, have taken cognisance of climate and topography in the planning of operations. Shaka and Mzilikazi planned all major operations for the harvest season, when food was plentiful. The Boers likewise timed their ultimatum to the British in October 1899 to coincide with the start of the summer. This was crucial, as much of the coastal region – through which the British troops had perforce to move – burns up almost to a desert during the hotter months. The moment the British broke through the escarpment north-east of Cape Town and moved beyond Ceres, they were exposed to severe heat and lack of water, and found little to sustain them in the countryside: perhaps only some sheep, goats, and ostriches.[56]

Table 1.2 Comparative temperatures in South Africa, in degrees Fahrenheit

	East coast (Durban)	Veld (Bloemfontein)	West coast (Cape Town)
January (summer)	74,1	73,4	59,5
July (winter)	68,4	47,3	54,3
Variation in average in temperature	5,7	26,1	5,2

Source: I.J. van der Waag, 'South Africa and the Boer Military System' in P. Dennis and J. Grey (eds.), *The Boer War: Army, Nation and Empire.* Army History Unit, Canberra 2000, p. 52

Belligerents in southern Africa encountered several scenarios defined largely by the presence or absence of water. The greatest political and military contrast was between the extensive and powerful Sotho and Nguni kingdoms anchored in the basins of the Limpopo, Crocodile and Tugela river systems, and the elusive, fleet nomads of the desert. The deserts and semi-arid regions of the west; the Highveld, which forms the core of central South Africa; the coastal plains and the escarpment formed four environments for politics and warfare (table 1.3).

The central plateau lies at 1 000 to 2 000 metres above sea level. It is flat or undulating, broken only here and there by solitary rounded hills (*koppies*) and mesas. It comprises terrain ranging from the rolling, fertile plains of the highveld and the wide open bushveld (savannah) of Mpumalanga to the red sands and scrub grassland of the Kalahari Desert. With an average altitude of 1 000 metres, the veld slopes down gradually from east to west, and all the major rivers thus flow across the plateau to the Atlantic, where there are no ports of consequence. In the north-east, the highveld plateau descends to the bushveld and Limpopo river valley. The 400 millimetres rainfall line demarcates the two warfare zones: a western arid zone, and an eastern grassland zone.

Table 1.3 Natural frontiers and the four-zones of warfare in southern Africa

Zones of warfare	Strategic frontiers	Nature of armies
Arid and semi-arid regions	Sea, desert	Light infantry
Highveld	Desert, mountains	Heavy infantry
Escarpment	Mountain ranges	Light infantry
Coastal plains: eastern zone	Swamps, rivers, mountains	Heavy infantry
western zone	Rivers, mountains, deserts	Light infantry & mounted infantry

It must, however, be stated clearly, and from the outset, that these zones were permeable. They shaped the ways in which polities formed and armies were raised, but they did not preclude the passage and later growth of those states and armed forces across several of these zones. The Dutch colonists, for example, showed a surprising ability to survive the British occupation: either by acculturation into the new structures, or by avoidance and trekking away further into the hinterland. This migration – later historicised by Afrikaner historians as 'The Great Trek' – was set in motion in the 1830s and eventually led to the establishment of a series of small, fractious Boer republics on the Highveld and eastern coastal plain. The commando system survived the British occupation and was transposed to Natal, the Orange Free State and the Transvaal, where it served as the military system for the Voortrekker communities. Without exception, all Voortrekker leaders (the wealthiest of the immigrants) were experienced commandants.[57] After a period of internecine squabbling and several setbacks, a commandant in charge of all commandants was deemed necessary. This eventually gave rise to the ranks of commandant general and chief commandant (*hoofkommandant*).[58] The small republics survived through accommodation with the local African polities, backed on several occasions by demonstrations of their superior firepower. Soon bankrupt and facing military defeat and possible annihilation, each of these republics in turn was absorbed by a larger neighbour, until ultimately all were annexed to the British Empire. Yet, this historicisation is a misnomer. Several treks were taking place at the same time.

Possibly the greatest treks of all were happening elsewhere in South Africa. This was part of the process known as the *Mfecane* ("crushing"), which from the late eighteenth century transformed the African polities on the Highveld and along the eastern coastal plain. In essence, the Mfecane was a series of wars triggered by drought and commercial competition, and exacerbated by the migration of Nguni groups escaping the violence on the eastern coastal plain onto the Highveld. Low-level warfare with periods of intensification was a way of life in Africa, defining both social role and function. Ecological disaster and the mass migration it triggered was part of the *longue durée*. Destabilisation and migration supplied the slave trade, and enhanced the appeal of the social bandit, as well as the power of the warlord. The latter seized the opportunity to assimilate large numbers of new clients into the warband, giving rise to new states.

What made the Mfecane different was the intervention of colonial groups (both slavers and trekkers). Slave raids were conducted from the Portuguese base at Delagoa Bay in the north, and by some Griqua groups from the south, across the Orange River. The impact of these raids, coupled with continued drought and insecurity within, led thousands of Africans to migrate across the central Highveld during the 1820s. Faced with similar circumstances in their new homes, some sought refuge as clients of relatively powerful, or at least defensively astute, chiefs, such as Moshoeshoe I (c.1788-1870) of the Sotho.

Zone 1 warfare: Arid and semi-arid regions

Thinly populated, with unfavourable agricultural conditions and open country, the arid and semi-arid regions of southern Africa – from the Kalahari Desert to the semi-arid West Coast – precluded long violent clashes between large numbers of people. Moreover, the death of a hunter inevitably meant loss of food and 'a fight once begun is feared almost like atomic warfare.'[59] The San,[60] who peopled southern Africa from time immemorial, avoided conflict whenever possible.[61] They were organised in small groups or bands, each comprising no more than 25 people. Wealth, which was seated in access to hunting grounds and adequate water rather than lordly obedience, induced supporters to follow. Military power relied on the voluntary enlistment of free people with their own equipment. The region was therefore more or less permanently led by people whose strength and prestige was largely achieved through their own merit, with followers whose numbers waxed and waned with the seasons.

Marshall (1960) described the San as a 'present-orientated people who make no great effort to hold the past in memory or teach their history to their children … no one remembers a time when things were very different'; as a result, 'the history and origin of settlement and of individual bands is lost in the past.'[62] However, over the past decades, the interface between history, archaeology and social anthropology has pushed back the occupation of southern Africa by several millennia. The pre-colonial populations have traditionally been distinguished as hunters, herders and farmers, but more recently, scholars have suggested that the criteria defining these groups should be considered as relative rather than absolute. Increasingly, the evidence suggests intensive interaction between the three types.

Pastoralists, who called themselves Khoikhoi, and hunters and gatherers who domesticated stock, moved into the subcontinent and occupied the veld of the western zone by 1 000 AD. The main invasion routes were along the western and eastern margins of the Kalahari basin, and through the river and water systems of the wetter veld zones. Contacts between the San and Khoi ranged from economic and cultural interaction to open warfare. The Khoi regularly fought each other and the San for access to resources (chiefly water) and gradually pushed the hunters out of territory suitable for their pastoralism. Forced into the more arid fringes of the veld, the San in response raided Khoi cattle and sheep. It was natural for the San, attempting to keep own-force battle casualties to an absolute minimum, to adopt a strategy that allowed them to deny battle and focus on the enemy's weakness.

The San used a variety of materials – ranging from stone and shell to plant fibres and animal products – and they fashioned, to a minor extent, their environment to make living easier. Yet, the areas they occupied were not uniform. Hunters in the drier territories migrated, while those in the wetter coastal areas were more sedentary. The patterns of migration conformed to the needs of the group: the presence of water or tracking game. Some San communities acquired domestic livestock from pastoralists some 2 000 years ago. The Khoi and San used the same weapons and tools, between which there was also little differentiation. Both possessed bows and arrows, bone-tipped spears and snares, and traps and digging sticks, which might be used to hunt and gather or defend territory. The effective range of the bows was limited – perhaps only 25 yards – but both the Khoi and the San were excellent field craftsmen.

European seafarers and shore parties – most notably the Portuguese and Dutch – made contact with Khoi groups all along the southern African coast from the Swakop River (at contemporary Swakopmund) to the Buffalo River (at contemporary East London). Further inland, in the mountains of the Western Cape and along the barren Northern Cape coast, they encountered San groups. European visitors recorded the relatively peaceful co-existence of the San with the western Khoi. C.F. Brink, who spent six months in the western hinterland in

1761, noted that the 'Namaquas … live scattered in small kraals or villages and for the rest live without any captain, always in peace with one another. Their wealth consists only in cattle which they have in abundance.'[63]

Khoi villages comprised a circle of 30 to 50 huts, sometimes surrounded by a perimeter fence of brushwood. Some Khoi chiefs welded larger groups into more rigid polities. The Cochokwa (or Saldanhars), for example, are described by Dapper as living in a constellation of fifteen or sixteen camps comprising a total of 400 to 450 huts, and they were reported in 1659 to number more than 16 000. The absence of fortifications and the element of surprise saw their defeat at the hands of a combined Charingurikwa-Namakwa force on the shores of Saldanha Bay in 1689.[64] Unlike the San, the Khoi clans, though independent, formed such military alliances. While Van Riebeeck estimated that Khoi clans ranged from 300 arms-bearing men among the Gorinhaiquas to as many as 8 000 among the Cochoquas, Kolb one hundred years later reckoned that the Great Nama could field an army of 20 000.[65]

Yet, with ample land, and Khoisan wealth situated in human life and livestock, flight made more sense to a nomadic people than putting up static, time-consuming ramparts or risking valuable human life. In any event, meagre enemy forces – Dutch expeditions, for example, seldom numbered more than 25 men – could not round up a scattered objective. Ensign J.T. Rhenius, who commanded an expedition to the north of the Orange River in 1724, was told by four Amaqua spies that, upon seeing the Dutch, their people planned to 'drive their cattle into the high mountain range and come with their fighting men to see if by night they could surprise us and kill us, making them master of our goods.'[66] In the face of a superior enemy, the Khoi defence was therefore one of dispersion rather than concentration in a fortified position.

With limited human resources, the Khoi avoided combat whenever possible and preferred strategies of migration. Yet, on two occasions, the Khoi adopted a persisting strategy: during the 1st (1659-1660) and 2nd VOC-Khoi Wars (1673-1677). On the first occasion, the Kaapenaars attempted to expel the Dutch from Table Bay; on the second, the Cochokwa of Saldanha waged war on the Dutch, again over land rights.[67] Unfortunately, the Khoi left no written record of these clashes, and European soldiers who did, took little trouble to write about Khoi tactics. As a result, a number of critical questions remain unanswered; for example, how did Khoikhoi tactics fare against the Liesbeeck forts? Khoi oxen were trained for war, and by driving their cattle between themselves and an enemy, the Khoi used their livestock as a moving rampart. This protective buffer not only shielded the Khoi troops, it was also used offensively to confuse the enemy and disrupt their battle order.

Yet, like the San, the Khoikhoi preferred to avoid close combat and in favour of long-range missile weapons (bow and arrow and throwing spear). The Khoi, all light infantry, were unable to storm the well-gunned castle. For their part, the Dutch lacked the information and mobility to locate the dispersed Peninsulars and force them to do battle. Neither side was able to defeat the other. The Khoi adhered to a successful raiding strategy, but were unable to dislodge the Dutch from their fortified positions. As such, the Dutch fortifications had as strategic rather than tactical value, and both wars had ambiguous outcomes.[68]

In the eighteenth and nineteenth centuries, in the manner of their forefathers, the Khoisan – by now groups of mixed descent, and known as the Kora or Koranna, Nama, and Griqua – migrated northwards, away from European expansion in the west and Nguni expansion from the east. Small and insecure, they embraced new technologies and soon possessed firearms and horses, which made them formidable adversaries along the Orange River.[69] The advance of the Cape colonial frontier from the Berg River to beyond the Orange River during the course of the eighteenth century, and the impact this had on local Khoisan communities, is narrated by Nigel Penn.[70]

Table 1.4 Zone 1 battles

Battle	Nature of forces	Strength	Killed and wounded	% Casualties of total forces	Outcome
Dithakong 1823					
Boomplaats 29 August 1848					
British	Combined	1 200	22	1,83	British
Voortrekkers	Mounted Infantry	300-500	7	1,75	Victory

Zone 2 warfare: The eastern region of the central plateau

The 400 millimetres rainfall line forms a convenient border, from a military point of view, between the arid and semi-arid region of the western half of the country and the second zone. The eastern region of the central plateau is geographically centred on the highveld grasslands, an upland area that was the origin of the west-flowing Vaal and Orange rivers as well as the eastward-flowing Limpopo and Crocodile systems. Much of the terrain is flat and cut by rivers that attracted dense settlements. It was the political and military opposite of zone one, where light infantry (chiefly bow and arrow) was the primary weapons system. In zone two, with adequate water and denser populations, larger states were formed. They were hierarchically organised and varied in size and strength. Although this was ideal cavalry country, the pre-colonial states of this region fielded large armies of spear-wielding, heavy infantry and tended to adopt combat strategies that manifested in pitched battles.

Most of the sources for this period are European in origin, with the attendant caveats. Several factors defined the African way of war and obscured European understanding of it. Writing in 1822, William Burchell described Tlhaping warfare as follows:

> Their warfare consists rather in treacherously surprising their enemy, and in secretly carrying off their cattle, than in open and courageous attack or in any regular combat. Their stratagems have in view, rather to fall upon the objects of their hostility during their sleep, to invade their country unexpectedly, or to outnumber them, than to meet them in open day face to face, or to fight bravely on equal terms. But if neither honour or glory, agreeably to European notions of them, attend these petty wars; neither do streams of human blood stain their fields of battle: in their humble way, they boast as much of having killed six men in a single rencounter [sic], as civilized nations do, of as many thousands.[71]

Setting aside his obviously Eurocentric perspective, Burchell was accurate in his general observation that warfare in Africa assumed a wholly different character to warfare in Europe. Different concepts defined war and peace. Objectives were different. And the means to achieve them were unique. The understanding of African warfare, Malyn Newitt has argued:

> … assumes a different dimension when one perceives that the formal manoeuvrings and clashes of armies or navies are but one end of a spectrum of violence which encompasses banditry, the enforcement of feudal power, forcible exaction of contributions or tributes, the enforcement of monopolies and other restrictions, raiding for slaves, cattle or other booty and even the crude competition for resources by starving peoples on the one hand and powerful vested interests on the other.[72]

Utilising the full spectrum of violence, African forces occasionally defeated technologically superior European enemies. Reckless European commanders were rendered vulnerable by the skilful use of terrain, bush craft and surprise at which indigenous troops were past masters.

Unlike the Nguni and their scattered homesteads, the Sotho generally lived in large, compact villages: Moffat saw 'innumerable vestiges' towns, some 'miles in circumference' and 'entirely built of stones.'[73] The first European eyewitness accounts of the Sotho date from 1801, when the British government at the Cape sent a cattle-seeking expedition under Truter and Somerville to the north. After 1801 travellers and missionaries to the Sotho were numerous, and several left detailed journals describing large settlements with stone hut foundations and enclosing walls.[74] Each household had its own compound comprising one or more huts and granaries in a courtyard surrounded by a reed fence or earthen wall (in Somerville's time, a hedge), with a single narrow entrance. This fence, according to Burchell:

> … was constructed of straight twigs and small branches, placed upright and parallel to each other, but so carefully interwoven, or connected, that they formed a defence so close and firm, that they were impenetrable to a hassagay and, at their lower part, even to a musket-ball. … This fence from its solidity and strength, might rather be called a wall, than a hedge.[75]

Inside the courtyard, Somerville goes on:

> … stands the hut with pillars of wood in front supporting the thatch roof, which extends over the mud wall forming a sort of portico or gallery. Within the house is also a second or inner mud wall enclosing a circular space – in which the master sleeps and above the more valuable movables are deposited. … The Huts are much superior in accommodation to those of the [Sotho] which are only a little more than a shelter from the rain.[76]

Barrow, another member of the 1801 expedition, reported that the houses of Dithakong, some 3 000 in number, were 'walled up with clay and stones, to the height of about five feet.'[77] Somerville described Dithakong's situation 'on the declivity of a bank greatly sloping to the margin of a small stream which runs along the bottom of it.'[78] Campbell, who visited Kaditshwene, another Tswana town, in 1820 reported: 'We were led … to an extensive enclosure surrounded by a stone wall, except at the gate by which we entered … Every house was surrounded, at a convenient distance, by a good circular stone wall.'[79]

Stone was largely used for protection against lions, rather than to counter the attack of an enemy force. Fortifications assumed the place of many soldiers on the defence and, requiring neither rations nor fodder, vastly simplified the defenders' supply problems. Although by their nature immobile, fortifications could support the attack by so economising on soldiers defending one place as to allow a superior concentration for offensive action elsewhere.[80]

The concentration of settlement on hilltops reflected both the degree of stratification in Sotho society as well as the military advantage of higher ground. Kay described Kaditshwene as standing 'on the very summit of a mountain, on every side of which access is extremely difficult'; while Campbell described Maseu as being sited on 'an eminence'.[81] The position of Dithakong upon a slope bound by a river, combined with the firepower of Griqua allies, saved the Tlhaping and Tlharo during a concerted southern Sotho attack in June 1823. In 1878, the ridge and stone walls of Dithakong again protected the Tlhaping defenders; on this occasion against the colonial forces under Lanyon and Warren. Lanyon opened the engagement with an artillery bombardment and for three hours shells rained down on the Tlhaping entrenchment. This was followed by an assault on two fronts: Lanyon attacking with the cavalry on the left, and Warren leading the infantry across the open ground and up the ridge. Chiefs Jantjie and Luka and their men offered stiff resistance, undoubtedly aided by their defensive positions.[82]

Like the Sotho and Tswana, the Venda built both in stone and in inaccessible places for protection. According to Monica Wilson:

> The capital Dzata, built by the incoming chiefs, though in ruins by 1930, clearly showed stone walling of two types, and some of the mountain villages had stone walls and passages 'built by the veterans still living in them.' In 1931 Professor Kirby watched the building of a new capital for Sibasa, the Venda chief, with stone retaining walls for terraces and stone stairways and walls enclosing passages. The village's plan was 'a kind of maze in which a stranger could easily lose his way', and the walls had breast-high loopholes through which spears could be thrust.[83]

These towns may have seemed well protected, but there were techniques to take them, time and circumstance permitting. Besiegers sometimes built their own earthen field fortifications around enemy strong points. Such lines of circumvallation not only helped besiegers resist sorties by the besieged, but also fully interdicted the besieged town's communication with the outside. If the besiegers could effect a complete blockade, they could eventually starve it out, on condition of course that they could supply their own army for long enough. A successful siege required a great superiority in strength, sufficient to overcome the defenders, ensure an adequate flow of supplies, and still defeat or at least ward off a relief force. Besiegers often had to contend with an army attempting to rescue the town and sometimes protected themselves with fortified camps or lines of circumvallation, a second ring of field fortifications facing outward to fight off the relieving army.

Mzilikazi and his Ndebele had a different experience regarding defence. Moving into the Marico district, he and his people settled a vast territory with fewer features. Nonetheless, he developed a sophisticated area defence by fortifying the district. The frontiers were protected by a chain of garrison towns: Mosega in the south (under the command of Mkalipi), Tshwenyane, Koppieskraal and eGabeni, the most northern. Each of these was a relatively large settlement that protected the surrounding countryside and guarded a section of the frontier. To the west, where climate and terrain provided protection and the broken Bechuana tribes posed no threat of invasion, Mzilikazi relied on natural defence and therefore posted smaller numbers of warriors on the frontier. The bulk of the population lived and kept their cattle within this circle, often in the most inaccessible places. Kraals were sited on sloping, dry ground in the proximity of water and firewood, good pasturage and arable ground. A division under Kampu was maintained to range this central area and occasionally the banks of the Marico River. Each year, after the first fruits ceremony, Mzilikazi despatched his warriors on raiding expeditions.[84]

In January 1837 a Boer-Sotho coalition force attacked the Matabele kraals around Mosega. They attacked at first light: Hendrik Potgieter lead a frontal attack on Mkalipi's kraal, while Gerrit Maritz turned its flank, from where he could fusillade the fugitives. Both Mzilikazi and Mkalipi, however, were at the royal kraal of eGabeni. The same strategy was followed at Tshwenyane, Marapu's kraal. Then the Boers proceeded to an isolated hill where Kampu commanded a powerful Matabele garrison, and where, unbeknown to the Boers, Mzilikazi had assembled the remainder of his army. Here, anticipating Mzilikazi's tactics, the Boer horsemen formed a long line, with extra weight on the flanks. They advanced slowly. Then the Matabele charged, the horns of the force spreading out to envelop the Boers, whose flanks galloped forward to meet the tips of the horns and 'blasted them asunder before they could meet in their encircling movement.' The entire commando then concentrated its firepower on the chest of the formation, which soon collapsed. The warriors fell back to eGabeni, where a final battle was fought before Mzilikazi's departure for modern-day Zimbabwe.[85]

Table 1.5 Zone 2 battles

<table>
<tr><th>Battle</th><th>Nature of forces</th><th>Strength</th><th>Killed and wounded</th><th>% Casualties of total forces</th><th>Outcome</th></tr>
<tr><td colspan="6">Vegkop
16 October 1836</td></tr>
<tr><td>Voortrekkers</td><td>Mounted infantry</td><td>35</td><td>2</td><td>5,7</td><td rowspan="2">Voortrekker victory, but loss of Voortrekker livestock</td></tr>
<tr><td>Ndebele</td><td>Heavy infantry</td><td>5 000</td><td>184</td><td>3,7</td></tr>
<tr><td colspan="6">Blouberg
June-July 1894</td></tr>
<tr><td>Bagananwa</td><td>Infantry</td><td>2 000</td><td>Unknown</td><td>-</td><td rowspan="2">Qualified Boer victory</td></tr>
<tr><td>Boers and allies</td><td>Mixed</td><td>7 000</td><td>Unknown</td><td>-</td></tr>
</table>

Zone 3 warfare: The mountainous escarpment

The nearly continuous escarpment of mountain ranges – sometimes gradual, but generally abrupt – between the coastal region and the plateau commences near the Tropic of Capricorn in the north-east and runs parallel to the coast. This is zone three. In effect, it encircles the central plateau to the west, south and east. As it passes southward, it gradually becomes more precipitous, with peaks rising to heights of over 3 000 metres in KwaZulu-Natal. From the south-west end of the Drakensberg, the escarpment takes a westerly course, running along mountain ranges like the Stormberg, the Sneeuberg, the Nieuwveld and the Kornsberg, where for a time it becomes merged in the parallel ranges north of Cape Town.

The mountainous escarpment provided refuge, first for the San in the face of the Nguni advance, and then, amidst the devastations of the Mfecane, to various scatterings, and became a place where new nations were forged. Here total destruction could be averted through sophisticated fortification and area defence. Moshoeshoe I (c.1788-1870), then still a petty chieftain of an insignificant clan of Sotho-speaking cattle breeders, skilfully utilised the terrain of the Maluti Mountains. In the early years of the Mfecane, Mantatisi had attempted to oust Moshoeshoe from his mountain stronghold at Butha-Buthe ('place of lying down'). But, having survived, the young king realised that sooner or later Mtiwane and Mpangazita, the conquerors of Zululand, would besiege him, and that his chances of preventing the penetration of his defences were remote. He therefore moved to Thaba Bosiu ('mountain at night'), a flat-topped mountain that overlooked the Caledon River valley. It was easily defendable, with the summits forming an almost unbroken chain of precipices and the base giving way to vast fertile plains. Piles of boulders were placed along the ridges overlooking the passes. Food supplies were replenished from the plains or by raids against enemy rearguards. Even the mighty Mzilikazi, after an unsuccessful and rather costly siege in March 1831, was convinced that Thaba Bosiu was impregnable.[86] A more sedentary life could be enjoyed in zone three and, in this part of the escarpment, the constant trickle of refugees that joined Moshoeshoe eventually led to the birth of the Basotho nation.

In the next generations, following the Great Treks and then the expansion of British interests north of the Orange River, the escarpment proved a useful barrier to Boer strategists. In the Anglo-Boer War of 1880-1881, the Boer armies invested the British garrisons of the Transvaal, assumed the strategic offensive in the Natal Drakensberg, and then waited for the British to attack northwards into the precipitous northern apex of the colony. The strategy paid off. The distraction in the Transvaal drew the public and official gaze in Britain, while the relief army dispatched under Major-General Sir George Pomeroy Colley met with a trio of disasters, at Laingsnek, Schuinshoogte, and Majuba. The three battles saw an escalating British casualty rate (table 1.6) – Colley himself was killed at Majuba – and the British government, having lost the taste for an escalating, distant war, opened peace negotiations. A similar strategy by the Kruger government in 1899 held off larger British armies for several months.[87]

Table 1.6 Zone 3 battles

Battles	Nature of forces	Strength	Killed and wounded	% Casualties of total forces	Outcome
Thaba Bosiu March 1831					
Basotho	Light infantry	Unknown			Decisive Basotho victory
Ndebele	Heavy infantry	Unknown	Heavy Ndebele losses	-	
Thaba Bosiu 18 August 1865					
Basotho	Light infantry	Unknown			Decisive Basotho victory
Boers	Mounted infantry	Unknown	Light Boer losses	-	
Laingsnek 28 January 1881					
British	Combined arms	1 216	199	16,4	Boer victory
Transvaal Boers	Mounted infantry	2 000	41	2,1	
Schuinshoogte 8 February 1881					
British	Combined arms	278	146	52,5	Boer victory
Transvaal Boers	Mounted infantry	300-500	18	4,5	
Majuba 27 February 1881					
British	Infantry	405	285	70,4	Decisive Boer victory
Transvaal Boers	Dismounted infantry	400-500	6	1,3	

Zone 4 warfare: The variety of the coastal plains

South Africa has a coastline of some 2 798 kilometres. The coastal plain rises gradually to an upland country, narrow on the east and west coasts, with terraced country or a gradual slope running up to the escarpment that marks the beginning of the expansive central plateau. The coastal zone has probably been the most vulnerable to external influence, both from the north and from across the seas. It is therefore the zone most influenced, first by Asia and then from Europe, having been the site for trading posts and small garrisons, all offering spaces from which to penetrate the hinterland. As such, as historian Gail Natrass notes, 'The coastal parts of South Africa have been the meeting place of diverse people for at least 500 years.'[88]

The country could not easily be invaded from the north-west. Historically, landward invaders were forced to use the bottlenecks on the north-eastern flank, making modern Mpumalanga and KwaZulu-Natal the scene of much military activity. Seaborne invasion took place at several sites along the coast, where secure bases were established for landward operations. However, these operations only saw sustained success when the military command took adequate notice of the military geography. Consequently, information on water resources – both for consumption and movement – gained in importance. The combination of these factors, and the creation of a meeting place for diverse peoples, ensured that zone four would be one of greater variety.

The coastal plains really formed two sub-zones: a western sub-zone, where cavalry predominated; and an eastern sub-zone, where infantry (mostly heavy but sometimes light) played a more important role. The western sub-zone, centred on a burgeoning Cape Town and an expanding frontier, was most affected by European influence. Here European settlers established ports and towns, from where the embryonic colony grew. Expansion most often took place through the parallel valleys of the southern Cape, yet neither firearms nor their perceived superior art of war conferred on them any sort of overarching power. Only the development of an Afro-European way of warfare, anchored in the commando system, brought success.[89]

For much of the eighteenth and nineteenth century, small African states were the rule in the eastern sub-zone. This remained so until the Mfecane, South Africa's 'time of troubles.' This part of the coastal zone is covered in part by a thick tropical rainforest, broken here and there by drier, more open country, and in part by lagoons, swamps and marshes. Able to support large numbers of people, the coastal plain accommodated large, densely populated states. Along the wide coastal plain numerous peoples found homes, large settlements were established, and there were good water supplies. However, as the Mpondo king Faku a Ngqungqushe (c.1780-1867) found during the violent convulsions that spread out in concentric circles during the forging of the Zulu nation, the plains remained vulnerable to further migrations from the north. As William Beinart has shown, peoples threatened by the Zulu and people displaced by them concentrated for defence, resulting in increased chiefly control. The Mpondo, who were attacked continuously throughout the 1820s, were, under their chief Faku, victorious in many of these clashes. Executing a fine Fabian strategy, Faku withdrew into the dense coastal forests and refused battle, only counterattacking when the invaders least expected combat. By concentrating against weaker elements of the invader, the Mpondo managed to inflict several defeats. But, by the time of the second Zulu invasion in May 1828, Faku and his people were forced to flee, their settlements devastated and their harvests and herds seized. To the west of the Mzimvubu, they concentrated their settlements around Faku's great place on the Mngazi and in river valleys nearby. Close settlement in prepared positions, possible only because of the absence of cattle, provided security, and the Mpondo remained in these valleys until at least 1838.[90]

As noted, terrain provided opportunities for warfare, but also set limits to human and, more specifically, military activity in both sub-zones. Cycles of wet and dry weather, resulting in periods of abundance or scarcity, destabilised proto-states and prompted migrations up or down the coastal zone or from the coastal zone into the hinterland. But there was a variation in weapons systems too, for in addition to this geographical gradient, there was a temporal one that witnessed the introduction of gunpowder and horses, which to southern Africa was an entirely new weapons system and weapon platform that threatened to change both the traditional method of waging wars and indeed also the very nature of the pre-colonial African state. Gunpowder weapons first played a role in the coastal waters when the Portuguese fired at startled Khoi in 1488. From here firearms gradually moved into the interior, but were not adopted by the Zulu and other Nguni for fear of the social and political change they would bring.[91]

The armies of the eastern zone of the coastal plains comprised almost solely of infantry. The main weapons were the throwing spear, and the *knobkierie* (wooden mace) and stabbing spear for shock action. Shaka and his predecessor, as we shall see, changed the face of warfare in southern Africa with the introduction of regiments of shock-action spearmen. The sometimes watery environment and thick vegetation made keeping horses impractical, and the wooded countryside made cavalry less attractive. Here infantry armies, armed mostly with shock weapons, predominated. Only in the far east, along the lower reaches of the Crocodile and Limpopo rivers, did marine forces exploit the water routes for mobility and surprise. Here the Tsonga – employing watercraft – enjoyed a different vehicle for strategic mobility and tactical surprise.[92]

Table 1.7 Zone 4 battles

Battles	Nature of forces	Strength	Killed and wounded	% Casualties of total forces	Outcome
Gqokli Hill May 1818					
Zulu and allies	Heavy infantry	5 000	2 000	40	Decisive Zulu victory
Ndwandwe	Light infantry	7 500	7 500	62,5	
Grahamstown 22 April 1819					
British Empire	Combined arms	480	3	0,6	British victory
Xhosa	Infantry	6 000	1 000	16,7	
Blood (Ncome) River 16 December 1838					
Zulu	Heavy infantry	10 000	3 000	30	Decisive Voortrekker victory
Voortrekkers	Mounted infantry	470	3	0,6	
Isandlwana 1879					
Zulu	Heavy infantry	20 000	4 000	-	Decisive Zulu victory
British	Combined arms	1 837	1 300	-	

Conclusion: Breaking camp

While South African history is written to a large extent with a red pen, the processes of state formation and patterns of warfighting differ greatly across the region, dependent upon historical time and geographic location. The general physical features of the country comprise a coastal plain, an interior plateau (the arid and semi-arid regions in the west and Highveld grasslands in the east), and an escarpment that marks the transition between the two. The varied geography makes for a ranging climate, mostly semi-arid, but subtropical along the east coast. The veld, on account of its altitude and remoteness from the sea, is subject to marked temperature variations between winter and summer. There are extremes of heat and cold, and a general tendency for the temperature to become hotter in summer and cooler in winter. As this chapter shows, cautious commanders, throughout South African history, have taken cognisance of climate and topography in planning operations as well as in defence of their inhabited environment.

The effect of the physical environment in shaping strategy and military operations may be illustrated from African warfare. There are, as elsewhere, numerous crossing points between geography, society, military technology, and strategy and warfighting. These crossing points, or frontiers, include military differentiation (the nature and design of armed forces), considerations of strategy and tactics (including offensive and defensive operations), and the impacts of disease and ecological factors, as well as the boundaries marking perceived social and cultural differences. Such frontiers all interact within spatial locations, where human activity is influenced by a range of geographic variables, from terrain, soil and vegetation to precipitation, contours and catchment areas. These variables define 'the carrying capacity and attractiveness of land', something that varies considerably. In South Africa, in terms of water and habitability, it changes from near zero in the case of the Kalahari Desert to the most favoured regions of the Eastern Cape, KwaZulu-Natal, Mpumalanga, Limpopo, and the eastern stretches of the Free State. Water defined the differences in carrying capacity and ultimately also the attractiveness of territory.[93] This attractiveness created competition for the natural resources and, in turn, fashioned the nature and style of resulting conflict.

As we have seen, the physical environment and its attractiveness for settlement produced four environments for war and politics. The armed forces of pre-colonial and colonial southern Africa varied from west to east and were defined by both the nature of the state and technological innovation, as well as the degree to which they were favoured by the physical environment. The western central plateau could support only minimal bands. Here merit ranked high and, although warfare was avoided, they could never field more than a few light infantry. Their political and military opposites were found on the eastern plateau, marked as it was by large polities, civil and military bureaucracy, and heavy infantry. The escarpment was a traditional refuge for small and medium-sized polities that in times of danger fielded medium-sized, sometimes coalition armies, comprising mostly light infantry but also heavy infantry. This combination of weapons systems, with the early addition of mounted infantry emanating from the European settlements in the Western Cape, was found on the coastal plain. And so the interplay between water and the physical terrain helped define both the nature of the pre-colonial southern African state as well as the nature of the armies they fielded. These four environments are summarised in table 1.8.

Table 1.8 Summary of the four-zones of warfare in southern Africa

	Zone 1 Arid and semi-arid	Zone 2 Highveld grasslands	Zone 3 Escarpment	Zone 4 Coastal plains
Size of states	Minimal bands	Large polities	Small and medium polities	Large polities
Size of armies	Small bands	Large	Medium	Large
Nature of armies	Light infantry	Heavy infantry	Light infantry	Heavy and light infantry and mounted infantry
Generalship	Meritocracy	Bureaucracy	Aristocracy	Bureaucracy
Strategy	Defensive: migration	Combat	Defensive: siege	Combat

The armed forces of the coastal plains, and later a wider southern Africa, varied gradually from west to east depending on the nature of the state and the degree to which technologies were available, on the one hand, and on the other, the degree to which the physical environment favoured these technologies. Thus, as one moved westward from the arid and semi-arid regions, where there were no waterways and many combatants rode on horseback, one met land of cavalry mixed with infantry, an increasing number of rivers, and heavy precipitation. Going further east toward and across the escarpment, the infantry component became larger, and as one approached the coast, watercraft plied the navigable stretches of the Limpopo and Crocodile rivers.

Although the study of the military history of Africa is in its infancy, historians gain much by working at the crossing points to military geography. An exploration of the interplay between warfare and environment in southern Africa, for one, highlights processes and patterns, always difficult at best when treating a broad sweep of history without the benefit of insights from other disciplines. South Africa may be centred on the populous, wealthy Highveld, at the heart of which lies the basin of the ancient Kaapvaal Craton and the rich rewards its rocks and soils yield. But equally so, South Africa is the desert, the mountains, and the coastal plains. There is clearly no single South Africa. This is a country of many zones and environments; a vast, complex region that has sustained and supported life for millennia. People travelled and traded, they hunted, and they fought wars. In this way, life on the Highveld grasslands interconnected with the coastal plains and the vast continent to the north. Life in these environments was diverse and complex, constantly challenged and enriched by intrusions, both cultural and economic, from regions exterior to it.

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76 Bradlow, E. & Bradlow, F. (eds.), *William Somerville's narrative of his journeys to the Eastern Cape Frontier and to Lattakoe, 1799-1802* (Cape Town: VRS, 1979), pp. 121, 130.

77 Barrow, J. *Travels into the Interior of Southern Africa*, Vol 1 (1801) and Vol II (1804); p. 391.

78 Bradlow, E. & Bradlow, F. (eds.), *William Somerville's narrative of his journeys to the Eastern Cape Frontier and to Lattakoe, 1799-1802* (Cape Town: VRS, 1979), pp. 115-116. The editors footnote that Schapera, I. (ed.), *The early Cape Hottentots described in the writings of Olfert Dapper (1668), Willem Ten Rhyne (1686) and Johannes Gulielmus Grevenbroek (1695)* (Cape Town: VRS, 1933), p. 36 noted that 'Tswana towns were usually sited in places where water was readily available and hills gave protection.'

79 Campbell, *1820*, I, pp. 223-224.

80 Jones, A. *The Art of War in the Western World* (Oxford: Oxford University Press, 1989), pp. 77-79.

81 Kay Campbell, *1820*, I, p. 171.

82 Shillington, K. *The Colonisation of the Southern Tswana, 1870-1900* (Braamfontein:w Ravan, 1985), pp. 12, 77-78. See also Lye, W.F. & Murray, C. *Transformations on the Highveld: The Tswana and Southern Sotho* (Cape Town & London: David Philip, 1980), p. 37.

83 Wilson, M. 'The Hunters and Herders' in M. Wilson & L. Thompson (eds.), *A History of South Africa to 1870* (Cape Town & Johannesburg: David Philip, 192), p. 174.

84 Becker, P. *Path of Blood: The Rise and Conquest of Mzilikazi Founder of the Matabele tribe of Southern Africa* (London: Longmans, 1962), pp. 153-55, 259.

85 Ibid. pp. 171-178.

86 Ibid. pp. 135-137. For an innovative study on the pre-colonial Basotho from a military perspective, see Ellis, J.E. 'n Militêr-Historiese Vergelyking van die Voorkoloniale Basotho (Suid-Sotho) van Suidelike Afrika en die Kikuyu van Kenia, (unpublished MA thesis, Stellenbosch University, 2001).

87 Van der Waag, I. J. *A Military History of Modern South Africa* (Johannesburg & Cape Town: Jonathan Ball, 2015), pp. 11-17. https://doi.org/10.1191/0968344505wh306oa

88 Natrass, G. *A Short History of South Africa* (Jeppestown: Jonathan Ball, 2017), p. 36.

89 See Van der Waag, I.J. 'Boer generalship and the politics of command', *War in History*, 12(1) (2005), pp. 15-43.

90 Becker, P. *Rule of fear: The life and times of Dingane, king of the Zulu* (London: Longmans, 1964), p. 24; Beinart, W. 'Production and the material basis of chieftainship: Pondoland, c.1830-80' in S. Marks & A. Atmore (eds.), *Economy and Society in Pre-industrial South Africa* (Harlow: Longman, 1987), pp. 121-122; Stapleton, T. 'Faku, the Mpondo and Colonial Advance in the Eastern Cape, 1834-53', in C. Youé & T. Stapleton (eds.), *Agency and Action in Colonial Africa: Essays for John E. Flint* (Basingstoke: Palgrave, 2011), pp. 12-33.

91 Vandervort, B. *Wars of imperial conquest in Africa, 1830-1914* (London: UCL Press, 1998), p. 14.

92 For the reasons why Africans did not as a rule build navies, see Chauveau, J-P. 'Une histoire maritime africaine est-elle possible? Historiographie et histoire de la navigation et de la pêche africaines à la côte occidentale depuis le XVe siècle', *Cahiers d'études africaines*, 26 (1986), pp. 173-235.

93 Thompson L. & Lamar, H. 'Introduction' in H. Lamar & L. Thompson (eds.), *The Frontier in History: North America and Southern Africa Compared* (New Haven & London: Yale University Press, 1981), p. 8.

CHAPTER 2

Saldanha Bay: The influence of underlying geology on military and naval history in the age of sail

Jacques Bezuidenhout & Thean Potgieter

Introduction

Saldanha Bay is a remarkable natural harbour on the west coast of South Africa, about 100 kilometres north-northwest of Cape Town. The unique geological setting gave rise to the formation of a large, deep and sheltered bay and an excellent natural deep-water port. Ignimbrite eruptions dated at ~500 Ma resulted in a protective granite barrier that was superimposed on the less resistant older granite bedrock. These ignimbrite protrusions define the present coastline around the entrance of Saldanha Bay, with the Saldanha and Postberg ignimbrite complexes to the north and the south, respectively. Subsequent shales and sandstone deposits on the granite systematically eroded, forming the current coastal plain and Saldanha Bay. The inner part of Saldanha Bay and the Langebaan Lagoon was eroded on the inland side of a break in the coastal ignimbrite barrier.

Due to its location and usefulness to shipping, Saldanha Bay was one of the best natural harbours along the South African coast on the long sea route to the East in the days of sail. This was recognised even before the Dutch created a settlement at Table Bay in 1652. The Dutch were well aware of the unique attributes of the bay, but never developed it further, mostly due to its insufficient

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sources of fresh water. During the next century and a half, Saldanha Bay was a valuable haven to shipping and also saw naval skirmishes. After conquering the Cape, the British realised the potential of Saldanha Bay as a naval base, but again it was not developed due to the lack of fresh water.

This chapter reviews the underlying geology of Saldanha Bay and demonstrates how it dictated the formation of the bay and impacted on the maritime and naval importance of the bay in the age of sail.

The geology of the Saldanha Bay area

The geology of the Saldanha Bay area is dominated by the so-called Cape Granite Suite, which outcrops amongst older Malmesbury shales and younger Cape Supergroup sandstones, from St Helena Bay in the west and almost to Knysna in the east (figure 2.1).[1] These granitic rocks were emplaced between 560 to 520 Ma as part of a greater Saldania belt, during a global Pan-African orogenic event when drifting tectonic plates merged into the Gondwana-Pangea supercontinent. The western part of the Cape Granite Suite (figure 2.1) was emplaced within three NW-SE trending terranes, separated by major tectonically faulted boundaries, of which the most prominent, the Colenso fault zone, runs just NE of Saldanha Bay, from Trekoskraal in the NW to Franschhoek in the SE. For some yet unknown reason, the Colenso fault zone also acts as a boundary between two different sub-types of granitic rocks, referred to as more northeasterly located I-types and more southwesterly located S-types on the basis of geochemical, and other, characteristics, where S-type magmas are likely derived through partial melting of a sedimentary crustal source."[2] For all practical purposes, S-types tend to be more aluminous than I-types, as reflected by the presence of aluminous mafic minerals, and are consistent with a more clay-rich (pelitic) source, such as the Malmesbury shales that the granites are hosted in.

As displayed by Cape Town's Table Mountain, the Cape Granite Suite was relatively soon after its emplacement deeply eroded to a peneplain, before the ~500 Ma onset of the deposition of a thick cover of fluvial sandstones, constituting the Cape Supergroup.[3] The Chapman's Peak drive is built primarily along such an unconformity between the older Cape Granite Suite and the Cape Supergroup. However, no Cape Supergroup are exposed within the Saldanha area, where the Cape Granite Suite is instead eroded even further, and unconformably overlain by much younger raised beaches and sand dunes deposited during Pleistocene interglacial high sea levels. This is very well illustrated at Hoedjies Point, where a sub-horizontal top surface of a weathered coarse-grained S-type granite, ~2-4 metres above the current sea level, is overlain by large rounded beach boulders amongst sea shells, exactly as can be observed on the lower lying active beach. This obvious beach deposit is then overlain by several layers of finer grained sand dune deposits, all of which have been weakly lithified into the Pleistocene deposits that cover large parts of the Saldanha area's underlying Cape Granite Suite (figure 2.1), together with even younger and more loose recent alluvial deposits including active sand dunes.

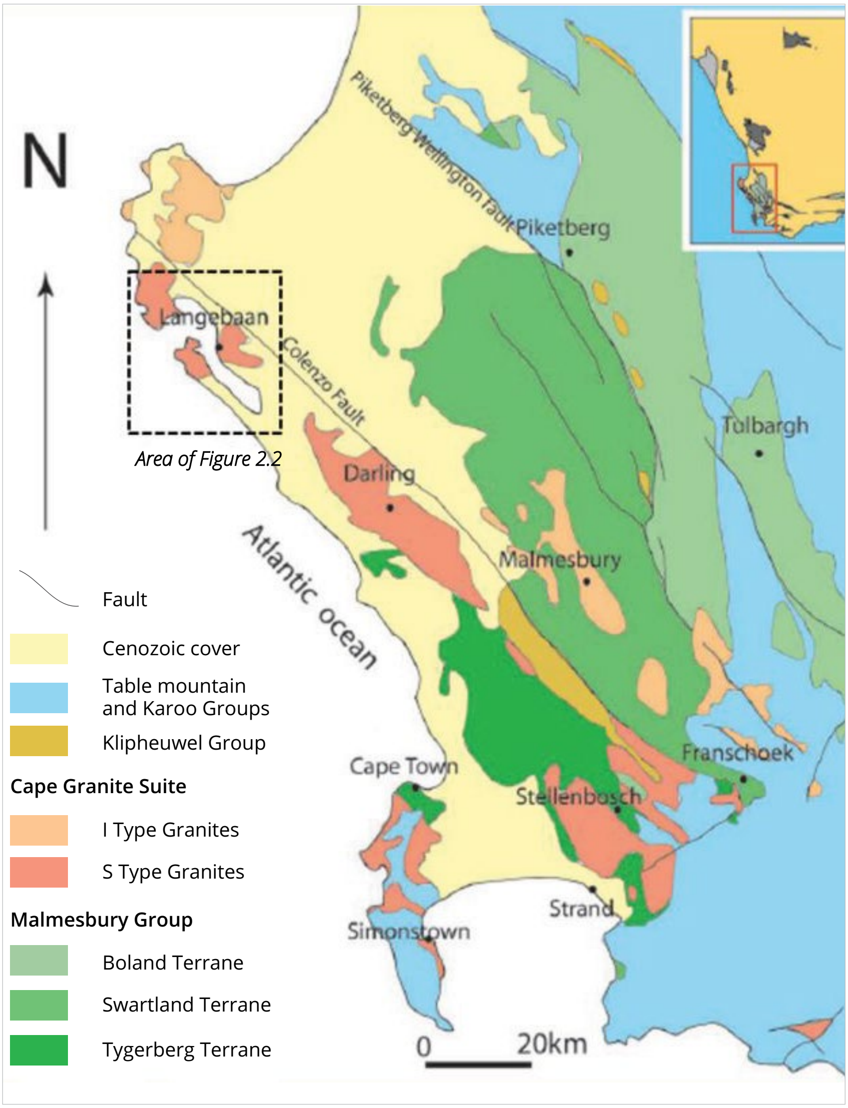

Figure 2.1 A geological map of the Cape Granite Suite in the western part of the Saldania Belt (compiled from various sources)

Source: Based on Theron et al. (1992), Belcher et al. (2003) and compiled by Villaros (2010)[4]

As mentioned, S-type granite intrusions dominate the more coastal Tygerberg Terrane of the Cape Granite Suite, located SW of the Colenso fault zone.[5] In greater detail, however, the most seaward part of the bay area is dominated by a very special granitic unit, known as Saldanha-Postberg ignimbrite (or quartz porphyry), which gives rise to the prominent hills that protect the inner bay. This ignimbrite is distinctly different from the otherwise coarser grained S-type granites with typically up to five-centimetre-large rectangular feldspar megacrysts, which appear to weather and erode more easily. The Saldanha-Postberg ignimbrite is exposed farther inland, behind the protective ignimbrites. Although similar quartz porphyritic rock types are also found elsewhere as obvious dyke-like intrusions – for example, at Cape St Martin (Otto, 1957)[6] – Scheepers and Poujol (2002)[7] were the first to propose that the Postberg peninsula was made up of ignimbrites, and Clemens and Stevens (2016)[8] followed this up by including the Saldanha portion as part of a larger ignimbrite complex, possibly related to a coinciding volcanic caldera. In several places, the ignimbrite is observed in contact with the coarser feldspar megacrystic granite, which relationships consistently indicate to be an older host rock.[9]

Ignimbrites have a very specific volcanic origin. They form after very explosive plinian eruptions collapse upon itself and its hot pyroclastic material (mainly consisting of glassy ash particles, but also unfragmented pumice clasts) is deposited within topographical depressions as so-called pyroclastic density currents. Thus, Saldanha's coarser feldspar megacrystic granite must have been eroded to the current outcrop level for it to have been overlain by an ignimbrite. Moreover, if these currents are hot enough, a thick flow can eventually fuse together into a welded ignimbrite, which is much stronger than a non-welded ignimbrite tuff. In fact, this could be the underlying lithological reason why the Saldanha-Postberg appears to be so much more resistant to mechanical erosion than the area's other granites. Under the microscope, the rock is characterised by more or less broken larger crystals of mainly quartz and feldspar, set in a very fine-grained matrix, which is thought to have been welded together with the pre-existing phenocrysts. In outcrop, the rock is also characterised by the presence of more or less flattened enclaves, which are interpreted as representing non-fragmented pumice clasts that were hot and soft enough to deform beneath the weight of the flow.

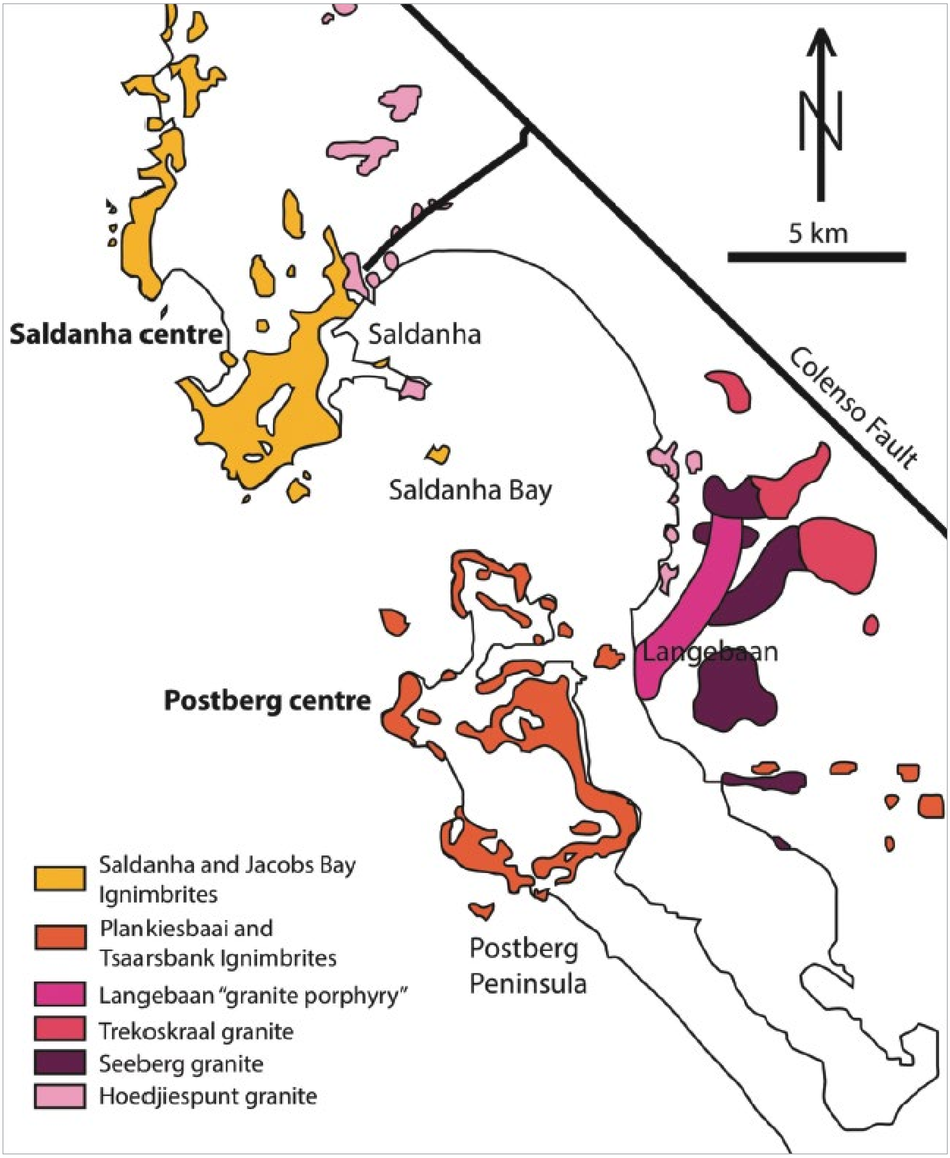

Figure 2.2 A geological map of the Saldanha Bay area (originally by Scheepers & Armstrong, 2002, and modified by Clemens & Stevens, 2016)[10] indicating the distribution of various pre-volcanic S-type granitic intrusions and the outcrop areas of the volcanic ignimbrites of the Postberg and Saldanha peninsula

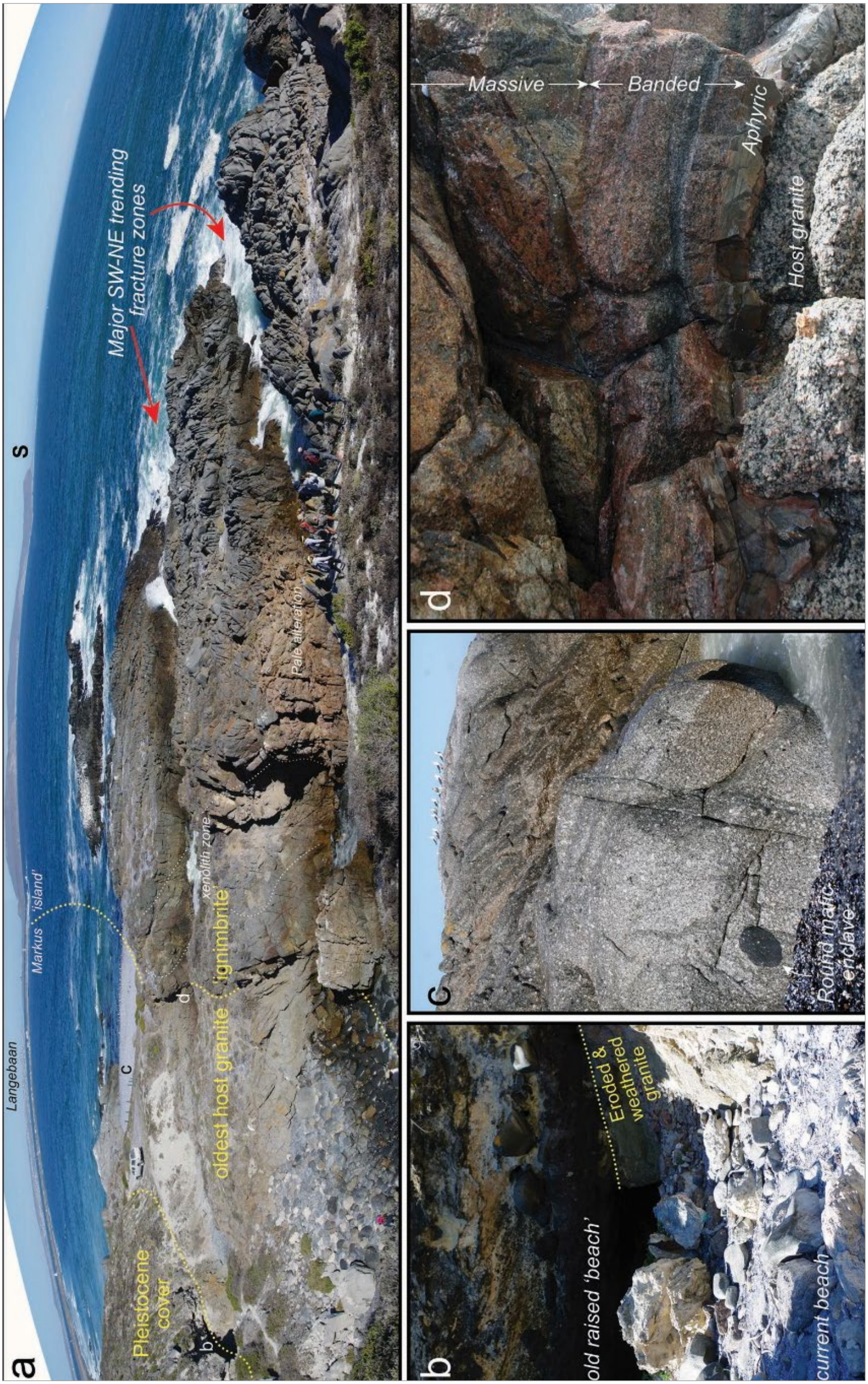
a
S
Langebaan
Markus 'island'
Major SW-NE trending fracture zones
Pleistocene cover
oldest host granite
ignimbrite
xenolith zone
Pale alteration
b
c
d
b
old raised 'beach'
Eroded & weathered granite
current beach
c
Round mafic enclave
d
Massive
Banded
Aphyric
Host granite

Figure 2.3 Geology along the Bomsgat contact. (**a**) Stitched image overview, looking SSW, across the Bomsgat locality, the Saldanha Bay inlet and the Postberg peninsula on the horizon (see figure 2.2). Note the youngest Pleistocene deposits overlie the area's oldest granites to the left, and the sharp and moderately SW-dipping contact between the older granite and a more competent 'ignimbrite' to the right. Both contacts are roughly correlated by yellow dotted lines, and, in the latter case, to another exposed contact across Marcus 'island'. Also note the two prominent SW-NE-trending gullies, along which possible major fault zones may have been preferentially altered and eroded. (**b**) Detail of the lowermost raised beach deposits, 2-4 metres above similar current beach deposits of large rounded ignimbrite boulders and seashells. (**c**) Detail of older granite, with its characteristic larger pale feldspar megacrysts, as well as one of many and variable types of enclaves that are typically hosted within this rock unit. (**d**) Detail of ignimbrite contact against the older host granite, locally made up of (i) a lower aphyric and very fine-grained contact zone, (ii) a porphyritic banded zone, and (iii) an upper, more massive porphyritic rock that characterises the rest of this unit.[11]

As one accepts that the Saldanha-Postberg ignimbrite is more resistant to mechanical erosion, and possibly also chemical weathering, than all other rock types in the area, it becomes obvious that Saldanha Bay's natural harbour formed as coarser grained, yet less competent, inland megacrystic granite was more deeply eroded behind the ignimbrite's protective barrier to the ocean. The reason why there is a harbour entrance right through the middle of such a 'barrier' is more speculative, but is consistent with the Postberg and Saldanha areas being two separate ignimbrites. However, if these two areas are parts of the same coherent unit, then it is also possible that the rock was locally weakened by tectonic faults, where the harbour entrance could then have been eroded by the sea. Such NE-SW-trending faults, at right angles to the coast line, are observed in outcrops along the harbour entrance and could intensify towards the deeper part of the channel.

Within the wide erosional depression that formed behind the ignimbrite barrier, a locally deeper inner bay is probably being maintained through oceanic forces and the sedimentary outlet provided by the outer bay channel. The continuous curve of the inner bay beach is likely shaped by diffraction of ocean swells as these move through the outer narrow channel inlet between Elands Point (originally "Eilands") and the Hoedjies Point to Marcus Island barrier. Similar wave diffraction may also be responsible for other characteristically curved smaller beaches along the sides of the outer bay. Otherwise, the inner bay area only exposes some sporadic coarser grained granite outcrops amongst predominantly younger sedimentary deposits, including both more lithified

Pleistocene calcretes and unconsolidated recent beaches and dunes. Only four small granite protrusions of coarser feldspar megacrystic granites (the Hoedjiespunt granite in figure 2.2) interrupt the inner bay beach at Leentjiesklip 1-3, and Lynch Point; whereas three different granite types (Langebaan, Trekoskraal and Seeberg granites, figure 2.2) have been mapped farther inland. Even though all of these inland intrusions appear to be less competent than the Saldanha-Postberg ignimbrite, there also appears to be some subtle competence that allows some to outcrop as more resistant hills than others.

Farther south, the shallow lagoon is apparently not located behind any protective ignimbrite, but is still separated from the sea along a narrow barrier of both lithified Pleistocene and more recent sand dunes and beaches. This might still be a consequence of the ignimbrite protrusions, however, as prevalent northward coastal drift along Sixteen Mile Beach has linked up with the Postberg 'island' as a narrow peninsula.

The geological features around Saldanha Bay provide protection for ocean-going vessels against various weather conditions. The bay is mainly divided into three parts, each with its own unique features. These parts are the outer bay, the inner bay and the lagoon, as marked in figure 2.4. The outer bay is at the entrance from the Atlantic Ocean, between the Saldanha and Postberg ignimbrite complexes to the north and south, respectively. The shores of the outer bay are consequently lined by weathered ignimbrite due to its constant exposure to the Atlantic Ocean swells. The passage from the outer bay to the inner bay runs between Hoedjies Point to Marcus Island and Elands Point (see figure 2.4), which is roughly on the contact of the Saldanha ignimbrite against the older host granite (Hoedjiespunt granite). The shores of the inner bay are mainly lined with sandy beaches, with occasional S-type granitite protrusions of the same origin of that at Hoedjies Point.

The inner bay provides protected anchorage from both southerly and northerly winds. The southerly winds occur during spring and summer. They can reach gale-force strength and usually blow for protracted periods. Strong northerly winds that are associated with winter frontal systems can also gust up to storm strength and higher.[12] The granite outcrops to the north and the islands to the south of the inner bay consequently provide shelter for ships all year round. The southern part of the inner bay forms a channel between the Postberg complex and the Langebaan granite porphyry into the lagoon. The Langebaan Lagoon is a large saltwater wetland with sand banks that are generally exposed during low tides. The northern part of the lagoon, around the islands, is deeper and allows for navigation by smaller ocean-going vessels. There are no perennial fresh water sources apart from a few small fountains that occasionally last through the dry and warm summer.

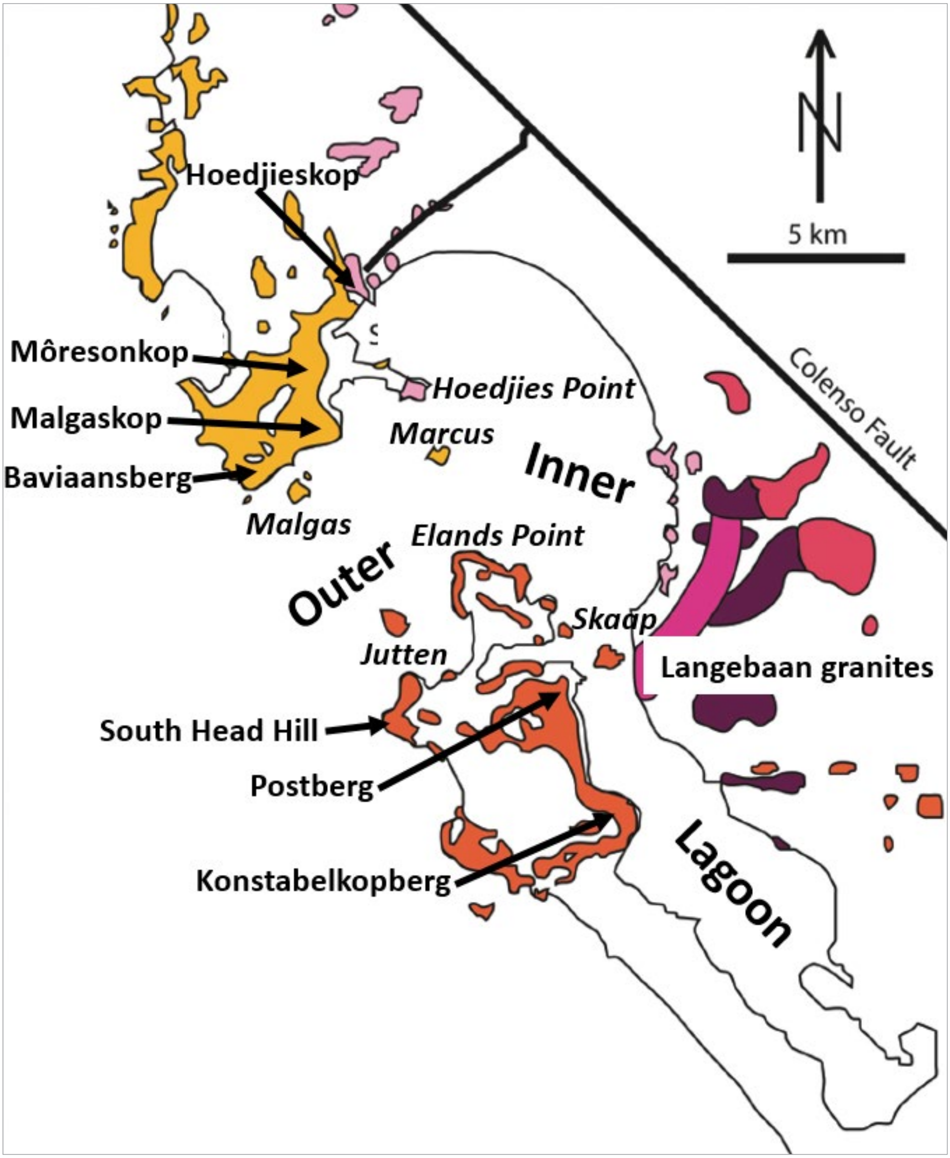

Figure 2.4 A geological map (adapted from figure 2.3) indicating the outer, inner and lagoon parts of Saldanha Bay, as well as major granite protrusions (islands and points are indicated in italics, and hills with arrows) in and around the bay

The importance of Saldanha Bay to shipping in the age of sail

The Cape of Good Hope is located at the southern tip of Africa, literally halfway to the East, which made it not only a valuable refreshment post for in- and outbound ships along the sea route, but also a base of strategic importance to maritime empires. Though it is usually associated with Table Bay (or Cape Town), the winter anchorage in Simon's Bay and the Simon's Town naval base, the term Cape of Good Hope implies much more than just the Cape Peninsula. It refers to the southern tip of Africa, with Cape Town at its centre; the west and southern Cape coasts, with anchorages and locations for provisioning ships; as well as the interior, with its agriculture and resources crucial for the shipping service and for sustaining this strategically important settlement.

Of note for this discussion is Saldanha Bay. It is certainly evident that the strategic importance of the bay was recognised by seafarers even before the Dutch settlement was established in Table Bay (later Cape Town) in 1652. However, this acknowledgement resulted from its unique natural history and geological features and their associated value to shipping, rather than its human and socio-economic history and value.

The bay was named *Aguada de Saldanha* (the watering place of Saldanha) after the Portuguese seafarer Antonio de Saldanha, on the mistaken belief that it was here that De Saldanha had watered his three ships in September 1503. However, De Saldanha had actually watered in Table Bay, which was referred to as the *Aguada de Saldanha* until November 1601, when the Dutch explorer Joris van Spilbergen on his route to the East sailed past Saldanha Bay, believing that it was the *Aguada de Saldanha*. Van Spilbergen did not anchor in Saldanha Bay but in Table Bay, and thinking he had 'discovered' a new bay he called it Table Bay after the impressive flat-topped Table Mountain on the southern shore of the bay.[13] Despite its barrenness and lack of fresh water, in error the name Saldanha Bay remained.

After 1652, when the Dutch East India Company (*Verenigde Oost-Indische Compagnie,* or 'VOC') established a post at the Cape of Good Hope, Saldanha Bay became an important replenishment post on the route to the East. However, the bay only gained true strategic value during the late eighteenth century, essentially due to the British conquest of India, the exponential expansion of the British Empire in the East, and the British preoccupation with the security of the vulnerable sea route linking Britain to the Eastern wealth (as the rich maritime trade had to round the Cape).[14]

Figure 2.5 Johannes Vingboons, *Kaart van de Saldanhabaai, Tafelbaai, Houtbaai en de Baai Fals* (circa 1665)[15]

The defence of the Cape rested on two variables. On the one hand, the Cape Peninsula was a naturally fortified position, thanks to the inhibiting coastline and windy conditions that posed a challenge to shipping and amphibious operations; on the other, its defence was improved by a system of man-made fortifications and a standing military force, as the VOC placed much emphasis on defending the Cape Peninsula against a foreign attack and landing.[16] With the expansion of the VOC colony at the Cape, outposts were established along the extensive coastline at locations such as False Bay, Hout Bay, Saldanha Bay, St Helena Bay, Mossel Bay and Plettenberg Bay. When foreign or enemy ships were sited, soldiers at the outposts had to inform the Cape authorities and in times of war had to move livestock, draught animals and wagons into the interior. However, enemy landings at Saldanha Bay, St Helena Bay or Mossel Bay were considered unlikely, as it would be very difficult to wage a campaign over the long distances with poor roads and without sufficient draught animals, wagons and horses.

From a shipping, military and defensive point of view, the VOC recognised the excellent properties of Saldanha Bay: it provided good anchorage and could be defended by placing strong fortifications on both sides of the entrance and on Marcus Island (in the middle of the entrance to the inner bay). However, Saldanha

Bay was not utilised and developed as a harbour, because it had little fresh water (specifically in summer, when very little rain would fall) and insufficient wood, as there were virtually no trees in the area. Wood was of great importance as fuel on land and at sea, and also crucial for ship repairs.

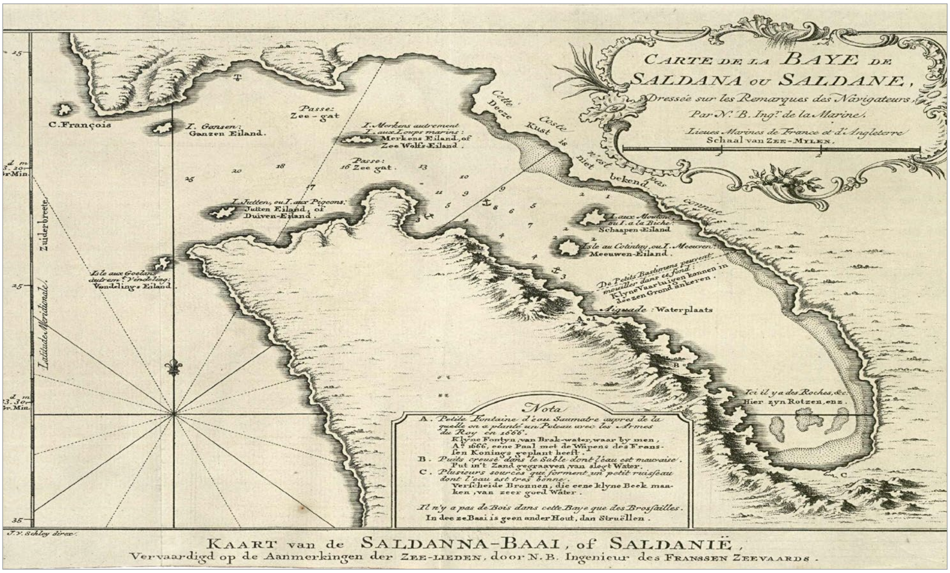

Figure 2.6 A Dutch chart of Saldanha Bay based on a French chart drawn from information provided by French seamen in 1666. Though it is not very accurate and more accurate maps and charts of the bay were produced soon afterwards, of note is the nautical importance of Saldanha Bay already at this stage, with a clear indication of where to anchor and where water could be found.[17]

Due to the interest of other European countries, notably the French, in Saldanha Bay, VOC soldiers were intermittently posted there from 1666, and in 1685 the VOC outpost "Saldanha Baaij" became permanent. The post holder had to despatch a mounted messenger to the Cape to report the arrival and departure of ships. If foreign ships put into the bay in need of provisions, they would receive just enough (excluding wheat or flower), to reach Table Bay or False Bay.[18]

As the VOC did not fortify the entrance of Saldanha Bay, it was virtually impossible to prevent an amphibious landing along its shores due to its size and long calm beaches. Its greatest defence however, was in its near desert-like surroundings with its lack of fresh water and its distance from the Cape, which, it was believed, would dissuade aggressors. Nonetheless, if enemy warships entered the bay in wartime, the post holder and his men had to remove all livestock and destroy all the provisions they could not remove. The post holder was also ordered to ensure that, should such an eventuality arise, burghers living in the area were also instructed to move their livestock, wagons, draught animals, food and all material that might be of assistance to an enemy, into the interior.[19]

From a shipping point of view, Saldanha Bay was excellent. Nearly enclosed by land, it provided a number of safe anchorages in all weather conditions, and due to a relatively narrow and deep entrance, in normal conditions there was no large swell inside the bay. The standing sailing orders that the VOC issued to its ships' captains contained detail on the sea conditions around the Cape, prevailing winds, instructions on the use of Table Bay, navigating into Saldanha Bay, the situation in Hout Bay, and sailing directions for entering False Bay and anchoring in Simon's Bay.[20] It was commonly known and understood that in bad weather or when strong southerly winds blew ships out of the roadstead in Table Bay, they could hide in Saldanha Bay.[21]

As early as 1683, VOC instructions to their skippers indicated that ships using the southerly anchorages in Saldanha Bay (Salamanderbaai or close to Meeuwen Island), should enter the bay by sailing close to the southern shore, and keep Jutten and Marcus Islands to port until reaching the anchorage at Salamanderbaai, close to Meeuwen Island (now Meeu Island), or to the north of Schaapen Island (now referred to as Skaap Island). Ships anchoring in Hoedjies Bay were to keep Marcus Island to starboard and Hoedjies Point to port (thus entering between the two).[22] However, VOC ships used the anchorage at Salamander and Meeuwen more often due to its proximity to the VOC post and the fresh water supply.

Ships often anchored in Saldanha Bay to hide in bad weather, or from gale force winds, before continuing their voyage. Some ships were despatched there from the Cape to overwinter, or for repairs.[23] During the summer months, ships en route to the East might find it difficult to make headway upon reaching the coast to the north of Saldanha Bay due to strong southerly winds coupled with the northward flowing Benguela current. One such example was the VOC East Indiaman *Voorschoten:* in April 1688 she could not reach the anchorage in Table Bay due to strong headwinds and had to disembark the French Huguenots she had on board in Saldanha Bay.[24]

Many ships had to put into Saldanha Bay due to an emergency. These ranged from storm damage to the rigging, leaks or damage to the hull, and a shortage of food and water, to a lack of crew on board due to illness, diseases or deaths during a voyage. Moreover strong headwinds, currents and bad weather could make it difficult to continue to Table Bay. From the data provided by Roux and Sleigh it is evident that during the VOC era (1652-1795), roughly 140 ships had to put into Saldanha Bay after experiencing some or other emergency at sea. However, the list is not exhaustive and does not include vessels that the Cape authorities sent to Saldanha to overwinter, for repairs, or due to war in Europe.[25]

Thanks to its calm waters and three flat beaches (on its northern, eastern and western shores) damaged ships were often sent to Saldanha Bay for repairs, with the Hoedjies Bay beach especially well-suited for caulking and careening of ships. During the VOC era, an estimated 61 damaged ships were sent to Saldanha Bay for repairs: nineteen between 1750 and 1795 alone,[26] and about 70 ships between 1653 and 1805.[27] Repairs consisted mostly of patching up leaks below the waterline, repairs to the hull; and in some cases ships were caulked. Repairs to smaller vessels were done mostly along the eastern shore of the bay, to the south of Schaapen Island. Larger vessels such as flute ships ('fluitskepe'), East Indiamen and frigates were repaired in Hoedjies Bay, because the deeper draft of these ships made it difficult for them to navigate the narrow and shallow channel between Schaapen Island and the eastern shore of the bay.

As Saldanha Bay had no dry-dock, quay or onshore repair facilities, ships were caulked on the beach. With the spring high tide the ship destined for caulking was brought as high up onto the beach as possible, and when the tide went out, she would be pulled over to her other side, if necessary. She could then be floated again with the next spring high tide. In September 1799 the sloop HMS *Rattlesnake* was damaged in a skirmish with the French frigate *Preneuse* in Algoa Bay. As the *Rattlesnake* required urgent repairs, she was sent to Saldanha Bay to be caulked. The whole process from preparing the ship, rigging her down to floating, and then rigging her up again was recorded in detail in the journal of one of her officers. It provides an interesting record of how the process unfolded, the experiences of the crew, while it is also a good topographical description of the bay.[28]

Though the potential of the Saldanha Bay for shipping and from a military strategic perspective was evident, water was an obvious problem that prevented further development. The best source of water along the shores of the bay was the fountain on the eastern shore of the Langebaan Lagoon ('Oostenwal'), which was utilised to provide a sustainable supply of fresh water in the late eighteenth century, but this source too proved inadequate.[29]

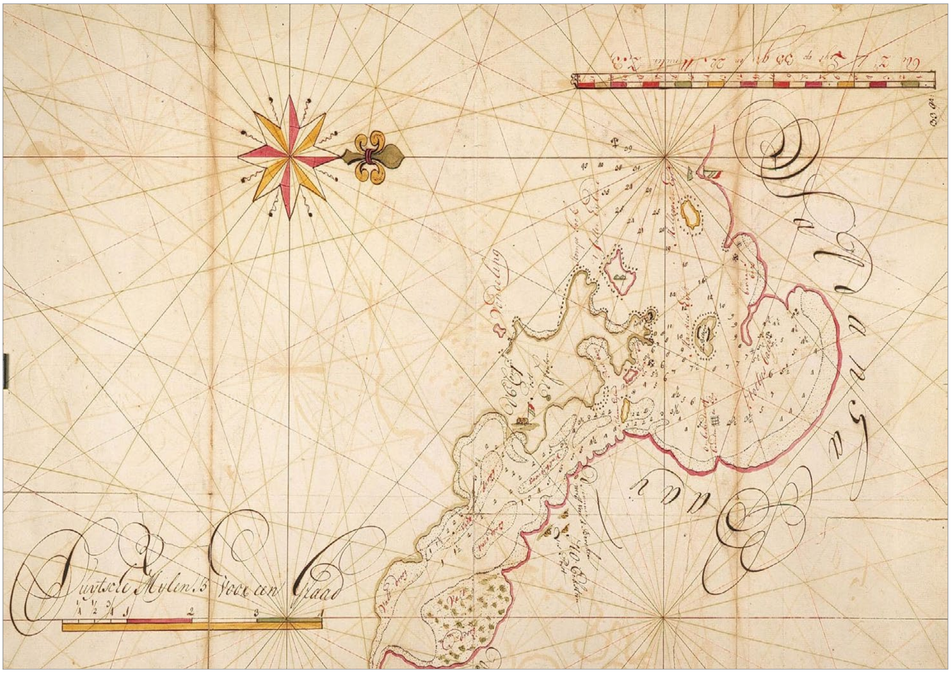

Figure 2.7 Isaak van Es, *Kaart van de Saldanhabaai* (circa 1792)[30]

After the British conquest of the Cape in 1795, the strategic potential of Saldanha Bay as naval base was emphasised, specifically as it provided good protection against gale-force winds. Barrow (an official and writer closely associated with the first British occupation and a strong proponent of British control over the Cape) considered Saldanha Bay as 'one of the best harbours, perhaps, in the whole world … [many] ships may lie in perfect security at all seasons of the year.'[31] Barrow made a number of suggestions to solve the fresh water problem, including deep wells and a channel from the Berg River to Saldanha Bay. As an easier option, he suggested that the British install a pipeline from the spring at Witteklip (at the current Vredenburg) 'about six miles distant.'[32] The Royal Navy commander at the Cape, Admiral Curtis, saw piping fresh water as only part of the solution, and emphasised that creating a naval base at Saldanha Bay would require extensive shore facilities, proper fortifications, a garrison and a water reservoir.[33] However, for nearly a century and a half, these ambitious ideas came to nought.

The Battle of Saldanha Bay, 1781: Disaster for the VOC

Due to its strategic location at the southern tip of Africa, the Cape of Good Hope was a crucial link in the maritime communication chain with the East during the late eighteenth century. As British interest in India grew, Britain became anxious about the security of the sea route. Specifically, should the Dutch and the French become allies in a war against Britain, the French presence at the Cape had the potential to be very problematic, as traffic could be interdicted and power could be projected from the Cape to the East. Moreover, it would deprive Britain of an important replenishment post.

Britain recognised that control of the Cape was central to its strategic interests, but as it was in Dutch hands and usually well defended in time of war, it would have to be taken by force. This implied despatching a strong naval contingent with troops and supply ships from Britain, establishing local sea control at the Cape, landing troops and equipment on enemy soil, and conducting operations ashore – a considerable undertaking, especially considering the distance over which power had to be projected.

The Dutch remained neutral during the Seven Years' War, but on the 20th of December 1780, during the American War of Independence, Britain declared war on the Dutch Republic (the Fourth Anglo-Dutch War, 1780-1784). Even before Dutch involvement in the conflict, the VOC had reminded the Governor of the Cape of Good Hope, Baron Joachim van Plettenberg, that defending the Cape against enemy ships was extremely important,[34] and ordered him to improve the artillery, fortifications and magazines of the Cape.[35] However, with no naval force, insufficient fortifications, and only a small garrison (530 regulars), the local militia and a locally raised Khoi unit to defend it, the Cape defences were underfunded and wholly inadequate.

Given this precarious situation, the Netherlands requested French assistance after the outbreak of the war with Britain. The French acceded, and when French intelligence reported that a British expeditionary force (under Commodore George Johnstone) had sailed for the Cape in March 1781, Admiral Pierre André de Suffren was despatched with a naval force and troops to prevent the Cape from falling into British hands. At Porto Praya, in the Cape Verde Islands, De Suffren stumbled upon Johnstone's force while the British were at anchor and replenishing. De Suffren immediately went on the attack, damaging some of the British ships and throwing Johnstone off balance. This made it possible for the French to be the first to arrive at the Cape, on 20 June 1781.[36]

Johnstone arrived in Cape waters a month later, and, upon capturing the ship *Held Woltemade* off Saldanha Bay, learned that De Suffren had already disembarked French troops.[37] As De Suffren's ships were also at the Cape, Johnstone decided not to attack it, but to rather focus on the five richly laden VOC East Indiamen that, according to the *Held Woltemade*, were at anchor in Saldanha Bay. On 21 July, Johnstone sailed into Saldanha Bay and immediately attacked the ships.

The Captain of the *Hoogcarspel*, Gerrit Harmeijer, was appointed as Commodore of the VOC squadron and instructed to make defence preparations to safeguard the ships.[38] These preparations included anchoring the ships close to each other in a line-ahead formation to the north of Schaapen Island, the between-deck spaces and cabins had to be cleared for guns, and all the guns had to be mounted on the seaward side of the ships to create a strong defensive battery. The spars and topmasts had to be slashed together and secured with light anchors in a semicircle to the seaward side of the ships, to defend them against fire-ships and make it difficult for other vessels to come alongside and board them. They also had to remove the sails from the ships, take various measures to ensure that the ships were not immediately ready to sail and that it would take major repairs to get them seaworthy, and they were instructed to rather destroy their ships than surrender them to an enemy.[39] In addition, they had orders to create fortifications in the entrance to the bay. Though the record indicates that Harmeijer and his captains did create a makeshift battery with thirteen light guns close to 'Hoedjiespunt', it was of no real military value, and they also anchored the ships in 'Hoedjiesbaai' and not to the north of Schaapen Island, as they had been instructed.[40]

The Dutch lookout hoisted the warning flag from *De Uitkijck,* Postberg, at 09:30. The British ships initially flew French flags, but at about 10:30, with sixteen ships already in the bay, they hoisted British flags.[41] Many members of the Dutch crews were ashore, and as their captains realised that they could not defend their ships against Johnstone's heavy warships, they chopped off anchor cables, hoisted the foretopsails (left on board to beach the ships), and, in some cases, set their ships alight.[42] The Dutch offered no resistance: within thirty minutes of receiving the message that the British were coming Commodore Harmeijer set the example by fleeing from his ship without firing a shot or setting his ship alight.[43] The British fired a few salvos at the Dutch, which only increased the speed of their flight. By 12:00, the leading British ships reached the VOC ships, anchored, lowered boats and took possession of the Dutch ships before the remaining defenders had time to damage or destroy them.[44] The British were able to quickly extinguish the fires, except on the *Middelburg*, whose Captain, Justinus van Gennep, took his orders seriously and made sure that his ship would be destroyed.[45] The Dutch crews who had to ensure that their ships were set alight were ashore at about 12:00.[46]

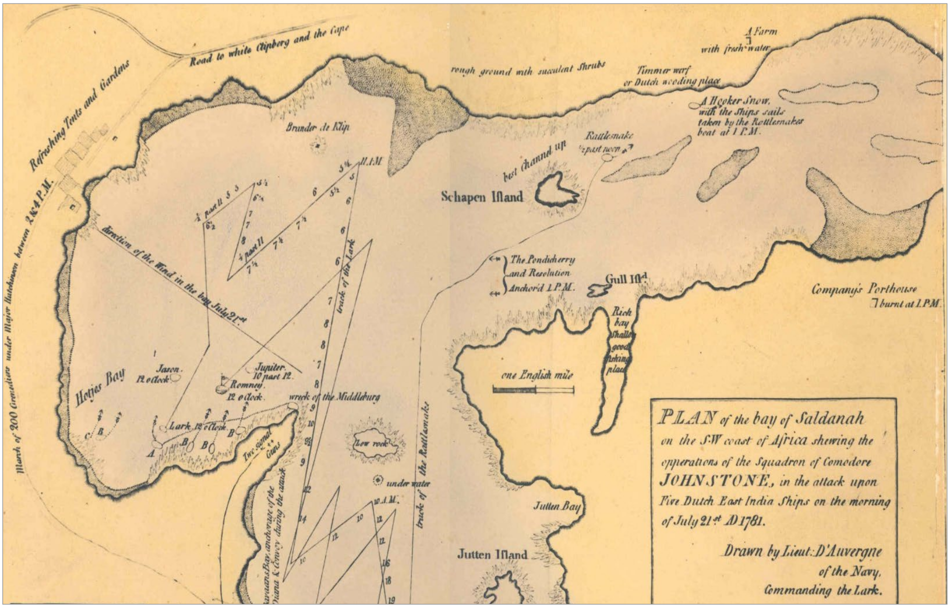

Figure 2.8 Capture of VOC ships in Saldanha Bay (21 July 1781), by Lieutenant D'Auvergne of HMS *Lark*. The map provides considerable operational detail, including the position of ships.[47]

The loss of the ships was a severe blow for the financially struggling VOC. They severely reprimanded the Cape Governor, Van Plettenberg, for leaving the ships unprotected in Saldanha Bay instead of sending them to Cape Town or False Bay, where they would have been under the protection of De Suffren's ships.[48] As a whole, the Anglo-Dutch War accelerated the ruin of the VOC and was disastrous to the Dutch state. It also illustrated that sea power would determine the fate of the Cape in times to come.

The Battle of Saldanha Bay, 1796: British defensive triumph

In 1792 the French Revolutionary War commenced, as France declared war first against Austria and Britain, and in 1793 against the Netherlands. The Cape of Good Hope was in Dutch hands, but due to its strategic location on the sea route to India, Britain regarded it as vital for the security of the shipping that carried Eastern riches to Britain. Late in 1794, France invaded the Netherlands, and the new Dutch State (the Batavian Republic) became an ally of France and an enemy of Britain. This caused considerable anxiety about the security of British shipping, as the Cape could become a base for French privateers.[49]

Figure 2.9 Capture of the Dutch East India Company fleet in Saldanha Bay in 1781, by Thomas Luny (1759-1837). Though Luny was a prolific maritime painter of the period, it is evident from the dramatic and fanciful painting that he was not present at the event and had not been to Saldanha Bay.[50]

Thus, in early 1795, zealous preparations were put in motion for an expedition to capture the Cape. Vice Admiral Sir George Keith Elphinstone (later Lord Keith), an experienced and capable naval officer, was appointed as commander of the task force and “Commander in Chief in all the Indian Seas”, with full powers to fight or negotiate, depending on the circumstances.[51] The Army commanders were Major Generals Sir James Henry Craig and Alured Clarke. The British arrived in False Bay on 11 June 1795 and tried to negotiate a Dutch surrender. When negotiations failed, a military campaign ensued, with the Dutch offering a poor defence and finally capitulating on 16 September 1795.

Britain established its authority firmly at the Cape and also established a naval base at Simon’s Town. The British were very concerned about the security of the Cape: they feared a French-Dutch attack, and the situation in the interior was also far from calm. Although General Craig improved the fortifications around Cape Town, Elphinstone still emphasised to the Admiralty that the first line in the defence of the Cape was the Royal Navy as ‘the safety of this place must depend on the Fleet …’[52]

This was the heyday of the Royal Navy. It was a well administered, well trained, experienced and extremely competent force, crucial for securing Britain and her global interests.[53] By comparison, the navies of France and the Netherlands were inferior, having lost much of their proficiency due to the removal of many capable aristocratic officers following revolution and political changes. The Batavian Republic did not enforce proper naval policy, and, due to their political affiliation, many inexperienced junior officers were quickly appointed and promoted in the place of more experienced officers of the old regime. The result was a lack of *esprit de corps,* poor discipline, distrust between officers and crews, poor maintenance, logistical problems and financial difficulties.[54]

In January 1796, British intelligence reported that the Dutch were equipping a squadron at Texel to recapture the Cape (with possible French assistance). The British government immediately reinforced the Cape with additional warships and troops to place it on a strong defensive footing.[55] The nine ships of the Dutch squadron (two ships of the line, three frigates, three smaller warships and one transport) departed from Texel on 23 February 1796, under the command of Rear Admiral Engelbertus Lucas. On 6 August, after a long and taxing voyage, they anchored in Saldanha Bay, to the north of Schaapen Island. They had very little water, many crewmen were ill, and due to much dissent amongst the crews, operationally they were in poor shape. When Lucas tried to gain intelligence about the military situation at the Cape, the locals warned him about the strong British force and suggested that he leave immediately. In spite of this, the Dutch took down their sails to be repaired and commenced with the long process of watering their ships from the sparse water supply on hand. Despite a strong southerly wind, Lucas even ordered the frigate *Bellona* around the treacherous Schaapen Island and anchored her opposite Stompe Hoek on 11 August to provide fire support at the watering place. He was labouring under the false expectation that a French squadron would arrive soon, when in fact a squadron under Rear Admiral De Sercey had already rounded the Cape bound for Mauritius.[56]

When Craig received news that Dutch ships were seen in the vicinity of Saldanha Bay on 3 August, he immediately alerted Elphinstone and dispatched cavalry to Saldanha Bay. Elphinstone thought the Dutch would round the Cape, and so, despite terrible weather conditions, he directly sailed out in a southerly direction, hoping to intercept them.[57] In the meanwhile, Craig learned on 6 August that the Dutch were at anchor in Saldanha Bay. Fearing that they might move into the interior, he issued proclamations prohibiting contact with the Dutch (on pain of death) and ordered all cattle and horses to be moved into the interior.[58] He also dispatched an advance force to Saldanha Bay, and marched with his main force (2 500 soldiers and eleven guns) on 14 August, leaving 4 000 troops to defend the Cape.

On 12 August, Lucas received word that about 600 British soldiers (Craig's vanguard) were approaching. With no reliable intelligence on the movements of the British squadron, some of his officers feared that they might be trapped, and urged him to sail for Mauritius immediately.[59] Lucas dithered, but eventually decided to depart on 14 August, once his ships were watered.[60]

When Elphinstone arrived back in Simon's Bay on 12 August, he learned that the Dutch were at anchor in Saldanha Bay. He wanted to sail to Saldanha Bay immediately, but this was impossible, due to storm damage to most of his ships in what he described as 'the most tempestuous weather I have ever experienced'[61] and the fierce south-easterly gale that still raged.[62] The next day saw more damage while numerous ships even dragging their anchors (HMS *Crescent* beached, HMS *Trident* struck a rock, and HMS *Tremendous* was nearly lost. However, after urgent repair work on 14 August, and when the wind allowed it on 15 August, Elphinstone straightaway put to sea with thirteen ships (including seven ships of the line).

As Craig's main force approached Saldanha Bay around noon on 16 August, they saw Elphinstone's ships at sea 'with all … sails crowded advancing with a fair wind directly to the mouth of the harbour.'[63] It was indeed a swift passage and excellent sailing from Simon's Bay to Saldanha Bay. It is interesting to note that Craig (an army officer) refer to a 'fair wind', while it was recorded as strong winds and gale force conditions by naval officers on both sides.

By late afternoon Elphinstone had blocked the channel to the north of Schaapen Island and immediately requested Lucas to surrender 'to spare an effusion of blood', warning him that 'otherwise it will be my duty … of making serious attack … the issue of which is not difficult to guess.'[64] Lucas met with his officers. Some argued for taking advantage of the strong southerly wind from astern to set sail and attempt a fighting escape, while others preferred to destroy their own ships rather than surrender to the British. However, most of the captains argued that the British had overwhelming force, and as their exit was blocked, it would be better to negotiate a good capitulation.[65] After a long discussion they decided to prevent a massacre, and Lucas ignominiously surrendered the following day.

Figure 2.10 This interesting contemporary depiction by J.C. Friderici shows British troops on the south-eastern shore of the bay, Dutch ships at anchor, and British ships sailing into the bay.[66] Clearly visible is the peninsula (referred to as Schier Island), with Postberg to the left and Konstabelberg to the right, and Meeuwen and Schaapen islands to the far right. In the extreme right of the picture are the northern shore and the entrance to Saldanha Bay.

The Lucas expedition had no real chance of success: it was not kept secret, was poorly organised, inadequately prepared, and lacked unity. In Lucas it had an incompetent commander who never acted decisively. The failure of Batavian-French diplomacy sealed the fate of the expedition, as it was doomed without French assistance. By comparison, the British had adequately reinforced the Cape, their energetic defensive efforts were crucial to their success, and in Elphinstone and Craig they had capable commanders that acted with vigour.[67] Britain had illustrated the virtual impossibility of retaking the Cape by force of arms and – as was a common feature of the colonial struggles between Britain and her European rivals – sea power ultimately determined the fate of the Cape.

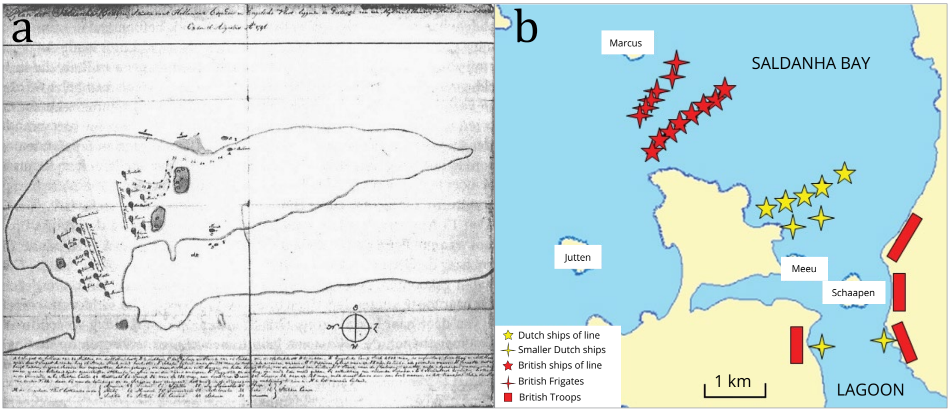

Figure 2.11 The disposition of naval forces in Saldanha Bay and the surrender of the Dutch ships, 16-17 August 1796: (**a**) is a drawing from the journal of Admiral Lucas,[68] and (**b**) an interpretation of data from ships logs and other sources of the time

Saldanha and the second British occupation of the Cape, 1806

In accordance with the stipulations of the Peace of Amiens (signed on 5 March 1802), Britain had to hand the Cape of Good Hope back to the Netherlands. As the VOC did not exist anymore, the Cape would fall under the direct control of the Netherlands, now known as the Batavian Republic.[69] In February 1803 the Dutch reassumed control of the Cape.[70]

General J.A. Janssens, the new Governor of the Cape, saw Saldanha Bay as militarily significant and considered that the bay might be used by the British in case of another attempt to capture the Cape. After visiting Saldanha Bay and St Helena Bay (in May 1804), Janssens instructed soldiers to be posted at these locations and stipulated the actions they should take in the event of an enemy force arriving on these shores.[71] In his report, Janssens described Saldanha Bay as an important location, even suggesting that the capital could be moved there in case of a strong attack on the Cape. However, forts had to be constructed to defend the entrance to the bay, while the lack of sufficient fresh water remained a serious problem. The report suggested constructing a channel from the Berg River; however, conceding that this might be too expensive, it proposed that water be collected in reservoirs during winter for the dry summer months as an immediate solution.[72]

The Peace of Amiens was short-lived, and hostilities between Britain and France recommenced in May 1803. Again the British emphasised the value of the Cape for the prosperity and security of the imperial project: it lay at the centre of the western and eastern parts of the empire, and it could be regarded as the 'grand outwork' of India as it secured the 'political and commercial interests in the East Indies.'[73] To British thinking, it would be 'truly dangerous', and very difficult to keep a watchful eye on the enemy if the French were to establish themselves at the Cape. As Britain feared that Napoleon's real focus might be India – the 'Jewel in the Crown' – the Cape had to be captured to 'crush in the cradle, the designs of the French upon India.'[74] Thus, in July 1805, the Royal Navy received orders to equip an expedition to take control of the Cape. Commodore Sir Home Popham was appointed as naval commander and Major General Sir David Baird as army commander. The expeditionary force comprised of nine warships, seventeen British East Indiamen, thirty-nine other transport ships,[75] and around 7 000 soldiers.[76]

The British commanders did not wish to attack the network of fortifications around Cape Town directly from the sea, and Muizenberg was also out of the question, because the British themselves had made its defences 'absolutely impregnable'. An attack therefore had to 'be attempted from a different quarter.'[77] It was decided that they would land about 26 kilometres north of Cape Town, at Losperdsbaai (now known as Melkbosstrand). In the meanwhile, Brigadier General Beresford would be despatched to Saldanha Bay with the 38th Infantry Regiment and the 20th Light Dragoons to acquire provisions, horses and cattle. If conditions were too adverse at Losperdsbaai, or if the Dutch opposition was too strong, the whole task force would land at Saldanha Bay.[78]

The first British attempt to land at Losperdsbaai (on 5 January 1806) failed due to a strong wind and rough surf. The following day, the weather improved and they accomplished the landings with only slight opposition from a Dutch patrol that was quickly forced to retire by gunfire from the supporting British naval vessels.[79] By nightfall, 4 000 troops, artillerists, about 500 to 600 sailors, and a number of artillery pieces were ashore.[80] The Dutch had lost a golden opportunity to frustrate the British landings, and now, instead of staying behind the fortifications of Cape Town with his inferior force, Janssens marched north to meet his enemy on the field of battle with only 1 951 men under arms.[81] He deployed his force to the east of the Blaauwberg on 8 January, but the superior British force dislodged the Dutch line and forced a retreat.[82]

In the meanwhile, Beresford and his troops had arrived in Saldanha Bay and managed to land despite some difficulties due to strong winds and problems with disembarking the horses. As burghers living around the shoreline immediately moved their cattle into the interior, Beresford directly advanced to the Dutch post at Theefontein (about 30 kilometres from the Saldanha Bay), where he managed to capture horses, cattle and considerable other provisions.[83]

Janssens managed to preserve his force after the retreat at Blaauwberg, and considered conducting a prolonged guerrilla-style campaign from the interior. General Baird, however, warned Janssens that this would leave him (Baird) with no choice but to devastate the colony, 'which must entail misery and ruin … [and] further Effusion of Blood'.[84] Negotiations commenced shortly afterwards, and Janssens surrendered with his troops on 18 January. For the second time in about a decade, the Cape was conquered due to its strategic importance and the imperial interests of Britain.

Concluding remarks

In the case of Saldanha Bay, a natural harbour located on the south-west coast of South Africa, just over 100 kilometres north of Cape Town, geology and natural history created the ideal conditions to provide the bay with an interesting military-strategic history spanning more than three centuries. The bay was shaped by unique geological events that can be traced back to the Pan-African orogenic event, when drifting tectonic plates merged into the Gondwana-Pangea supercontinent. The geology of the bay is dominated by granite rock, with several of the protrusions in excess of 60 metres above mean sea level. These resistant granite outcrops significantly influenced the erosional formation of the natural harbour, which from a shipping point of view resulted in an ideal haven with calm waters and a number of safe anchorages along its shores.

Due to the geological characteristics, the potential military-strategic importance of the bay was quickly recognised. Despite the fact that shipping and navies frequented the bay from time to time, it was never fully developed as a port due to a shortage of fresh water. As a result of its natural features, obvious value from a nautical point of view, and ideal location on the important sea route to the East during the age of maritime empires, much of the recorded history of Saldanha Bay after the arrival of the Dutch definitely has a military-strategic slant.

The historical record indicates that the unique attributes of Saldanha Bay made it a place of value to shipping in the days of sail. Ships that were damaged or sought shelter from wind and weather found a safe haven in the bay, as its unique geological attributes provided safe anchorage, protection against the weather, and good conditions for caulking ships. After a difficult voyage at sea, many ships replenished their supplies in Saldanha Bay before continuing their voyage; while in times of war, it became a hideout for merchant vessels and naval forces. The bay saw two naval skirmishes whose outcome impacted fundamentally on the course of South African history: one linked to a foiled British attempt to capture the Cape, and the other a British action that prevented the Cape from falling into Dutch hands. These events clearly illustrate the important role of sea power and maritime power projection in shaping greater historical processes and influencing world history in the age of maritime empires.

Though Saldanha Bay is good example of how geological characteristics can create a unique port, it is also an example of how climatic and geological conditions inhibited the further development of a harbour and port city due to a lack of sufficient supplies of fresh water. In fact; this aspect inhibited the military as well as socio-economic development of an excellent natural harbour along the South African coast for close to three centuries. As a later chapter indicates, the history of Saldanha Bay took a new turn during the twentieth century.

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CHAPTER 3

Wasted geography: The British annexation of the Cape in 1795

Thean Potgieter & Hennie Smit

Introduction

In the year 480 BC, the Greeks and Persians gave the world a name for bravery against vastly superior odds, as well as for the force-multiplying effect of geography (in this case a narrow pass): Thermopylae.

Fast-forward 2 275 years to the Dutch settlement at the Cape. As British interests in India expanded substantially during the late eighteenth century, eastern trade became important for British prosperity. However, the sea route that linked Britain with India was vulnerable, because the rich maritime traffic had to round the Cape of Good Hope, located at the southern tip of Africa, literally halfway to the East. The Cape was in Dutch hands from 1652, and under the control of the VOC. In accordance with its charter, the VOC had a monopoly on Dutch-Asia trade and had the sovereign right to maintain troops and garrisons, fit out warships, appoint governors over foreign (Asian) populations, conduct diplomacy and conclude treaties.[1] Though the VOC appointed and controlled its own military and executive staff, VOC officials had to swear an oath of allegiance to the States-General of the United Provinces (Dutch Republic).[2]

The Cape was usually well defended during the oft-fought wars of the eighteenth century, and from the Seven Years' War (1756-1763) onwards it

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gained considerable strategic importance. In wartime, Britain was therefore very anxious about its valuable trade with the East and the security of the Cape sea route. In 1781 a large British expedition was dispatched to capture the Cape, but it failed due to the intervention of the French naval and military force. The result was that the British war effort in the East was impeded by the French-Dutch alliance and their control of the Cape. With the outbreak of the French Revolutionary War in 1792, Britain was anxious to prevent the Cape from falling into French hands, and when the Netherlands became an ally of France in 1795, Britain immediately dispatched a joint expeditionary force to capture the Cape of Good Hope.

Taking the Cape from the sea would entail an amphibious operation. Though amphibious warfare posed serious challenges at the time, proper planning, preparations and sufficient force under experienced command were important prerequisites. In addition, the navy and army components had to cooperate operationally and tactically, with naval support being crucial during and after landings. Operational guidelines (dating from 1763) available to British officers stipulated that, upon deciding on a landing site, 'the whole command is given to a Sea Officer who conducts them to the place of landing ...'[3] Once the men were out of the boats and actually set their feet ashore, the Army commander took command of the soldiers. But as a military force on foreign soil had to be supported from the sea, a good working relationship between the commanders remained crucial.

The British faced many difficulties in their quest to capture the Cape. Cape Town was well fortified, but landing at other locations would be difficult as the British had an inadequate force, no transport and would face geographic challenges. In addition, weather conditions at the Cape were often adverse and posed challenges to sustained naval operations. To the British advantage were the political divisions in the Netherlands and at the Cape, and the fact that it had only a small garrison, with no Dutch or French naval forces at hand to defend it. Moreover, due to their distance from Europe, the Dutch at the Cape lacked intelligence about recent political and military developments in Europe. Yet, in the end, the British would prevail, despite the geographical and other advantages enjoyed by the Dutch.

This chapter places geography central to the British occupation of the Cape of Good Hope in 1795, and investigates the reasons why the favourable geography was not used to better effect by the defenders.

The physical geography of the Cape Peninsula and surrounding area

The Cape Peninsula is situated on the south-western extremity of Africa, in South Africa figure 3.1). The physical geography of the area is dominated by the mountains of the Cape Peninsula. This mountain range forms the western boundary of the area under discussion, starting with Table Mountain in the north, with a series of peaks stretching south to Cape Point. Bordering the Cape Peninsula to the east is a relatively flat area of loose, unconsolidated sands, the Cape Flats. The Cape Flats connect the Cape Peninsula to the mainland, with the Hottentots-Holland Mountains bordering the area in the east.

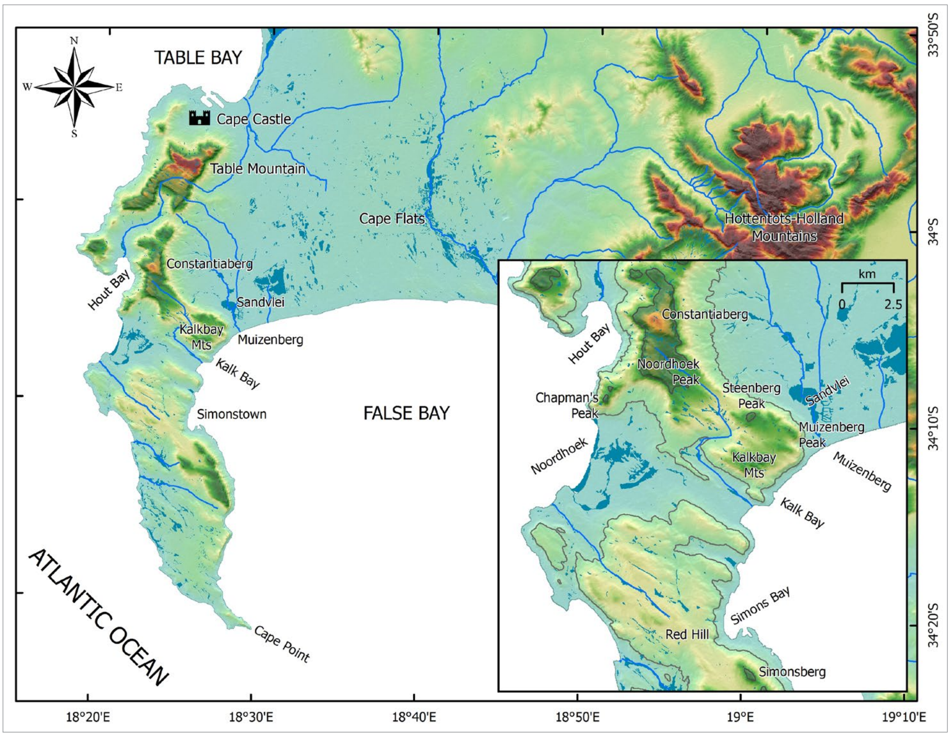

Figure 3.1 The Cape Peninsula and surrounding area
Source: Map by T. Flügel

The area is bounded by two bays, the larger of which is False Bay, to the south of the Cape Flats and bordered by Cape Point to the west and Cape Hangklip to the east. This south-facing bay is where the British force dropped anchor in 1795. To the north, a smaller bay, Table Bay, forms the northern border of the area. Cape Town is situated east of Lion's Head and Signal Hill and north-east of Table Mountain, with the north-facing Table Bay forming its northern boundary.[4]

The Cape Peninsula and surrounding area is characterised by three main types of exposed rocks: the metamorphic rocks of the Malmesbury Group, the Cape Granite Suite that intruded into the Malmesbury Group, and the younger sedimentary rocks of the Table Mountain Group. The Malmesbury shale is the oldest rock in the area. These shales were intruded by the Cape Granite Suite about 545 Ma.[5] The granites can be seen near sea level in various places around the Cape Peninsula, most spectacularly along Chapman's Peak Drive on the Atlantic seaboard, but also near Simon's Town and between Kalk Bay and Muizenberg, among many others.[6] On this platform, the sediments of the Cape Supergroup developed. The Graafwater and Peninsula formations, the two lowermost formations of the Cape Supergroup, are exposed on Table Mountain, as well as further south towards Muizenberg and Cape Point.[7] The Graafwater Formation consists of sandstones and mudstones, and is responsible for the lower, gentler slopes in some areas of the Peninsula.[8] Stratigraphically overlying the Graafwater Formation, and forming most of the surface area of the mountains of the Cape Peninsula, are the course-grained, light grey, quartsitic sandstones of the Peninsula Formation.[9] These quartzose sandstones are highly resistant and produce the spectacular steep cliff faces typical of the mountains of the Peninsula.[10]

The Cape Flats, to the east of the Cape Peninsula, is a low-lying, relatively flat area consisting of unconsolidated Holocene and Quaternary sands underlain by Malmesbury Group shales. The Cape Flats link the Cape Peninsula to the Hottentots-Holland Mountains of the mainland. These mountains share a similar geology with the mountains of the Cape Peninsula.[11]

To the east of Muizenberg is a lake and swamp system (the lakes are called 'vlei' in the local vernacular) consisting of a series of permanent small, shallow (approximately 1-2,4 metres deep) freshwater and estuarine coastal lakes with extended swampy areas in between. These lakes drain into False Bay.[12] Closer to Muizenberg, the Sandvlei (also sometimes spelled Zandvlei) system consists of a small, well-mixed estuarine lake.[13] The vlei has a surface area of approximately 121 hectars, and the main vlei is approximately 2,5 kilometres long with a mean depth of 1,5 metres.[14] Situated on the edge of a relatively flat sandy plain of recent marine origin, it was reputedly named by Jan van Riebeeck in recognition of its situation on this coastal plain. The vlei is fed by three streams, the Sand, Westlake and Keysers, and together with the surrounding marshy area forms an almost impenetrable barrier to movement on foot.[15]

The physical geography of the area between Simon's Bay and Cape Town was considered a major obstacle in the way of any invading force. Behind Simon's Bay, the sandstone cliffs of Red Hill rise to 255 metres above sea level, while the Simonsberg to the south reaches 547 metres above sea level.[16]

Only one road to Cape Town existed, running along the coast past Muizenberg and then across the peninsula. The passage was specifically difficult between Kalk Bay and Muizenberg. From Kalk Bay the route was sandwiched on a narrow strip of land between the sea and the almost vertical sandstone cliffs of Kalk Bay Mountain and Muizenberg Peak. Past present-day Muizenberg, the topography flattens out, providing multiple positions from which to attack Cape Town. So good was the obvious defensive strength of the area between the cliffs and the sea, that Elphinstone called it the 'Thermopylae of the Cape Peninsula.'[17] Here the defenders of the Cape had the sea to their one side, and the steep slopes and almost vertical cliffs of Kalk Bay Mountain, Muizenberg Peak and Steenberg Mountain on the other. To the east, the Sandvlei marshes – the large area of surface water and waterlogged soil on the Cape Flats, stretching from the beach near Muizenberg a few kilometres inland and extending eastwards for a few kilometres – made a flanking attack by the British virtually impossible.

The wind regime of the Cape Peninsula and its influence on shipping in the age of sail

The Cape Peninsula and surrounding area has a Mediterranean climate, characterised by what Van Doorn, O'Riain and Swedell termed 'extreme seasonality.'[18] This seasonality is not only reflected in rainfall regimes (the area receives about 75 per cent of its annual rainfall during winter),[19] but also – and which is more important for this investigation – in the seasonal reversal of winds.

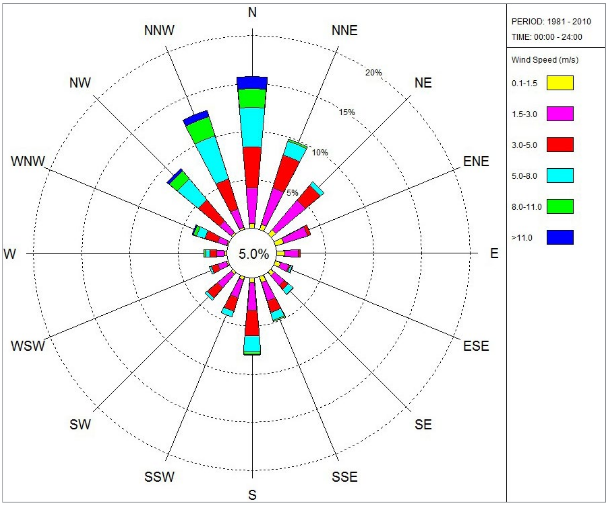

Figure 3.2 The wind regime of Cape Town in June[20]

From figure 3.2 it is clear that, in winter, the wind blows from a northerly direction (between NE and NW) more than 50 per cent of the time. These northerly winds also blow the strongest, with wind speeds exceeding 11 metres per second during a sizable proportion of the time. In a comparison between the wind fields of Cape Town, Port Elizabeth and Durban, Schumann and Martin concurred with this; they also suggested that higher energy was recorded over longer periods at Cape Town, and that the maximum energy is considerably higher at Cape Town than at the other two sites.[21]

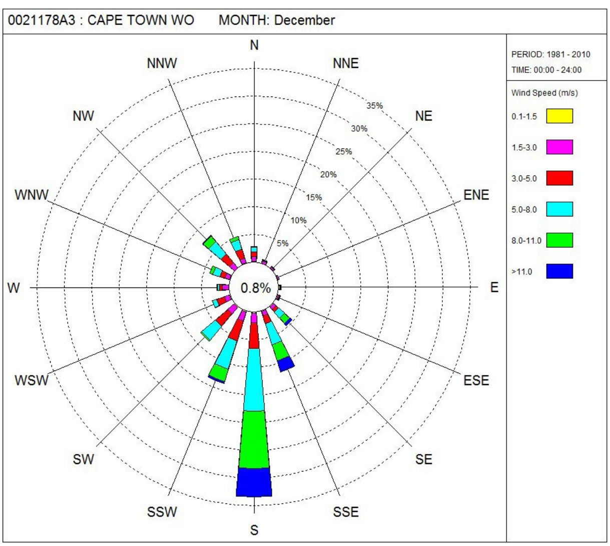

Figure 3.3 The wind regime of Cape Town in December[22]

Figure 3.3 depicts the wind field in Cape Town in December. This summer situation clearly indicates a complete reversal of the winter winds. During December the winds blow predominantly from the south. The total percentage of south-westerly to south-easterly winds over the period exceeds 70 per cent, as also found by Schumann and Martin.[23] The higher wind speeds of above 11 metres per second are found exclusively for the southerly winds.

In the days of sail, and without sheltered man-made harbours at the Cape of Good Hope, the wind regime had an obvious effect on the regulation of shipping at and around the Cape. Table Bay, the main anchorage at the Cape, had a large and commodious anchorage that was safe for ships during the summer with its prevailing southerly winds, but it was open to the north and unsuitable as a winter anchorage due to prevailing northerly winds in winter. Severe northerly gales often blew ships onto the shore of Table Bay, and many richly laden VOC ships perished at the Cape, often with all hands. The western shore of False Bay provided good protection against the winter winds, and Simon's Bay could even shelter a small number of ships in summer.

The VOC took possession of Simon's Bay in 1671, but though ships anchored in False Bay from time to time, it was difficult to provision them. After another ferocious storm on 20 May 1737 wreaked havoc with shipping in Table Bay (only one of the ten ships at anchor survived), an alternative arrangement had to be made. In 1742 a post to provision ships was established in Simon's Bay, and by 1753 all ships were instructed to use Simon's Bay from mid-May to mid-August.[24] The standing orders issued to VOC captains included, among other, information about the sea conditions and prevailing winds around the Cape, as well as instructions on the use of Table Bay, entering False Bay, and anchoring in Simon's Bay.[25] By the 1760s captains were sternly ordered not to be at anchor in Table Bay between mid-May and mid-August, on pain of a fine of three months' salary.[26] By 1792 VOC ships had to anchor in Simon's Bay from 10 April to 1 September, and Simon's Town developed, as warehouses, a large hospital and a stone pier were erected. Although VOC anchorages had to be covered by coastal fortifications, this was not the case in Simon's Bay.

British attempt on the Cape: strategic setting and opposing forces

Late in 1794 France invaded the Netherlands. The Dutch *Stadtholder* (William V, Prince of Orange) fled to England and the new Dutch State (called the Batavian Republic) became an ally of France and an enemy of Britain. Because the British feared that the Cape of Good Hope might fall into French hands and become a base for French privateers, much anxiety existed amongst the directors of the English East India Company (EEIC). On 4 January 1795, Sir Francis Baring, Chairman of the EEIC, emphasised the importance of the Cape for refreshment of EEIC ships, affirming that whoever is 'master of the Cape will be able to protect or annoy our ships.'[27] He requested the Secretary of State for War, Henry Dundas (later Lord Melville), to consider annexing the Cape, as they might surprise the defenders and win an easy victory; for if the Cape were lost, there was no substitute.[28] The idea enjoyed firm support in the British establishment, as it was feared that the 'feather in the hands of Holland' would become a 'sword in the hands of France.'[29] At the insistence of British politicians, the exiled Prince William of Orange wrote a letter to the VOC authorities at the Cape on 7 February 1795, requesting that they welcome British warships and allow British troops into the castle as 'Troops and Ships of a Power in Friendship and Alliance' coming to prevent the 'Colony from being invaded by the French.'[30]

The British immediately commenced preparing in earnest to take the Cape. Sir George Keith Elphinstone (later Lord Keith, and known as such in the Royal Navy annals) was appointed as naval commander of the task force and 'Commander in Chief in all the Indian Seas,' with full powers to fight or negotiate depending on the circumstances (figure 3.4).[31] Elphinstone studied Cape affairs,[32] made the naval arrangements, prepared for a winter campaign, and arranged for assistance from the EEIC as well as the Governor-General in India. Due to the anticipated winter weather conditions around the Cape at their expected arrival time, the Army Commander, Major-General Alured Clarke, and the bulk of the soldiers were dispatched to São Salvador (da Bahia, in Brazil) to await orders. Elphinstone also arranged with the Portuguese governor of Salvador for Clarke's reception. His organisational and command capacity 'strikingly manifested' in the preparations for the expedition.[33]

The expeditionary force sailed in three groups. Captain John Blankett (with three third-rate ships of the line and a sloop) departed on 16 February with Major-General Sir James Henry Craig and 515 soldiers of the 78th Regiment on board. On 3 April Elphinstone's squadron of six ships (three third-rate ships of the line, a frigate, a sloop and a cargo ship) set sail for the Cape. The main body of 3 000 troops under Major-General Alured Clarke departed on 15 May to Salvador.[34] Clarke's orders were plain: if Elphinstone and Blankett were not successful, he was to make 'an immediate and vigorous attack on the Cape to take possession of the Colony in His Majesty's name.'[35] Elphinstone and Blankett rendezvoused off Cape Point on 10 June 1795 and arrived in Simon's Bay at about 16:00 the next day.[36]

Figure 3.4 Sir George Keith Elphinstone[37]

As a result of the financial plight of the VOC, the defences of the Cape were depleted. After the Württemberg Regiment (previously stationed at the Cape) left for Batavia in 1792, the garrison comprised only 1 302 full-time officers and men, which included a regular infantry battalion (571 officers and men), the locally raised *Pandoer Corps* (about 200 strong), 57 infantrymen at the depots of the Meuron and Württemberg Regiments, 44 *sipahis* (Malay infantry), and an Artillery Corps (430 officers and men). As burghers between 16 and 60 were obliged to do military service, the burgher militia added about 2 300 men, which raised the total number of defenders available to about 3 600.[38]

The Cape had an extensive system of fortifications. The Castle in Cape Town was the main fortification, but doubt existed about its effectiveness as it was an out-dated fortification that could be outflanked, and it had a limited arc of fire. Numerous batteries and smaller forts were therefore erected around the

Cape and in Table Bay to create a system of defensive lines. The Amsterdam, a casemate battery armed with sixty-six 24-pounders and six 12-inch mortars, was considered the most formidable fortification in Table Bay.[39] Camps Bay had an entrenchment and a battery, and Hout Bay had three batteries.[40] In total, around 400 artillery pieces (of which some were not properly mounted), and nineteen ovens capable of producing 450 rounds of red-hot shot in fourteen minutes, were available to defend the Cape Peninsula.[41] Although many fortifications were far from formidable, as a whole, they served as a major deterrent. In the 1790s, a certain Captain De Jong (a Dutch naval officer) expressed the opinion that with 2 500 soldiers to defend the Cape, it would be very difficult to take it from the sea.[42] However, in False Bay the defences were lacking. Only two small batteries (armed with four 24-pounders and four 4-pounders each) with a limited field of fire were erected in Simon's Bay. Hence, as British intelligence reports indicated, False Bay was the ideal place for a hostile force to conduct a landing.

Figure 3.5 Fortifications around Cape Town, 1793.[43] This contemporary depiction of the formidable fortifications around Cape Town makes it evident why the British chose to rather land in False Bay.

British arrival at the Cape and negotiations

A few hours after Elphinstone had anchored off Simon's Town (on the evening of 11 June 1795), the news reached A.J. Sluysken, the VOC Commissioner at the Cape and the highest politico-military authority.[44] The Council of Policy met immediately and decided to send Lieutenant-Colonel C.M.W. de Lille with 200 infantrymen and 100 artillerists to Simon's Town to strengthen the garrison of 110 infantrymen and 50 gunners. The burgher militia from the outlying districts were also called up to assist with the defence, but the response was poor.[45]

The Cape government had no reliable news of the latest events in Europe. Though they considered Britain and the Netherlands to be allies, recent information suggested that the Netherlands might have changed sides. Matters were made worse by the gross dissatisfaction with the VOC control, local political divisions, internal strife, and turmoil in the interior. Many of the burghers and soldiers were opposed to the stadtholdership and supported the Dutch *Patriotten*, while the officers and VOC officials were mainly loyal supporters of the *Oranje Partij*. In the light of the pro-British sentiments of Colonel Robert Jacob Gordon, the Commander of the Garrison, the British assumed that he might welcome a British take over and persuade the garrison to change sides.[46]

Figure 3.6 Colonel Robert Jacob Gordon in the uniform of Commander of the Garrison at the Cape of Good Hope[47]

Negotiations commenced, providing some British officers with the opportunity to visit the Cape, inspect the fortifications, and as Elphinstone stated to 'gain as much intelligence possible.'[48] The first to visit the Castle were two officers who delivered the letter from the Prince of Orange and a report from Elphinstone and Craig on 14 June.[49] Gordon tried to convince the Council of Policy that the British were allies, but the other members stressed that as their loyalty was to the Netherlands, not a Prince, the British should not be allowed to land at the Cape.[50] The Council replied that British assistance would be appreciated in case of a French attack, but that the Cape was capable of defending itself.[51] On 19 June Craig visited Cape Town and tried to convince the Council to hand over authority, but they repeated that under the lawful constitution of the Netherlands the Cape must be defended.[52]

With the Cape refusing to capitulate, the British position became more precarious by the day: they had no foothold ashore, there was a desperate shortage of water and provisions on some of the ships, and many men were suffering from scurvy.[53] Though this was somewhat alleviated by the Dutch allowing the sick ashore for medical care, and by some provisioning to the squadron, supplies were still very low.[54] Yet, in the light of the geographic realities, and without draught animals, field guns, artillerists, engineers and a substantial infantry force, it would be very difficult to capture the Cape by force if the Dutch used their geographical advantage and retreated behind their fortifications.[55] Well aware of this, Elphinstone summoned Major General Clarke from Salvador on 18 June.[56]

On 22 June Elphinstone and Craig issued a proclamation offering British protection to Cape citizens and inviting them to negotiate directly with the British.[57] In response, the Council of Policy ceased negotiations with the British, stopped supplying the squadron, and removed all horses, oxen and other draught animals from Simon's Bay and Fish Hoek. Elphinstone reacted by capturing three VOC ships at anchor in Simon's Bay. Due to the weak fortifications at Simon's Town and the strong British naval force, the Dutch evacuated Simon's Town and withdrew to Muizenberg on 29 June.[58] Negotiations had failed – it was now time for military action.

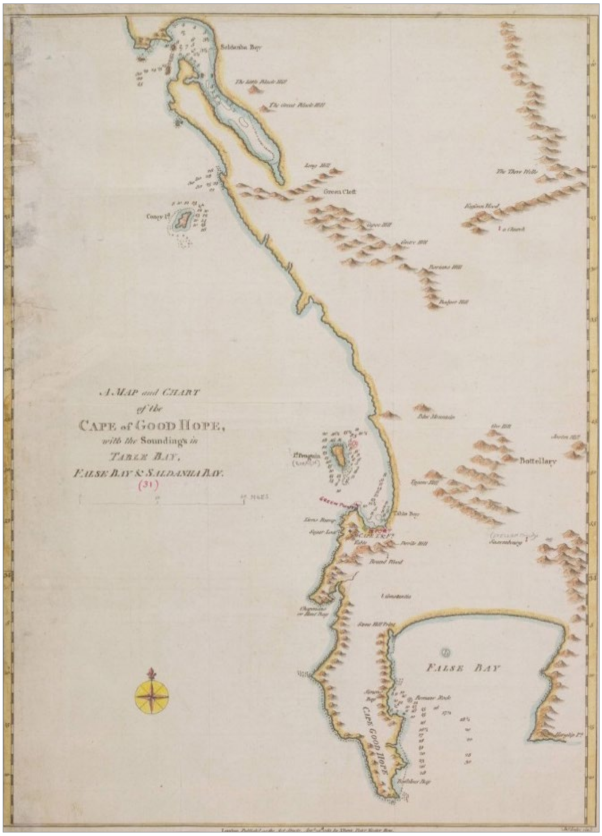

Figure 3.7 Map and chart of the Cape of Good Hope, 1781[59]

Attack on Muizenberg: assaulting a natural defensive position

In the late eighteenth century, amphibious operations were difficult and the attacker was exceptionally vulnerable during the attempted landing. The British had no specialised vessels, and the landing of troops, ammunition, equipment and supplies would have to occur from open ships' boats, which would be difficult under sustained fire. The lack of proper defences in Simon's Town was a grave Dutch military error – even though, in this case, it would have been difficult to hold the town in the face of a large-scale amphibious attack and the naval gunfire support available to the British. The Dutch evacuation of this important position was therefore a blessing, as it allowed the British to easily achieve a crucial operational objective: to establish a beachhead on foreign soil.

Both Elphinstone and Craig realised that if their offensive was to succeed, it had to force the Dutch position at Muizenberg. It seemed that Muizenberg was the pivot of the whole land campaign, as it blocked the route to Cape Town. The coastline to the north of Simon's Bay offered access to the-low lying area between Kalk Bay and Noordhoek (see figure 3.5). Here a west-east striking fault allowed the resistant sandstones to be eroded, and it was possible to reach the Atlantic Ocean through this gap in the mountains. Unfortunately for the British, a series of high peaks to the north of this area blocked their access to Cape Town. Starting with Chapman's Peak (592 metres) in the west and extending all the way to Kalk Bay Mountain (515 metres) above Kalk Bay, these mountains all but cut off any access to Cape Town. To the north of these peaks, Muizenberg (507 metres), Steenberg Peak (537 metres) and Noordhoek Peak (689 metres) completed the formidable barrier to any invading army.[60] To sail around Cape Point, land in Hout Bay and access Cape Town via Kloofnek was a possiblility, but Hout Bay had well-armed fortifications guarding the entrance to the bay.[61]

During July, Elphinstone and Craig planned the assault on the Muizenberg position and pondered on how to force the Dutch from it. They even considered a large strategic turning movement through the mountains from the direction of Constantia (or the present-day Tokai, to be more exact) to threaten the Dutch rear, cut off their communications, and compel them to abandon Muizenberg.[62] It was a fanciful manoeuvre that posed massive challenges and would be very difficult to execute in the rugged terrain of the Steenberg Mountains. The element of surprise would be crucial, and soldiers would have to be very fit to execute it swiftly; moreover, they would have to find trails over the mountain. The idea was discarded and it was decided that a direct assault on Muizenberg remained the best option, but that it had to be a joint operation, with the advance ashore supported by naval gunfire.

Though naval gunfire support would be crucial to the assault on Muizenberg, Elphinstone was concerned about the 'shallowness of the water, the uncertainty of the wind,'[63] and the effectiveness of his gunnery due to the effect of the long rolling swell. The Navy then took soundings to establish whether the ships could approach to within three-quarters of a mile from the beach,[64] and Elphinstone reassured Craig that, given 'a westerly wind with a smooth sea', his ships would be on their post.[65] The landing of seamen with boats at Muizenberg was also considered, but it was disregarded as the commanders were convinced that the Dutch would not stand.[66]

Military specialists of the time identified Muizenberg as a point of strategic value and a good defensive position. Though strong Dutch defence would make it difficult for the British to take, only a portion of the Cape defenders (200 infantry, 120 artillery, 200 mounted burghers and 150 pandours) were deployed there.[67] Despite requests from Dutch officers to improve the Muizenberg position, Gordon considered it unnecessary.[68]

The British attack on Muizenberg commenced on 7 August. While troops and two battalions of seamen (roughly 1 600 men)[69] marched from Simon's Town, four warships and a small gunboat sailed to Muizenberg, providing gunfire support along the route. The British drove the Dutch from their picket at Kalk Bay, and simultaneously to the land attack on Muizenberg the ships fired full broadsides, 'thundering showers of shot' at the Dutch positions.[70] De Lille and his infantry fled in great confusion, leaving everything except five field guns behind, and retreated to Lochner's Farm. Only a few gunners with two 24-pounders conducted some sort of defence. Though the guns embedded themselves into the sand and had to be redirected after every salvo, the Dutch succeeded with a number of hits on the British warships. Eventually the artillerists were forced to retreat by the overwhelming gunfire. However, around the mountain and out of range of the ships' guns, some artillerymen and burghers made a stand and drove the British van back to Muizenberg.[71]

The British were astonished that the Dutch did not properly defend the strong Muizenberg position and by De Lille's hasty retreat. Captain Robert Percival, a British officer, remarked that the Dutch 'neither behaved with courage or prudence, nor took a proper advantage of their strong positions … and with a degree of folly scarcely to be accounted for … abandoned the important place which they should have defended to the last extremity.'[72] Very telling is Percival's remark that the natural defensive position at Muizenberg struck him 'with wonder at its strength', and the British reflected 'with a mixture of surprise and contempt on the Dutch troops who allowed ours so easily to take possession of it, while it is so exceedingly strong that a very few men with field pieces might defend it without any risqué to themselves, and arrest the progress of a whole army.'[73]

Figure 3.8 Attack on the Muizenberg position, August 1795[74]

Figure 3.9 Battle of Muizenberg, August 1795. The painting depicts the naval vessels providing gunfire support to the attacking forces ashore.[75]

There was also much discontent amongst the Cape burghers, further fuelled by the fact that De Lille took a defensive position behind Sandvlei, and promptly retreated to Wynberg when Craig resumed his advance on 8 August.[76] De Lille was removed from his post, as many in the Dutch camp called him a traitor and considered the defence of the Cape sabotaged.

Final operations and Dutch surrender

Major B.C. van Baalen was in command at the Dutch position at Wynberg. However, his superior officer, Gordon, kept himself busy with improvements on the Mouille Battery at Cape Town, while the real threat was from Muizenberg.[77] The Cape burghers now saw their government as incapable of organising an adequate defence and believed that they should be allowed to organise the defence of the Colony.[78] Sluysken assured the population that the Cape would be defended as best as possible, and the Council of Policy again refused a request from Elphinstone and Craig to surrender the Cape to the British.[79]

The British now dug in at Muizenberg, but, as the assaulting force, their hold was precarious. They did not have access to agricultural products and were in urgent need of supplies; they also lacked equipment, military reinforcements, field guns, cash, and transport – without which their advance through the difficult terrain would be extremely laborious. Their predicament was eased by the Dutch lethargy. If the Dutch had performed persistent, well-organised attacks on the British beachhead, things would have been very difficult for them. When the East Indiaman *Arniston* arrived from St Helena Island on 9 *Aug*ust with 400 additional troops from the EEIC, nine field guns and cash, they were much relieved.[80] Yet, provisions and ammunition were still running very low, and on 1 September Elphinstone and Craig decided to wait six more days for Clarke's reinforcements before either risking battle or retiring to their ships.[81] At the insistence of the burghers and some of the officers, the Dutch authorities agreed to an attack on the British position, but before such an attack could occur, Clarke's long awaited reinforcements sailed into False Bay on 3 September.[82] The British immediately prepared for attack, and on 14 September they advanced on Wynberg with 4 000 to 5 000 men that included sappers and artillery.

The impetus of the British attack forced the Dutch to retreat. The situation seemed hopeless, and Gordon and Sluysken stressed that the Cape could no longer be defended against an overwhelming British force.[83] Negotiations commenced and Clarke agreed to a 24-hour truce at midnight on 14 September. The surrender documents were signed on 16 September. Many of the Dutch soldiers and burghers blamed their officers, and specifically Gordon, for the poor defence of the Cape. The situation threatened to get out of hand, and the Dutch leadership urged the British to come to their aid as soon as possible.[84] On the same day, the British occupied the batteries outside Cape Town, while 1 400 men marched into the town. As the Dutch garrison marched out of the Castle to surrender, the soldiers jeered and swore at their officers, calling them traitors.[85]

News of the capture of the Cape caused considerable relief in Britain.[86] The First Lord of the Admiralty, Earl Spencer, referred to the Cape as a 'very valuable acquisition … obtained for this country at so little expense of lives and money … one of the most advantageous we have ever made.'[87] Dundas congratulated Elphinstone on 'the surrender of Cape Town' and for placing such an 'essential establishment under the dominion of Great Britain.'[88] Neither the House of Orange nor the interest of the Netherlands was mentioned, and it is clear that the conquest was purely in the interest of Britain.

Elphinstone was later honoured with a peerage. Gordon, on the other hand, was of no more use to the British, and at the Cape he was regarded as a traitor: he was ostracised, attacked and discredited. On Sunday morning 25 October 1795 he committed suicide in his garden.

Concluding remarks: wasting geographic advantages in defence

Commanding an expeditionary force and conducting defensive operations at this time were demanding endeavours. Commanders needed a clear strategic grasp and had to be able to make independent command decisions. It was not possible for both sides at the Cape to regularly consult with higher authority on important decisions, and the Dutch authorities also lacked up-to-date information on events in the Netherlands. Though Elphinstone had received guidelines from the British government beforehand on policy and strategic matters, he made independent decisions at short notice and then explained them in his reports to his political masters. A good example is his timely decision to summon Clarke to the Cape, which quickly and decisively caused the Dutch capitulation.

The success of the Elphinstone expedition was due in large measure to the clarity of purpose of the British: both the political establishment and the military commanders had a clear understanding of what the objective was, and all effort was concentrated on maintaining that objective. Elphinstone and Craig initially thought that the Cape authorities would welcome the British force, but when they realised that this would not occur, they exploited the military option to achieve the objective. British military planning, preparation, intelligence and organisation was very good, especially considering the brief timelines and relative haste with which such a vast undertaking was realised. This could only be achieved successfully with first-rate command and control, and a good working relationship between the naval and military commanders (Elphinstone and Craig). Such a relationship was evident: their correspondence is proof of an open, co-operative spirit and the emphatic trust that existed between them.

Operationally and tactically the British were initially at a disadvantage. They had no foothold ashore, and they lacked overwhelming force, supplies, draught animals, artillery and engineers. In geographical terms they were far from the centre of power and faced seemingly insurmountable obstacles. However, the Dutch did not use this to their advantage. Elphinstone knew that the 'hazardous weather conditions … severe storms, fog, and particularly strong north-west gales caused numerous ship tragedies and severely affected shipping around the Cape.'[89] His knowledge of the prevalent wind regime of the Cape influenced his decision to anchor in False Bay and not Table Bay in June 1795. By sheltering in False Bay, Elphinstone escaped the winter storms that could wreck his ships in Table Bay. Simon's Bay was also not nearly as well defended as Table Bay and surrounds, with only two small batteries guarding the bay.[90] Having said that, the Dutch had the opportunity to move a greater force (more arms and men) to assist with the defence of Simon's Bay; yet they did not seem to consider contesting a landing. The Dutch abandonment of Simon's Bay and retreat to Muizenberg provided the British with a beachhead from where they could launch an attack against Cape Town at a time of their choosing. In addition, it was a secure anchorage in the potentially adverse winter weather conditions of the Cape of Good Hope, and gave them the opportunity to replenish their water supplies and repair their weather-beaten ships.

British success was not only due to their military prowess, but was aided by the weak Dutch defence: indecision, disunity, low morale, poor command decisions – and the fact that they did not use the geography of the battle space to maximum advantage. A specific example of this is their failure to adequately strengthen the chokepoint at Muizenberg and conduct a vigorous defence of this ideal geographical position. Allowing the British free access to Cape Town and its surroundings to observe the geography and defences of the Cape, and thus gain valuable intelligence, is another. Geography can help or hinder the attacker and the defender in equal measure, and the geography of the Cape was wasted by the Dutch defenders, contributing in no small way to their defeat.

When the Netherlands became an ally of France, the alliance had access to bases around the world. As some of these bases, such as the Cape of Good Hope and Ceylon, were of much strategic importance and, from the British point of view, threatened India, Britain had to act quickly to occupy them in order to protect her strategic and economic interests. Through their success, the British effectively illustrated the strategic gains to be made from properly executed exploitation of maritime power projection. Though British efforts were bolstered by Dutch mistakes and apathy, maritime power made the swift execution of the expedition possible, while through good command and control the objective was achieved. Britain therefore effectively utilised military power as a policy instrument.

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CHAPTER 4

A historical analysis of the influence of climate and terrain on the South African military operations in East Africa, 1940-1941

Evert Kleynhans

Introduction

The deployment of the 1st South African Division (1st SA Div) to East Africa during the Second World War is the subject of a number of historical and popular works. The first works published on the South African deployment to this theatre provide a rare in-depth narrative on the campaign, and appeared as early as 1941, to help bolster wartime morale. These works, despite being overtly propagandistic, add to the discussion about the South African offensive operations in East Africa.[1] On the other hand, some publications that followed barely attempted historical objectivity in their analyses of the successes and failures of the South African offensive operations; while others offered a unique, and highly doubtful, perspective on elements of the Union Defence Force's (UDF) deployment.[2] The unfortunate (and politically motivated) closure of the Union War Histories Section in 1961, after the appearance of only three official histories, meant that an official history of the South African deployment to East Africa during the Second World War, though planned, never materialised.[3]

In an attempt to ensure that the official histories programme of the Union War Histories Section would continue, the Advisory Committee on Military History tasked Neil Orpen and his team to complete the recording of South Africa's

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participation in the Second World War. The resultant publications – best classified as semi-official histories – largely lack original research and rely too heavily on the unpublished manuscripts of the Union War Histories Section.[4] The first volume of the *South African Forces in World War II* series appeared in 1968, under the title *East African and Abyssinian Campaigns*. Though primarily a campaign history, Orpen's work is the most complete publication to have appeared regarding the South African operations in East Africa. However, the book fails to effectively place the South African operations during the campaign in a strategic context against the backdrop of the more significant Allied offensive operations in the theatre.[5] Some of the more recent works to appear on the South African operations in East Africa merely recirculate the ideas and concepts emanating from earlier publications, and thus add no new strategic or operational analysis of the campaign itself.[6] A number of recently published academic articles and postgraduate dissertations bolster the available historiography and bring a new, in-depth perspective to the study of the South African participation in the East African campaign.[7] The latest work to appear on the campaign is Andrew Stewart's *The First Victory: The Second World War and the East Africa Campaign*.[8] Stewart critically discusses the entire East African campaign and offers a detailed discussion of the operational and strategic levels of war during the campaign. His discussion of the South African offensive operations, and the impact of climate and terrain on the Allied military operations, remains somewhat lacking. It is, however, the most complete account of the East African campaign to date.

The historical impact of the East African climate and terrain on the UDF operations during the campaign has received little to no scholarly attention. This is in stark contrast to concurrent trends in international historiography, where the analysis of the historical impact of climate and terrain on warfare has proven popular, especially amongst military historians and geographers.[9] There are, however, five works that deserve mention. Two publications, *Nine Flames* and *Salute the Sappers*,[10]cover the South African Engineer Corps (SAEC) deployment to the East African theatre during the war. These books help one appreciate the significant influence of geography on the offensive operations during the East African campaign, as well as the strenuous efforts of the South African engineers to provision the Allied Forces with sufficient water supplies during operations. Deon Visser first addressed the specific impact of water, especially the provision thereof, on South African military operations in a 2011 article.[11] The following year he co-authored an article with Ezekiel Nyanchaga that specifically focussed on the SAEC water supply operations during the East African campaign.[12] Both of these articles addressed little-known aspects of the South African campaign, and Visser and Nyanchaga offered a fresh analysis of a crucial determinant to the military operations during the East African campaign. The most recent South African academic work to appear on the campaign is Elri Liebenberg's *The Springboks in East Africa: The role of 1 SA Survey Company (SAEC) in the East African Campaign of World War II, 1940-1941*. The article is, however, fraught with military and historical inaccuracies, and adds little to the available historiography.[13]

Despite the recent analysis of the East African campaign, and various aspects of the UDF deployment to this theatre, several gaps remain, especially on the impact of climate and terrain on the South African military operations. To fill the identified hiatus in the historiography, this chapter has three aims: firstly, to discuss the distinct East African operational environment; secondly, to evaluate the influence of the operational environment on the planning for the campaign, and in particular that of the South African offensive operations; and lastly, to investigate the effect of the physical environment on the South African military deployment to East Africa throughout 1940 and 1941. In doing so, the chapter uncovers aspects of the South African campaign that have received little or no scholarly attention before.

The East African operational environment

In December 1939 and March 1940, the office of the Chief of the General Staff of the UDF drafted two separate military appreciations on the strategic situation in East Africa. These appreciations were drafted in lieu of the possible deployment of South African troops to Kenya to help check Italian aggression in the event of war. The British in particular feared that the Italian forces in East Africa could simultaneously overrun Sudan and Egypt, after which its forces might threaten the British possessions of Kenya and Tanganyika, and possibly even South Africa.[14] The military appreciations provided the South African defence planners with valuable information on the East African operational environment. Of particular importance was the detailed discussion in each appreciation about the influence of the topography and climate on the theatre of operations and future operations. The appreciations confirmed that the topography of the theatre conferred both a strategic and an operational advantage on the defenders of Italian East Africa, though they rarely used it to their benefit during the campaign. The unforgiving East African terrain encompassed an area of approximately 870 000 square kilometres, extending from the flat, featureless and almost waterless bush country of the Northern Frontier District (NFD) in Kenya to the coastal plains of Italian Somaliland and the rolling bush country and mountains of Abyssinia.[15]

Figure 4.1 Map of the general relief of the East African theatre of operations[16]

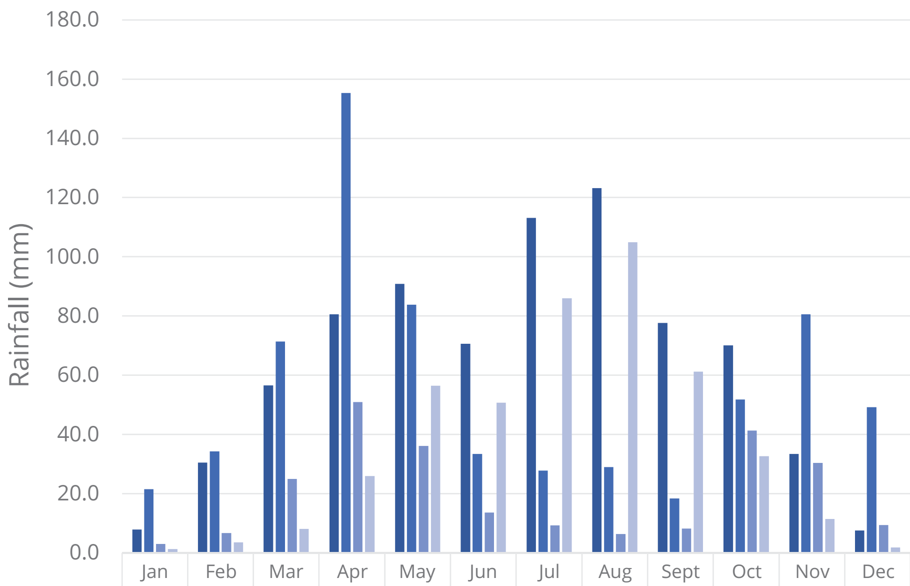
The topography of Kenya varies considerably. The areas at altitudes below 1 200 metres above sea level were bush country, arid and sweltering hot. The areas above 1 500 metres, where the climate was healthy, and where the political, economic and military hub of the British protectorate was situated, were known as the highlands. The Kenyan Highlands offered the Allied forces a strong defensive position from where they could protect their lines of communications stretching north into the NFD. The NFD, in turn, at an average elevation of 360 metres above sea level, bordered on southern Abyssinia and Italian Somaliland, and was considered very hot and arid. It comprised a low-lying, waterless semi-desert with very few geographically defendable positions. During the rainy season, this area also turned into a quagmire, which proved a significant obstacle to any military force trying to traverse it.

Lake Rudolph (Turkana), situated to the north-west of the Kenyan Highlands, formed the Allied left flank, while the Tana River formed the right flank of the Kenyan Highlands from Garissa to its mouth in the Indian Ocean. The area to the west of Lake Rudolph was considered very difficult country for military operations, though the flank was vulnerable in the event of war. The Tana River in the east was a serious obstacle from Garissa to its mouth, especially in wet weather, and it provided excellent protection to the Allied right flank. The coastal route from Malindi to Mombasa had two ferry crossings, which could be easily outflanked by Italian forces in the event of an invasion. After crossing the Kenyan border into southern Abyssinia, the altitude rose to 1 200 metres above sea level and continued rising gradually. A high range of mountains further traversed the spine of Italian East Africa from north to south. The mountains along the Abyssinian Plateau, at an average elevation of 2 750 metres above sea level, formed a stable defensive position with high ridges and deep valleys. The Abyssinian Plateau extended to the west and continued to present a firm defensive position to the Italian forces, especially against attacks originating from the Sudan or Kenya.[17]

Figure 4.2 Terrain typical of the Northern Frontier District in Kenya[18]

Figure 4.3 South African motorised infantry traversing a stretch of waterless desert[19]

Regarding climate, the military appreciations concluded that East Africa had extreme variations in rainfall and temperature, which, in turn, fostered a diverse disease ecology. The proximity of East Africa to the equator, the Indian Ocean and the inter-tropical convergence zone (ITCZ), greatly influenced the climate of the theatre of operations. When combined, the extreme rains, varied temperatures and prevalence of disease made East Africa a challenging theatre in which to conduct military operations. There were two distinct rainy seasons in East Africa: a 'small' one towards the end of the year, and a 'long' one from April onwards. The rains thus limited the campaign seasons to January, February and March, and about the end of May to October. The rainfall was nearly always accompanied by thunderstorms, which naturally affected the movement of armed forces. In the NFD, torrential rains also turned the black cotton soil into an impassable morass. Despite the rain and the presence of some large rivers, water remained a scarce commodity in the areas below 1 200 metres above sea level throughout the year. Water was, however, more plentiful in a 240-kilometre belt to the north of the Kenya-Abyssinia border, owing to the presence of permanent streams originating in the Abyssinian Plateau.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Ethiopia	7.9	30.5	56.5	80.6	90.8	70.6	113.2	123.2	77.7	70.0	33.4	7.6
Kenya	21.5	34.3	71.4	155.3	83.8	33.5	27.8	29.0	18.4	51.8	80.6	49.2
Somalia	3.0	6.7	25.0	51.0	36.1	13.6	9.3	6.3	8.2	41.4	30.4	9.4
Sudan	1.2	3.6	8.1	25.9	56.4	50.7	86.0	104.9	61.2	32.7	11.5	1.9

Figure 4.4 Average rainfall in the East Africa theatre of operations, 1939-1941[20]

Regarding temperature, the low-lying areas of East Africa were described as arid and hot, with warnings against sunstroke, while the temperatures inland and in the highlands were moderate and healthy. At sea level, the average temperature varied between 26 degrees and 29 degrees; in the NFD between 21 degrees and 27 degrees; and from 2 400 metres above sea level it dropped to about 16 degrees. The annual range of mean monthly temperatures was small across the theatre of operations and rarely differed more than 3 degrees. The diurnal range, however, was considerable and varied from 9 degrees at sea level to as much as 15 degrees in the interior on fine days.[21]

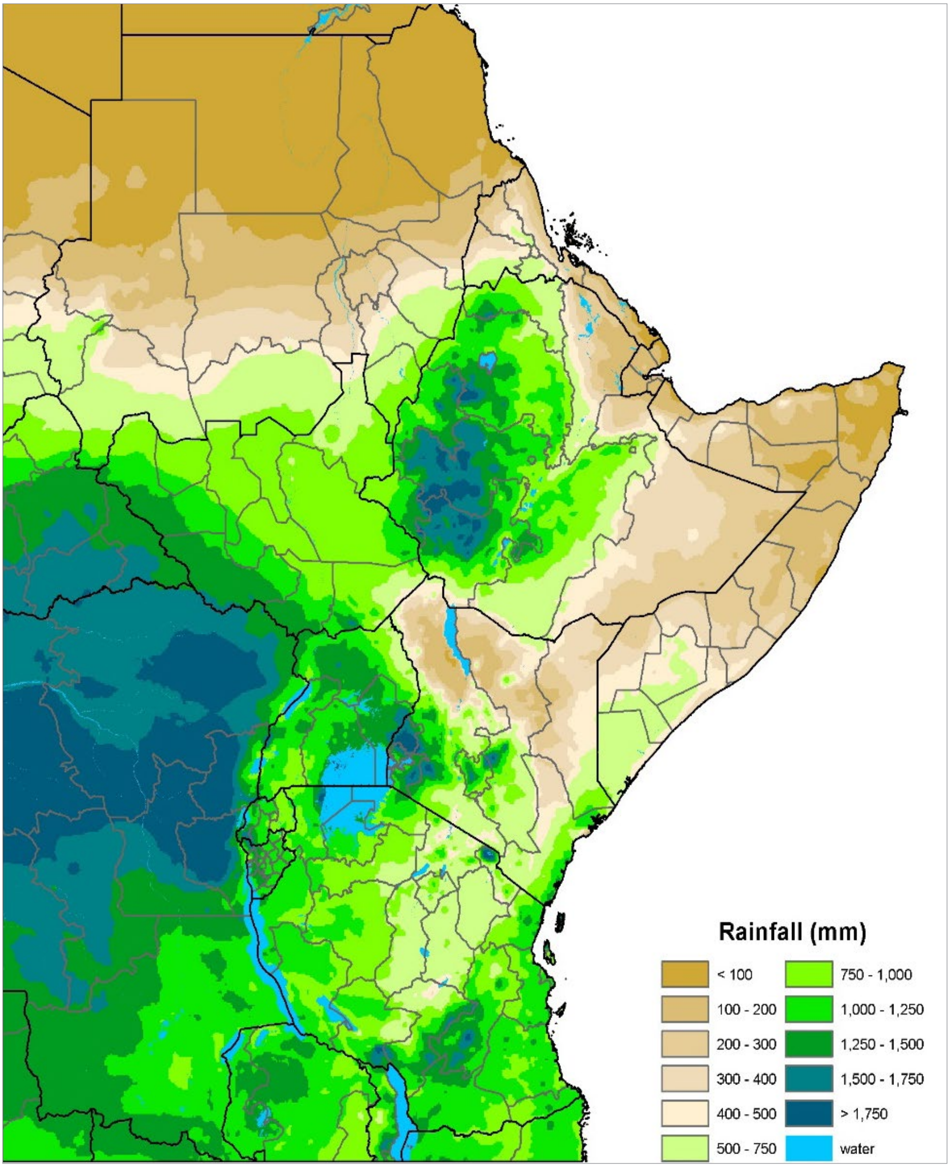
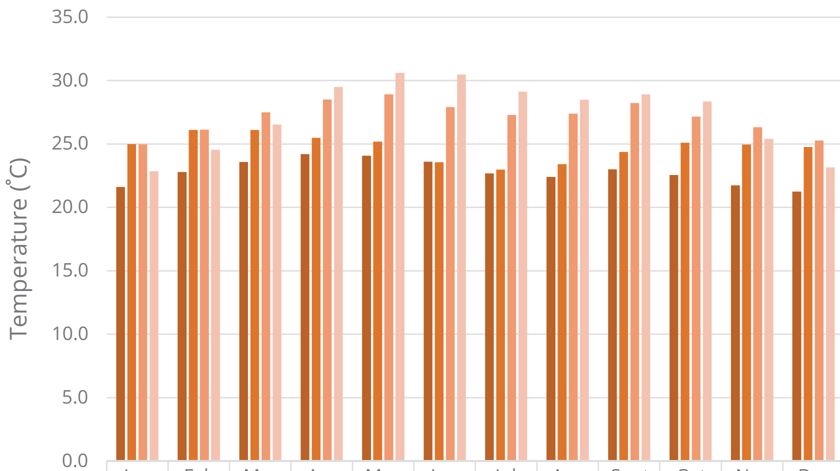


Figure 4.5 A map of the average annual rainfall in the East African theatre of operations[22]



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Ethiopia	21.6	22.8	23.6	24.2	24.1	23.6	22.7	22.4	23.0	22.6	21.7	21.2
Kenya	25.0	26.1	26.1	25.5	25.2	23.6	23.0	23.4	24.4	25.1	25.0	24.8
Somalia	25.0	26.1	27.5	28.5	28.9	27.9	27.3	27.4	28.2	27.2	26.3	25.3
Sudan	22.9	24.5	26.5	29.5	30.6	30.5	29.1	28.5	28.9	28.4	25.4	23.2

Figure 4.6 Average temperatures in the East Africa theatre of operations, 1939-1941[23]

In the NFD and the coastal areas, marked by sporadic rainfall and extreme temperatures, disease was particularly rampant. Malaria, especially prevalent in the NFD, necessitated the issue of adequate supplies of quinine. Due to high levels of salts in the soil and water, dysentery – often referred to as the 'Habaswein Itch', 'Wajir Clap' or 'Buna Balls' – also caused significant health problems. Moreover, the preponderance of tsetse fly and horse sickness negated the use of animal transport for an advance across the NFD.[24] The South African defence planners thus realised that any Allied advance into Abyssinia and Italian Somaliland would be tough owing to the relentless topography and the extreme climate of the East African theatre of operations.

Strategic and operational planning

At a strategic meeting held in the Sudan in October 1940, the Commander-in-Chief of the Middle East, Lieutenant General Sir A. Wavell, decided that if a series of coordinated attacks were launched from Kenya and the Sudan, the Italians could be driven from East Africa. Before this meeting, it was established that the Italian forces in East Africa, despite their numerical superiority over the Allies, were too few for the Supreme Commander of the Italian forces in East Africa, Prince Amadeo of Savoy, the Duke of Aosta, to consider an advance across the NFD into the Kenyan highlands.[25] It was agreed that the conquest of Italian East Africa was dependent on two key factors. Firstly, the strategic port of Kismayu needed to be captured before an all-out invasion of Abyssinia could be considered, as this would shorten the Allied lines of communication across the inhospitable NFD. Secondly, the coordinated attacks had to be effected between December and March when there was a gap in the rainy weather conditions, because of the severe influence of rainfall on operational mobility. By the end of the meeting, it was agreed that the Allied offensives in East Africa would start early in 1941.[26] During the first week of December, Wavell met with Lieutenant General A.G. Cunningham and Major General W. Platt, the commanders of East Africa and the Sudan respectively, to decide on an overall plan of action for the upcoming offensive operations. It was agreed that if the Massawa-Asmara area, Djibouti and Addis Ababa, considered the strategic nerve centre of Italian East Africa, was threatened in unison, Italian resistance would crumble piecemeal. The success of the combined offensives, however, rested on three pillars: an advance from Sudan by Platt's forces; from Kenya Cunningham had to advance on and capture Kismayu; and last, an internal revolt needed to be fostered amongst the Abyssinians, as this would harass Italian lines of communication and make the countryside ungovernable.[27]

Upon his return to Nairobi, Cunningham decided to postpone Operation Canvas, the offensive operation aimed at capturing Kismayu, until May/June 1941. His decision, contrary to Wavell's original plan, was based on several considerations. First, Cunningham argued that a shortage of water supplies would prevent the movement of a large body of men over the waterless NFD. Second, Italian morale was thought to be extremely high after the capture of British Somaliland. Third, some of his troops were not yet fully trained for offensive operations. Fourth, Cunningham argued that he did not have sufficient motor transport at his disposal to provision his forces on the long lines of communications that would be created by an advance on Kismayu. Fifth, he was cautious of the operational weather-gap and the arrival of the dreaded 'long' rains in April, as it would detrimentally affect the planned offensives. Cunningham therefore decided to immediately advance on the frontier with Abyssinia and Somaliland and establish a defensive line. These movements were collectively known as the 'cutting out' operations and would culminate in the establishment of a series of administrative facilities and supply depots to secure sufficient stockpiles before the main Allied offensive began in 1941.[28]

Throughout December, Cunningham was eager to launch an attack somewhere along the Kenya-Somaliland border. The planned attack was significant for three reasons. First, an attack would reduce the vast area of no-mans-land between Cunningham's forward positions and that of the Italian vanguard. Second, such an attack would provide Allied engineers with the opportunity to improve vital communication links and water sources in the NFD to support future operations. Last, Cunningham believed that he could gain psychological ascendancy over the Italian troops by attacking isolated outposts. On 16 December, elements of the 24th Gold Coast Brigade (Bde) and 1st South African Infantry Brigade (SA Bde) successfully attacked and captured El Wak, situated on the Kenya/Somaliland border. The victory at El Wak was significant for three reasons. First, the belief that Italian morale was far superior to that of the Allied forces was immediately proven wrong. Second, after the fall of El Wak, the Italian High Command decided to withdraw all Italian forces to their defensive line on the Juba River in Somaliland. Only a handful of irregular troops were left to the west of the river to act as harassing troops, while two well-fortified Italian outposts remained at Afmadu and Kismayu. Finally, the victory at El Wak decided the pace and intensity of the remainder of the campaign in East Africa.[29] The Allied forces' thrust towards Addis Ababa was now hastened by six months after the success at El Wak, because Cunningham realised that it was possible to secure a firm foothold across the Juba River by the time the dreaded 'long' rains arrived.[30]

The influence of climate and terrain on the South African military operations

The nature of the South African offensive operations in East Africa varied considerably between the limited deployment of the 1st SA Div to southern Abyssinia, and that of the 1st SA Bde that served with the 11th and 12th African Divisions through Italian Somaliland and into central Abyssinia. In a theatre where topography and climate relentlessly influenced military operations, it is apposite to divide the South African operations into two broad categories: those of the highly mobile opening stage of the campaign, and the infantry slog and penultimate battles in the mountains of central Abyssinia. The first battle for

Major General G.E. Brink's 1st SA Div was fought from 16-17 January 1941, when he ordered the 2nd SA Bde, under the command of Brigadier F.L.A. Buchanan, to occupy and hold the wells at El Yibo and El Sardu in the NFD.[31] The plan was to envelop the Italian forces occupying the area around El Yibo by armour and infantry acting in a mutually supportive role. The three biggest obstacles facing the South African fighting patrol during the operations were the extreme heat, the lack of adequate maps, and a severe shortage of water.[32] The capture of El Yibo and El Sardu was completed within three days without meeting any real Italian resistance. This victory helped to ensure that the frontier regions of the Kenyan border were cleared of the Italian presence by the end of January 1941. In hindsight, it was principally the lacklustre Italian resistance encountered, the nature of the terrain, and the distinct weather-gap during the opening salvos of the campaign that convinced the South Africans that the nature and speed of their operations called for the accepted doctrine to be abandoned in lieu of tactical and operational requirements. This would become a hallmark of the South African offensive operations during the East African campaign.[33]

On 31 January, the 1st SA Div started to cross the Kenyan frontier into southern Abyssinia. During the ensuing offensive operations, the 2nd and 5th SA Bdes, the latter commanded by Brigadier B.F. Armstrong, successfully captured the Italian strongholds at Gorai (1 February); El Gumu (1 February); Hobok (2 February); Banno (9 February); and Mega (18 February). During the attacks on Gorai, El Gumu, Hobok and Banno, in particular, the South African soldiers met only token resistance from the Italian colonial and irregular defenders, while the armoured cars showed immense courage and dash during each attack.[34] Brink's initial offensive operations in southern Abyssinia were marked by a high degree of mobility, as well as mutually supportive attacks launched by infantry, armour and the air force. During the opening salvos of the campaign, the terrain encountered allowed for the varied employment of the South African armour and motorised infantry, owing to the ability of the vehicles to deploy cross-country. With few undulations in the initial terrain encountered, armour was often used in wide flanking movements throughout the bush. This allowed the South African commanders to constantly effect an envelopment and gain both a tactical and operational surprise by deploying their armour boldly, which often left the accompanying infantry with only mopping-up operations around the objectives. This phase of the campaign was primarily fought during the dry season, in the period after the 'short' rains', when the South African troops experienced average daily temperatures ranging from 37 to 43 degrees – the former measured in the shade. The severe temperatures experienced, often fluctuated by a hot wind, had a determined effect on the offensive employment of South African troops. Water consumption by men and machines increased exponentially in areas where it was severely limited, and naturally added strain on the already extended lines of communication.[35]

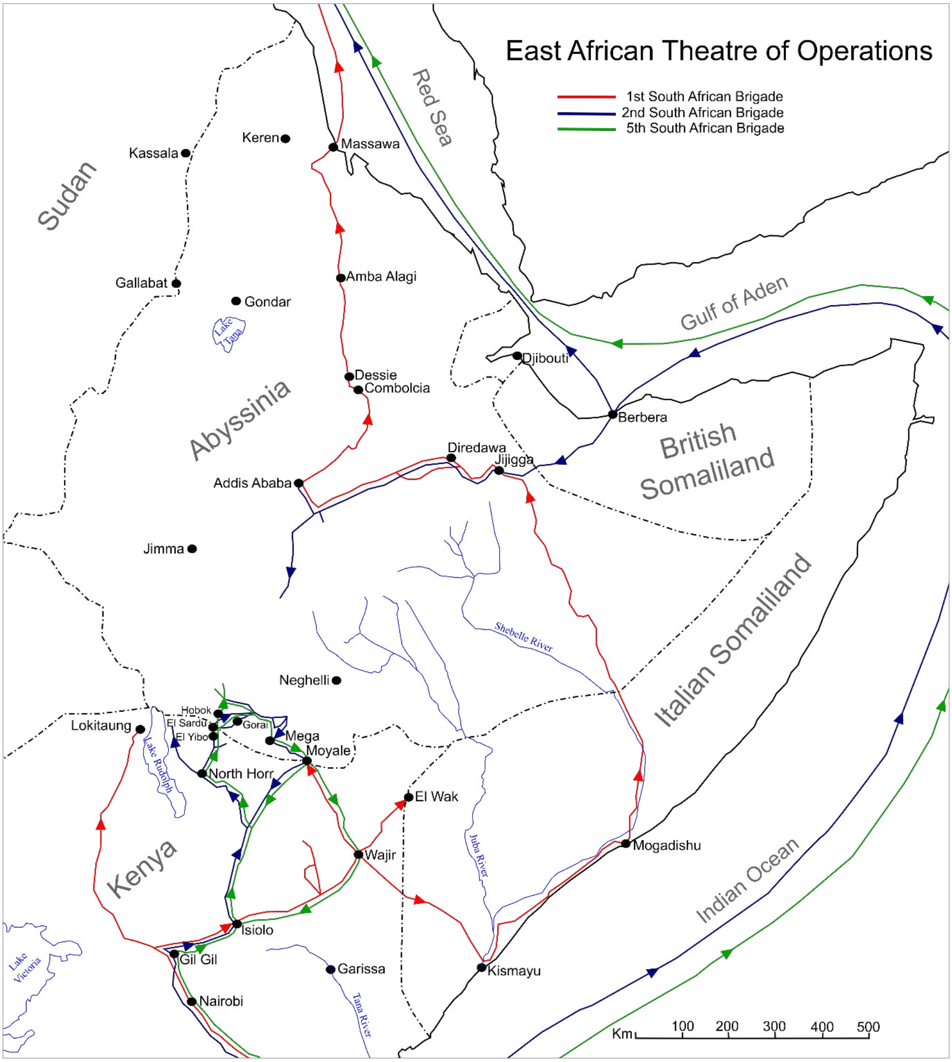


Figure 4.7 A map of the principal South African routes of advance in East Africa, 1940-1941[36]

Figure 4.8 South African armoured cars advancing into southern Abyssinia[37]

The final operation of the 1st SA Div in February was to capture the Italian fort at Mega, the strongest Italian bastion left in southern Abyssinia. The fort at Mega was protected by experienced Blackshirt and Colonial Infantry battalions, and was reinforced by heavy artillery and a series of minefields. Brink was indeed anxious when planning for the attack on Mega, because the assault on the fort would be the first instance during the entire campaign where South African fighting skills would be matched against a predominantly white Italian force. The South African plan of attack on Mega was based on an operational envelopment, aimed at cutting the Italian line of retreat into the Abyssinian hinterland towards Neghelli and Yavello. Owing to the rough terrain encountered, the main attack on Mega was primarily an infantry affair. For the first time during the South African operations in this sector, the armour only acted in a support role. In fact, the Italians only surrendered after the South African soldiers successfully scaled a dominating precipice, which silenced the supporting Italian artillery, and a final bayonet charge. The unpredictable nature of the East African climate was also first experienced by the South Africans during the battle of Mega. When the fighting started, the average daily temperature was more than 37 degrees. Overnight, however, the East African weather closed in and a sudden torrential downpour engulfed Mega and its surroundings. This ensured that the

South African infantrymen had to endure a very cold and uncomfortable night out in the open. The soldiers had to contend with severe exposure due to fighting in summer-issue field dress, and because their blankets were unable to reach them. Nevertheless, the successful South African occupation of Mega ensured that southern Abyssinia was effectively cleared of all forms of Italian resistance by the end of February 1941.[38] Despite the inherent effect of the climate and terrain on the South African military operations, the 1st SA Div accumulated a number of operational and tactical victories that led to the capture of a vast number of Italian men and equipment. By April 1941 the mainstay of the 1st SA Div withdrew from the theatre and redeployed to North Africa.[39]

After the 1st SA Bde's success at El Wak, the Italian forces fell back to the Juba River, the only natural defendable feature in Somaliland and the site of the main Italian defensive line in the south. Cunningham's plan for the advance into Somaliland required swift, sharp action, essential for capturing adequate supplies and water at Afmadu, Jelib, Gobwen, Jumbo and the coastal port of Kismayu. The advance into Somaliland effectively started on 12 February.[40] The 1st SA Bde, commanded by Brigadier D.H. Pienaar, played a crucial role during the advance into Somaliland, and often operated as the vanguard of the Allied forces. By mid-February, owing to a rapid advance – and the fact that the Italian soldiers made no viable defensive stand – Afmadu, Gobwen and Kismayu were captured. Pienaar successfully forded the Juba River at Yonte on 17 February, whereafter the 1st SA Bde captured Jumbo, Margherita and Jelib by the end of February. The fording of the Juba River is considered as one of the most significant events, not only of the campaign, but of the entire war fought in Africa. The successful crossing of the Juba River before the arrival of the dreaded 'long' rains meant that the hinterland of Italian Somaliland was now open for a rapid advance along the tarred Strada Imperiale highway.[41]

The new route of advance, and the terrain encountered, drastically influenced the deployment of South African troops. The dense bush and open desert flats so characteristic of the Italian Somaliland coastal belt, and to a large extent conducive to mobile warfare, gave way to sweeping mountains that dominated southern and central Abyssinia. The South African armour, now confined to roads and tracks, lost their freedom of movement, and infantry operations gained primacy. The Allied advance was extremely rapid, and after the battlefield successes at the Marda Pass (21 March), Harar (25 March), and Diredawa (29 March), Addis Ababa was successfully occupied on 6 April. After the capture of the Marda Pass and the occupation of Addis Ababa, the ever-present open flanks completely disappeared, and the highly mobile phase of the southern advance was replaced by a tedious infantry slog for the mountains.[42]

Figure 4.9 South African engineers successfully fording the Juba River[43]

The fall of Addis Ababa did not see the end of mies still occupied a series of well-established mountain defences at Combolcia, Dessie and Amba Alagi where they intended to make a final stand. The battles of Combolcia (25 April), Dessie (27 April), and Amba Alagi (4-19 May) were primarily infantry affairs supported by artillery, and were fought in some of the harshest conditions of the entire campaign. The South African soldiers often had to attack in driving rain and mist, while operating in extremely hostile terrain. For the South Africans, more adept at mobile operations, mountain warfare and its attendant challenges was something distinctly new. In spite of the defensive advantages offered by the key terrain, the Italian defence of the mountains was negligible, to say the least, and after the victory at Amba Alagi in May, the Italians sued for an armistice.[44]

Despite the armistice, the arrival of the dreaded 'long rains' detrimentally influenced the remaining Allied operations aimed at capturing Gondar and subjugating central Abyssinia. In fact, after the fall of Amba Alagi, the remaining Allied offensive operations were halted until the 'long' rains had ceased all together – owing to the fact that all lines of communication had been rendered useless by impassable stretches of mud across large tracts of the East African theatre. As such, the last Italian forces only surrendered at Gondar in November. In a mere fifty-three days, however, Cunningham's troops advanced more than 2 700 kilometres from the Kenyan frontier to Addis Ababa and occupied some 580 000 square kilometres in the process. They also captured more than 50 000 prisoners, all for the loss of 135 men killed, 310 wounded, and another 59 missing. The South African losses alone were 73 men killed, with an additional 197 battle-related casualties. At the time, these operations were considered a military record, with the offensive operations carried out at a pace seldom surpassed in history, mainly due to the at times favourable climate and terrain, and the feeble Italian resistance encountered.[45]

Figure 4.10 South African infantrymen during the battle for the mountains[46]

Figure 4.11 Extreme rainfall rendered large tracts of the theatre of operations impassable[47]

Conclusion

The East African operational environment, shown to be complex and hybrid in nature, had a distinct influence on the operational deployment of the Allied forces throughout the campaign in East Africa. The climate and terrain of the East African theatre also served as crucial factors during the planning and execution of the South African and Allied military operations throughout the campaign. Owing to favourable terrain and climatic conditions, the South African forces were highly mobile during the opening phases of the campaign, and their offensive operations were underpinned by operational and tactical envelopments during which mutually supportive attacks by infantry, armour and the air force were the order of the day. As the campaign progressed from the vast expanses of the NFD and Somaliland to the mountainous bastions of central Abyssinia, the terrain and climate changed considerably, which ensured that infantry operations gained primacy. The two largest determinants during the military campaign remained access to sufficient water sources, and the ever-present East African rains. Despite these inherent difficulties, the South African and

Allied forces overcame the challenges posed by the East African operational environment and liberated Italian East Africa by the end of 1941. The 1st SA Div next deployed to the North African theatre, where the operational environment changed drastically and posed several new challenges to the South Africans.

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CHAPTER 5

Military prospecting for groundwater by geology and geophysics: Work by 42nd geological section (South African engineer corps) in Africa, the Middle East and the Mediterranean region during the Second World War

Edward P.F. Rose

Introduction

42nd Geological Section of the South African Engineer Corps (SAEC), mobilised during the Second World War in August 1940, was the first geological team ever to be raised to support operations by the British Army.[1] From 1943 it became one of only three such teams ever raised. Moreover, it was the only geological team ever to be raised to support British forces through operational deployment in campaign areas, and the only team ever to support British forces in wartime by means of geophysical survey. Its function was to undertake field reconnaissance by geological and geophysical means in order to determine sites suitable for drilling boreholes to abstract potable groundwater – a secure and adequate water supply being essential for any concentration of troops, and supplies from surface sources being generally inadequate for major troop concentrations in arid or semi-arid regions. The manpower assigned to the unit changed slightly over time as a consequence of practical experience and changing military requirements, but by September 1943 the Section had an "establishment" that comprised five officers and 33 other ranks, plus a lance-corporal, a private, and five local drivers/batmen attached in supporting roles.

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A recent article demonstrated that between August 1940 and the end of the war, 13 officers in total contributed to the leadership of the unit, and that they were nearly all exceptionally well qualified in terms of their academic achievements and their professional geotechnical experience.[2] This article complements that account by describing the work done by the unit when deployed to an operational base in East Africa (near Nairobi, Kenya) from October 1940 to September 1941, and from there to a base in North Africa (near Cairo, Egypt) from September 1941 to the end of hostilities in September 1945 and a few months beyond. Detachments from the Section were to work in East Africa, North Africa, the Middle East, and parts of the Mediterranean region.

The principles and practice of geophysical prospecting had been established before the war.[3] Electrical resistivity was therefore known to be a technique particularly useful in groundwater investigation. By passing a current into the ground through two electrodes and measuring potential differences between two other electrodes, information can be obtained on the electrical resistivity of the rocks through which the current is passing. From this, the nature of the rocks and the depths at which changes take place may be inferred: different rocks have different resistivities. Additionally, where appropriate, the Section surveyed by means of a vertical force magnetometer. Some rocks, such as sills and dykes intruded into a sedimentary sequence, have higher magnetic permeability than others, so the technique allows their presence to be detected beneath a cover of superficial deposits.

42nd Geological Section was mobilised at Zonderwater, some 35 kilometres east of the city of Pretoria, on 26 August 1940:

> It was at Sonderwater [sic] that the Engineer Training Camp was established for the mobilizing and equipping of [South African Engineer Corps] units. From February to June 1940 those units which were already in existence were called up in turn for one month's continuous training prior to being called up for full-time service. During this period the first full-time engineer unit, 16 Field Company, was formed, trained, and sailed for East Africa … From June onwards engineer units were called up and new units formed as fast as training facilities and equipment became available.[4]

Presumably referring to the same locality, one of the Section's first three officers later noted that they were sent to Premier Mine near Cullinan, also east of Pretoria, for preparatory military training.[5] They attended a course 'for rapid conversion in a matter of weeks into officers and gentlemen' but conversion to the former was never really completed: '… we considered ourselves primarily scientists.' Completion of the course supposedly equipped the Section to deal with everything from gas warfare to gunnery.

East Africa

The Section was assigned for operational service as part of the British Army's Middle East Command. This had been created in August 1939 as war loomed to embrace the separate army commands of Egypt, Sudan, and Palestine-Jordan, plus Cyprus (and later Malta), but was extended in early 1940 to include British land forces in East Africa and British Somaliland.[6] The Section's War Diary records that the unit left Zonderwater by train on 26 September 1940 and embarked on a troopship at Durban on 27 September.[7] Durban was the then Union Defence Force's 'usual port of embarkation for the north'.[8] The diary records that the Section arrived at the port of Mombasa, in southern Kenya, on 3 October. Moving inland by rail, on 6 October it arrived at Nairobi, Kenya's capital and largest city (figure 5.1). It was to be based near there for future operations as part of HQ Troops.[9]

Thereafter the unit was split into small detachments, usually of one officer and a technical non-commissioned officer, plus drivers and labourers, deployed in the field as and when required. It was found from field experience as work progressed that the Section's electrical resistivity surveys were most conveniently carried out by parties of seven persons: an officer to choose the site for investigation; one trained technician to lay out the line of survey and attend to minor electrical breakdowns (such as loose connections and broken leads); another trained technician to take the instrument readings, calculate the results and plot the resistivity curves; and four "labourers" (one to move each of the four electrodes). Ideally there was an eighth man, for odd jobs or to relieve one of his companions.[10] Drivers and cooks were also required, according to the conditions of work.

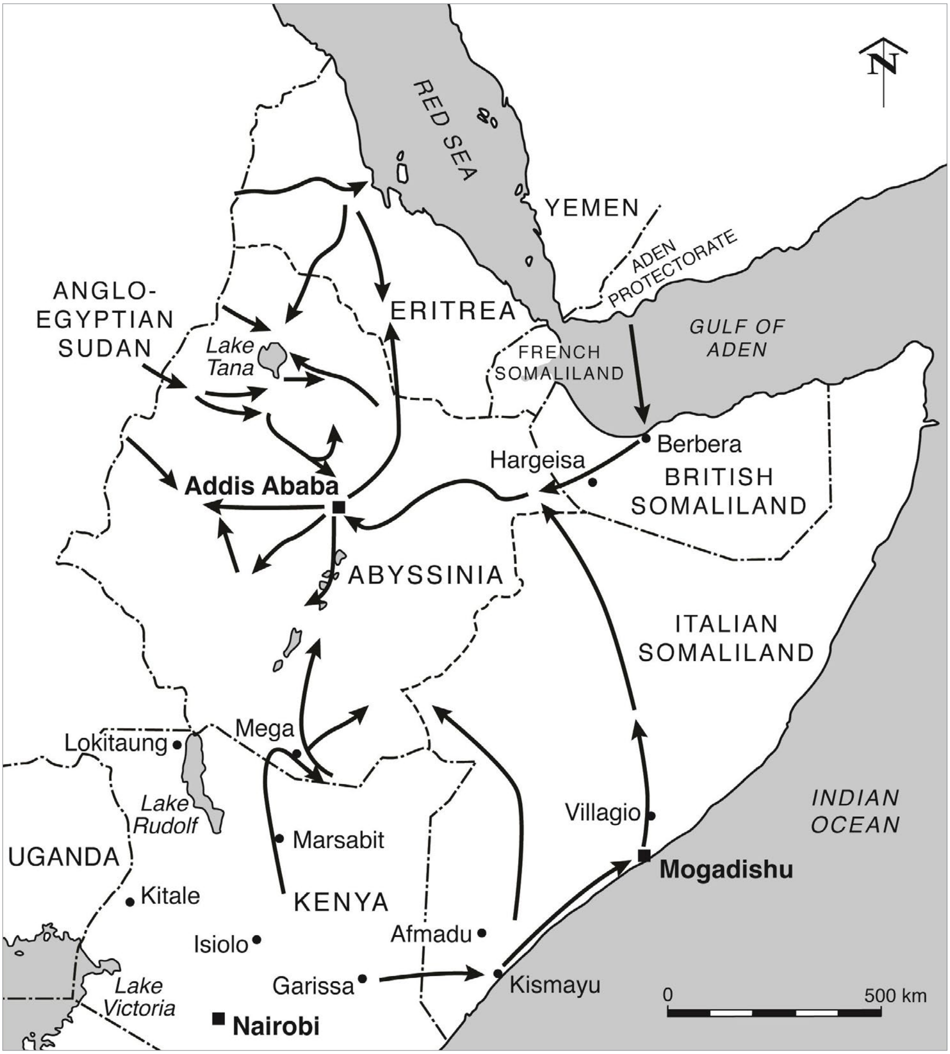

Figure 5.1 Map of East Africa for 1941, with towns mentioned in the text and main British campaign routes (arrowed)[11]

Geological mapping

Kenya's population of European origin was then mainly concentrated in the pastoral highlands of the country, and tribesmen in remote areas were sometimes hostile to visitors. Geological survey had been restricted accordingly, and there was no recent geological map of the country as a whole. The Section duly compiled one (figure 5.2).[12]

Beneath the map title, its key credits the map to '42nd Geological Section SAEC'. The bottom of the key records that the compilation was based on information derived from five members of the Kenya Geological Survey,[13] ten Survey publications, and five officers of 42nd Geological Section who worked in Kenya between 1940 and 1941.[14] 'Geological information [was] compiled and drawn' by one of the five officers: Lieutenant A. Huddleston, attached to the Section from the Royal West African Frontier Force and formerly employed as a geologist with the Gold Coast Geological Survey.[15] Faintly classified above its title as 'restricted', the map was evidently compiled in 1941, although published for more general use later, in 1944.

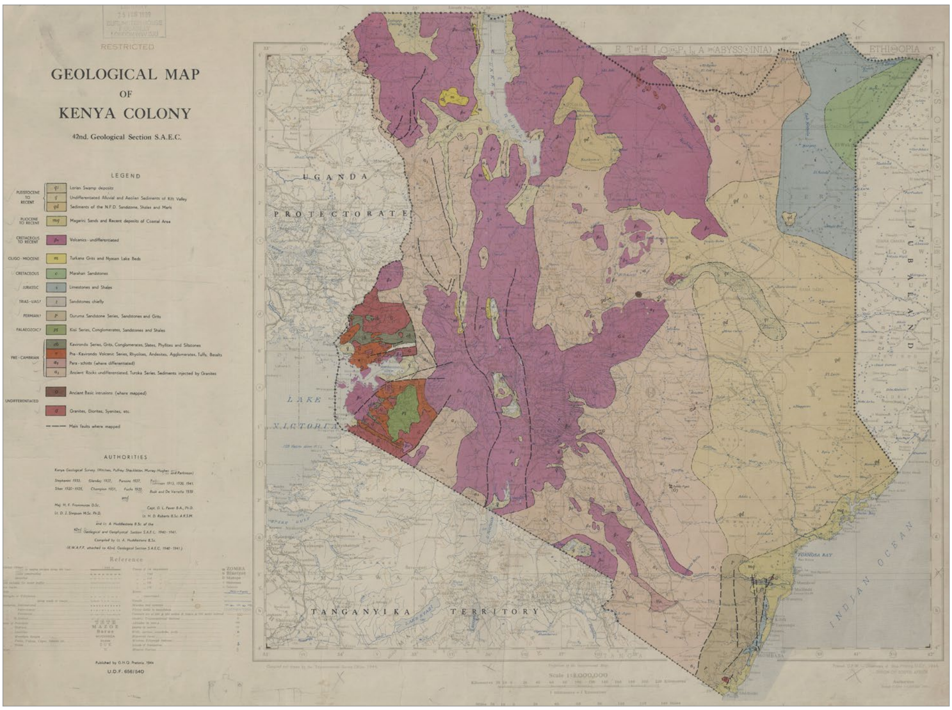

Figure 5.2 Geological map of Kenya compiled in 1940-1941 and printed as one sheet at scale of 1: 2 000 000[16]

A map at larger scale was published as four sheets.[17] These too record that 'Geological information [was] compiled and drawn by Lieut. A Huddleston, attached 42nd Geological Section SAEC', with details of the map sources used. Classified as 'security', the maps were printed by the 'East African Survey Group' in 1942, sheet 3 in April and the other sheets in November.

From geological and geophysical surveys it became clear that Kenya's hydrogeology could be described in terms of three main regions:[18]

1. The low-lying coastal plains (<100 metres above sea level), situated in the east of the country, mostly comprising Pliocene or Pleistocene to Recent weakly consolidated "shales", sandstones and clays (the four units shown at the top of the key in figure 5.2). In this region surface water supplies in the dry season are essentially absent, and there are no surface features to guide site selection for boreholes. Geophysical surveys were therefore necessary, to locate permeable sandstones floored by impermeable clays within the subsurface sedimentary sequence.
2. The Precambrian or Basement Complex, a large western area, some 180-360 kilometres wide and more than 300 metres above sea level, of well-cemented sediments intruded by granites (the six units shown at the bottom of the key in figure 5.2). Weathered (and so relatively permeable) zones could easily be detected by resistivity measurements.
3. The Cretaceous to Recent volcanic rocks (shown widespread in purple on figure 5.2) covering almost all of the highlands of west-central Kenya and crossed from north to south by the Great Rift Valley. Resistivity measurements in this region were successful in locating the decomposed and water-saturated floor of various lava flows and the sediments sandwiched between them, features not detected from surface observations.

Borehole site selection

The reconnaissance and surveys carried out by the Section included a significant amount of geophysical work. Electrical resistivity was the technique most commonly used. A handbook later illustrated resistivity curves that included ten examples from Kenya, three from Italian Somaliland, and one each from Abyssinia and the Sudan border – evidence of the Section's operational role in these regions.[19] Additionally, magnetometer surveys were employed at times to provide evidence regarding structures such as faults, and minor intrusions such as dykes.

The Section's work was 'mainly of an operational nature', and during the Abyssinian and Somaliland campaigns its members worked in conjunction with, and ahead of, 36th Drilling Company SAEC.[20] This company followed the Section, to sink boreholes at the sites recommended. Consequently, the Section has been credited with facilitating the rapid British and Commonwealth victory over Italian forces.[21] Specifically, by locating adequate supplies of water in the arid regions of northern Kenya and along the Italian Somaliland-Kenya border, the Section enabled the troops to move forward much more rapidly than would otherwise have been possible. Referring to one borehole in particular, which was drilled in the arid coastal plain and enabled troops to advance from the region east of Nairobi into Italian Somaliland and hence into Abyssinia, the Commander-in-Chief Kenya General Cunningham said that 'even if the Unit did no more useful work it had justified its formation.'[22] In total, 60 boreholes were drilled, with a 55 per cent success rate and an average tested yield of fresh water of 1 100 gallons per hour (1,4 l/s), compared with 31 per cent success for 90 other boreholes drilled without Geological Section recommendation, with an average yield of 200 gallons per hour less.[23]

Contribution to victory

British strategy for the East African Campaign had been worked out at a conference in the Anglo-Egyptian Sudan at the end of October 1940.[24] An unsuccessful attack eastwards into Abyssinia was launched in November, followed by successful attacks eastward into Eritrea initiated in January 1941, eastward and northward from Kenya into Italian Somaliland and Abyssinia in February, and south from Aden into British Somaliland in March (figure 5.1). Operations from Kenya were led by Lieutenant-General Sir Alan Cunningham, who commanded about 77 000 troops, including contingents from British East Africa (33 000), British West Africa (9 000) and South Africa (27 000). Abyssinia's capital city, Addis Ababa, was captured in April 1941, and the main Italian force in the country surrendered in May, although smaller units fought on in isolation until November.

The Section was to be widely active in Kenya, Abyssinia, Italian Somaliland and British Somaliland, its principal achievements summarised as:[25]

1. Geological reconnaissance in central and northern Kenya and the subsequent location of water, which opened up a route for the 21st (East African) Brigade north through Marsabit (figure 5.1) and into Abyssinia via Mega – beginning at Isiolo in central Kenya.[26]
2. Geological reconnaissance west of Lake Rudolf (figure 5.1) in northern Kenya. This opened routes for the 25th (East African) Brigade and the 24th (Gold Coast) Brigade, and provided a 'backdoor entry' into Abyssinia – from Kitale to Lokitaung.[27]

3. Geological reconnaissance along the 150-kilometres Berbera–Hargeisa road in British Somaliland (figure 5.1). Provision of water enabled prisoner-of-war camps for defeated Italian troops to be set up in this area.
4. Geological reconnaissance along the 320-kilometres road from Nairobi east to Garissa and then the port of Kismayu at the southern end of Italian Somaliland (figure 5.1). Location of water along this route – ending at Afmadu – made a speedy advance into Italian Somaliland possible.[28]

In addition, water points were established at Mogadishu (the major port and capital city of Italian Somaliland) and inland at Villagio Duca degli Abruzzi (figure5.1); also at eight permanent camps in Kenya and one in British Somaliland.[29]

After the campaign

The Section's work in East Africa came to an end in August 1941, as hostilities in the region drew to a close, but its War Diary records that its second in command, Captain G.L. Paver, had been sent to Cairo in June to prepare for a new assignment: in Egypt.[30] Middle East Command was reorganised at various times, and in August 1941 an East Africa Command was separated from it. 42nd Geological Section was to be retained in Middle East Command, to support continuing combat operations.

The Section's operational move involved some staff changes. The officer commanding, Major H.F. Frommurze (at 42 years of age by far the oldest officer in the unit) returned to his pre-war civilian duties at the Geological Survey of South Africa. Captain Paver, formerly his junior colleague at the Geological Survey, was selected for promotion to succeed him.[31]

Three officers attached to the Section whilst in East Africa had successively transferred back to East African forces, which were being reorganised at this time.[32] Changes within East African forces included a reorganisation of the Water Supply Maintenance Unit (WSMU), East African Engineers, a unit that had been in existence since the beginning of the war, principally to maintain existing water points.[33] When the Geological Section left for Egypt, the WSMU took on new functions: the location, drilling and equipping of boreholes – functions previously fulfilled by the Section and 36th Drilling Company SAEC. The new WSMU therefore included a 'geological [and geophysical] section',[34] 'some of whose officers were formerly attached to the South African Unit.'[35] When the WSMU evolved in January 1943 into 41st (East African) Water Supply Company, East African Engineers, its geological section comprised a captain, a subaltern, two British non-commissioned officers, and forty African other ranks.[36] The impact of 42nd Geological Section in East Africa thus included the legacy of technical expertise as well as the boreholes and geological maps that remained after its departure.[37]

North Africa

The Section sailed to Egypt from the port of Mombasa in Kenya, and from September 1941 set up its base on the outskirts of Cairo in northern Egypt, near the River Nile and some 165 kilometres south of the Mediterranean Sea (figure 5.3).[38] That autumn, Middle East Command was re-structured to include two separate Army commands: troops in the Western Desert west of the Nile as far as the front line became the 8th Army; and troops east of the Nile, focused in Syria and Palestine, became the 9th Army.[39] The main part of the Geological Section, led by Major G.L. Paver, was primarily assigned to support the 8th Army and its Western Desert campaign. A detachment of the Section to support the 9th Army was led by Captain D.J. Simpson and based at Beirut – a city that became the capital of Lebanon when that country gained independence from Syria in 1943.[40]

Figure 5.3 Map showing Armed Forces' areas to which Boring Sections Royal Engineers were deployed during the Second World War, with contemporary national boundaries. Shading as for figure 5.4[41]

Boring Sections Royal Engineers

The Section guided the drilling of wells to provide potable groundwater for British troops, primarily by Boring Sections of the Royal Engineers (the 'RE'), but also drilling by units of the Australian and the South African forces, and civilian agencies.[42] The Boring Sections were widely deployed in the countries covered, at times, by Middle East Command (figure 5.4), their assignment (and so that of the Geological Section) being guided by the geologist staff officer at the Command's general headquarters, in Cairo, Lieutenant (later Captain) F.W. Shotton RE.[43] War Diaries for the Boring Sections preserved in the UK's National Archives at times refer to assistance from 42nd Geological Section provided to No. 1 Boring Section,[44] and to Nos. 3,[45] 4,[46] 5[47] and 6.[48]

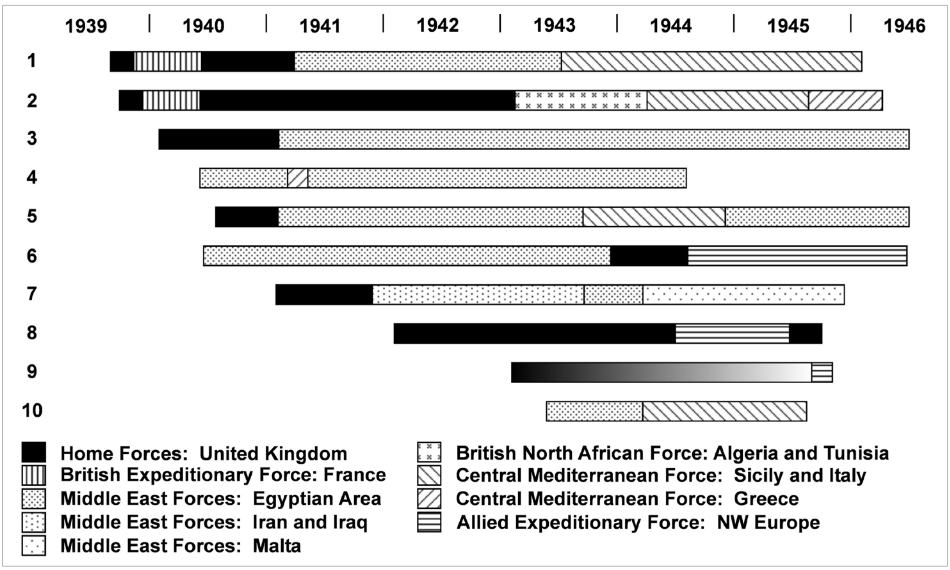

Figure 5.4 Deployment, by Armed Forces' area, of Boring Sections RE, numbered 1-10 (left-hand column), progressively raised for the British Army between the years 1939 and 1943 and mostly disbanded by 1946; graded shading indicates uncertainty as to the exact time of movement[49]

Egypt and Libya

According to the Section's War Diary, Captain Paver prepared the way for the unit to deploy to Egypt.[50] He began his journey from East Africa by train on 27 June, continuing by sea from Mombasa to land at Suez on 11 July, finally arriving in Cairo by 12 July. He reported that day to the Engineer-in-Chief of Middle East Command; was assigned to the same branch as geologist Lieutenant F.W. ('Fred') Shotton; and visited the Geological Survey of Egypt, meeting its director

(Dr. Little). In the following few days he read through reports on all military 'boring operations' in Egypt; went with Shotton and a Major Van Sickle (an experienced well-borer)[51] to examine the region bordering the Cairo-Alexandria Road; had further discussions with Shotton on 16 July; and returned to Nairobi in Kenya on 21 July. The War Diary ends on 31 August with the completion of work in East Africa, so September appears to have been the month in which the Section moved to Cairo.

Subsequently, the Section's main work in Egypt concentrated on the Western Desert region, from the Nile Delta west to wherever the front line was located.[52] After the war, Fred Shotton published five articles in a series that described details of water supply in the Middle East campaigns. The first, an account of the main water table of the Miocene limestone in the coastal desert of Egypt, made no reference to the Geological Section.[53] Evidence for its activity comes from the second article, on perched water supplies above the main water table of the Western Desert. That includes reference to the Fuka Basin (figure 5.5):

> the supreme example of a geo-hydrological structure being fully elucidated by the Army … After the shape of the Fuka basin had been determined by boring, the 42nd Geological Section of the South African Engineering Corps (O.C. Major G.L. Paver) ran a series of resistivity traverses across it and showed that geophysical methods could assist in working out the underground shape of a shallow limestone/clay contact.[54]

The third article, on the construction of water-collecting galleries along the Mediterranean coast of Egypt and eastern Libya, was also published without reference to the Section.[55] However, the fourth, on the development of water supplies from boreholes adjacent to the Cairo-Alexandria desert road in north-west Egypt, gave acknowledgement to 'Major Paver and Captain Roberts' of the Section, both for specific borehole information and other collaboration.[56] Clearly, the reconnaissance of July 1941 had developed into a major project, as the proliferation of military camps and airfields along the road – with their consequent demand for water supplies – made it a region of 'extreme military significance.' Paver and Roberts provided guidance for a drilling programme that continued into 1944.[57]

The fifth article focused on the desert of north-east Egypt, between the Nile Delta and the Suez Canal, where numerous military establishments (many of them large) drew heavily on the Sweet Water Canal for supplies, via filtration and sterilisation plants.[58] However, groundwater sources were also important, to provide an alternative means of supply in case the treatment works were put out of action by enemy aerial attack; to lessen demand on the system; and to shorten the pipeline distribution network. The drilling programme totalled over 3 000 metres. Some boreholes in this area 'were sited by a diviner in the early days when the Army still countenanced such methods', but most of the 73 military boreholes in the area were sited by means of geological survey, many after 'resistivity probes'– so work by the Geological Section.[59]

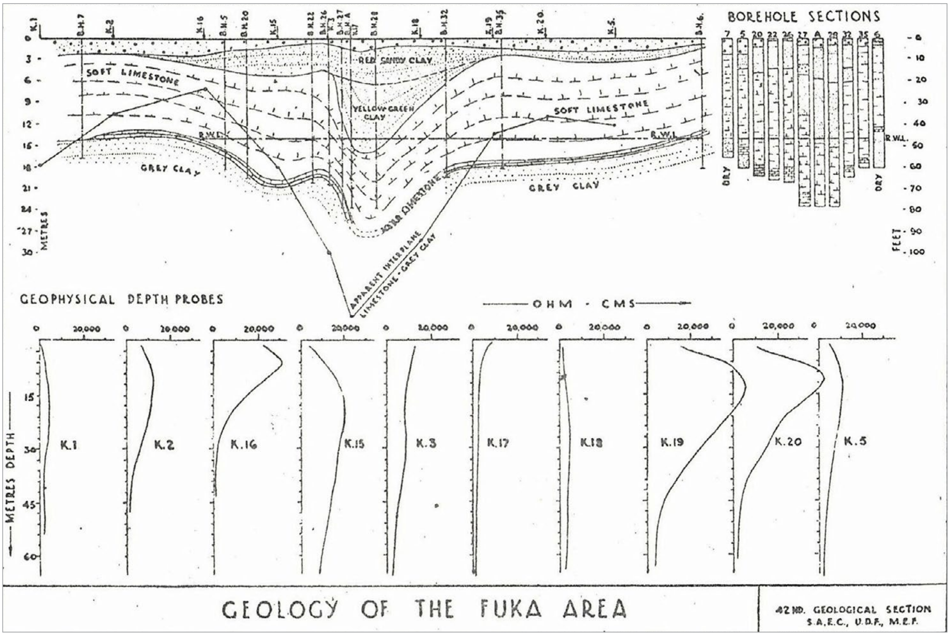

Figure 5.5 The Fuka Basin, north-west Egypt: Geological cross-section with indication of borehole positions and stratigraphical logs, with (below) electrical resistivity curves representing the same cross-section, showing consistency with the borehole data[60]

Shotton was in the process of assembling records concerning water supply in the south-east desert of Egypt, the "Red Sea hills" area, when he was recalled to England, in September 1943. Paver took up his duties as the geologist staff officer at Middle East Command, whilst still directing the work of the Geological Section, and completed the series of publications Shotton had initiated. Unsurprisingly, Paver's articles contain more data than Shotton's on geophysics, and more specific references to the work of the Section. Thus the account that Shotton had initiated for the south-east desert was partly illustrated by diagrams that illustrated the geophysical as well as geological factors influencing the selection of borehole sites in the region's Precambrian formations.[61] In total, 41 military boreholes were emplaced in this area. As the Western Desert campaign westwards from Egypt merged with the North African campaign eastwards from Morocco and Algeria, elements of the Section moved westwards into Tunisia.[62] One officer even reached Algieria.[63]

The Middle East

Whilst part of the Section deployed westwards from the unit's base near Cairo, other elements were deployed eastwards, into Syria and Lebanon, Palestine and Transjordan, Iraq and Persia.

Syria and Lebanon

For Syria and Lebanon, water supply work was begun by Major G.R.S. Stow RE.[64] Stow had served with distinction in command of Boring Sections RE, including the drilling of boreholes within the Fuka Basin in Egypt.[65] His work was 'carried on by various members of the Geological Section of the South African Engineer Corps, notably Capt. D.J. Simpson, Capt. G.C.L. Clarke, Lieut. R. Borchers and Lieut. A.O. Thom[p]son,' assisted by local officers of the Public Works Department, and particularly by L. Dubertret of the local government Geological Department.[66] A geological map was compiled for the region; also an innovative water quality map;[67] and 81 boreholes were drilled. Work was still in progress during September 1943.[68]

Electrical resistivity surveys were used:

1. to establish the presence of, and depth to, the water table in the coastal plain and to give some estimate of quality;
2. in the coastal plain alluvial sediments, and in the Bekkaa valley alluvial conglomerates, to select sites with the most porous formations beneath, in order to yield maximum supplies by avoiding impermeable clays;
3. to establish the presence of, and depth to, perched water tables in mountain limestone areas (figure 5.6);
4. to locate the presence of water-bearing fissures or porous beds in volcanic igneous rocks; and
5. to differentiate between underlying impermeable marls and more porous water-bearing limestones.

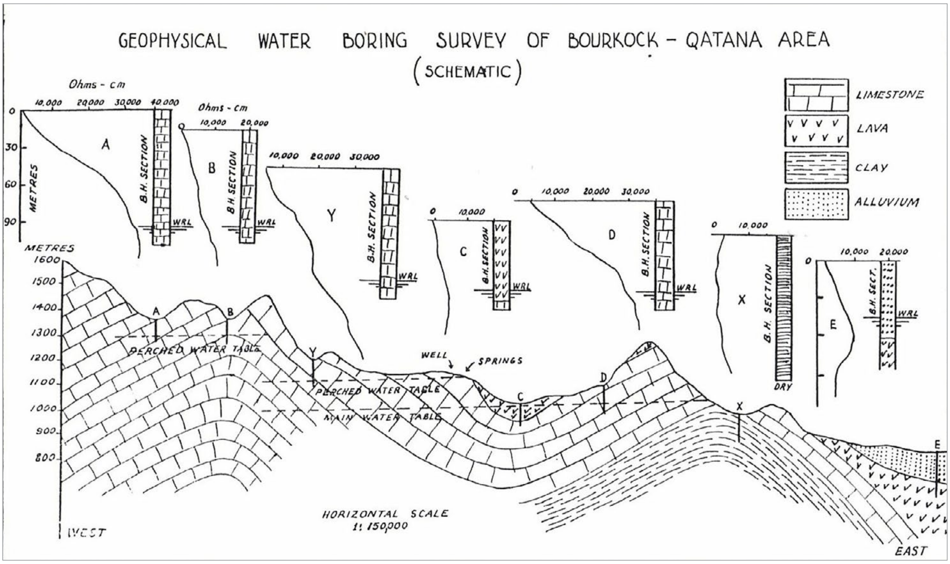

Figure 5.6 Schematic geological cross-section from west to east across the Bourkock-Qatana region in the mountainous area south of Damascus in Syria[69, 70]

Palestine and Transjordan

For Palestine (effectively modern Israel), drilling for water was carried out to obtain water supplies for military camps, aerodromes, base installations and hospitals.[71] It was also carried out, in the Sinai Desert, to provide operational supplies and to serve the road linking Palestine to Egypt.

Considerable information was available from civilian agencies concerning the groundwater resources of Palestine. The military authorities duly gained access to this, notably via the Water Commission of the Palestine Public Works Department, the Geology Department of the Hebrew University, and a 'Dr Loehnberg' (a consulting hydrogeologist/geophysicist).

Topographically, northern Palestine comprises, from west to east, a coastal plain, mountain uplands, and the Dead Sea rift valley that contains the River Jordan. The desert regions of the Negev (or "Negeb") and Sinai lie to the south and south-west. Most of the military boreholes were situated on the coastal plain – a region then understood as of Plio-Pleistocene sands, gravels and clays resting upon Miocene, Eocene or (more commonly in central Palestine) Cretaceous limestones.[72] Early hydrogeological investigations for military supplies were carried out by Major B.W. Leake RE, assisted by the Palestine Government

Geologist and Dr. Loehnberg. Subsequent geological and geophysical surveys for the development of new sources of groundwater were carried out under the field supervision of Captains D.J. Simpson and G.C.L. Clarke, and Lieutenants R. Borchers and A.O. Thompson, of 42nd Geological Section. Well boring was contracted to No.1 Australian Boring Section, Royal Air Force; Nos. 1, 5 and 7 Boring Sections RE; and No. 104 Water Boring Section, SAEC.

Applications of geophysics in this region included:

1. iso-resistivity mapping (for example, figure 5.7) in the Plio-Pleistocene deposits of the coastal plain to ensure maximum supplies and to avoid encountering a stratigraphical unit of impermeable clay at too shallow a depth;
2. location of depth to faulting within underlying limestones in mountain borderland regions;
3. location of localised or perched water tables in mountain limestone areas; and
4. measurement of thickness and comparative porosity of alluvial deposits in dry river valleys (wadis).

The military surveys concluded that boreholes in the Plio-Pleistocene sediments of the coastal plain would produce yields of 10 000 gallons per hour (g.p.h.) [12,6 l/s] if the impermeable clay beds were avoided; bores in the mountain borderland could, under favourable circumstances, provide good yields from the underlying Cretaceous limestones; bores in the mountain uplands were more problematical, but yields of 1 000 g.p.h. could be obtained; water in the Sinai Desert was best obtained from dug wells – rather than boreholes – in wadi gravels, with yields of 1 000 g.p.h. and sometimes more; and the Negev area, although not developed, had geological structures potentially favourable for obtaining moderate supplies from medium to deep bores.

For the country of Transjordan (now essentially Jordan) adjacent to the east, development of water supplies took place in conjunction with the development of two main supply routes (the Aqaba-Maaan-Amman road and rail route, and the Haifa-Baghdad road), and at a few isolated localities.[73] Well boring was carried out initially, in 1940, by Palestinian contract drillers, but subsequently by Boring Sections RE and the South African Engineer Corps: 24 boreholes in total.[74] The Geological Section carried out geophysical surveys to guide selection of particular borehole sites. It also completed a comprehensive water resources survey for the country.

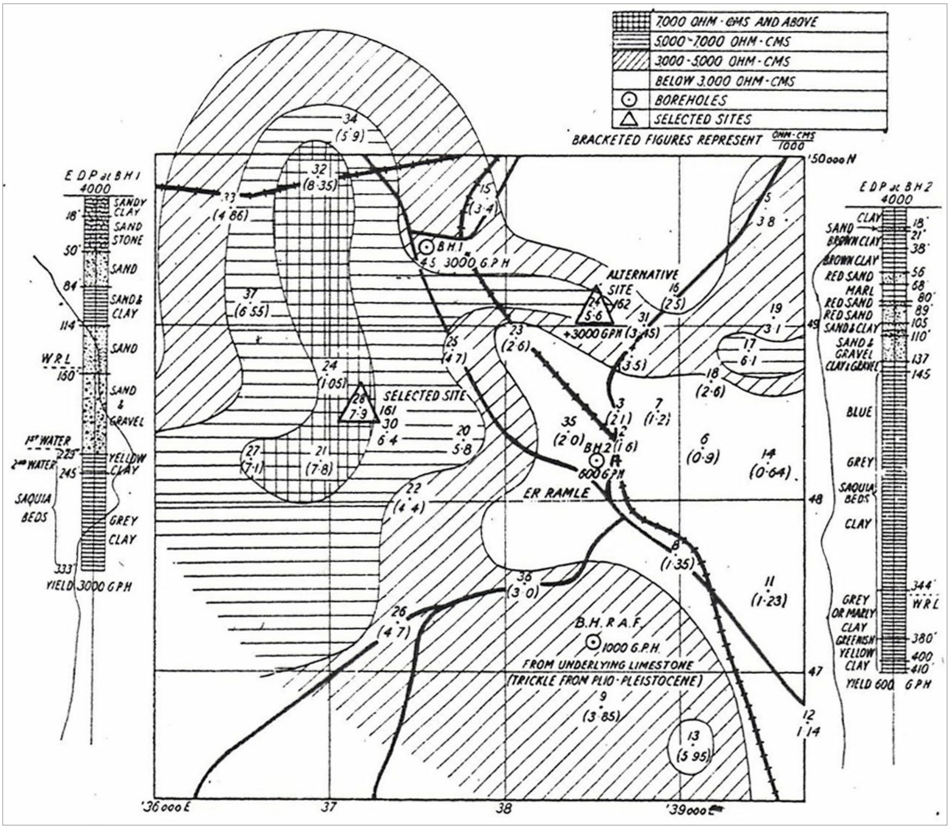

Figure 5.7 Iso-resistivity map, at depth of 60 metre, for Plio-Pleistocene sedimentary rocks of Ramle (present-day Ramla) in the coastal area of central Palestine, with resistivity curves and stratigraphical logs for two borehole sites[75]

Geological investigations relating to groundwater supplies were carried out initially by Major Fred Shotton, and geophysical surveys made under the field supervision of the Section's Captain D.J. Simpson and Lieutenant A.O. Thompson. Thompson also completed detailed surface water supply reconnaissance surveys. Three groundwater provinces were consequently distinguished in:

1. north and central parts of the country, Late Cretaceous limestones were the main aquifers, with yields in the order of 250-1 000 g.p.h. of good quality water;
2. south, earlier "Nubian Sandstone" yielded only low supplies (100-200 g.p.h.) of poor quality water from aquifers at considerable depth; and
3. extreme south, the coastal area near the port of Aqaba had a water table at sea level, with water of only fair quality drawn only from the top.

Military applications of geophysics for Transjordan were primarily resistivity measurements in:

1. limestone country, to locate and estimate depths to the water table and to elucidate sub-surface structure;
2. Nubian Sandstone, similarly to locate and estimate depths to the water table and to measure the depth to underlying granitic bedrock;
3. granitic escarpment area to the east, to measure the depth of wadi gravel deposits; and
4. coastal areas, to trace the occurrence of coarse sands and gravels and to give information concerning salinity.

However, magnetic measurements were also made in Nubian Sandstone areas, to trace major faults in the underlying granitic basement and granite areas, to locate the presence and trend of minor intrusions (dykes).

Persia and Iraq

For Persia (now Iran) and Iraq, military development of water supplies was actively pursued during the war by units of the Royal Engineers, particularly during the period 1942-1943, in planning for a possible total evacuation of Allied forces in the Middle East.[76] No. 7 Boring Section RE not only constructed boreholes, but also carried out extensive hydrogeological reconnaissance in Iraq and central Persia.[77] Detachments of 42nd Geological Section also carried out extensive hydrogeological and geophysical surveys, in northern Iraq and in south-east Persia.[78] A detachment assigned to the British 9th Army surveyed for groundwater in Iraq, in the region of Mosul, north to the border with Syria. A detachment assigned to the British 10th Army operated in Persia, in the south-east desert area of that country, for about three and a half months, before being recalled to Cairo.

All the work was directed towards the establishment of adequate water supplies along main routes: Haifa-Baghdad (the Iraq desert road); Baghdad-Kermanshah-Teheran (a road route); Ahwaz-Arak-Teheran (a rail route); Isfahan-Yezd-Zahidan (the south-east desert road), and Zahidan-Meshed-Teheran (a road to the Union of Soviet Socialist Republics, “Russia”). Since the routes were mainly confined to alluvial plains, and only occasionally traversed mountain areas (by way of detritus-covered valley floors), groundwater investigations fell into two obvious categories: water supplies in the plains or broad valleys, and those in narrow mountain defiles. Geophysical surveys were deemed to be of great assistance when directed towards:

1. establishing the presence of, and depth to, the main free water table in the valley fill deposits;
2. locating in these deposits zones of high porosity at water-table level, so maximising potential abstraction;
3. mapping the sub-surface alluvial/bedrock contact, thereby assisting location of favourable drilling sites at the valley sides when so required;
4. locating faults and dykes in the bedrock; and
5. locating high porosity zones in alluvial deposits of the Euphrates valley.

The Mediterranean region

Allied victory in North Africa was achieved in May 1943, with the surrender in Tunisia of the remaining German and Italian forces.[79] Thereafter, greater attention was given to the potential development of groundwater resources on the Mediterranean islands of Cyprus and Malta (figure 5.3), and later in Italy and Greece.

Cyprus

Drilling for water on the eastern Mediterranean island of Cyprus was undertaken on a fairly extensive scale to secure supplies of water for military camps, defence areas, aerodromes and hospitals.[80] This work was done in co-operation with the Irrigation and Water Supply Department of the Cyprus Colonial Government. The island's geological and hydrogeological conditions had been fairly well established by this time, but the Geological Section was to generate an updated geological map as part of its survey work – a map used to guide emplacement of boreholes (figure 5.8).[81]

A resistivity survey of the Nicosia airfield region generated an iso-resistivity map 'typical of the technique of representation of the geophysical measurements carried out by the 42nd Geological Section …which is slightly different from the method of individual interpretation of depth probe curves as employed by previous continental geophysicists'.[82] Geophysical surveys for the location of borehole sites for water were carried out largely under the field supervision of Captain G.C.L. Clarke.[83] They resulted in a significant improvement in the proportion of boreholes yielding adequate water.[84] Before November 1943, 46 boreholes were drilled without the benefit of geophysical guidance, of which 21 (46 per cent) were successful in locating adequate groundwater. After November 1943, with geophysical guidance, 19 holes were drilled, of which 16 (84 per cent) were successful.

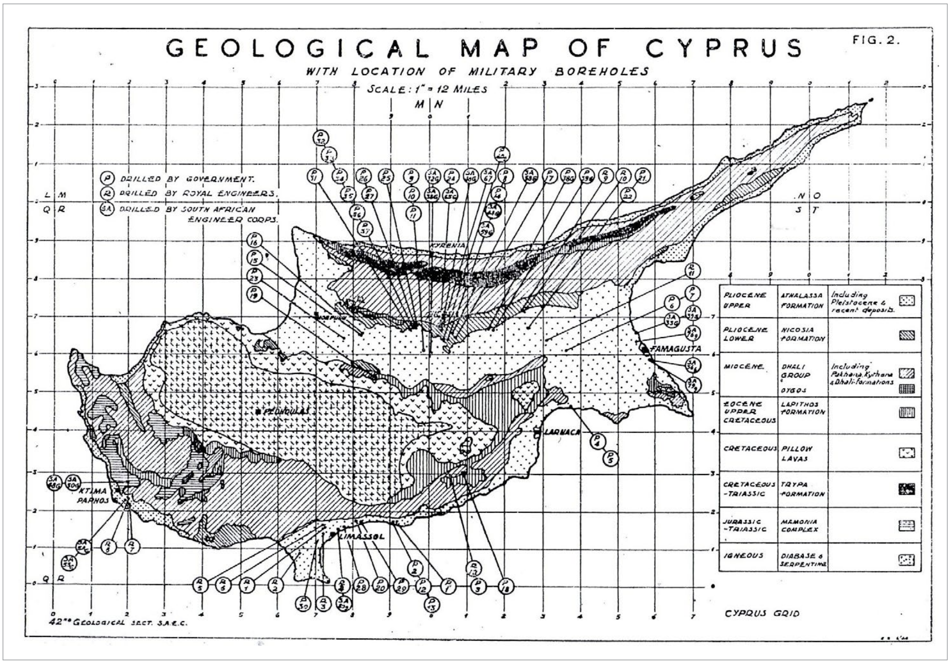

Figure 5.8 Geological map of Cyprus with location of military boreholes, compiled by 42nd Geological Section SAEC, distinguishing boreholes drilled by government agencies from those drilled by Royal Engineers or by SAEC units[85]

Malta

Water supply has always been a problem on Malta. The largest island of a small archipelago situated between Tunisia and Sicily, in the central Mediterranean area, it experiences a Mediterranean climate of cool wet winters and hot dry summers. The main features of geology and of groundwater occurrence had been well established pre-war, but proposals to use Malta as a base to support the Allied invasion of Sicily (in July 1943) and operations on the Italian mainland (from September 1943) led to military action to enhance water supplies. The Director of the Geological Survey of Great Britain, Dr. E.B. (later "Sir Edward") Bailey, was sent from England to Malta (via Gibraltar) in February 1943 to provide hydrogeological advice, and was soon followed more directly from Egypt by a detachment of No. 3 Boring Section RE.[86]

At the end of his six weeks of fieldwork on Malta, Bailey generated a report that discussed hydrogeology with a new degree of precision. It was already well known that the geology comprised a Late Miocene "Upper Coralline" limestone formation separated by a "Blue Clay" from underlying "Globigerina" and "Lower Coralline" limestones of Early Miocene/Late Oligocene age (figure 5.9). The Upper Coralline limestone contained a perched aquifer, whereas the main water table lay at about sea level within the Globigerina or Lower Coralline limestones. Bailey compiled a map contouring the height of the Globigerina/ Lower Coralline formation boundary to guide boring operations.

However, only one borehole was put down during the time of Bailey's visit; 36 more were to follow between March and August 1943. The choice of sites was guided by visits (in April, May and June) of geologist staff officers from Cairo – Captain Shotton and Major Paver – and by geological and geophysical investigations carried out by 42nd Geological Section.[87] Paver was later to compile an account of Malta as one of the case histories on water supply in the Middle East campaigns, but, unlike others by Shotton and by himself, it was not published.[88] It was superseded by a more extensive account, written mostly between September and November 1945.[89]

Military well drilling on Malta was re-activated in March 1944, when No. 7 Boring Section RE arrived from Egypt.[90] The unit began boring in April, and continued until October. In total, 122 holes were drilled on behalf of the Civil Government and the War Department, 24 on behalf of the Air Ministry, and three on behalf of the Admiralty. To guide drilling, a detachment of one officer and 12 men from the Geological Section was based on Malta from March until October 1944. The Section revised Bailey's structural contour map for the island, and helped to guide a project that effectively created 'an entirely new water works for the Island'.[91]

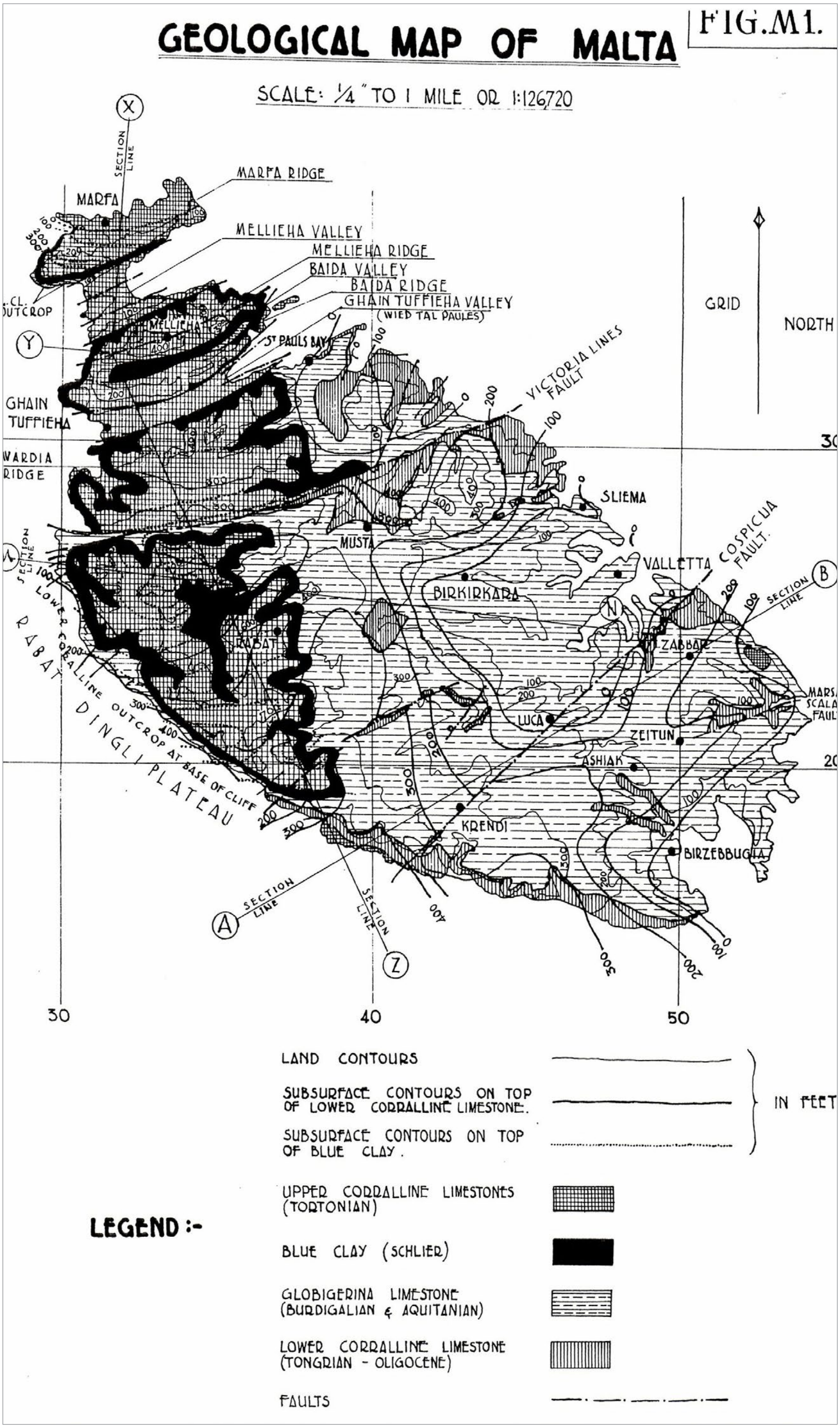

Figure 5.9 Geological map of Malta;[92] original at scale of 0,25 inch to 1 mile (1: 126 720)[93]

Italy and Greece

At the end of the North African campaign the main work of the Unit was virtually over as the theatre of war moved rapidly to Europe where water supply problems were not as important as they were in the semi-arid and desert areas of Middle East Command.[94] However, one detachment went with the expeditionary force to Italy; another went on a brief visit to the Aegean; and another went to Greece.

The Italian campaign began with the Allied invasion of Sicily from North Africa in July 1943, followed by invasion of the Italian mainland in September.[95] Allied forces were supported throughout the campaign by a Staff Officer (Geology), Captain (later Major) J.V. Stephens.[96] As the campaign developed, he was supported by another geologist as a Deputy Assistant Director of Works (Major W.A. Macfadyen), and Lieutenant P.A. Spens was temporarily attached to a Boring Section RE in order to undertake geological reconnaissance.[97] Stephens obviously had access to the expertise of 42nd Geological Section: his personal document file, now preserved in the Royal Engineers Museum, Library and Archive at Chatham, contains details of its establishment as at September 1943.[98] Some geophysical work was undertaken in Sicily in September and October 1943, directed by Captain [Digby] Roberts, Officer Commanding No. 3 Detachment 42nd Geological Section.[99] His detachment was in Sicily, operating with No. 1 Boring Section RE under extremely difficult conditions, with inadequate transport and little perceived need for its services. However, War Diaries for the Boring Sections RE deployed to Sicily and subsequently mainland Italy make no mention of Section assistance after November.[100]

No. 4 Boring Section RE had deployed to Greece in March 1940, but was one of the first units of the British and Commonwealth expeditionary force to be evacuated, on 24 April, before the Geological Section had arrived in the Middle East.[101] The Section's Captain Simpson reported on a "special duty" reconnaissance to the Greek islands of Castel Rosso and Leros in 1943.[102] However, a new British expeditionary force did not move to Greece until October 1944. The German occupation force had largely withdrawn, and the Allied force consisted mainly of specialist troops to help reconstruct the country's infrastructure. These quickly became caught up in the civil war that had followed German withdrawal. An insurgent attack on a base area was fought off by South African engineer units that included 104th Water Boring Section, 43rd Water Treatment Section, and 42nd Geological Section.[103] It was in Greece that the Section suffered its only casualty of the war: one man killed by a sniper.[104] From 22 April 1945 the Allied force was supported by No. 2 Boring Section RE.[105] This received guidance on

15 June 1945 from the officer commanding 42nd Geological Section, prior to taking over a series of tasks from 104th Water Boring Section.[106] Well drilling operations in Greece were to continue for some months after Allied "Victory in Europe" had been achieved on 8 May.

Geophysics versus water divining

An article in the *New York Times* newspaper late in 1942 reported that dowsing was of significant use within the British Army, particularly in the Middle East.[107] This provoked a strong denial in December from Major-General Tickell,[108] the Director of Works at HQ Middle East Forces, and a government denial in the UK Parliament. The term 'water diviners' was held to be demeaning to the skill of earth scientists.[109]

The dowsing allegation prompted a letter from the Director to make the existence and expertise of 42nd Geological Section more widely known, and to invite applications from geologically trained officers of the British and Indian armies to attend a training course in geophysical methods to be presented by Major Paver as officer commanding.[110] At least one such course was given, in April to May 1943. Training was attended by eight officers with drilling responsibilities west of the Nile,[111] and four men from units more widely dispersed east of the Nile.[112]

The date of the course coincides with that of completion of a handbook on the location of underground water by geological and geophysical methods.[113] Written by four members of the Section (Major Paver, Captain Simpson, Sergeant Clarke and Staff-Sergeant Freeman), it was published by SAEC. As explained in its preface, dated 30 April 1943, the handbook drew on pre-war experience in South Africa 'and on nearly three years of war-time prospecting in the countries covered by the East African and Middle East campaigns.' It was re-published on 12 April 1945, as the war drew to an end, as a supplement to one of the volumes of *Military Engineering,* the multi-volume textbook series that was to continue to guide the work of the British Army's Royal Engineers.[114] An opening chapter discusses the occurrence of underground water in relation to the commoner rock types and geological structures. Subsequent chapters describe the electrical resistivity method of geological prospecting; the interpretation of resistivity curves; the organisation of electrical resistivity surveys; and the principles and field procedure associated with surveys by magnetometer. Although its illustrations are all from work undertaken before April 1943, it is a part of *Military Engineering* that has never subsequently been revised.

Conclusion

The 42nd Geological Section made a significant and unique contribution to the development of water supplies in support of the British Army during the Second World War by deployments in East Africa, North Africa, the Middle East and elsewhere in the Mediterranean region. It generated coloured geological maps of Kenya and of Cyprus, and pioneered the British Army's use of resistivity and magnetometer surveys rather than dowsing as a means of prospecting for groundwater. Applications of geology demonstrated by the Section and the few geologists to have served as such as British staff officers during the Second World War led to the post-war creation of posts for a small number of geologists and/or geophysicists within the British reserve army to maintain that expertise to the present day.[115] The Section had a long-term as well as a timely impact.

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14 Major H.J. Frommurze DSc, Captain G.L. Paver BA PhD, Lieutenants D.J. Simpson MSc PhD, H.D. Roberts BSc ARSM & A. Huddlestone [sic] BSc. The last is a typographic error for Huddleston, as shown by Rose, E.P.F. 'Officers of 42nd Geological Section, South African Engineer Corps: Geologists and geophysicists who created a unique unit that supported the British Army during the Second World War', *Scientia Militaria: South African Journal of Military Studies*, 46 (2018), pp. 19-35.

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16 Reproduced courtesy of the Geological Society of London library.

17 [*Geological Map of] East Africa – Security*, Scale 1:1 000 000. Nairobi: East African Survey Unit, 1942. The sheets comprise 1. Uganda (north-west), 2. Marsabit (north-east), 3. Lake Victoria (south-west) & 4. Mombasa-Nairobi (south-east). All may be seen in the British Library, London, UK: Shelfmark *BL 66424(2)*.

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44 WO 169/1831 records that Lieutenant [Digby] Roberts and subsequently Captain Paver with men of 42nd Geological Section arrived at Fuka in Egypt in October 1941.

45 WO 169/10863 records that Captain Simpson of 42nd Geological Section accompanied the geologist Captain Shotton plus a geologist (Lieutenant Drever) from the Boring Section on a reconnaissance to the Egyptian/ Palestine border in March 1943; WO 169/20312 that Major Paver and Captain Roberts attended a drilling demonstration in Egypt in July 1945.

46 WO 169/16338 records that Major Paver and Lieutenant Lowenstein of 42nd Geological Section accompanied reconnaissance visits to sites on the Cairo-Alexandria Road in Egypt in February 1944; Lowenstein again in April, and Paver in May and June.

47 WO 169/10865 records that Major Paver visited in May 1943, whilst the unit was operational in Tunisia; WO 169/20313 that Captain Roberts visited in May 1945, Lieutenant Thompson in June, and Major Paver in November whilst in the Middle East.

48 WO 169/1835 records that Lieutenant Digby Roberts and ten other ranks were attached in September 1941, plus two further but unnamed offers in October, for service at unspecified sites in the Middle East.

49 From Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138, courtesy of the Geological Society of London. From January 1944 the Sections were re-named Boring Platoons.

50 WO 179/948 in the War Office series, The National Archives, Kew, near London, UK.

51 According to a letter dated 22 June 1941, preserved in file WO 201/2812.

52 Simpson, D.J. 'Water and warfare', *Proceedings of the Geological Society of South Africa,* 63 (1960).

53 Shotton, F.W. 'Water supply in the Middle East campaigns. I. The main water table in the Miocene limestone in the coastal desert of Egypt', *Water and Water Engineering,* 49 (1946), pp. 218-26.

54 Shotton, F.W. 'Water supply in the Middle East campaigns. II. Perched water supplies above the main water table of the Western Desert', *Water and Water Engineering*, 49 (1946), pp. 257-263.

55 Addison, H. & Shotton, F.W. 'Water supply in the Middle East campaigns. III. Collecting galleries along the Mediterranean coast of Egypt and Cyrenaica, *Water and Water Engineering,* 49 (1946), pp. 427-436.

56 Shotton, F.W. 'Water supply in the Middle East campaigns. IV. Water supplies adjacent to the Cairo-Alexandria desert road', *Water and Water Engineering*, 49 (1946), pp. 477-486.

57 WO 169/16338 records that Major Paver and Lieutenant Lowenstein of 42nd Geological Section accompanied reconnaissance visits to sites on the Cairo-Alexandria Road in Egypt in February 1944; Lowenstein again in April, and Paver in May and June.

58 Shotton, F.W. 'Water supply in the Middle East campaigns. V. The desert between the Nile delta and the Suez Canal', *Water and Water Engineering*, 49 (1946), pp. 529-540.

59 Ibid.

60 From Anon. *Military Engineering Vol VI – Water Supply*, Supplement No. 1. 'The location of underground water by geological and geophysical methods', WO Code No. 7490 (London: The War Office, 1945). See also: Shotton, F.W. 'The Fuka Basin', *Royal Engineers Journal*, 58 (1944), pp. 107-109.

61 Paver, G.L. 'Water supply in the Middle East campaigns. VI. The south-eastern desert of Upper Egypt (Red Sea hills)', *Water and Water Engineering*, 49 (1946), pp. 653-662.

62 The War Diary of No. 5 Boring Section RE (WO 169/10865) records that Major Paver visited the unit in Tunisia from 16 to18 May 1943.

63 Lieutenant Borchers; see Simpson, D.J. 'Water and warfare', *Proceedings of the Geological Society of South Africa*, 63 (1960), p. xxv.

64 Paver, G.L. 'Water supply in the Middle East campaigns. VII. Syria and the Lebanon', *Water and Water Engineering*, 50 (1947), pp. 61-76.

65 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

66 Paver, G.L. 'Water supply in the Middle East campaigns. VII. Syria and the Lebanon', *Water and Water Engineering*, 50 (1947), p. 61.

67 See figure 5 of Paver, G.L. 'Water supply in the Middle East campaigns. VII. Syria and the Lebanon', *Water and Water Engineering*, 50 (1947).

68 War Diary WO 179/949 contains an appendix by Clarke recording his visit to Syria from 23-29 September 1943.

69 Figure 5.6 shows perched and main water tables within folded limestone bedrock, plus electrical resistivity curves plotted for depths of about 100 metres at the seven sites indicated on the cross-section, with stratigraphical logs for the wells drilled at those sites, and rest water level for the six productive wells.

70 From Paver, G.L. 'Water supply in the Middle East campaigns. VII. Syria and the Lebanon', *Water and Water Engineering,* 50 (1947).

71 Paver, G.L. 'Water supply in the Middle East campaigns. IX. Palestine', *Water and Water Engineering*, 50 (1947), pp. 381-93.

72 Paver, G.L. 'Water supply in the Middle East campaigns. IX. Palestine', *Water and Water Engineering*, 50 (1947) tabulates data for 113 military boreholes.

73 Paver, G.L. 'Water supply in the Middle East campaigns. X. Trans-Jordan', *Water and Water Engineering*, 50 (1947), pp. 442-49.

74 See Paver, G.L. 'Water supply in the Middle East campaigns. X. Trans-Jordan', *Water and Water Engineering*, 50 (1947), appendix A.

75 From Paver, G.L. 'Water supply in th Middle East campaigns. IX. Palestine', *Water and Water Engineering*, 50 (1947), pp. 381-393.

76 Paver, G.L. & Digby Roberts, H. 'Water supply in the Middle East campaigns. XI. Persia and Iraq', *Water and Water Engineering*, 51 (1948), pp. 84-93, 136-145.

77 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

78 Paver, G.L. & Digby Roberts, H. 'Water supply in the Middle East campaigns. XI. Persia and Iraq', *Water and Water Engineering*, 51 (1948), pp. 84-93, 136-45.

79 Dear, I.C.B. & Foot, M.R.D. (eds.), *The Oxford Companion to the Second World War* (Oxford: Oxford University Press, 1995).

80 Paver, G.L. 'Water supply in the Middle East campaigns. VIII. Cyprus', *Water and Water Engineering*, 50 (1947), pp. 247-56.

81 Browne, R.V. & McGinty, J. *Geological Map of Cyprus*. Scale 4 miles: 1 inch, 1:253 440. Published by 42nd Geological Section, SAEC, General Headquarters, Middle East Forces, 1946.

82 Paver (1947), pp. 247-256.

83 War Diary WO 179/949 contains an appendix by Captain Clarke giving details of his visit to Cyprus from 16-22 October 1943. Simpson, D.J. 'Water and warfare', *Proceedings of the Geological Society of South Africa*, 63 (1960), p. xxii recorded that although Simpson visited the island twice, 42nd Geological Section worked there after he had left the unit in late 1943.

84 An appendix to Paver's article tabulates data for 70 boreholes sunk for military purposes on Cyprus during the war (Paver, G.L. 'Water supply in the Middle East campaigns. VIII. Cyprus', *Water and Water Engineering*, 50 (1947), pp. 247-56).

85 From Paver, G.L. 'Water supply in the Middle East campaigns. VIII. Cyprus', *Water and Water Engineering*, 50 (1947), pp. 247-256.

86 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

87 Paver, G.L. Problems of water supply in the Middle East. Case 11. Boreholes for water in Malta. Unpublished report, GHQ, Middle East Forces, 1945. [Catalogued within the Shotton Archive, Lapworth Museum of Geology, University of Birmingham, UK].

88 Paver, G.L. Problems of water supply in the Middle East. Case 11. Boreholes for water in Malta. Unpublished report, GHQ, Middle East Forces, 1945. [Catalogued within the Shotton Archive, Lapworth Museum of Geology, University of Birmingham, UK].

89 Morris, T.O. *The Water Supply Resources of Malta* (Valetta: Government of Malta, 1952).

90 Morris, T.O. *The Water Supply Resources of Malta* (Valetta: Government of Malta, 1952); see also Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

91 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology,* Geological Society of London, Special Publications 362 (2012), p. 121.

92 From Paver, G.L. Problems of water supply in the Middle East. Case 11. Boreholes for water in Malta. Unpublished report, GHQ, Middle East Forces, 1945. [Catalogued within the Shotton Archive, Lapworth Museum of Geology, University of Birmingham, UK].

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94 Simpson, D.J. 'Water and warfare', *Proceedings of the Geological Society of South Africa*, 63 (1960), p. xxxvi.

95 Dear, I.C.B. & Foot, M.R.D. (eds.), *The Oxford Companion to the Second World War* (Oxford: Oxford University Press, 1995).

96 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

97 WO 169/10865 in the War Office series, The National Archives, Kew, near London, UK.

98 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

99 Appendix C (dated 14 October) to the Section's War Diary for October 1943, WO 179/949. See also Appendix B: Reports for 26 August-3 September, indicating that Roberts was at Tripoli in Libya awaiting transport to Sicily; for 17-30 September, indicating that his Detachment had moved to Sicily; for 1-10 October, and recording difficult operating conditions.

100 WO 169/10861 refers to an officer from 42nd Geological Section being attached to No. 1 Boring Section in Sicily for most of November 1943.

101 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

102 Appendix C (dated 14 October) to the Section's War Diary for October 1943, WO 179/949.

103 Anderson, K. *Nine Flames* (Cape Town: Purnell & Sons, 1964), p. 217.

104 Simpson, D.J. 'Water and warfare', *Proceedings of the Geological Society of South Africa*, 63 (1960), p. xxxvi.

105 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

106 War Diary WO 170/5117.

107 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), pp. 105-138.

108 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), table 7.

109 De Beer, J.H. 'Term "water diviners" demeaning to skill of earth scientists', Letters to the editor, *The Water Wheel*, 10, no. 6/6 (2011), p. 5.; De Beer, J.H. 'The contribution of South African geophysicists in World War II', in J.H. de Beer (ed.), *The History of Geophysics in Southern Africa*. Stellenbosch: AFRICAN SUN MeDIA, 2015, pp. 74-84.

110 Rose, E.P.F. 'Groundwater as a military resource: Development of Royal Engineers Boring Sections and British military hydrogeology in World War II' in E.P.F Rose & J.D. Mather (eds.), *Military Aspects of Hydrogeology*, Geological Society of London, Special Publications 362 (2012), table 8.

111 Major G.R.S. Stow, Captain W.J. Stone, and Lieutenant P.A. Spens of 'D' (later 797) Boring Company RE (Officer Commanding, Second-in-Command, and Officer-in-Charge of the Geology Section respectively), Captains T.B.C. Harris, R.C. Paget & H.D. Stow (Officers Commanding Nos. 1, 4 and 5 Boring Sections RE within 'D' Boring Company), and Lieutenants A.D. Blackie and P.M. Stevens (of 1 and 5 Boring Sections respectively): War Diary WO 169/10770.

112 Lieutenant H.I. Drever, Officer-in-Charge of the Geology Section, and three other ranks from within 798 Boring Company RE, seemingly attended the same three-week course, which ended on 15 May (War Diary WO 169/10771).

113 Paver, G.L., Simpson, D.J., Freeman, C.J. & Clarke, G.C.L. *The Location of Underground Water by Geological and Geophysical Methods* (Cairo: South African Engineering Corps, General Headquarters, Middle East Forces, 1943). Reprinted as Anon. *Military Engineering Vol VI – Water Supply*, Supplement No. 1. 'The location of underground water by geological and geophysical methods', WO Code No. 7490 (London: The War Office, 1945).

114 Anon. *Military Engineering Vol VI – Water Supply*, Supplement No. 1. 'The location of underground water by geological and geophysical methods', WO Code No. 7490 (London: The War Office, 1945).

115 Rose, E.P.F. & Rosenbaum, M.S. 'Sapper Geology: Part 4. Royal Engineers Specialist Advisory Team geologists', *Royal Engineers Journal*, 131(2) (2017), pp. 95-102.

CHAPTER 6

"Wehrgeologenstelle 12": Rommel's military geology team in North Africa, 1941-1943

Hermann Häusler

Introduction

In 1940 the state of the colonisation of northern Africa was as follows: Italy had occupied Libya, Great Britain had colonised Egypt and the Sudan, and France possessed Algeria, French Morocco and French West Africa. The Free French under De Gaulle had settled French Equatorial Africa. After Italy declared war on France and Great Britain, Benito Mussolini attacked Egypt in September 1940. British forces successfully repelled this attack and conquered Cyrenaica (the eastern coastal region of Libya). Following a meeting between Adolf Hitler and Benito Mussolini in January 1941, the German Armed Forces High Command created the Africa Corps (*Afrika Korps*), under the command of General Erwin Rommel.

At that time the Corps consisted of three divisions: Division Brescia, Division Ariete, and the 5th Light Division. From April to July 1941, *Wehrgeologenstelle 12* (Military Geology Team 12, hereafter MGT 12) was deployed to the military geography officer of the Africa Corps. In July 1941 the German and Italian troops of the Africa Corps were reorganised as the *Panzer* Group Africa, and MGT 12 was deployed to the engineer officer of the army staff. The *Panzer* Group Africa was reorganised as the German-Italian *Panzer* Army Africa, with the Africa Corps as the major German component, in January 1942. In October 1942, after their

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defeat at the Second Battle of El Alamein, the *Panzer* Army was redesignated the German-Italian *Panzer* Army (*Deutsch-Italienische Panzerarmee, Armata Corazzata Italo-Tedesca*). In February 1943, during the final stages of the Desert War, the headquarters was upgraded to Army Group Africa (*Heeresgruppe Afrika/Gruppo d'Armate Africa*) to manage the defence of Tunisia. Hans-Jürgen von Armin replaced Rommel as commander of the Army Group in March, and surrendered his forces to the Allies on 13 May 1943, thereby ending the Axis presence in Africa.[1]

Knowledge of the geology the terrain was vitally important for the mobility and water provisioning of the mechanised divisions, first during Rommel's forward pushes through Cyrenaica and north-western Egypt, and then again during the retreat of the German-Italian forces to Tunisia. This chapter provides an overview of the scope and significance of German military geology work in North Africa, particularly during the first phases of the Desert War, from 1941-1942, and with particular reference to German, Italian and British off-road trafficability maps.

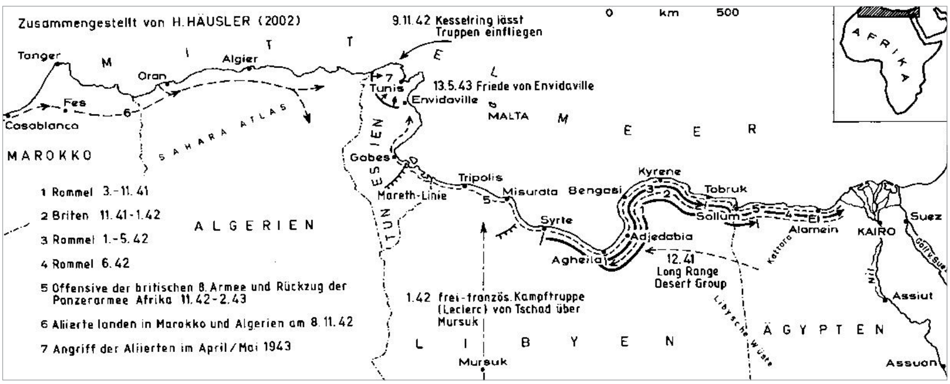

Figure 6.1 The seven phases of the North African theatre of war, 1941-1943.
Phase 1: Rommel's first offensive in Cyrenaica (March-November 1941).
Phase 2: British offensive in Cyrenaica (November 1941-January 1942).
Phase 3: Rommel's second offensive in Cyrenaica (January-May 1942).
Phase 4: Rommel's push to El Alamein (June 1942).
Phase 5: Offensive of 8th British Army and retreat of *Panzer* Army Africa (November 1942-February 1943).
Phase 6: Allied forces land in Morocco and Algeria.
Phase 7: Allied offensive in April/May 1943.[2]

Rommel’s *Wehrgeologenstelle 12*

This chapter focuses on German military geology work in the North African theatre of war in 1941-1942, highlighting three phases of Rommel’s warfare(see figure 6.1, phases 1-3). Phase 1 describes the team’s work during Rommel’s first offensive from March to November 1941; phase 2 refers to the German defence against the British offensive from November 1941 to January 1942; and phase 3 describes Rommel’s second offensive from January to May 1942 (figure 6.2).

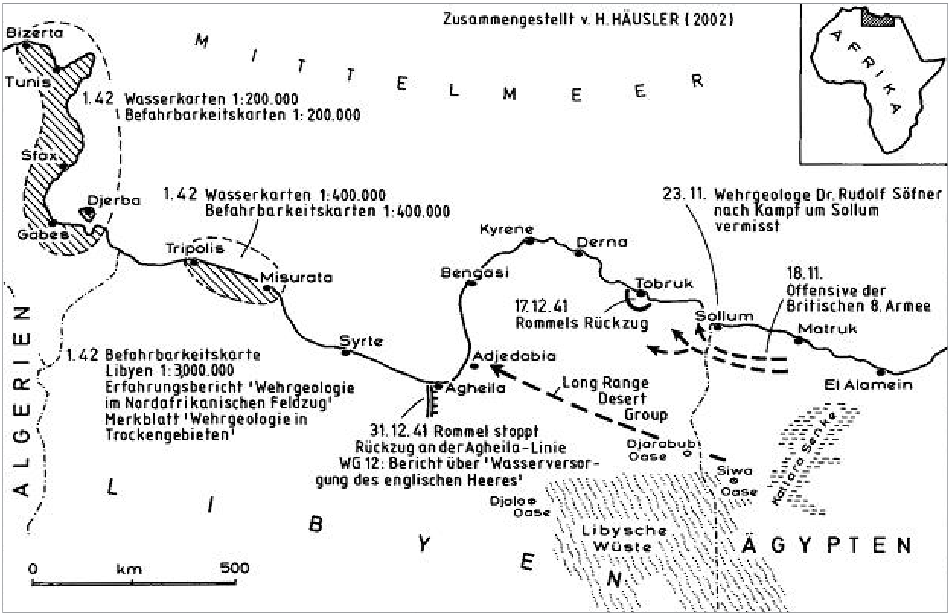

Figure 6.2 Military geology works during Rommel’s first offensive in Cyrenaica (March-November 1941)[3]

The German General Staff of the Army provided military geographic and geological information on northeast Africa, in particular Libya and Tunisia in 1941, and Egypt in 1942.[4] The main goal of *Wehrgeologenstelle 12* (hereafter MGT 12) was to prepare current information on off-road trafficability for motorised divisions, to support German and Italian troops with precise information on locations with sufficient potable water, and to perform geological investigations to assist in finding locations for the positioning of defences.[5]

The average daily use of freshwater for a division was between 120 000 and 150 000 litres,[6] which had to be filled into containers and distributed. The provision of freshwater for the Africa Corps in northern Libya, with temperatures of 35 degrees in the shade, therefore came to about 400 cubic metres per day. It was known that about 2 000 cisterns, with a total capacity of 400 000 cubic metres of fresh water, had once existed along the coast and in the Cyrenaica, most of them from Roman times. Due to the lack of information – or perhaps because of their destruction – it was an important task to reconnoitre functioning wells and calculate the actual amounts of potable water. Where wells were lacking, the military geology team investigated aquifers using both geophysical equipment and drilling. In addition, the team was equipped with chemicals to check the water quality.[7]

Off-road trafficability maps at scales of 1:100 000 and 1:400 000, respectively, were based on expeditions by the military geology team using wheeled vehicles and reconnaissance flights. These maps differed significantly from the going maps provided by desert experts for the 8th British Army.

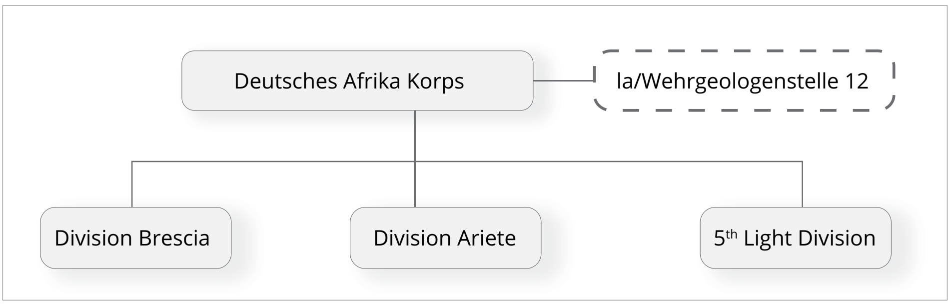

Figure 6.3 Organigram of the German Africa Corps and its military geology team in 1941[8]

On 11 April 1941, MGT 12, headed by Dr Leo Medard Kuckelkorn, landed with cars and field equipment at Derna to support Rommel's first attack toward the fortress of Tobruk (figure 6.3). As in the case of military geology teams elsewhere, MGT 12 initially consisted of eight members: two senior geologists, one junior geologist, one technician, one draughtsman, one typist and two drivers. They were provided with four vehicles to conduct reconnaissance and groundwater investigations: two well equipped geology cars (one with geophysical equipment, and the other equipped with a drilling rig) and two cars with Benoto drilling rigs.

In 1943, a second and third military geology team (teams 6 and 8) were deployed in North Africa to conduct a comprehensive investigation of locations suitable for the water supply of the approximately 100 000 personnel involved in Rommel's rapid offensives with off-road motorised divisions along hundreds of kilometres. The military geology fieldwork of MGT 12 comprised the securing of water supplies in coastal areas and deserts, landscape classification for motorised tank divisions, and the fortification of positions. The team regularly reported to the military geography officer of the Africa Corps, and later also to the engineering officer of *Panzer* Group Africa. In addition, MGT 12 was regularly in touch with MGT 29, the German military geology staff in Berlin-Wannsee.

Monthly reports from March 1941 to October 1942 provide a detailed account of the geological team's activities during the various stages of Rommel's campaign in northern Libya and Egypt.[9]

Phase 1: Rommel's first offensive: Benghazi – Derna – Tobruk – Bardia – Sollum

During Rommel's first offensive, from March to November 1941 (figure 6.2), MGT 12 received orders to:

◊ prepare water supply at Bardia (14 April 1941);

◊ prepare water supply at an airfield west of Tobruk (16 April 1941);

◊ fortify and prepare water supply at Halfaya Pass, south-west of Sollum (July to September 1941);

◊ produce a water supply map of the entire coastal region between Derna and Port Saïd (August to September 1941);

◊ prepare water supply in coastal areas between Cyrene and Derna (7-19 September 1941); and

◊ conduct military geology reconnaissance around Bir Hacheim (September to October 1941).

During the last month of the offensive, the team were given additional instructions to:

◊ produce a water supply map of the coastal area from Tobruk to Halfaya Pass;

◊ produce a water supply map and card index for the area from Derna (Cyrenaica) to the Nile, including detailed sketches, geological profiles, and technical and hydrochemical data for 120 locations;

◊ produce a water supply map of the coastal area from Tobruk to Halfaya Pass; and

◊ perform shallow drilling for fresh water with Benoto-drilling rig near Sollum.

Phase 2: Rommel's defence against the first British offensive: Tobruk – Derna – Benghazi – El Agheila

From 18 November 1941 to 20 January 1942, the British offensive from Marsa Matruk toward Sollum and Tobruk (figure 6.4) forced the Africa Corps to retreat from Cyrenaica. MGT 12 conducted operations (a) before and (b) during Rommel's retreat up to the stronghold at the Marsa-Brega position, west of Agheila:

a. MGT 12 operations prior to Rommel's retreat:
   - ◊ produce a final report on cisterns between Sollum and Sidi Omar;
   - ◊ produce as short report on the geology of positions and mining between Sollum and Halfaya Pass;
   - ◊ groundwater exploration around Bardia;
   - ◊ study the going map of north-west Egypt based on British spoils of war; and
   - ◊ study the possible consequences of blasting Aswan Dam.

b. MGT 12 operations during Rommel's retreat:
   - ◊ prepare water supply for troops east of Tobruk;
   - ◊ conduct reconnaissance trips to improve landscape classification for the going map (scale 1:400 000) of the Cyrenaica;
   - ◊ report on the water supply of the British Army based on spoils of war from 5th South African Brigade;
   - ◊ road trafficability from Agheila to Marada;
   - ◊ prepare landscape map and going map of surroundings of Agheila 1:100 000;
   - ◊ prepare landscape map and going map of Libya 1:300 000; and
   - ◊ prepare water supply map and card index of cisterns and wells.

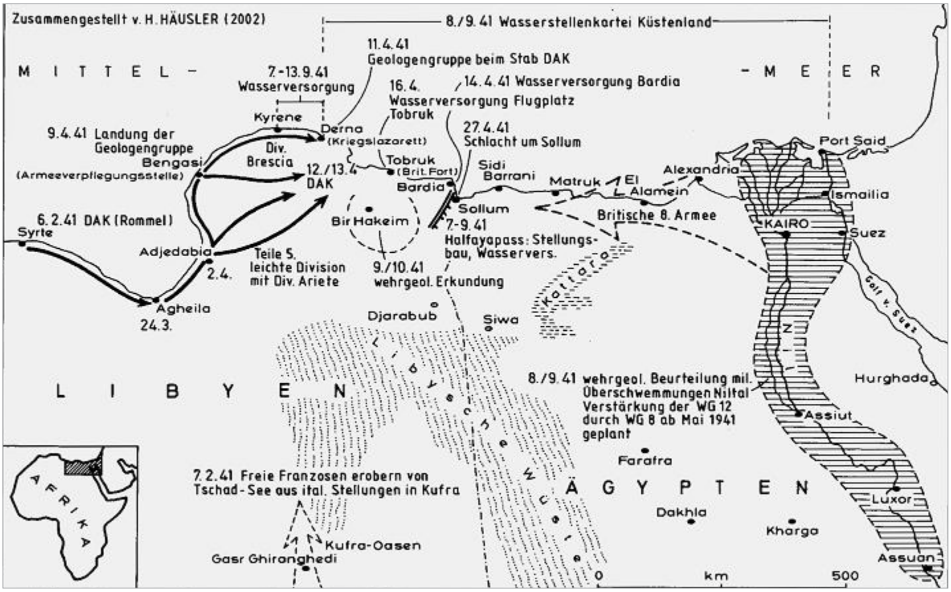

Figure 6.4 Military geology activities during the British offensive in Cyrenaica (November 1941 to January 1942)[10]

In addition to reports and leaflets on military geology in the desert areas, MGT 12 had already prepared basic information about Tunisia in January 1942 including:

◊ water supply maps (scale 1:200 000) of Tunisia, sheets Cap Bon, La Goulette, Sousse, El Djem, Sfax, Kerkerna, Mahares, Gebes, Sidi Chammakh, Medienne, Biserta, Tunis and Maktar;

◊ landscape classification and off-road trafficability maps (scale 1:200 000) (same sheets as above);

◊ water supply maps (scale 1:400 000) of Triplotania, sheets Zuara, Tripoli-Misurata, Gadames and Giado-Misda;

◊ landscape classification and off-road trafficability maps (scale 1:400 000) (same sheets as water supply maps above); and

◊ geological map (scale 1: 1 000 000) of Tunis, including explanations and geological profiles.

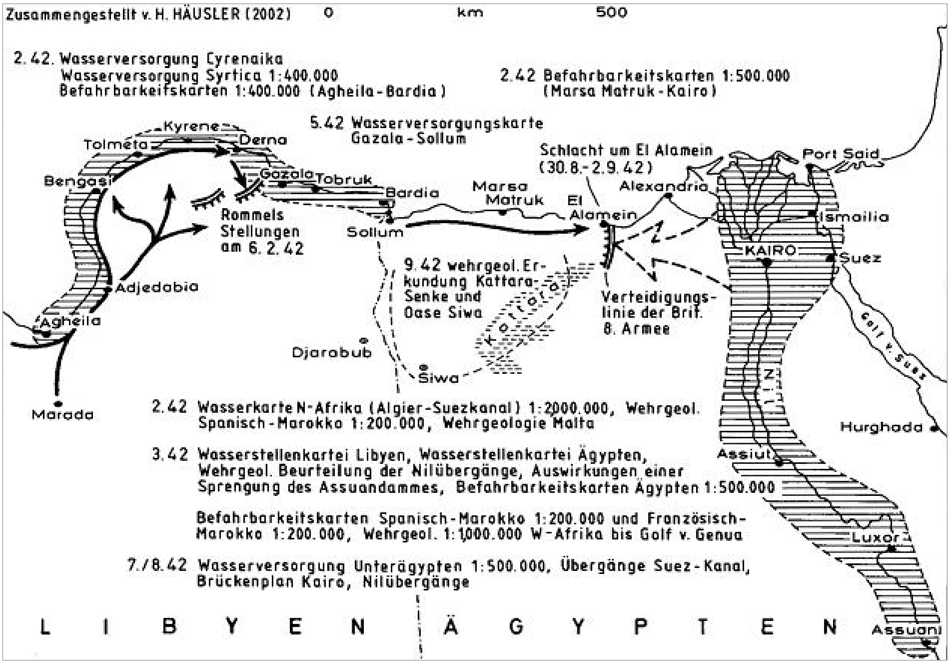

Figure 6.5 Military geology works during Rommel's second offensive in Cyrenaica (January-May 1942)[11]

Phase 3: Rommel's second push into the Western Desert: Agheila – Gazala – Tobruk – Bardia – Sollum – El Alamein

From January to May 1942 Rommel attacked the British troops and recaptured Cyrenaica (except for Tobruk), and in June 1942 the 5th German-Italian Tank Army advanced eastward and attacked El Alamein, where Rommel was stopped (figure 6.5). From 16 January to 28 February 1942, MGT 12 prepared the following:

◊ landscape classification and off-road trafficability 1:400 000, topographic sheet Agheila, based on field reconnaissance, geodetic measurements and aerial photos;

◊ an update of landscape classification and off-road trafficability 1:400 000, topographic sheets Ajedabia, Bardia, Benghazi, Bir Hacheim, Derna and Marada;

◊ landscape classification and off-road trafficability 1:500 000, topographic sheets Marsa Matruk and Cairo;

◊ a report on the consequences of potential destruction of Aswan Dam; and

◊ a report on the water supply of Cyrenaica.

In March 1942, MGT 12:

◊ printed going maps (1:400 000), topographic sheets Agheila and Marada, Benghazi and Ajedabia, Derna,Bir Hacheim and Bardia, as well as 1:500 000 Matruk and Cairo; and Libya at a scale of 1:3 000 000;

◊ updated the water card index of Libya and Egypt based on Britain spoils of war.; and

◊ enlarged topographic maps from 1:400 000 to 1:100 000, sheets Zauiet el Mamama and Hagfet Gelgaf, enhanced by route reconnaissance.

Phase 4

During April and May 1942, MGT 12 reported on trafficability crossing the Gebel south and south-west of Umm er Rzem. In addition, the water card indexes of Libya and Northwest Egypt were finalised. On 25 May 1942, shortly before the attack on Tobruk, the army high command of the 5th Tank Army distributed the water card index (part 1) of the military geology team to its troops – the Italian X (tenth) Army Corps, the Italian XX (twentieth) motorised Army Corps, the Italian XXX (thirtieth) Army Corps – and to the command of the Africa Corps and its 15th and 21st *Panzer* Divisions, as well as to the 90th Light Division.

The 1:400 000 water supply maps of Cyrenaica comprised the sheets Syrte, Agheila, Benghazi-Ajedabia, Cirene, Giovanni Berta, Derna – Bir Hacheim. To allow for more detail, the map sheets Gazala – Sollum West and Gazala – Sollum East were done at 1:100 000 scale.

After this attack, further advance of 5th German-Italian Tank Army toward Cairo was planned during the German-Italian offensive, which lasted from 26 May to 22 October 1942. This is documented by detailed studies of MGT 12, because in addition to the 1:100 000 scale cross-country trafficability maps of the El Alamein front section, the following expertises, dated August 1942, were provided:

◊ a current road map and a map of channels based on aerial reconnaissance flights on spoils of war;

◊ the water levels of the Nile River;

◊ crossing sites on the Nile in the Delta-Barrage section, 15 kilometres north-west of Cairo (with map and tables, including potential locations for blasting the route to the Nile River);

◊ cross sections of Nile River; and

◊ a water supply map and a water well card index of topographic sheet Cairo 1:500 000 were provided to the lower commands of the 5th *Panzer* Army.

Following the Second Battle of El Alamein (30 August to 2 September 1942), the *Panzer* Army again retreated westward. After the Allied troops landed in Morocco and Algeria on 8 November 1942, the offensive toward the positions of the 5th *Panzer* Army around Tunis ended with the peace of Envidaville on 13 May 1943. Military geology support of the German-Italian forces became less important during this last phase of the North African campaign.

Groundwater investigations and water supply maps

In addition to the investigation of water from cisterns, the geology team used resistivity measurements for identifying groundwater aquifers in the desert. These were then drilled with simple equipment that had been shipped from Berlin. Groundwater quality and salinity was tested with a special suitcase of chemicals, in accordance with Dr Hartwig Klut's textbook on on-site investigation of water.[12] This knowledge of aquifers and confining beds enabled the exploitation of groundwater for the troops.

Figure 6.6 depicts an example of fluvial and eolian deposits overlying Miocene limestone at Agheila el Garbia. Near Agheila, in the Sirte Basin of Libya, a number of smaller and larger flat saline plains (*sebkh)* lie in the transition zone to the desert, mostly in shallow depressions (*grarets*), in which the outflowing waters of *wadis* or groundwater streams come to an end. Below the salt clay, the soil is damp. Lines of dunes shift across the *wadi* beds, while small islands stand out from them; at other times, large parts are completely covered by sand, with the result that the character of the *sebkha* can scarcely be recognised. Immediately adjacent to the *sebkha* sweet water is found at a shallow depth.[13] The geological investigations at Agheila el Garbia revealed that the gravelly aquifer was overlain by dunes and that it was possible to exploit the fresh water source by means of trenches.

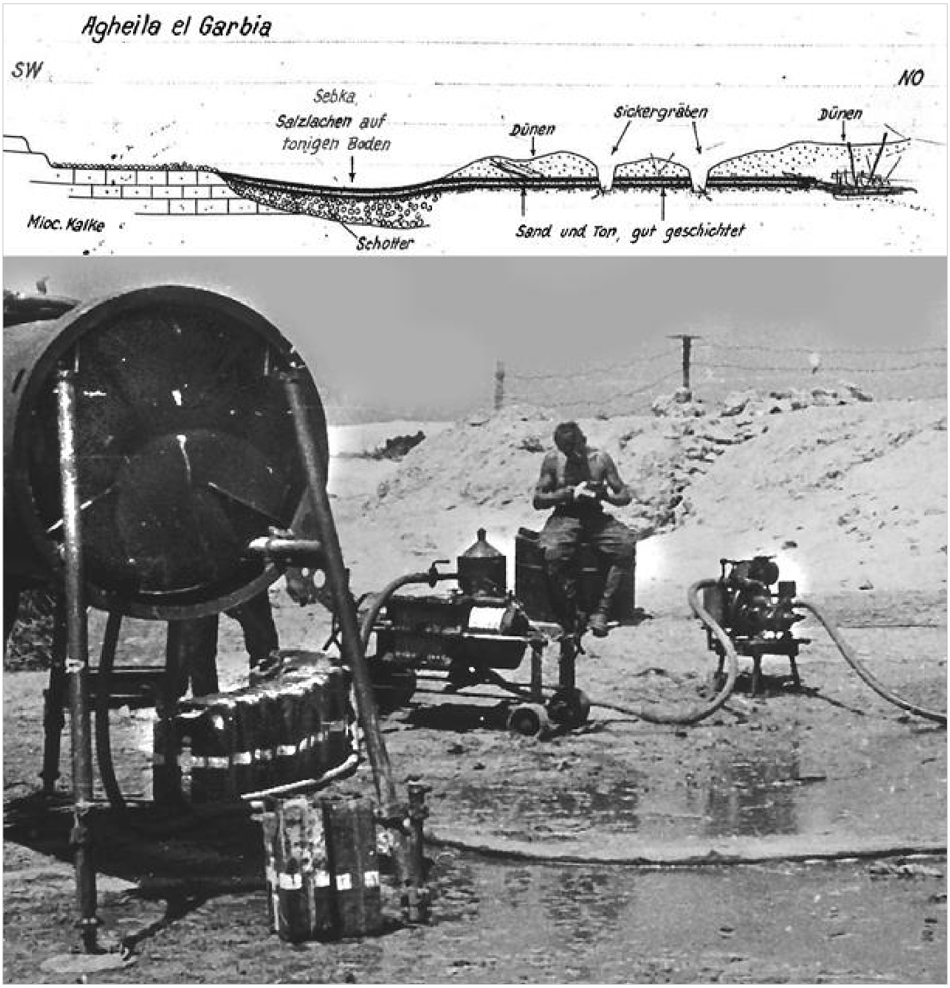

Figure 6.6 Water supply from trenches in fluvial gravels and dunes at Agheila el Garbia, Sirte Basin, May 1941[14]

Another aquifer type was trenched by Italian troops in gravel beds near Martuba, which is located southeast of Derna in the north-western Cyrenaica (figure 6.7).

The military geology team regularly wrote detailed listings of investigated wells and reported them to the army engineer of the Afrika Corps and the *Panzer* Army. All results on groundwater investigations, springs and wells were compiled in water supply maps, such as sheet Matruk at a scale of 1:500 000, compiled in May 1942.[15]

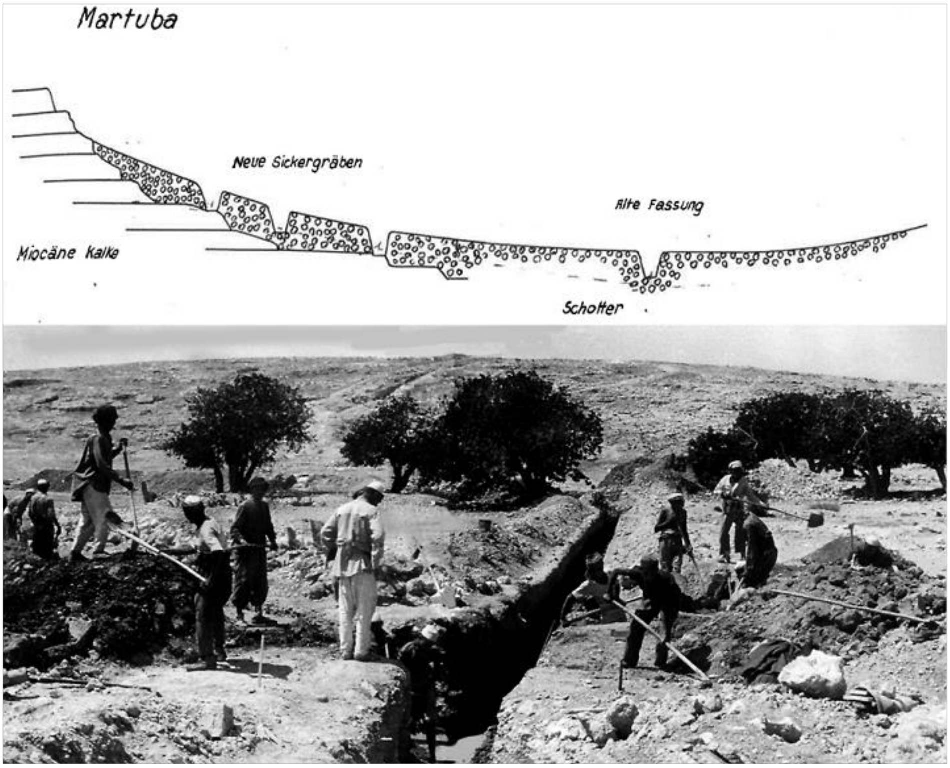

Figure 6.7 Water supply from slope debris at Martuba, south-east of Derna, May 1941[16]

Figure 6.8 depicts the coastal section of this map in north-western Egypt between Sollum and Tobruk. Different colours indicate different sources of information: German sources are blue, Italian sources are green, and those of British origin are red. Additional comments refer to the quality of the spring waters and wells, and also to their capacity. The green circle marks Sidi Barrani (in Egypt), where the main water pipe from Bardia (Libya) ended. The note in green handwriting affirms that, when functioning properly, the water yielded 500 cubic metres of slightly salty water per day, and advises that new wells with a capacity of 100 cubic metres/day could be dug within only three days. To the east of Sidi Barrani, Italian sources indicated five coastal wells yielding a maximum of 10 cubic metres of water per day. According to British information, there were four major wells, each approximately 27 metres deep, at Sidi Barrani, which could provide 9 cubic metres of potable water per day. Many local wells to the south were up to 50 metres deep, such as Sânyet Khoraishif to the southeast of Sidi Barrani, which yielded good fresh water, as indicated by both German and Italian sources.

Figure 6.8 Water supply map Matruk at original scale 1:500 000, prepared by MGT 12 in May 1942, with information colour-coded by source[17]

Comparison of German, Italian and British maps for assessment of off-road trafficability in North Africa

At the beginning of the Second World War hostilities, there were only a few asphalt roads along the coast and sand tracks in the desert of Cyrenaica. The mechanised divisions therefore needed good information on off-road trafficability for wheeled and tracked vehicles for rapid attack and retreat, and the logistics of gasoline, food and water supply.

The three examples of trafficability maps and going maps discussed below all refer to the same area between Tobruk and Bardia. The German and Italian maps are at a scale of 1:400 000, and the British map at a scale of 1:500 000. Whereas the German trafficability map was hand-coloured, the Italian and British maps were printed, and it is very interesting that the printed maps resemble each other significantly with respect to map design and key arrangement of the going classification. It cannot be ruled out that the 1:500 000-scale British going map of Bardia, dating from October 1941, was a spoil of war about which MGT 12 had reported in November 1941. Therefore, the Axis and Allied forces had similar trafficability maps for their motorised divisions in North Africa.

German landscape classification for off-road trafficability

Despite Libya having been an Italian colony for decades, no trafficability maps were provided to the German-Italian troops in 1941. In addition to preparing water supply maps, including card indexes, it also fell to MGT 12 to draw trafficability maps at 1:400 000, using aerial photographs and their own reconnaissance of off-road movement for potential battlegrounds for Rommel's attacks and retreats. As maps could not be printed by Italian firms in Tripoli in time, MGT 12 produced several hand-drawn coloured copies. These *Befahrbarkeitskarten* were not going maps as such (compared to the British going maps – see below), but informed Rommel's troops on landscape classes relevant to the movement of motorised divisions. The landscapes were predominantly classified by geomorphology and vegetation.

Figure 6.9 depicts the German trafficability map 1:400 000, sheet Bardia, highlighting linear topographic elements, such as steeper slopes, which were classified as non-passable off the roads (black triangles), or gentle slopes, classified as mostly passable (blank triangles). Red arrows indicated major through-routes. The map includes additional information on major wells relevant to the use of rapid brigades by the 5th *Panzer* Army.

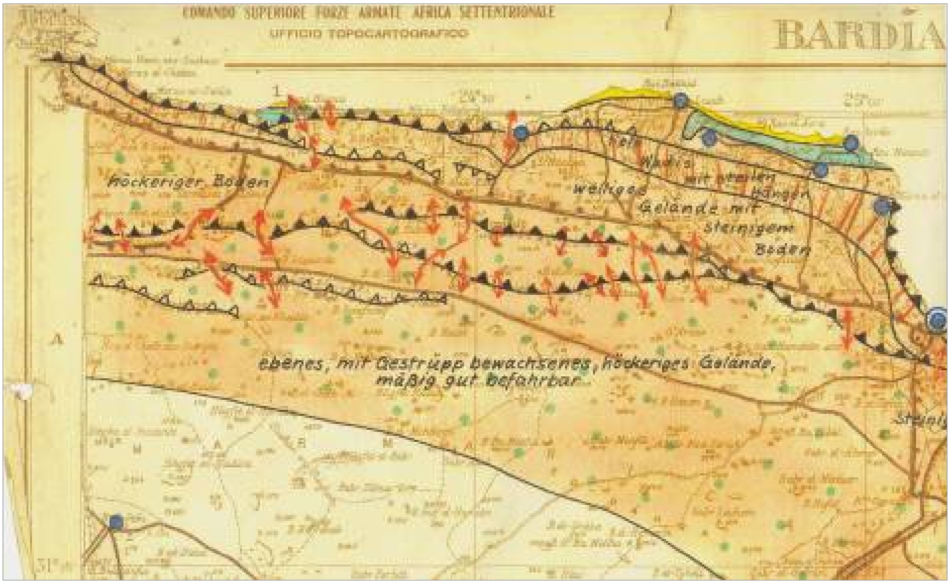

Figure 6.9 Section of the hand-coloured German trafficability map at original scale 1:400 000, sheet Bardia, provided by MGT 12[18]

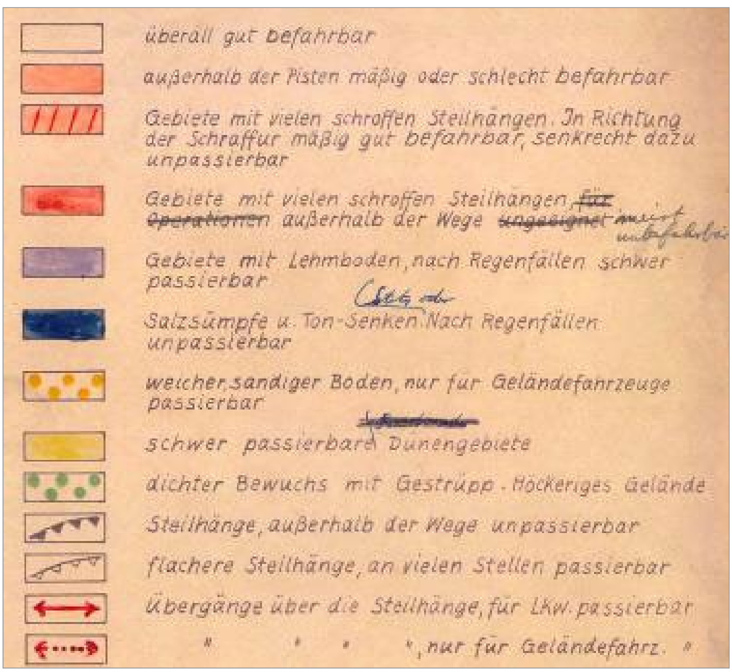

Figure 6.10 Section of the legend of the German trafficability map of Cyrenaica 1:400 000, sheet Bardia[19]

The legend in figure 6.10 provides rather a lot of information in a clear and succinct manner, indicating not only general levels of trafficability, but also more specific information; for example, white areas designate good trafficability; orange areas moderate to poor off-road trafficability; orange areas with red hatches indicate steep slopes and moderate to poor trafficability; red areas would be virtually impassable off-road; and yellow dots designate soft, sandy soil, only passable by cross-country vehicles. The short summaries provided a rapid overview of the major features of the terrain; for example, 'flat, shrub-covered, bumpy terrain, moderate trafficability' (the area indicated with green dots in the southern part of figure 6.9).

In short, the legends of German trafficability maps were easy to read and understand, and provided pertinent and clear additional information pertaining to the movement of mechanised forces in any particular area, such as the condition of roads, the trafficability of rock escarpments and densely vegetated areas, and the effect the weather might have on trafficability of a given area (for example, areas shaded in purple had loamy soils and would become very difficult to traverse after rain). They also gave an overview on the capacity of wells, which was crucial for planning the water supply of the mechanised divisions in the absence of supplementary water supply maps or any detailed card indexes, which were not typed by the military geology team in large numbers.

Italian off-road trafficability maps 1:400 000

The Italian maps were produced by the Special Cartographic Service of the Italian Armed Forces (FF. AA. = *Forze Armate*) of North Africa (*A.S. = Africa Settentrionale*), and were probably printed in Tripoli. The trafficability classification of, for example, Italian sheet Bardia 1:400 000 (figure 6.11) and the British going map 1:500 000 of the same sheet (figure 6.12) are identical in nearly every detail, except for the legend. Due to the fact that the Italian going map of this sheet was printed in August 1940, while the British one was printed in October 1941, it can be concluded that the Italian off-road trafficability map was reproduced prior to Rommel's actions in North Africa from earlier British spoils of war.

Figure 6.11 Section of the printed Italian trafficability map at original scale 1:400 000, sheet Bardia, provided by the Cartographic Office of the Italian Armed Forces High Command of North Africa (*Commando Superiore Forze Armate Africa Settentrionale*), printed in August 1940[20]

The Italian trafficability map was intended for mixed mechanised forces and was printed in both Italian and German. The legend is basically identical to that of the British going map 1:500 000, sheet Bardia (figure 6.13):

◊ Ovunque intransitabili – Allgemein unpassierbar ≈ generally impassable (green shading).

◊ Necessario riconoscere il terreno prima di effettuare il movimento. Velocita ridotta a Marcia bassa 13 kilometres. all`ora – Aufklärung notwendig vor Märschen. Dauernd Benutzung kleinerer Gänge. Marschgeschwindigkeit bis 13 kilometres in der Stunde ≈ reconnaissance essential before movement. Continuous low gear to 13 kilometres per hour (yellow).

◊ Terreno solido e buono. Qualche zone sabbiosa – 13 kilometres all`ora – weg gut und fest. Einige Sandplätze. 13 kilometres und mehr ≈ Hard and good terrain with few sand areas. 13 kilometres per hour and more (dark yellow).

◊ Percorso agevole – alcuni rallentamenti dovuti a svolte ed alla presenza di tratti di terreno molle o di terreno roccioso. Velocita dai 9-19 kilometres all`ora. – Gutes Fahrgelände. Aufenthalt durch Umwege und weiche Sandstrecken oder Felsen. 9 bis etwa 16-19 kilometres in der Stunde ≈ Fair going. Delay by soft sand or rocks. 9-19 kilometres per hour (orange).

◊ Terreno solido e buano. Nessun ostacolo. Velocita superiore al 16 kilometres all`ora. – Gut und fest. Keine Hindernisse. 16 Stundenkilometer und mehr bis unbeschränkt ≈ Firm and good. No obstacles. 16 kilometres per hour and more; no limit (red).

◊ Terreno poco sicuro quando piove. – Unsicherer Weg bei nassem Wetter ≈ Terrain not safe in wet weather (green cross).

British going maps 1:500 000

The British going map, sheet Bardia, crossing the Egypt-Libya border was a compiled map at scale 1:500 000, comprising the purple grid of the Egyptian topographic map 1:500 000 and the red Libyan grid of the Italian topographic map 1:400 000 merged with details of Italian topographic maps 1:100 000 (figure 6.12).

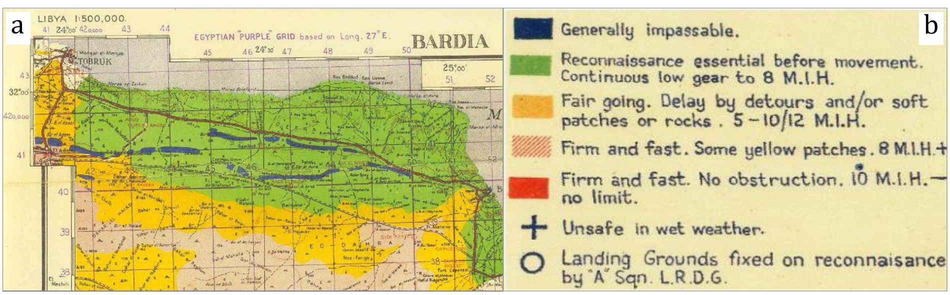

Figure 6.12 (**a**) Section of the British going map, sheet Bardia 1:500 000, printed by the South African Geodetic Survey in October 1941, and (**b**) legend of the same map[21]

The going classification was compiled by the military engineer of the general headquarters of the British 8th Army (Operations Officer) and was based on the recommended speed for mixed mechanised forces (both wheeled and tracked vehicles) on desert terrain of 8-12 miles per hour. It distinguishes between six terrain classes, five of them differentiated by colour. Red areas indicated firm ground without obstacles and allowed speed calculations of 10 miles per hour and more. Yellow areas allowed fair going with speed up to 12 miles per hour; delay had to be calculated when detours and/or soft ground or boulders reduced the speed to 5-10 miles per hour. Red dotted areas with yellow patches indicated a trafficability class between red and yellow, allowing for movements with a speed of 8 miles per hour. Green areas basically indicate low speed with continuous low gear up to 8 miles per hour, and reconnaissance was essential before movement. The colour blue was used for landscape generally impassable for mixed mechanised forces and a simple cross marked areas with unsafe trafficability conditions during wet weather. Special map sheets relevant to the logistics of the Long Road Desert Group (LRDG) highlighted landing grounds fixed on reconnaissance by the A-squadron of the LRDG.[22] British going maps were classified as ‘most secret, not to be published’.

Comparative scope and importance of military geology work in the preparation of trafficability maps for Axis and British forces in North Africa

Having based forces in Egypt since 1882, the British had accumulated considerable knowledge and experience in desert regions. They were, therefore, able to assess trafficability and provide water supply for the Commonwealth brigades and divisions as well as the British LRDG, but these did not have any organisation comparable to the military geology teams of the German armies. Additional information on British trafficability maps suggests that the terrain evaluation and trafficability classes were based on the interpretation of geomorphological features, updated by LRDG aerial photography and route descriptions. The maps were printed by South African Geodetic Survey, a team of which was possibly deployed to the 1st South African Division of the British XXX (thirtieth) Corps.

The Italian trafficability map, sheet Bardia 1:400 000 (printed in August 1940) is largely identical to the British going map, sheet Bardia 1:500 000 (printed in October 1941), differing only in terms of the colouring of the trafficability classes. As noted before, this suggests that the Italian forces had captured British going maps as a spoil of war some time prior to printing their own map in August 1940, and from then on used overprints of the British maps. Although the legend is provided in Italian and German, it is not clear which brigades had access to these maps in August 1940. However, it is reasonable to assume that they were known to the high command of the *Panzer* Group Africa by 1941, at which time MGT 12 designed a new type of a landscape classification combined with information on trafficability (see figure 6.9).

Conclusion

The military geology work of *Wehrgeologenstelle 12* was crucial to the movements of the Axis forces in North Africa during the Second World War. Initially deployed to Rommel's Africa Corps, and later under the high command of the *Panzer* Army Africa, the team provided the divisions in the Western Desert with comprehensive and detailed information for rapid offensives and retreats.

In addition to tactical support for Rommel's forces, the military geology team also had orders to prepare the next operational steps of the German-Italian army to reach Cairo in 1941 and to retreat to Tunisia at the end of 1942. The team also produced leaflets and reports on their work, and regularly communicated with the German military geology staff at Berlin-Wannsee.

The scope and value of their work notwithstanding, MGT 12 was short-staffed and received limited technical or logistical support. For two years, the small group of maximum ten members discharged their specialist duties amid the challenging conditions of Rommel's unconventional warfare, equipped with only their geophysical and hydrochemical equipment, a few cars and trucks, and drilling rigs.

Comprehensive terrain evaluations and sound knowledge of soil and subsoil conditions or groundwater aside, the German-Italian forces faced a number of challenges that ultimately proved insurmountable. They had to contend with the unfamiliar and harsh desert climate, and, due to long communication lines, they were plagued by a constant shortage of supplies – from camouflage and feints, to intelligence, to fuel and ammunition. Rommel's advance to Egypt was decisively halted by the British Eighth Army at the Second Battle of El Alamein on 11 November 1942.

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14 Photograph and geological profile produced by Dr. Leo Jakob Medard Kuckelkorn, provided by Dr. Kore F. Kuckelkorn, Köln, Germany.

15 Water supply map produced by Dr. L.J.M. Kuckelkorn, provided by Dr. Kore F. Kuckelkorn, Köln, Germany, now in the collection of Dr. Dierk Willig, Euskirchen, Germany.

16 Photograph and geological profile produced by Dr. Leo Jakob Medard Kuckelkorn, provided by Dr. Kore F. Kuckelkorn, Köln, Germany.

17 Water supply map produced by Dr. L.J.M. Kuckelkorn, provided by Dr. Kore F. Kuckelkorn, Köln, Germany, now in the collection of Dr. Dierk Willig, Euskirchen, Germany.

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CHAPTER 7

The influence of geography on the development of the Second World War defences of Saldanha Bay harbour

Thean Potgieter & Jacques Bezuidenhout

Introduction

Geographically, the Cape of Good Hope – which includes the west coast of South Africa – has some of the most inhibiting sea conditions on the planet. Exposure to strong southerly winds during summer and frontal systems during winter causes large Atlantic Ocean swells all year round. Saldanha Bay, situated north-northwest of Cape Town, is one of the finest natural harbours on the long and often inhospitable coastline of South Africa. However, despite its obvious geographical attributes and apparent value to shipping, the bay lacked fresh water, and consequently, it was never properly developed as a commercial seaport, while its obvious naval and military potential was only really exploited during the Second World War.

During the days of sail, the ideal disposition of Saldanha Bay as a fine natural harbour on the difficult sea route to the East was well recognised. The bay offered a safe haven for ships experiencing emergencies at sea and many vessels took advantage of the ideal conditions for repairs. In times of war, it served as a hiding place and even saw a few naval skirmishes.

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The unique properties of Saldanha Bay and its glaringly obvious potential to be developed as a naval base did not go unnoticed after Britain conquered the Cape from the Dutch (first in 1795 and then again in 1806). However, due to the lack of fresh water, the bay was only properly developed as a well-fortified base of strategic military importance during the Second World War, when the Mediterranean became too dangerous for Allied shipping and they had to use the alternative sea route around the Cape of Good Hope for maritime communications between the West and East. The subsequent high concentration of shipping around the Cape lured German submarines to these waters to hunt for prey, necessitating improvements to fortifications at South African harbours, and, in particular, the installation of comprehensive defensive systems at Saldanha Bay.

This chapter illustrates how geographical realities dictated the development of these harbour defences during the Second World War.

The geography of the Saldanha Bay area

The bay was shaped by unique geological interactions that can be traced back to the Pan-African orogenic event, when drifting tectonic plates merged into the Gondwana-Pangea supercontinent. The most seaward part of the bay area is dominated by ignimbrite complexes that have pyroclastic volcanic origins. These units, known as the Saldanha and Postberg ignimbrite complexes, gave rise to the prominent hills to the north and south of the entrance to the bay. These resistant outcrops protected the inner part of the bay, while systematic erosion of shales and sandstone deposits formed the large natural inner bay.

The unique geology of the area guided the geomorphology, resulting in one of the finest natural deep-water harbours on the South African coastline. The bay has a maximum navigational length of 12 kilometres and width of 11 kilometres, with different parts of the bay having relatively even depth profiles. The shear dimensions of the bay, combined with the natural safety it provides from the prevailing winds and ocean swells, guarantees sheltered anchorage for oceangoing vessels. The topographical features that provide protection against weather conditions also created a good platform for military and naval defence of the bay.

The bay can be roughly divided into three parts, each with its own unique geomorphological features. These parts are the outer bay, the inner bay and the lagoon, as marked in figure 7.1.

Figure 7.1 A Google Earth image that indicates the outer, inner and lagoon parts of Saldanha Bay, as well as other geographical features mentioned in the text. N = Northern headland; S = Southern headland; H = Hoedjies Point; E = Elands Point.

The outer bay has an average depth of 30 metres and is bordered by large hills to the north and the south.[1] The hills to the north (Môresonkop (87 metres), Malgaskop (112 metres) and Baviaansberg (72 metres) form the Saldanha complex; those to the south South Head Hill (111 metres), Postberg (193 metres) and Konstabelkopberg (188 metres)) form the Postberg complex.[2] The entrance from the Atlantic Ocean lies between a northern and southern headland (marked on figure 7.1 as N and S, respectively). There are also three islands within the outer bay, Malgas Island (9 metres) in the north, Jutten Island (34 metres) in the south, and Marcus Island (8 metres) in the eastern part. Most of the outer bay is exposed to the ocean and therefore affected by high wave action from the predominantly south-westerly swells. Eroded ignimbrite outcrops and boulders line the shores of the outer bay. There are sandy beaches on either side of outer bay, one in the north (North Bay beach) and one in the south (Jutten Bay beach).

The inner bay has an average depth of 13 metres and is considerably more protected from the Atlantic Ocean swells.[3] The passage from the outer bay to the inner bay runs between Hoedjies Point to the north and Elands Point to the south (marked in figure 7.1 as H and E, respectively). Marcus Island lies between these two points on the boundary of the inner and the outer bay, and is now connected to Hoedjies Point by an artificial pier. The shores of the inner bay are mainly lined with sandy beaches with occasional granite protrusions. The Saldanha (120 metres) and Hoedjieskop (71 metres) hills dominate the northern part of the inner bay.[4] The southern part of the inner bay gives way to a passage between the Postberg complex and Langebaan Point, as the entry to a southern lagoon. Skaap Island (16 metres) lies in the middle of this passageway. The smaller outcrop of Meeu Island (9 metres) lies just to the west of Skaap Island.

The inner bay also provides protected anchorage from the prevailing southerly and northerly seasonal winds of the area. The south-western coastline of South Africa experiences dry southerly winds during spring and summer. These summer winds can reach gale-force strength and often blow for protracted periods. Severe winter storms that are linked to cold frontal low-pressure systems result in strong northerly winds.[5] The winds associated with these frontal systems can gust up to storm strength and higher. The hills to the north and the islands to the south of the inner bay thus provide shelter from the seasonal winds.

The Langebaan Lagoon, a shallow stretch of water south of Skaap Island, constitutes the third part of Saldanha Bay. Most of this area is a saltwater wetland, with large sand banks that are exposed during low tides. However, the northern part of the lagoon is deeper, making it possible for smaller oceangoing vessels to navigate the tidal channels.

Except for a few streams that only flow during the height of the rainy season, there are no fresh surface water river inlets into any part of the lagoon or the bay. The meagre rainfall in the area mostly emanates from cold frontal systems that move in from the west, mainly during winter. The average annual rainfall is 270 millimetres, of which 217 millimetres falls in winter and 53 millimetres during summer.[6] The granite bedrock that lines the inner bay is a poor aquifer, and underground and surface water dries up quickly during the warm summer months when rainfall is low. The combination of low rainfall, hot summers and sandy top soils results in a semi-arid climate for the area. The cold Benguela current that brings Antarctic water up the coast further inhibits precipitation and humidity; however, the cold, nutrient-rich current provides a wealth of food for many marine species, and, in turn, an abundance of seafood for people.

Saldanha before the outbreak of the Second World War

Before the First World War (1914-1918), a thorough analysis was made of fortifications at South African harbours and of the coastal artillery requirements along the South African coast. New fortifications were created, while existing fortifications at important bases and ports such as Durban, Simon's Town and Cape Town were substantially upgraded. However, the development of Saldanha Bay as a port remained stymied by insufficient fresh water supply.

During the First World War, Major J.G.W. Leipoldt, a South African intelligence officer, surveyed the Saldanha Bay area to establish whether it might be of value to an enemy. Leipoldt, however, suggested that an enemy would first have to secure water supply from the Berg River, some 30 kilometres distant, for this to become a possibility.[7] Hence, while improvements to the system of coastal fortifications and fixed defences around the South African coast continued during the First World War, this did not include the creation of coastal defences at Saldanha Bay.

On the eve of the Second World War, the Union Defence Force again set about upgrading fortifications at Durban, Cape Town and Simon's Town.[8] However, despite the fact that the creation of coastal defences in Saldanha Bay to secure it as a relief anchorage had featured in the British Admiralty's war plans for a number of years, no action was taken before the outbreak of the Second World War in 1939.

South Africa and the Second World War

After the Union of South Africa declared war against Germany on 6 September 1939, emphasis was placed on the importance of South Africa to the Allied war effort. As South African land, air and naval forces had to support commonwealth forces in other theatres of war and had to constantly watch over the coastal trade routes, the Union Defence Force expanded drastically during the first two years of the war.

The history of an indigenous South African Navy dates back to 1922, when, the South African Naval Service (SANS) was created with three small ships. However, due to budget cuts during the Depression years, the ships and their crews were paid off (in 1933-1934) and only a skeleton staff remained. This was still the position at the outbreak of the Second World War in 1939, when the country's utterly neglected naval establishment had to suddenly prepare for war. The South African Division of the Royal Naval Volunteer Reserve (RNVR(SA)) was mobilised for service with the SANS and the Royal Navy, and additional staff was recruited. As no purpose-built warships were available, ships from the country's fishing fleet and merchant ships had to be converted for naval use. The small oceangoing navy thus created for the defence of the Union's ports and coastline was restructured into the Seaward Defence Force (SDF) in October 1939, with 428 personnel (including 47 officers), 17 vessels in service, and a few shore establishments.[9] The SDF and the RNVR(SA) were still separate entities, but following discussions between the Union government and the British Admiralty it was agreed that they should be amalgamated into the South African Naval Forces (SANF) on 1 August 1942.[10]

Soon after the outbreak of the Second World War, the intelligence picture indicated that real threats existed around the South African coast. This was illustrated by the sortie of the German pocket battleship *Graf Spee* into the South Atlantic, while German commerce raiders operated in the Atlantic and Indian Oceans and mined the South African coast, and the U-boat threat was omnipresent. These factors triggered a great expansion of South African coastal artillery, and by December 1941 a variety of coast artillery guns, ranging from quick-firing 6-pounder guns to heavy 9,2-inch guns, were installed at Walvis Bay, Saldanha Bay, Robben Island, Cape Town, Simon's Town, Port Elizabeth, East London and Durban. The biggest, the 9,2-inch guns, were deployed at the Apostle Battery at Llandudno, the Lions Battery above Simon's Town, on Robben Island, and at the Da Gama Battery in Durban.[11]

After France fell to Nazi Germany in May 1940, Italy entered the war on the side of the Axis powers. Having previously invaded Ethiopia in October 1935 and captured Addis Ababa in May 1936, the Italians now attacked British positions in Egypt, Sudan, Kenya and British Somaliland, setting in motion an Allied campaign to expel them from Ethiopia. South African forces were heavily engaged in this campaign, up to the surrender of the main Italian force in 1941.[12]

In North Africa, the so-called Western Desert campaign also commenced after the Italian invasion of Egypt in September 1940. When the British succeeded in pushing the Italian forces back, Nazi Germany responded to Mussolini's request for assistance by sending the Afrika Korps, under the command of General Erwin Rommel, to their aid. The Axis forces under Rommel then pushed the British back to Egypt, and various large-scale desert offensives ensued, with South African land, air and naval forces becoming heavily involved.

Vessels of the small South African naval establishment were despatched to the Mediterranean following an urgent request from the British Admiralty to the South African government in November 1940 for anti-submarine patrol vessels. The South African Seaward Defence Force (SDF) responded by despatching four converted whalers (the HMSAS *Southern Floe*, HMSAS *Southern Isles*, HMSAS *Southern Maid*, and HMSAS *Southern Sea*) to the Mediterranean.[13] Rear Admiral Hallifax (Director of the SDF) notified the Admiralty of this on 22 November, and Commander-in-Chief (C-in-C) of the Mediterranean Fleet, Admiral A.B. Cunningham promptly requested that the vessels sail for Alexandria as soon as possible.[14] On 15 December 1940 the small flotilla of four converted whalers – now designated the 22nd South African Anti-Submarine Group – under the command of Lieutenant Commander A.F. Trew left Durban and sailed for the Mediterranean.[15]

As a result of the war in North Africa and intensive fighting in the Mediterranean, the latter was no longer safe for much of the Allied shipping. As a result the Cape sea route assumed critical importance and commercial, as well as naval traffic visiting South African ports multiplied (for example, the number of warships visiting Cape Town rose from ten in 1938-1939 to 306 in 1942-1943).[16] South African ports, port infrastructure and dry docks were now of strategic importance to the war effort. Although the ports provided storage space and were crucial for replenishment and repair work, they had limited capacity and soon became saturated. These infrastructure limitations made the creation of additional facilities imperative, and in 1941 South Africa, in consultation with Britain, started expanding the port facilities of Cape Town, Durban and East London. In addition, the two governments agreed to share the cost of developing a port at Saldanha Bay for both military and naval purposes.[17]

In the meanwhile, the Allied situation in the Far East deteriorated drastically after Japan joined the War at the end of 1941 and quickly captured a number of British bases (Hong Kong fell on 25 December 1941 and Singapore on 15 February 1942). It immediately impacted on the strategic importance and defence of South Africa. Although the Union Defence Force had expanded drastically and South African air and naval forces kept continuous watch over the coastal trade routes, South Africa itself and its ports were still very vulnerable to a large-scale attack. Extensive Japanese operations over an enormous geographical area substantially increased the threat, and the British War Cabinet regarded attacks on South African ports by Japanese naval vessels and carrier-borne aircraft as well as mine-laying by Japanese vessels a distinct possibility. Some elements of the South African population even feared a Japanese invasion.[18]

As for the German threat, increased traffic around the coast implied more target opportunities, resulting in increased submarine activities in the Southern Oceans between October 1942 and February 1945. It reached a peak in October 1942, when thirteen ships were sunk in four days. It is estimated that, within a 1 000 miles of the South African coast, 133 merchantmen were sunk and six damaged by U-boats, a further twenty were captured or sank by surface raiders, while mines accounted for two ships sunk and two damaged – a total of 163.[19] As far as naval vessels are concerned, one was lost in a submarine attack and one suffered mine damage. About 400 survivors were rescued at sea by South African naval vessels.[20]

Submarine activities had to be countered with increased anti-submarine patrols, the introduction of a group convoy system and improved air reconnaissance. Anti-submarine protection at sea was provided by vessels from the SANF and available Royal Navy units, as well as British and South African maritime air patrols. However, as the SANF had a limited number of minesweepers and anti-submarine vessels (converted trawlers and whalers) in service, the inherent danger to shipping that rounded South Africa or had to wait in the roadstead was obvious.[21] Convoys were common, and it is estimated that during the War about 400 convoys, with approximately 50 000 ships and six million men on board, visited South African ports, while about 13 000 of these ships underwent repairs in South Africa's harbours.[22]

In terms of the fight against submarines, only two submarines were destroyed: one off Cape Town by HMS *Active*, and one in the South Atlantic by a Catalina aircraft (see below). Japanese submarines, operating off the east coast of Africa, sank 21 ships in the Mozambican Channel during June and July 1942 (one was sank only 115 miles from Durban).[23]

The influence of geology and geography on the creation of fixed defences at Saldanha Bay

By early 1942, the sheer volume of shipping on the Cape sea route, resulting from the war in the Mediterranean and Japanese entry into the war, was causing considerable congestion at South African ports. At peak periods, more than fifty ships (the highest count was eighty) regularly awaited berths in the roadstead outside Cape Town and Durban, leaving them vulnerable to submarine attack. The development of proper harbour defences for Saldanha Bay, which would allow the bay to be used as a relief anchorage and a convoy assembly point, thus became an issue of the highest importance and immediate concern.[24]

Virtually surrounded by land and offering large anchorage with calm waters, Saldanha Bay could accommodate many ships. It also was ideally located along the South African coast, could be made submarine-proof, and was earmarked as a convoy assembly point. However, the defensive arrangements and associated base facilities at the bay had to be created from scratch. There was already a shore base in Saldanha Bay, and during 1941 preparatory work had progressed on fixed fortifications to protect the entrance to the bay. Placing coastal batteries on higher ground had obvious military advantages, and the close proximity of the Noordkop and Baviaansberg to the entrance of the bay made them ideal for this purpose.

The Noord Battery (also known as Noord Bay Battery) was developed on Noordkop, commonly known as Malgaskop. The main function of Noord Battery was close defence, while it was also the examination battery. In line with the approach taken for creating the so-called 'emergency coast batteries' along the coast of England in 1940, this battery was armed with two breech-loading BL 6-inch (152 millimetres) Mk XI 50-calibre, high-velocity British naval guns on P5 naval mountings modified for service ashore.[25] These guns, supplied by the Royal Navy Dockyard in Simon's Town, were mounted and operational by 15 June 1942. The 6-inch Mk XI guns came from obsolete naval vessels. They were first mounted in 1906 as secondary armament on pre-dreadnoughts battleships, but later served as the primary armament of many armoured and light cruisers.[26] Mounted on board ships with an elevation of 15 degrees, they had a range of about 13 000 metres, but mounting them as coastal defence gun ashore made a higher elevation possible (22,5 degrees), giving them a maximum range of 16 000 metres.[27]

Another 6-inch battery, the Baviaan's Battery, was created on Baviaansberg, west-southwest of the Noord Battery. This battery had a dual role of close defence and counter-bombardment, and replaced the original examination battery.[28] In January 1943 the two guns at Noord Battery were moved to Baviaan's Battery. The Noord Battery was then armed with even older, and obsolete, breech-loading BL 6-inch Mk VII naval guns on P3 mountings.[29] The 6-inch Mark VII guns dates from 1899 and was first mounted on the *Formidable*-class battleships commissioned in September 1901. The guns were also mounted on numerous battleships, cruisers and monitors as both primary and secondary armament. They were mounted as coast defence guns across the British Empire from the First World War to the 1950s, with a maximum range of 14 450 metres at an elevation of 20 degrees.[30] During the First World War some of these guns were even mounted onto travelling carriages and used by the British Army as field guns.

The entrance to Saldanha Bay was narrowest between Hoedjies Point and Eilands Point, with Marcus Island situated between these points. From a defensive perspective, it was therefore necessary to also place batteries to cover the narrowest part of the entrance to the anchorage of Saldanha Bay from north to south. In addition to the heavier Noord and Baviaans batteries, two batteries, each armed with two 12-pounder quick firing guns, were therefore created in the entrance between October and December 1942. These were the Hoedjies Battery (also known as Hoetjies Battery), located at Hoedjies Point, and the Eilands Battery, on Schier Island (commonly referred to as Elands Battery).[31] Their main armament was the QF 12-pounder 12-cwt gun, a common and versatile 3-inch (76,2 millimetres) naval gun that first saw service in 1894 and remained in use until the middle of the 20th century. Mounted on a pedestal secured to the ground, these guns were a common sight at harbour defences, and at 40 per cent elevation they had a maximum range of around 10 740 metres.[32] The 12-pounder batteries would provide protection for the anticipated defensive boom. They were also referred to as 'anti-motor torpedo boat' batteries, and although it was highly unlikely that an enemy would approach Saldanha Bay by motor torpedo boat, due to distance and other factors, they could engage any target (such as U-boats on the surface) closer inshore.

In addition, six coast artillery searchlights were also installed – two each at the 12-pounder batteries and two below Noord Battery. These searchlights were positioned close to sea level to assist with the detection and identification of vessels, as they would be outlined against the backdrop of the opposite shoreline. Pairs of searchlights were installed in each location in order to illuminate possible targets at the crossing of the beams, which then provided the guns with an accurate target position.

In terms of staff, the South African coastal artillery establishments around the Cape was initially manned by the SA Permanent Garrison Artillery (manning Fort Wynyard Battery in Cape Town and the fixed defences in Simon's Bay) supplemented by volunteers from the Cape Garrison Artillery. In February 1940 they were renamed the Cape Peninsula Artillery Brigade, and staff serving at the fixed defences of Simon's Bay, Table Bay (including Robben Island), and Saldanha Bay were initially part of this unit.[33]

Women were integral to South African coastal artillery during the War. The first members of the Women's Auxiliary Army Service were posted to 2 Heavy Battery at Simon's Town in August 1940. From September 1941 women were trained as range takers as part of an elite artillery unit, the Artillery Specialists Women's Auxiliary Army Service (ASWAAS). They staffed control instruments at batteries and were the only female combatants serving in South African forces during the Second World War. Of the 485 women that served in the ASWAAS during the War, eighteen were commissioned, 31 rose to the rank of staff sergeant and 49 became sergeants, while their colleagues served as lance bombardiers or bombardiers.[34]

From 1943 the newly created South African Women Auxiliary Naval Service (SWANS) took over some of these duties, and after April 1944 SWANS trained in controlled mining operations staffed the control and detection equipment at Saldanha Bay. SWANS were responsible for the anti-submarine fixed defences, asdics (sonar anti-submarine detection) and other watch duties (which included visual and hydrophone watches).[35] In an official report, the SWANS were praised for the 'tremendous contribution' they made to 'ensure the safety of our harbours' as the only 'female personnel … in all the Allied navies … entrusted with such responsible work – anywhere in the world.' Appreciation was also expressed for their 'sporting ability' and 'prowess' in arranging concerts, parties, dances and such."[36]

Creating anti-submarine defences at Saldanha Bay

The creation of anti-submarine underwater defences at Saldanha Bay emanated from the work of a sub-committee of the British War Cabinet on Defence Arrangements for the Indian Ocean Area. Early in 1942 the committee recommended that the underwater defence arrangements at the most important South African ports be improved, and that the military and naval development of Saldanha Bay be accelerated in line with the increasing threat.[37]

The threat seemed imminent. Attacks had occurred on shipping in Sydney Harbour and Diego Suarez late in May, and the Allies were aware of the presence of a Japanese surface raider and submarines (which might carry midget submarines) off the east coast of Africa, at the height of Durban and Lourenço

Marques, during June and July.[38] Due to its location and importance as a port, Durban was considered specifically vulnerable, but other ports also required enhanced protection

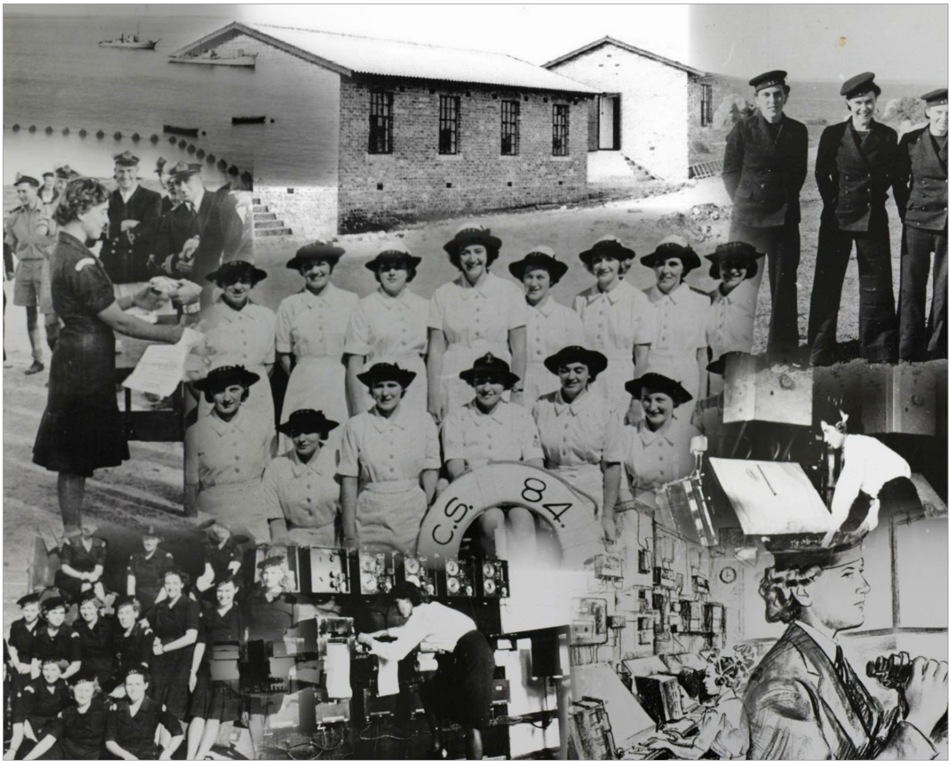

Figure 7.2 Members of the South African Women Auxiliary Naval Service (SWANS) at Saldanha Bay during Second World War (collage of pictures in the collection of the South African Navy Museum in Simon's Town)

Underwater indicator loops and harbour defence asdics (sonar anti-submarine detection) were installed at Cape Town, Durban and Saldanha Bay between 1942 and 1943. The work was preceded by surveys to locate the most suitable areas for placing the loops in the approaches to these harbours, as well as the building of control huts and creation of other infrastructure. Nearly 140 miles of cable were used off Durban to lay seven loops (extending roughly from the Bluff to Umhlanga Rocks), each with three parallel lines four miles in length, and each connected to a control station up to eight miles distant. Four three-legged loops, each about four miles long, were laid off Melkbosstrand and around Robben Island to Clifton Beach to cover the approaches to Cape Town harbour. Seven short loops were also laid off Port Elizabeth and became operational in 1944.[39]

Underwater indicator loops were long sections of cable laid on the seafloor at the entrances or in the approaches to harbours with the purpose of detecting enemy submarines by means of magnetic sensing. A submarine passing over such a stationery loop of wire produced an induced current in the loop. Even if a submarine was degaussed, it would still have sufficient magnetism to produce a small current in a loop – enough to be detected.[40]

The complete plan for the anti-submarine defences at Saldanha Bay included the installation of an anti-submarine and anti-torpedo boom barrage or defence system and harbour defence asdics, substantial lengths of armoured cable for anti-submarine underwater indicator loops in the approaches to the bay, a controlled minefield (the only in South African waters), as well as the shore stations and warehouse facilities required to support these installations and operations. It was very expensive, requiring much infrastructure, substantial technical equipment and large quantities of stores, not to mention specially fitted vessels and highly trained personnel to manage and staff the whole system.[41]

Although a controlled minefield was recommended for several South African ports, only one was laid, at the entrance of Saldanha Bay. Earmarked as a convoy assembly point, the bay was a sizable, land-locked harbour where a large anchorage could be protected by a relatively small and sheltered minefield. Plans were made in 1942 and the controlled minefield and loops were laid early in 1943 by HMS *Manchester City* and HMS *Spindrif*. The latter vessel, originally a trawler commissioned by the German Navy, was captured by the Royal Navy in 1940 and converted into a controlled minelayer. As the SANF took responsibility for the controlled minefield, she was handed over to the SANF in July 1943 and became HMSAS *Spindrift*.[42]

The minefield and loops were located north-south between Hoedjies Point and Eilands Point, the narrowest point in the entrance to Saldanha Bay. Three mine loops protected the northern section (from Hoedjies Point to Marcus Island) and five the southern section (between Marcus Island and Eilands Point). There were twelve mines in each loop. Three overlapping guard loops (each 1,3 miles long) were laid approximately a mile seaward of the minefield as the first line of detection of an intruding submarine. The cables of all eleven loops ran to the control station on the east side of North Bay.[43] The mine loops technically functioned in a similar way to the indicator loops, but were smaller in scale.[44]

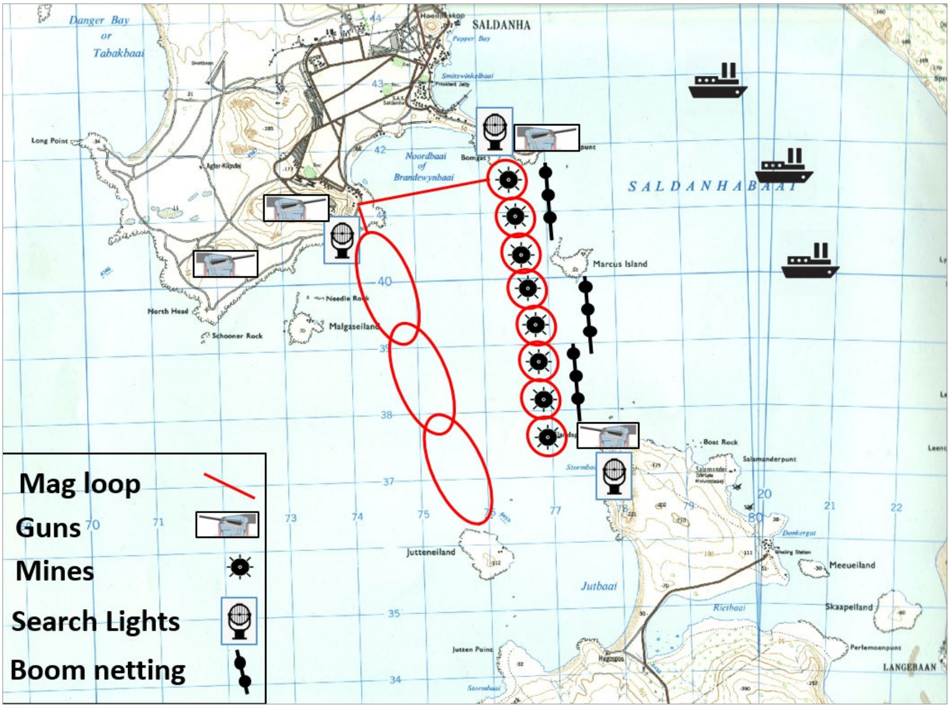

Figure 7.3 Map indicating the location of fortifications at the entrance to Saldanha Bay during the Second World War (compiled by J. Bezuidenhout)

In April 1942 it was decided that Saldanha Bay also required anti-torpedo and anti-submarine boom defences and nets between Hoedjies Point and Eilands Point. The boom defence vessels HMS *Barcross* and HMS *Barbrake* arrived in Saldanha from Britain in September 1942 and January 1943 respectively. These ships, and HMS *Fernmoor* (a merchant ship converted into a boom-carrying vessel), had to lay and maintain the boom defences across the entrance to the bay.[45] The *Barcross* and *Barbrake* were transferred to the SANF in January and February 1943 (now with the prefix HMSAS to their names) and continued their boom defence duties at Saldanha Bay.[46]

In the original design, the boom defence system had a gate that could be moved to open and close. However, as this would require two additional vessels, it was substituted by a permanent opening. Three booms were staggered in sections, so that a torpedo fired from seaward could not pass through. The section between Hoedjies Point and Marcus Island had one boom, while the entrance was north-south between Marcus Island and Eilands Point, as this section had two overlapping booms.[47] To support these underwater defences, the Saldanha Bay coastal defensive system also received a mobile coast-watch radar to provide early warning of any unidentified or unknown surface targets. The radar installation (and the signal function) was operated by a special signals detachment, while the indicator loops were manned by the SANF.[48]

Figure 7.4 HMSAS *Barcross* at work laying and servicing anti-torpedo boom defences at Saldanha Bay (South African Navy Museum Simon's Town)

A control building for the large-scale underwater indicator loops planned for the sea approaches off the entrance of Saldanha Bay was erected at the perimeters of the entrance to Saldanha Bay in 1942. However, these loops were never installed. In the early stages of the project, there were insufficient vessels and equipment available to lay them, and by 1943 the entrance to Saldanha Bay was already well defended (with a controlled minefield, anti-torpedo nets, smaller mine loops, asdics, a radar installation and various coastal batteries), while the importance of the bay declined from late that same year due to progress in the war against submarines in the Battle of the Atlantic.

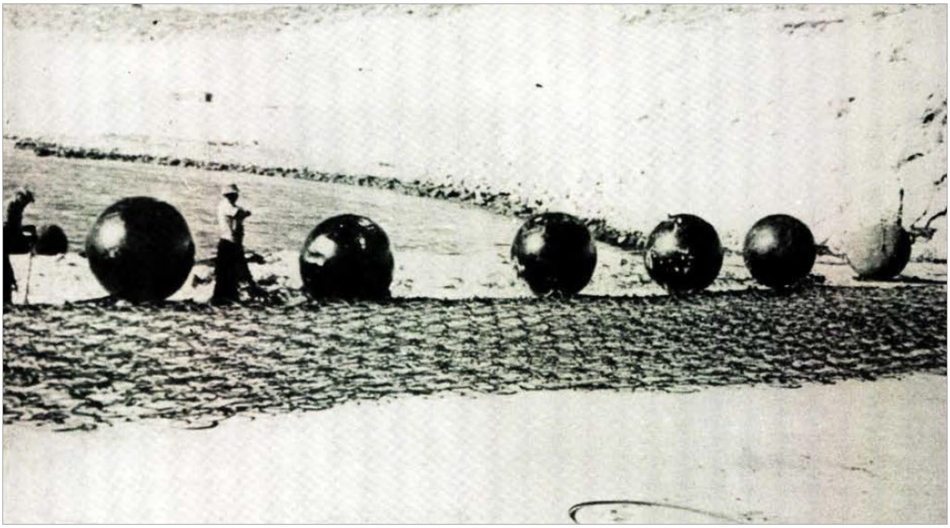

Figure 7.5 An anti-torpedo net being secured to spherical floats at Saldanha

Notes on Second World War operations in and around Saldanha Bay

Of the many potential threats to shipping around the South African coast during the Second World War, submarines posed the greatest menace. To counter submarine activities, vessels from the SANF and the Royal Navy engaged in continuous anti-submarine patrols and convoy duty, while from the air, the sea route was patrolled by a variety of aircraft of the South African Air Force (SAAF) and the Royal Air Force (RAF). The first PBY Catalina flying boats operated from Saldanha Bay at the end of October 1942, and a flying boat base was established at the old whaling station at Donkergat.[49] The Langebaan Lagoon, in the southern part of the bay, is a 15 kilometres long wetland protected from Atlantic swells by the Postberg peninsula. The lagoon stretches from north to south, which aligns its length with the prevailing wind of the area, making it an ideal runway for seaplanes.

From February 1943 onwards, RAF Squadron 262 started operating Catalina flying boats from the Congella Base in Durban, and as they later also conducted operations from Langebaan,[50] the Congella Air Station Langebaan Detachment resulted in the creation of the current Langebaanweg Air Force Base.[51] It switched to Sunderland aircraft during 1945[52] and as this squadron almost entirely consisted of SAAF personnel, it was renumbered 35 Squadron, SAAF on 15 February 1945.[53]

The PBY Catalina, is arguably the most legendary 'flying boat' of the Second World War. Also used to spot and destroy German U-boats, 3 200 of these craft were built between 1939 and 1945, making it is possibly the most prolific amphibious aircraft in history. They were quite big aircraft, with a wing span of 13,7 metres, length of 19,5 metres, height of 5,65 metres, maximum weight of 16 067 kilograms and powered by two 1 200-hp Pratt & Whitney Twin Wasp R-1830 engines. They were armed with two machine guns in glass 'blisters' and three depth charges underneath each wing. But what made them so valuable as submarine hunters was a normal range of 3 782 kilometres and a remarkable maximum range of 4 960 kilometres.[54]

At 04:20 on 11 March 1944, three Catalinas took off from Langebaan, flying southwards in search of three U-boats suspected of rounding the Cape. A U-boat was spotted on the surface about 939 kilometres off Langebaan (at 41.28S and 17.40E), and one of the Catalinas (under the command of Flight Lieutenant F.J. Roddick) immediately attacked with her guns and dropped five depth charges on the U-boat. However, the port wing, float mechanism and starboard engine of the Catalina were severely damaged by fire from the 20 millimetres and 37 millimetres anti-aircraft guns of the U-boat, and she had to return to base. The U-boat submerged, but resurfaced – probably due to damage sustained in the attack – as a second Catalina (commanded by Wing Commander E.S.S. Nash) arrived on the scene at 11:33. Nash immediately dropped all six his depth charges from a height of only 25 metres.[55] The U-boat quickly sank with all hands.[56] It later transpired that the boat, the UIT 22, was a former Italian submarine (the *Alpino Bagnolini* of 1 166 tons) carrying raw materials to Germany from the Far East, and had not been actively hunting for prey around the South African coast.[57]

For the service men and women at Saldanha Bay, the war passed without major military operations and life became rather monotonous, with the notable exception of two 'incidents' – both of which proved to be false alarms. The first caused quite some excitement on the evening of 1 June 1944, when SWANs Labuschagne, Klonus and MacFarlane reported two crossings on the indicator loops and blew two lines of the controlled minefield. Searchlights were immediately switched on and the examination vessel searched the area, but there was no sign of wreckage. The bottom was also searched afterwards with echo sounding and ground sweeping, but no evidence of a submarine was found.[58] It was the only time that a controlled minefield was 'fired in anger' by female watch keepers and they were praised for the 'efficient manner in which they carried out their duties.'[59] In the second incident, on 11 January 1945, an unidentified ship approaching the entrance to the bay failed to react to requests about her identity, prompting the Noord Battery to fire a 'bring to' round at the ship. The vessel, however, was soon identified as a British merchantman, and she was allowed to continue her voyage.

Figure 7.6 The submarine UIT-22 at Bordeaux, 14 February 1943[60]

Figure 7.7 The UIT-22 under attack by Wing Commander Nash's Catalina[61]

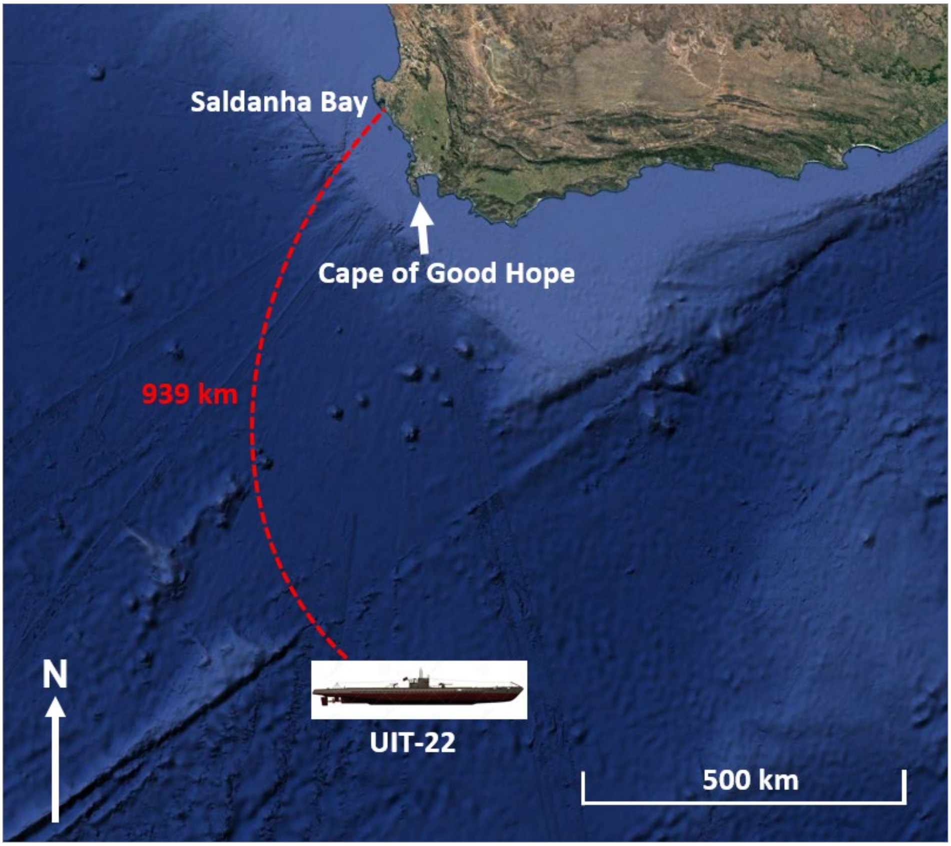

Figure 7.8 Google Earth image indicating where UIT-22 was sunk, 939 kilometres south of Langebaan (Compiled by J. Bezuidenhout)

As the war drew to a close and the threat to the South African coast diminished, the Baviaans and Hoedjies Batteries were placed under care and maintenance in October 1944, and the Eilands Battery in May 1945. The minefield at the entrance to Saldanha Bay was blown on 6 April 1945 (and the record indicates that no-one on the boats in the area who came to witness the event went without fish).[62]

Some of the coastal artillery batteries that were placed under care and maintenance during the later stages of the war were revived and placed under a new dispensation early in 1946. The Saldanha Bay batteries (Noord Bay, Baviaans, Hoedjies and Eiland) became 8 Heavy Battery, under the command of Major E.L. Brereton-Stiles, only to be placed under care and maintenance again in March 1947.[63]

Probably the most positive impact of the Second World War on Saldanha Bay was not of a military nature. For centuries, the development of the bay and the small towns along its shores had been hampered by a lack of fresh water. The situation changed dramatically when the Union Defence Force created a pipeline to the Berg River in order to satisfy the wartime fresh-water needs. The first piped fresh water reached Saldanha in February 1943.[64]

Concluding remarks

Saldanha Bay is located on the south-west coast of South Africa, just over 100 kilometres north of Cape Town, on one of the major sea routes between Europe, Atlantic America and the East. The geomorphology of the area offers protection from the prevailing winds and the Atlantic Ocean swells and provides sheltered anchorage in a large area of the bay. These and other natural geological and geographical features of Saldanha Bay make it an ideal harbour, and have endowed the bay with an interesting military-strategic history spanning more than three centuries.

Though the military-strategic importance of the bay was recognised at an early stage, it was never fully developed as a port due to a shortage of fresh water, and further development only occurred when a sufficient supply of fresh water became available during the Second World War. From a military-strategic point of view, Saldanha Bay reached the zenith of its importance during the Second World War, when it was extensively fortified to serve as a safe assembly point for large convoys. The two hills on the northern coastline close to the entrance of the bay formed the nucleus of the harbour's defence system, with two smaller batteries close the shoreline, as well as an extensive anti-submarine and boom defence system across the entrance. The decision to extensively fortify Saldanha Bay and use it as a location for large convoys to assemble was facilitated by its unique geomorphological attributes. Due to these factors it was possible to develop impregnable anti-submarine defences in the narrow entrance to the bay and create coastal fortifications that effectively covered the entrance to the bay. The result was that for a short time during the Second World War Saldanha Bay was indeed a point of strategic importance to the war effort.

The fresh water pipeline from the Berg River also boosted the socio-economic development of Saldanha Bay in the post-Second World War era. For the first time the bay had a sufficient supply of fresh water to sustain a growing population and encourage economic development. Over the ensuing decades, the bay area has seen significant development, including harbours for fishing and small craft, marinas for leisure activities, general cargo berths, as well as a massive iron ore jetty and oil terminal.

The Second World War naval base in Saldanha Bay became a training base of the South African Navy. Although the bay is of scant military-strategic importance within the strategic context of the early twenty-first century, its unique attributes remain.

Figure 7.9 At Noord Battery two rusted and out-of-service 6-inch naval guns still guard the entrance to Saldanha Bay more than seventy years after the end of the Second World War (Photo by J. Bezuidenhout)

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CHAPTER 8

The Cuvelai-Etosha basin: An environmental and climatic linkage to the operations of the warring parties in the 1966-1989 war for Namibian independence

Loide Shaamhula & Martin Hipondoka

Introduction

The South West African People's Organisation (SWAPO) was established in 1960 against the South African rule in Namibia.[1] When the International Court of Justice (ICJ) condoned South Africa's mandate over Namibia in July 1966, it ignited SWAPO to activate its militant enterprise, whilst South Africa was emboldened to keep a firm grip on the territory. Within a month, the first battle between the South African Defence Force (SADF) and the People's Liberation Army of Namibia (PLAN), SWAPO's military wing, took place at Omugulugwombashe,[2] a forested area on the western fringes of the Cuvelai Basin. This war lasted for 23 years and ushered in the general elections under the auspices of the United Nations and subsequently Namibia's independence in March 1990, with the SWAPO government in power.

The centre of gravity of this war stretched over an area known as the Cuvelai-Etosha Basin (figure 8.1). The basin covers an area in excess of 100 000 kilometres^2 straddling southern Angola and northern Namibia.[3] While some pivotal battles took place on the periphery of the basin, both the maiden and

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final battles of this war took place in this area. Literature on military geography stresses the importance of knowledge of the terrain of the battleground for the success of any military operation. The location, size and shape of a land mass have a great influence on any military operation.[4] At a local level, the timing of the military engagement, weather and terrain have more impact than any other physical factor. Securing positional advantage in terms of terrain, deposition of resources, riverbanks, hilltops and forests is also underscored as an advantage to warring parties during combat.[5]

Two types of location, absolute and relative, are crucial to military operations. While absolute location offers distinct advantages to military geographers, the use of relative location is preferred. Relative location is considered the most important, as it allows for the determination of spatial relationships between locations of interest.[6] Relative location not only provides specific geographical detail about possible battle fields, but also vital information about aspects such as transportation and roads, the most appropriate type of weapons to use, and communication requirements and water sources, all of which are crucial for operational planning and battle preparation.[7] However, both absolute and relative locations are critical in operational planning; for example, the sequencing and prioritising of events based on travelling time and the efforts required to reach the objectives of the operation.[8] Therefore, knowledge of the location, terrain, vegetation, climatic conditions and topography aspects that determine the ease of movement, observation and engagement during an operation, or which may shield from enemy fire are essential. The movement of troops, whether on foot or horseback, or in motorised vehicles, can be hindered by topography and environmental and soil conditions. Bedrock type and strength are important factors in the construction of defences. The availability of water supplies can influence the location of military installations, while mountainous terrain can provide cover to forces or small groups of operatives. In addition, atmospheric conditions, such as temperature, precipitation, winds and relative humidity, along with daylight hours and darkness, strongly affect the timing and conduct of combat operations and support.[9]

A study was conducted to evaluate the impact of the environmental and climatic conditions of the Cuvelai-Etosha Basin on the military operations of the belligerents during the war for Namibian independence from 1966-1989. In particular, the research focused on the timing of publically documented military engagements between the warring parties in relation to aspects such as droughts, floods and seasonality within the Cuvelai-Etosha Basin during that period. This narrow focus on environmental and climatic factors necessitated a tunnel-vision approach. While political and diplomatic ramifications are vital in shaping military postures and deployments, environmental and climatic factors have a direct impact on military field operations. Knowledge of the environmental and climatic setting of a theatre of war is critical for adaptive military operations.

Study area

The Cuvelai-Etosha Basin is a transboundary landscape dominated by a wetland system with a vast, self-sustaining hinterland of forest, woodland and long grass in some places.[10] The Cuvelai drainage system originates in the southern Angolan highlands and extends across the featureless plains of northern Namibia, resulting in shallow ephemeral watercourses, locally known as *iishana* (*sign. oshana;* figure 8.2).[11]

Major floods (called *efundja*) from local rainfall and floodwater from Angola contribute to seasonal formation of a wide network of *iishana*, which converge in the Omadhiya Lakes/Lake Oponono system to form a single stream that dewaters into the endorheic Etosha Pan. While there is often an abundance of water in the Cuvelai-Etosha Basin during the rainy season, most *iishana* are dry for the greater part of the year. The area dries up as water is either lost to evapotranspiration or by seeping into the soil. In Namibia, the basin is home to approximately 40 per cent of the population, making it the most densely populated region in the country (with an average of 10 people per square kilometre).[12]

The basin extends from the subtropical northern area to the semi-arid zone in the south. Its climate is influenced by the inter-tropical convergence zone (ITCZ), a low-pressure belt of moist air that shifts southwards to the Tropic of Capricorn during late October and November, and returns northward across the northern part of Namibia in late January through to April. The Cuvelai therefore experiences the same subtropical weather systems that prevail over much of southern Africa, with summer rainfall, occurring between late November and March, and a dry winter season that peaks between the months of June and September. The average annual rainfall in the northern part of the basin is in excess of 900 millimetres, more than double the average of 400 millimetres in the south. February and March are the wettest months; however, rainfall is highly variable in space and time.[13] The available but incomplete records for the period

1966-1989 reveal that floods occurred on twelve occasions, with three years of drought and four years of normal rainfall in between (figure 8.3).[14] Winter temperatures drop to around 10 degrees in the southern part of the basin, while daily maximum temperatures during summer may rise to 40 degrees.[15, 16]

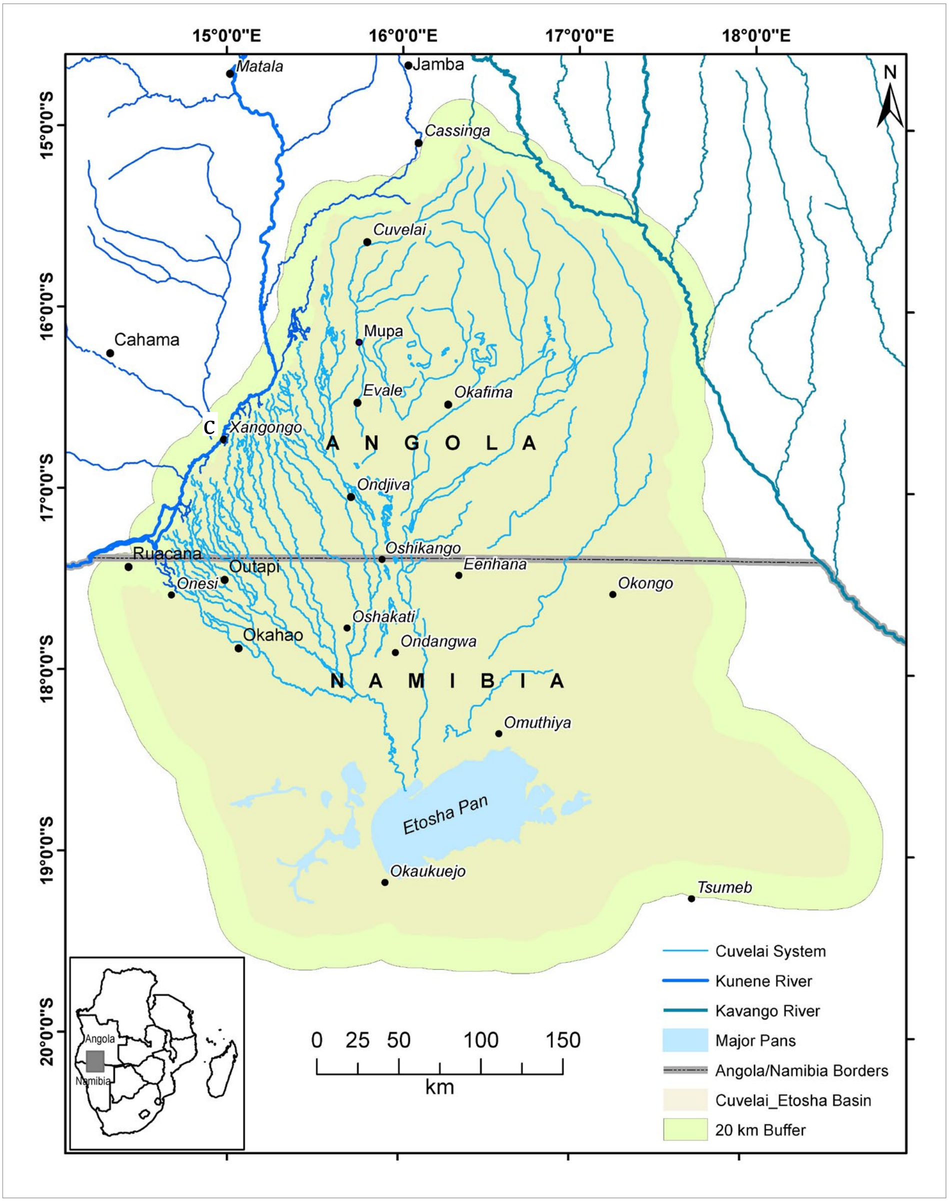

Figure 8.1 Study area: The Cuvelai-Etosha Basin and 20 kilometres buffer around its margins

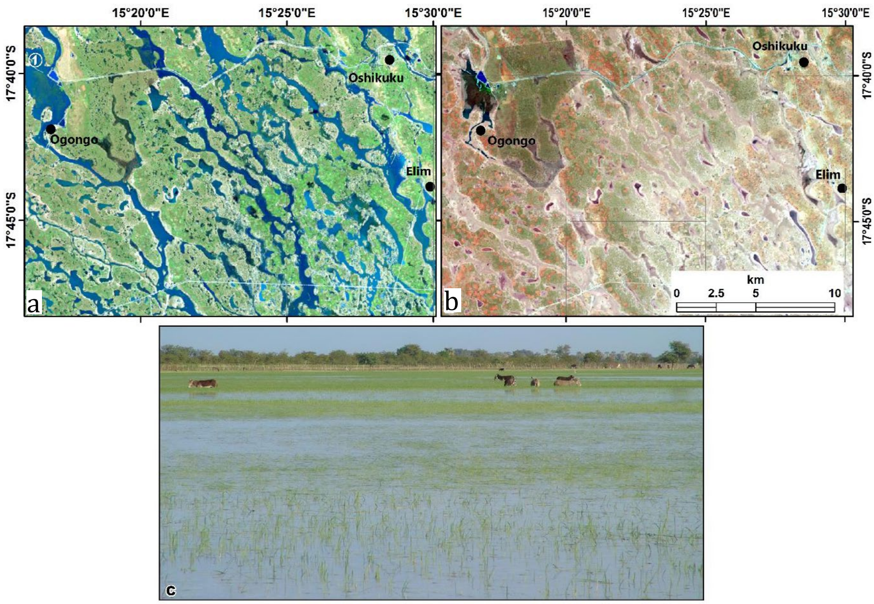

Figure 8.2 (**a**): Landsat 5 image of *iishana* during the wet season (April 17, 2010).
(**b**): Landsat 5 image of *iishana* during the dry season (August 5, 1992).
(**c**): Ground view at site 1 (upper left corner of image b) during the wet season (March 2017). The partly submerged grazing animals in the background show the typical water depth.[17]

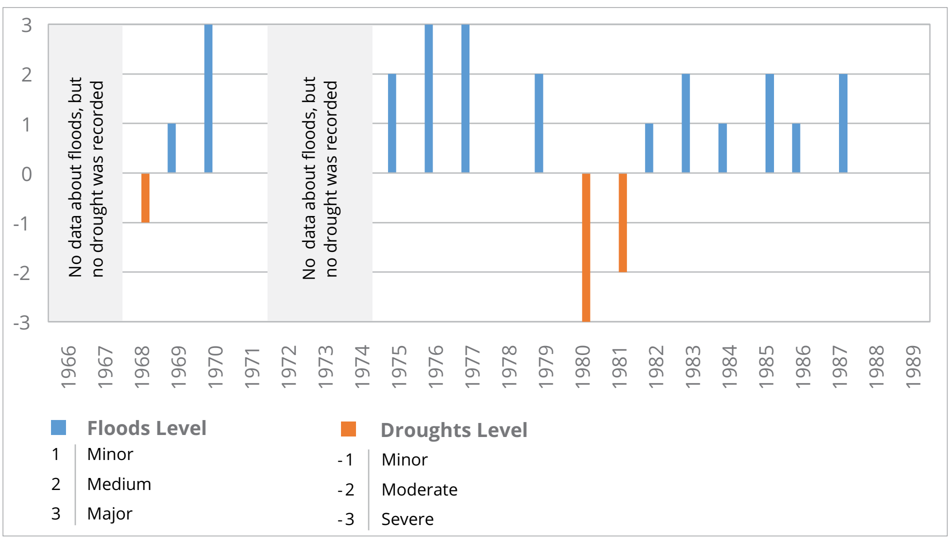

Figure 8.3 Flood and drought records for the Cuvelai-Etosha Basin during the study period 1966-1989[18]

Research methodology

Secondary sources comprising four journal articles, four books (table 8.1), fifteen articles from *The Namibian* newspaper, and one online resource[19] were examined for evidence of targeted military engagements.

Table 8.1 Journal articles and books consulted for locations and nature of engagements

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Using content analysis, the data was categorised, sorted and evaluated for valid inferences by interpreting and coding textual material.[20] The database captured the nature of battles (for example, which side was on the offensive), as well as the location, date and where applicable, the name of the operation. The duration of the operation was also recorded, but was not factored into the analysis. This implies that a fifteen-minute battle and an engagement that stretched over days were both entered as a single entry, based on the date the engagement occurred or commenced; and each engagement was therefore considered as a single event. A combination of site descriptions and dates of engagement was useful for avoiding duplication.

In order to allow for spatial analysis using a Geographic Information System (GIS), data were manually geocoded based on the provided site description. Two main sources – a database of localities (over 12 000 entries) culled from the 2011 Namibian Census and Google Earth – were used to derive coordinates in degree decimals.[21] Due to the vagueness of some site descriptions (for example, "25 kilometres south-west of Oshivelo"), the derived coordinates inevitably captured general localities. Other locations (such as the Elundu military base, for example) allowed for much more refined geocoding. The geocoding accuracy is therefore relative to localities, and not exact GPS positioning. Misspelt or ambiguous place names (for example, Chana Omadane) and inadequate information (for example, southern Angola) were some of the limiting factors to successfully geocoding corresponding events.

Following the data cleaning, spatial analysis was carried out using the ArcGIS 10,3 package. A 20 kilometres buffer zone was arbitrarily set around the basin margin to delimit the study area, in consideration of warring parties' mobility into and from the basin. The intersect tool was used to extract events falling within the study area. The frequency of military engagement per unit area, based on the geocoded data, was generated by means of kernel density estimation. The default search radius, based on the spatial configuration and number of input points, was employed to correct spatial outliers, which have a tendency to make the search radius unreasonably large.[22] Each of the derived kernel density calculations was classified using the standard deviation and rounded off to the nearest integer (for the first entries and SADF offensives) or the nearest tenth.

Results and discussion

A total of 602 military engagements were recorded between 1966 and 1989, of which 512 (85 per cent) were successfully geocoded to a locality level. Military engagements that occurred in the study area comprised 75 per cent (n=383) of the geocoded subset. PLAN was on the attack on 209 occasions (55 per cent), while 39 (10 per cent) of the events were attributed to SADF offensives. Because the SADF offensives often lasted from weeks to months, recording the beginning of the operation as a single event masked a critical component in these tallies; nonetheless, discrete and documented battles that occurred during an operation were recorded as such, and thus featured as separate entries in these figures. The remainder (135 or 35 per cent) of these military engagements were not evidently clear about who was on the attack. Figure 8.4 shows the spatial distribution and prevalence of military engagements between the warring parties in the study area.

There is a clear pattern to the spatial distribution of these military engagements. Attacks by PLAN were localised mainly on the Namibian side of the basin, whereas the SADF launched most of their offensives on the Angolan side. This corroborates the assertion that, following a concerted yet futile attempt in the 1970s to root PLAN out of Namibia, the SADF mounted several operations in Angola as a pro-active measure aimed at pushing back and thwarting the military movement and activities of their adversaries in Namibia.[23] The distribution of incidents attributed to either party mirrors this pattern, with higher incidences occurring on the Namibian side of the basin.

After the beginning of the war in 1966-1975, there was a lull in publically documented military engagements in the study area (figure 8.5). This may be attributed to the fact that neither party initially appeared to be quite ready for war. SWAPO's headquarters were based in Zambia, and their forces tracking vast distances on foot from there to the Cuvelai-Etosha Basin was physically straining and logistically challenging.[24] The geographical battle ground therefore shifted to the Caprivi strip (now the Zambezi region) during that period, due to its close proximity to Zambia.[25] Modern weaponry for PLAN was also inadequate, to the extent that, in some instances, they resorted to engaging their opponent with knives, bows and arrows – hunting weapons that could be put to discreet use, unlike gunfire, which might alert their opponent and betray their presence.[26]

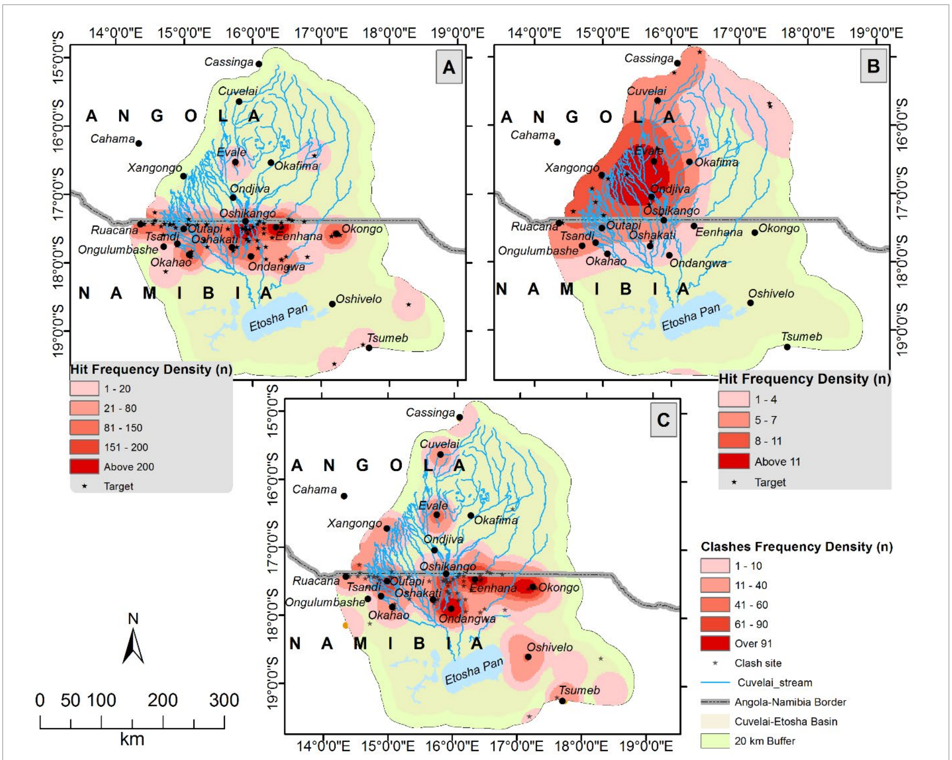

Figure 8.4 Frequency density of military engagements in the Cuvelai-Etosha Basin: (**a**) PLAN on the offensive; (**b**) SADF on the offensive; (**c**) Either party on the offensive, with clashes and skirmishes. Note: Class intervals are based on the respective standard deviations rounded off to the nearest integer (first entry and for (**b**) or nearest tenth.

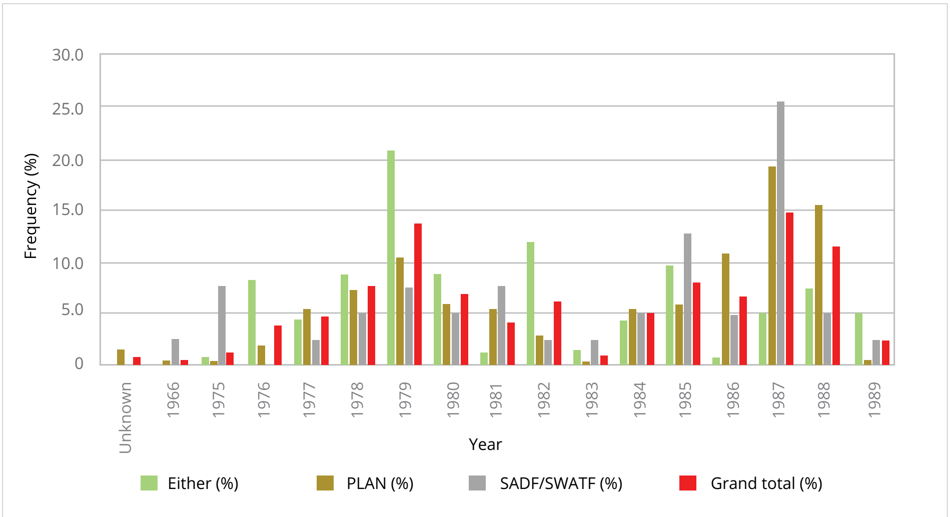

Figure 8.5 Level and intensity of military engagement of the warring parties (1966-1989)

The SADF faced challenges of its own. Its troops comprised largely fresh, young conscripts, newly graduated from high school and lacking in field experience, particularly in an unfamiliar landscape.[27] There were also logistical issues. The army's primary armored vehicles, for example, were powered by inflammable petrol instead of diesel, which was risky in the wooden savanna. The air force was similarly strained; some of the warplanes, for instance, had insufficient fuel tank capacity to cover the vast spaces of southern Africa.[28] Moreover, heavy reliance on military hardware dating back to the Second World War negatively impacted the performance and shooting range of their weaponry.[29]

SWAPO relocated its headquarters to Angola following its independence in 1975, and PLAN was able to upscale its military operations, as the subsequent attacks in the study area shows (figure 8.6). Military engagements between the warring parties increased gradually, reaching a peak in 1979. During that period, PLAN consolidated an underground network of logistical support from the local population, while the SADF abandoned its exclusivity practices and sole reliance on white conscripts and reservists for troops. The decline in military engagements in the study area during the early 1980s may be attributed to several factors, including a number of SADF incursions into Angola and two consecutive years of drought conditions during that period (figure 8.2). The lowest level of military engagement from 1975 onwards was recorded in 1983. Thereafter, military activities intensified for a second time, reaching a final climax in 1987. Unlike in the case of drought conditions, which coincided with reduced combat, there is no indication that floods had any significant impact on military encounters in the study area at any time of the war.[30]

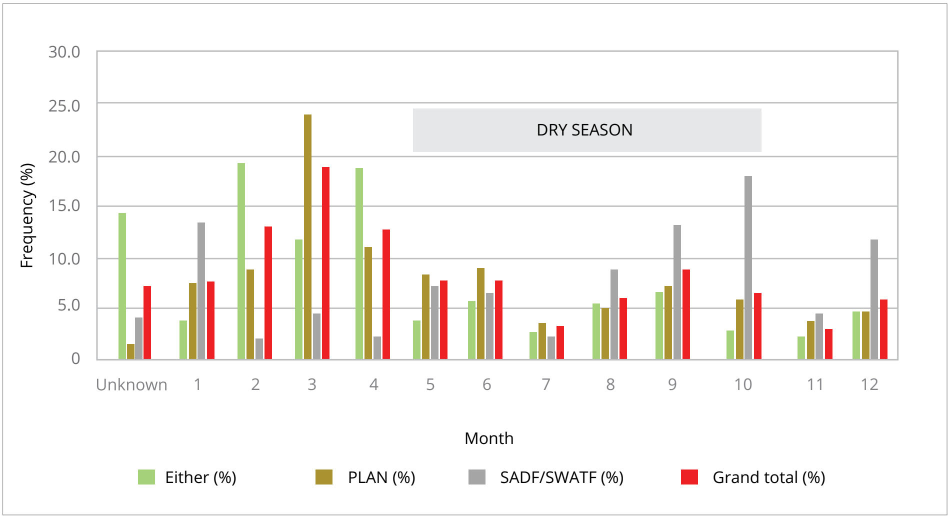

Figure 8.6 Level and frequency of military engagement by months

Aggregating the data by months and, by extension, seasons, revealed that the two warring parties had distinct preferences in waging the offensive. PLAN preferred to attack during March, one of the two wettest months, when the water level is likely to be at its highest, while the SADF favoured October, at the end of the dry season, for offensives (figure 8.7). This mismatch in terms of timing may be directly rooted in environmental and climatic factors. During the wet season, much of the Cuvelai-Etosha Basin is characterised by lush groundcover and heavy tree foliage suited to concealment; and in years of good rainfall, large expanses of waterlogged depressions and flowing *iishana* are prevalent (figure 8.2). Vehicular navigation in muddy terrain would therefore become a limiting factor during the rainy season. In addition, high levels of lethargic, distress and disease, such as malaria, are common during that period.[31] Whilst these conditions affected everyone, non-natives were particularly vulnerable. Moreover, PLAN was also less dependent on mechanised mobility than the SADF.[32] SWAPO turned these logistical and environmental challenges into opportunities, with PLAN evolving to actively strike when the SADF was least mobile.[33] Another advantage to PLAN of striking during the rainy season was that frequent rainstorms obliterated their tracks, further reducing the effectiveness of SADF follow-ups and already strained patrols.[34] All in all, 60 per cent of PLAN attacks were carried out during the rainy season (figure 8.7).

Conversely, the onset of the dry season posed more significant environmental challenges to PLAN than to the SADF, whose offensives were mostly launched at the end of the dry season (60 per cent). PLAN's movements were customarily made on foot, in an environment that became water-deficient during the dry season.[35] The SADF took due cognisance of this critical challenge facing their opponent and increased the pressure by ambushing PLAN at, or planting land mines around, the scant water sources across the basin.[36] At the same time, with trees shedding their leaves, the forest offered little cover and PLAN's camouflage uniforms with their grass-green and yellowish-brown blotches no longer matched the sandy background.[37]

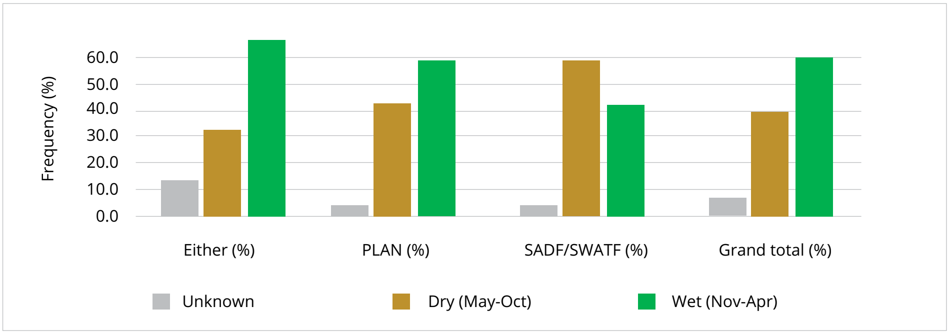

Figure 8.7 Level and frequency of military engagement by seasons

As an adaptive mechanism, the majority of PLAN soldiers left the battlefield at the onset of the dry season for refresher training aimed at advancing combat skills and performance.[38] This arrangement translated into high concentrations of PLAN troops in bases in Angola. This, coupled to enhanced motorised mobility during the dry months, presented the SADF with ideal environmental and climatic settings for launching large-scale offensive operations into Angola during that time of the year.[39, 40] When conducted in consecutive years, these dry season operations in Angola bore the hallmarks of pre-emptive strikes by disrupting or thwarting PLAN's ability to mount meaningful attacks in Namibia during the subsequent rainy seasons. The SADF could expect a salutary net outcome from this war of attrition – which, ironically, is also an integral component of guerrilla warfare.

Conclusion

This chapter focused on the impact of the environmental and climatic factors in the Cuvelai-Etosha Basin with respect to the publically documented military engagements between the SADF and PLAN during the struggle for Namibian independence from 1966-1989. A lack of publically documented military encounters in the study area during the first years of the war was attributed to logistical challenges on both sides, but by 1975, the Cuvelai-Etosha Basin again became the theatre of war. The ensuing progressive combat in the basin reached a peak in 1979. During the period that followed, a combination of SADF military operations in Angola and two consecutive years of drought (1980 and 1981) may have contributed to a decline in military engagement until 1983 (when it reached the lowest level after 1979). The conflict came to a climax in 1987.

While drought conditions in the study area coincided with fewer military engagements between the warring parties, no discernible trend emerged with regard to floods. PLAN took the offensive during the rainy season, taking advantage of the lush ground cover, dense vegetation for concealment, and inundated terrain – with the concomitant reduced mechanised mobility of the SADF. For their part, the SADF launched their attacks at the end of the dry season to exploit the challenges faced by their opponents in having to cross great distances on foot with limited water sources and few concealment options.

Access to primary sources on both sides would afford further insights with respect to the identification of relevant environmental and climatic factors and the implementation of mitigation measures for adaptive military operations.

Acknowledgements

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